

# UNDERGROUND INNOVATIONS

NEWS FROM ROBBINS



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## RECORD-BREAKING EPB FINISH AT MASSIVE METRO

**EARLY COMPLETION AND FAST ADVANCE** were just two of the reasons to celebrate May 24 when a Robbins EPB completed tunneling in Moscow. City officials and contractors celebrated the record-breaking achievements of the 6.2 m (20.3 ft) diameter mixed ground machine amidst rainy and stormy conditions. The TBM achieved a 37.8 m (124 ft) advance in one day at the end of April 2013—a milestone for Russian EPBs in the 6 to 7 m (20 to 23 ft) diameter range.

The machine, launched in early 2013, also made excellent rates of 150 m

(492 ft) per week and 621 m (2,037 ft) in one month. “The soil condition, crew experience, rigorous schedule, continuous conveyor, and the reliability of the Robbins TBM are all factors that helped achieve the record,” said Vadim Bocharov of SK MOST.

Robbins Field Service has also been at the site to assist in training of the crew in proper operation and maintenance of the High Performance (HP) TBM with variable frequency drives. “We can operate the power, thrust, and torque at 100%, because that is the benefit of a Robbins

machine.” The machine will now be disassembled in the receiving station site and launched on an additional 1.4 km (0.9 mi) tunnel in the last quarter of 2013.

The machine is just one of several Robbins EPBs on a massive metro project where dozens of TBMs are operating simultaneously. Two 6.6 m (21.6 ft) diameter Robbins EPBs are excavating left and right-hand tunnels, each 2.0 km (1.2 mi) in length, for contractor Engeocom. A third machine refurbished by Robbins for Engeocom, nicknamed “Julia”, is also excavating a 2 km (1.2 mi) section of tunnel. The machines represent the first time Robbins EPBs have been used in Russia.

Moscow’s Metro Development Program, unveiled in 2012 by the Moscow Government, calls for 150 km (93 mi) of new metro lines within the next eight years. Work has been around the clock, with close to 18,000 workers and specialists engaged in the projects. Their number is expected to reach 35,000 by the end of 2013.

LEFT: The 6.2 m (20.3 ft) Robbins EPB was launched in Moscow in early 2013.  
RIGHT: The EPB broke through on May 24, 2013 after achieving a Russian record for metro-sized EPBs.  
*Photo Credit: SK MOST*





The record-setting Robbins Main Beam for the Indianapolis Deep Rock Tunnel Connector was built in 1976, and is owned by the Shea/Kiewit Joint Venture,

## NEW GROUND SUPPORT ADVANCES

### IMPROVED GROUND SUPPORT SYSTEMS

on five new Main Beam TBMs are based on worldwide field observations. The TBMs, destined for a project in China, feature adaptable systems for changing conditions.

“We are building heavy duty machines for hard rock, and it is satisfying to see all we have learned from past projects being put to use. The cutterheads are reinforced and fully equipped with wear-resistant material, and the TBMs are designed with much more sophisticated ground support than we have ever provided before,” said Lok Home, Robbins President.

The ground support system offers maximum flexibility, allowing the contractor to choose between the McNally System--consisting of steel slats extruded from pockets in the roof shield--or ring beams, rock bolts, and wire mesh.

On each of the 8 m (26 ft) diameter TBMs the ring beam erector and roof drill system are mounted on the same rail system, but are capable of independent movement. The rotating ring beam erector includes an indexer—a loading tray—at the bottom of the erector. Six pieces are loaded into the indexer and then pinned before they are expanded against the wall to make a ring. Transport of materials takes place in the tunnel invert.

## SPEEDY WORLD RECORD TBM RACES THROUGH ROCK

### RECORD ADVANCE IN 24 HOURS

is just one of many triumphs for a 6.2 m (20.2 ft) Robbins Main Beam TBM operating at the Indianapolis Deep Rock Tunnel Connector in Indiana, USA. The machine was originally built in 1976 and used most recently on the Second Avenue Subway Project in New York City,

