

PERU CHALLENGE: RE-LAUNCH AT OLMOS



The world's second deepest tunnel, 2.0 km (1.2 mi) below the Andes Mountains, is being bored with a Robbins 5.3 m (17.4 ft) Main Beam TBM.

Overcoming obstacles is the name of the game at Peru's Olmos Trans-Andean Tunnel. Crews have successfully faced rock bursting, floods, and fractured ground. The latest challenge, a large rock bursting event that stalled tunneling for several months, was surmounted with the re-launch of the 5.3 m (17.4 ft) diameter Robbins Main Beam TBM in August 2010.

Since 2007, excavation of the world's second deepest tunnel has been anything but easy. The 13.9 km (8.6 mi) long tunnel, beneath up to 2,000 m (6,500 ft) of cover, is located in highly stressed, volcanic geology consisting of schists, argillaceous rock, quartz mica schist, quartz porphyry, andesite, tuff, and pyroclastic breccias up to 175 MPa (25,000 psi) UCS.

By 2009, two years into tunneling, the TBM had entered sections of high cover where crews experienced large overbreaks and catherdrilling, along with rock bursting. "We encountered about 1,200 m of highly fractured ground, with over 8,500 recorded rock bursts. Cavities also formed during tunneling that had to be injected with grout," said John Simm, Robbins Field Service Superintendent.

To better contain the fractured rock, Robbins and contractor Odebrecht worked together to make changes by installing a novel type of TBM ground support. The machine's roof shield fingers were removed and replaced with the McNally Support System, supplied by C&M McNally Engineering of Canada.

The McNally system works by replacing the curved finger shield plate for a curved assembly of pockets with rectangular cross-sections. Steel or wood slats are extruded from the pockets as the TBM advances, containing fractured ground and rock bursting directly behind the cutterhead support.

The measures led to increased advance rates, though the changeable ground conditions remained a challenge. New TBM modifications include extended side and vertical supports to restrict any falling ground that might trap the cutterhead. In addition, Robbins engineers relocated the operator's cabin to back-up deck #2 to increase safety during rock bursting events. Since its re-launch, the machine has successfully excavated 123 m (403 ft) of difficult ground, with completion of the tunnel expected by summer 2011.



A 5.44 m diameter Slurry Machine for the Tokyo Metropolitan Subway, similar to the one that will be used at Zhanjiang Bay. Photo Credit: Copyright Mitsubishi Heavy Industries Mechatronics Systems, Ltd. 2010

ROBBINS CONVEYORS TRANSPORT SEATTLE'S SOFT GROUND

Twin Robbins continuous conveyor systems will efficiently transfer muck behind two EPBs in Seattle, Washington, USA. The Herrenknecht EPBs will begin excavating twin 3.5 km (2.2 mi) long tunnels for the University Link (U220) rail tunnels in Spring 2011.

The identical 3.5 km (2.2 mi) long conveyor systems will consist of extensible fabric belt with a 185 kW (250 HP) main drive plus 150 kW (200 HP) booster drive. The majority of the conveyor systems will be in the tunnel, while short sections will be mounted in the open cut area due to limited space at the launch shaft.

The Traylor/Frontier Kemper JV ordered the conveyor systems based on similar designs used at the Upper Northwest Interceptor Sewer in California, USA. That project featured a record-breaking 4.25 m (13.9 ft) diameter Robbins EPB and conveyor system that operated at over 90% availability.

Specially designed, sealed transfer points, plus primary and secondary belt scrapers, will aid in minimizing the spillage of water-bearing ground. Robbins' patented curve idlers will also aid in transferring muck through curve radii as small as 600 m (2,000 ft).

The components are being manufactured at the Glen Daniel facility in West Virginia, USA, and will be shipped to the jobsite in May 2011.

ROBBINS WILL SUPPLY SLURRY TBM FOR SUB-SEA TUNNEL

At up to 60 m (200 ft) below the water level, a new sub-sea tunnel in southern China promises to ramp up the nation's steel output. Robbins will supply a 6.26 m (20.5 ft) diameter Slurry TBM to excavate the 2.7 km (1.7 mi) long Zhanjiang Bay Cross-Sea Tunnel.

The tunnel is part of a larger fresh water transfer project that will draw from the nearby Jianjiang River to supply a new steel plant on Dong Hai Island. The tunnel will travel beneath the bay with up to 22 m (72 ft) of overburden.