The contractor-owned machine was refurbished and redesigned in Cleveland,

**The TBM achieved a world record for machines in the 6 to 7 m diameter range: 124.7 m (409 ft) in 24 hours.**

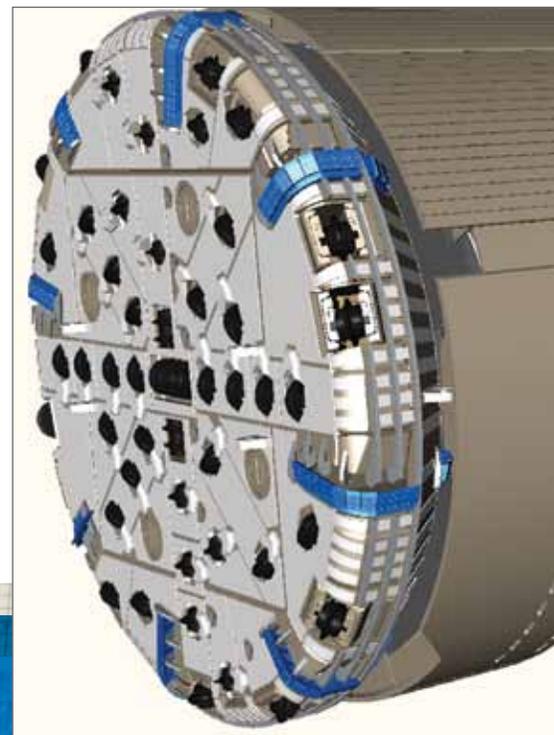
Ohio and Mt. Pleasant, Pennsylvania. Its latest rebuild included a fitting with variable frequency drive motors and new components including a back-loading cutterhead with 19 inch disc cutters and rescue chamber.

The TBM was launched in early 2013 from a deep shaft and began its excavation in limestone and dolomite rock. Muck removal is being achieved with a Robbins continuous conveyor system including both horizontal and vertical belts.

The record rate occurred on June 12, 2013 when the machine achieved 124.7 m (409 ft) of advance in 24 hours—a milestone for TBMs in the 6 to 7 m (20 to 23 ft) diameter range.

Once complete, the tunnel will be lined with unreinforced concrete, making the finished diameter 5.5 m (18 ft). Cleaner water is the ultimate goal of the city’s new DRTC, which will include in its scope four shorter tunnels that will be added on afterwards.

The DRTC will convey up to 2.1 million m<sup>3</sup> (550 million gal) of combined sewer overflows daily to the Southport Advanced Water Treatment Plant. By 2025 the network of five tunnels will total over 40 km (25 miles), and will reduce wastewater overflow into the White River, Fall Creek, Pogues Run and Pleasant Run waterways by 95% or more.



# A PHOTO FINISH

## AT WASHINGTON D.C.'S BI-COUNTY TUNNEL

### WITH 40 YEARS OF TUNNELING WORKS

under its belt, a veteran machine wrapped up its tenth project on April 26, 2013. The 3.0 m (9.8 ft) diameter Robbins Main Beam TBM, originally built in 1976, completed the Bi-County Water Tunnel between Maryland and Washington D.C., USA for the Oscar Renda/Southland/SAK (RSS) Joint Venture.

The TBM's history includes a world record in its size class of 3 to 4 m (10 to 13 ft) at the Plateau Creek Project in 2000, when it bored 67 m (220 ft) in one 10-hour shift. "We did consider a new TBM, but we knew the history of this machine and its record performance in the past," said Tim Winn, principal/director of Southland Contracting, Inc.

After undergoing refurbishment and enlargement of the main bearing to 2.5 m (8.2 ft) to accommodate hard rock, the machine was launched in July 2010. The TBM bored an initial 1.2 km (0.7 mi) from Connecticut Avenue to the Stonybrook shaft, and was then removed and relaunched from the Connecticut site in the opposite direction.

The robust TBM bored a further 7.2 km (4.5 mi) of hard granite rock up to 140 MPa UCS, fractured ground, and voids that required installation of steel

sets, rock bolts, and wire mesh.

Excavation in the 7.2 km (4.5 mi) length of tunnel at a small diameter was a challenge, requiring adequate air movement using a 900 mm (3 ft) diameter duct along the tunnel crown and several fans. Muck was removed using single track muck cars with California switches placed every 3 km (2 mi).

Now that TBM excavation is

**"We did consider a new TBM, but we knew the history of this machine and its record performance in the past."**

--Tim Winn, Principal/Director, Southland Contracting

complete, work begins on installation of 7.3 km (4.5 mi) of 2.1 m (6.9 ft) diameter steel pipeline that will connect previously-installed pipework with the new pipe.

The Bi-County Water Tunnel will increase supplies of clean drinking water to eastern areas of two counties in both Maryland and Washington D.C. The increased water supply will alleviate current capacity limitations from an existing 1.4 m (4.6 ft) diameter main.

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### NEW PERUVIAN TUNNEL TO IRRIGATE ARID FARMLAND

The Puyango-Tumbes Irrigation project is a bi-national agreement between Peru and Ecuador that will result in improved irrigation of massive swaths of farmland. Two dams will distribute water through a network of conduits to 40,500 hectares (100,000 acres) of farmland.

The newly accelerated construction program calls for hard rock tunneling, and will utilize the refurbished Robbins Main Beam TBM that bored the Olmos Trans-Andean Tunnel--a 5.3 m (17.4 ft) diameter veteran machine that broke through in December 2011.

The Consorcio Fronterizo, consisting of Construcción y Administración Hidalgo & Hidalgo purchased the machine from contractor Odebrecht, and are planning to begin refurbishment in summer 2013.

Under the current plan one dam will be constructed in the Peruvian city of Linda Chara to capture 30 cubic meters (8,000 gallons) per second of water from the Puyango River.

The work also includes the construction of a second dam, which will be built in Ecuador's Loja province.



LEFT: New support systems maximize options in variable ground.  
TOP RIGHT: Launch of the veteran TBM at the Bi-County Tunnel.  
BOTTOM RIGHT: The Robbins Main Beam made its final breakthrough on April 26, 2013. Photo credit: WSSC



SUMMER 2013



LEFT: Robbins Small Boring Units (SBU-As) were used on a series of 17 crossings for Mexico's massive El Realito aqueduct. RIGHT: Work with Robbins 54-inch (1.4 m) and 36-inch (900 mm) SBU-As took place in Class II and III rock conditions.

## MULTIPLE CROSSINGS IN MEXICO PUT SBUs TO THE TEST

**MULTIPLE CROSSINGS TESTED THE METTLE** of two hard rock Small Boring Units (SBU-As) in Mexico, ultimately proving their durability and efficiency. A 54-inch (1.4 m) diameter SBU-A excavated 318 m (1,043 ft) worth of road and rail crossings, while a second 36-inch (900 mm) SBU-A bored 427 ft (130 m) of crossings in Class II and III rock conditions.

The SBUs excavated crossings for the El Realito aqueduct--a massive 77 mi (124 km) long pipeline in Mexico's Guanajuato state that will bring potable water to about 1.45 million people once its two stages of construction are completed.

Crossing work for Mexican contractor Ingeniería en Túneles y Redes, S.A. de C.V. is estimated to be complete in 1.5 months--the contractor is excavating 17 crossings in both soil and hard rock using pipe jacking and the SBU-A/Auger Boring Machine (ABM) setup.

The SBU-As, designed for the rock conditions, are welded to the lead steel casing prior to excavation, and set up with a concrete block in the bore pit. Thrust is provided by the ABM through the casing,

while torque is generated by a full-face auger. Robbins SBU-As, in diameters from 24 to 72 inches (600 mm to 1.8 m) can be fitted with cutting tools for either hard rock or mixed ground conditions.

At El Realito, the first project in Mexico to use SBUs, the contractor believes the use of the machines provides a competitive advantage. "The SBUs provide very good performance and quality. Cutter wear has been good, and the Robbins team has been very helpful and willing to solve any problem that has arisen," said Ing. Jorge Mirón González, Director General of Ingeniería en Túneles y Redes, S.A. de C.V. In the rock conditions, the machines were able to achieve 13 to 23 ft (4 to 7 m) of advance per day.

Once complete, the aqueduct will extend from a dam in El Realito on the Santa Maria River to the city of San Luis Potosi where 264 gallons (1 cubic meter) of raw water per second will be treated at a water treatment plant. A second phase will bring the water to the city of Celaya and make the pipeline a total length of 85 mi (137 km).

### 2013 EVENTS CALENDAR

Robbins will participate in the following trade shows:

#### RETC

June 23-26  
Washington D.C., USA

*Robbins Technical Sessions:*

*High Cover Ground Support  
EPB Design for Fast Advance  
Unique EPBs at Emisor Oriente*

#### Rapid Development Conference

August 14-16  
Sydney, Australia

*Robbins Technical Session:*

*Improving Mining Methods  
through Mechanized Technology*

#### No Dig Down Under

September 1-4  
Sydney, Australia

#### ICUEE

October 1-8  
Louisville, Kentucky, USA

#### CityBuild

October 15-17  
Moscow, Russia



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