The supply of the machine is a full cooperation between Mitsubishi Heavy Industries Mechatronics Systems, Ltd. (MHI-MS) and The Robbins Company. Robbins will supply components in China, assembly, and local support throughout excavation, while MHI-MS will provide key components and engineering expertise for the Slurry TBM and back-up system. The machine will be assembled in the Robbins Shanghai manufacturing facility.

The TBM, for contractor Guangdong No. 2 Hydropower Engineer-

ing Co., Ltd., will be delivered to the jobsite in March 2011. "Robbins fully expects that its entry into the Slurry TBM market will gain quick acceptance, as has been the case with our entry into the soft ground EPB market," said Lok Home, Robbins President.

The high-powered machine features 20 thrust cylinders for a total thrust of 46,000 kN (10.3 million lb)—a feature needed due to the 6 bar of water pressure expected in the bay. A mixed ground cutterhead with hard facing will be fitted with interchangeable knife-edge bits and disc cutters for geology including coarse to abrasive sand, gravel, and silt.

To effectively remove the water-bearing ground, a large slurry chamber will combine the muck and bentonite while applying even pressure through the mud screen across the face. Two probe drills, mounted on spherical joints for increased range of motion, will probe ahead and pre-grout depending on the geology and need for intervention. Tunneling is expected to be complete in 2011.

DUAL EPBs UNDERCUT DOWNTOWN ZHENGZHOU



Two 6.3 m (20.7 ft) Robbins EPBs are excavating just 8 m (26 ft) below downtown Zhengzhou, China using foam and bentonite soil conditioning to minimize surface settlement.

Zhengzhou, a city of 7 million people, is set to become a crossroads for rail commerce in China. Excavation of Zhengzhou Metro's new Line 1 tunnels began on September 28, 2010 when the first of two 6.3 m (20.7 ft) diameter Robbins EPBs was launched from a 16 m (52 ft) deep shaft.

The second machine is scheduled for a launch later in Autumn. Both TBMs, for the 11th Bureau of the China Railway Construction Corp. (CRCC), will excavate under downtown Zhengzhou with cover as low as 8 m (26 ft). The parallel 3.6 km (2.2 mi) long tunnels will pass through four intermediate stations between Kaixuan and Tongbo areas. Ground is expected to consist of clay, fine sand, loess, and some pebbles, with little groundwater.

Line 1 of Zhengzhou Metro will consist of 26 km (16 mi) of tunnel and 22 stations once complete in 2013.



Left: *The first and only TBM ever to operate on the Faroe Islands, a 3.35 m (11.0 ft) diameter Robbins Main Beam, was launched in September 2010.*

Above: *The first of three Robbins Main Beam TBMs in Malaysia will launch in November 2010, six weeks ahead of schedule.*

FAROE ISLANDS TBM WILL CARVE OUT NEW HYDRO TUNNEL

The Faroes, a collection of 18 wind-swept islands in the North Atlantic, are home to nearly 48,000 people. Situated between Iceland and Norway, the mountainous islands receive an average of 250 days of rainfall annually, creating significant runoff. These features make the islands ideal for small hydropower plants utilizing collector tunnels to transport rainwater.

The first and only TBM to ever operate in the Faroes, a 3.35 m (11.0 ft) diameter Robbins Main Beam machine, is extending one such hydropower project with an 8.4 km (5.2 mi) collector tunnel. A launch ceremony was held in mid-September 2010.

The Robbins TBM, for Danish and Faroese contractors MT Hojgaard and J&K Petersen, was originally purchased in 1984 and has since excavated about 25 km (16 mi) of tunnel for the Eidi Hydropower Plant. The latest project, known as Eidi II, is part of a new green energy initiative by the utility agency for the Faroes: Strey moy, Eysturoy and Vágoy (SEV). The tunnel will collect water from 25 streams, increasing the annual capacity of the plant from

about 43 GWh to about 60 GWh.

The veteran SEV-owned machine underwent some refurbishment to the gearboxes, main bearing, lube system, and hydraulic hoses. "Prior to starting up this project, we contacted Robbins for an assessment. We got an immediate response, and two men were sent to inspect the machine. They concluded it was in good condition following the upgrades," said Anders Nedergaard-Hansen, Head of the Power Production Department for SEV.

Robbins is also providing key spare components including the cutterhead, grippers, hydraulic, and lube systems. Robbins Field Service personnel have also been provided for the project duration.

By October 2010, the machine had excavated several hundred meters of tunnel in basalt rock with no problems. "We are looking into using the machine for additional projects in the next five to ten years. The TBM was well-built by Robbins, and we have done a good job maintaining it," said Nedergaard-Hansen. Tunneling at Eidi II is expected to be complete in March 2013.

MALAYSIA TBMS PREPARE FOR LAUNCH AHEAD OF SCHEDULE

Preparations for Malaysia's largest infrastructure project, the Pahang-Selangor Raw Water Tunnel, are ramping up. By October 2010, the first of three 5.2 m (17.2 ft) diameter Main Beam TBMs was assembled in a chamber and walked through an adit to the excavation site. Launch took place in November 2010.

The second TBM is currently being readied at the jobsite, while the third TBM has recently been completed in the Robbins Shanghai, China manufacturing facility. A factory acceptance ceremony for the third and last machine was held the first week of November.

Assembly of the three machines occurred simultaneously, making for challenging logistics. On average, TBM assembly requires a skilled crew of 20-30 fabricators, welders, and technicians, but shorter delivery schedules require up to 60 people in two shifts. "We have an experienced group in China that has been building machines for many years and has completed these machines six weeks ahead of schedule," said Mike Kolenich, Robbins Manager of Projects.

The three TBMs will excavate 35 km of tunnel for the SNUI JV, a consortium of Shimizu Corporation, Nishimatsu Construction, IJM Corp and UEM Builders Bhd. All tunneling is expected to be complete by 2013.



Left: Recent international projects include a sewer tunnel bored with a Small Boring Unit (SBU-A) and ABM in Rajasthan, India. Top: Kenny Clever of the Robbins SBU Division visits a jobsite in Pennsylvania, USA, with Trenchless Technology editor Sharon Bueno.

ROBBINS SMALL BORING UNITS EXPAND AVAILABILITY WORLDWIDE

With new staff added in the U.S. and to multiple worldwide locations, Robbins Small Boring Units are more accessible than ever. Kenny Clever, SBU Sales Manager-Eastern U.S., joined Robbins in January 2010, while Chris Sivesind continues as the Sales Engineer for West and Central U.S. and Canada. The Division is headed up by Utility Tunneling Manager Tom Fuerst, and supported by ten sales associates covering 19 countries including Singapore, Malaysia, the U.K., and India.

"These developments are great news for utility tunneling contractors," said Sivesind. "Our responses are much quicker, which translates to faster turnaround times." Clever agrees with the benefits: "Our additional staff have increased our ability to visit the jobsites, interact with the customers face-to-face, and follow up on their needs."

The Robbins SBU Division offers a wide variety of products for utility tunneling in both hard rock and mixed ground, from 600 mm (24 in) diameter Small Boring Units (SBU-A)s for use on crossings up to 150 m (500 ft), to small diameter Double

Shield TBMs capable of excavating 6 km (4 mi) or more.

Clever sees several trends emerging in the utility tunneling industry: "Today's tunnels are longer and larger diameter, with complex ground conditions. The SBU mixed ground cutterhead is a superior tool that many contractors are not yet aware of." Mixed ground cutterheads can be designed for any of the Robbins SBUs, allowing the machines to tackle clay and/or mixed ground with cobbles and boulders, rather than hard rock.

Future goals for the SBU Division include expanding contractor knowledge of SBUs to a wider, international arena. Recent worldwide projects include a sewer tunnel at Mt. Abu in Rajasthan, India, and SBU-A crossings in Portugal, Spain, and South Africa.

"What we would like contractors to know, overall, is that these machines are more economical than other methods, such as microtunneling in hard rock," said Sivesind. "For the right ground conditions, they are the most cost effective option out there."

EVENTS CALENDAR

Robbins will exhibit at the following trade shows:

2010

International No-Dig
November 8 - 10
Singapore

CIGIE (The Green Show)
November 24 - 27
Beijing, China

2011

UCT
January 25 - 27
Houston, Texas, USA

bC India
February 8 - 11
Mumbai, India

CONEXPO-CON/AGG
March 22 - 26
Las Vegas, Nevada, USA

NASTT No-Dig
March 27 - 31
Washington D.C., USA

