

# UNDERGROUND INNOVATIONS

NEWS FROM ROBBINS



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## FIELD SERVICE ROCKS AT INDIA'S LONGEST TUNNEL

### ABRASIVE ROCK, FLOODING, AND TIGERS.

The harsh jobsite conditions and other challenges have all made tunneling at India's Alimineti Madhava Reddy (AMR) Water Tunnel a challenge like no other. The 43.5 km (27 mi) long tunnel, being excavated with two 10.0 m (32.8 ft) Robbins Double Shield TBMs, will be the world's longest tunnel without intermediate access once complete. Due to its location below India's largest tiger reserve, no surface excavation is permitted.

In total 90 Robbins field service personnel are working with the contrac-

tor Jaiprakash Associates Ltd. (JAL) at two sites on either end of the tunnel. The machines, about 12 km (7.5 mi) and 6 km (3.7 mi) into the project, will meet in the middle for disassembly.

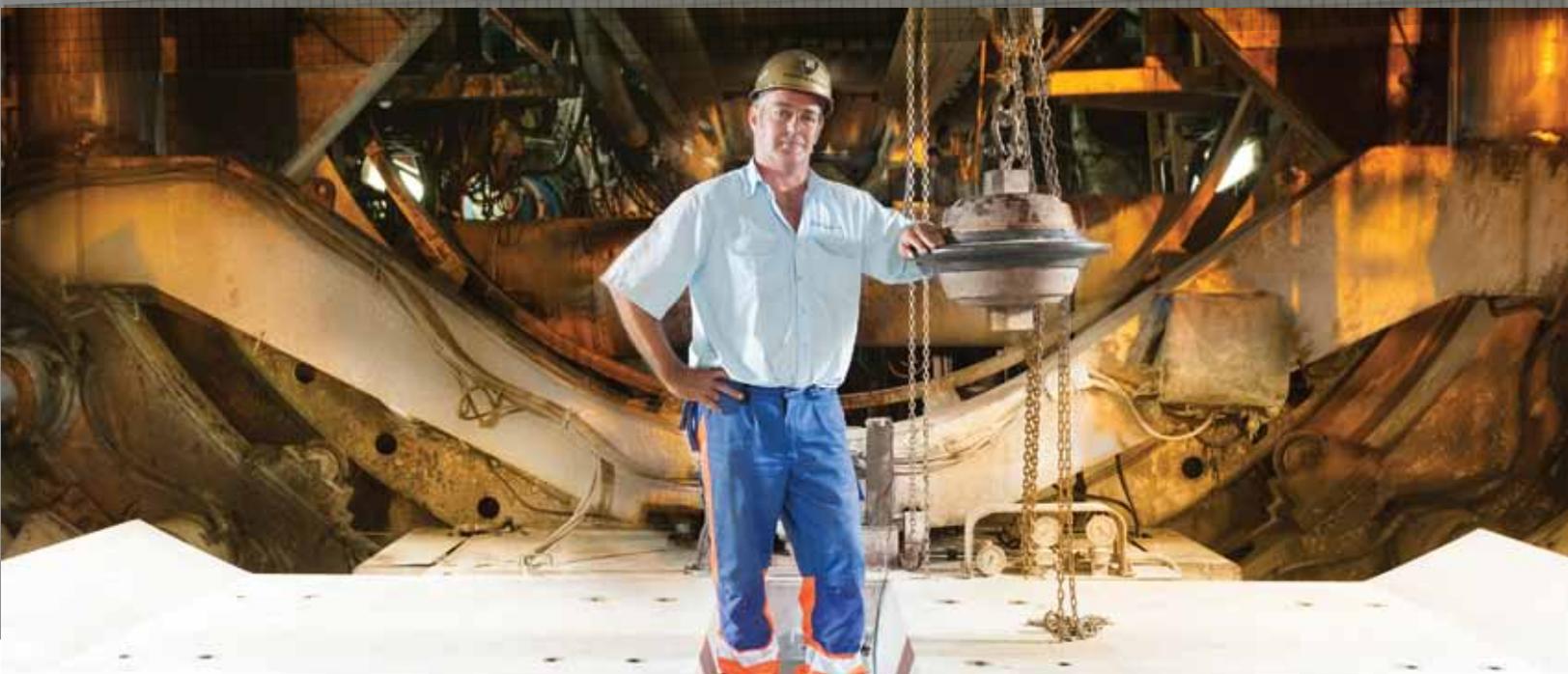
Challenges began with abrasive rock that increased consumption of cutters and conveyor belt components on the continuous conveyor systems responsible for muck removal: "The geology consists of 60% quartzite and 40% granite. We bored through several fault zones with blocky geology. Large sections of rock caused some damage to conveyor

transfer points. We solved this problem by installing deflection plates in the transfer points to reduce the fall of the rock," said Jim Clark, Robbins Projects Manager India.

In the exceedingly difficult conditions, extensive training was also needed for the JAL crew, who had experience with Drill and Blast but not TBMs: "At the start of the project we had extensive training including TBM maintenance and operation. Typical utilization of the TBM at the start of the project was around 35%, and through the training program we increased this utilization to around 45%," said Clark.

While the obstacles at the AMR Project are not over yet--expected fault zones below a river and a 200 m (650 ft) wide bedding plane between sections of quartzite and granite lay ahead--the contractor is confident: "We are a very close knit team. Robbins is very good and professional, and whenever we have needed help, they came and assisted us with advice," said Brigadier MS Boperai, JAL Joint President.

Field Service Site Manager Pierre Claassen oversees work at AMR, where two 10.0 m (32.8 ft) Double Shield TBMs are overcoming multiple obstacles to bore the world's longest tunnel with no intermediate access.





The first of three Robbins Main Beam TBMs broke through on March 22, 2013. The Malaysian water project will be southeast Asia's longest tunnel once complete.

## CENTRAL SUBWAY EPB GEARS UP

### A UNIQUE EPB IS MAKING ITS WAY

to San Francisco, California, USA, following a shop acceptance in February 2013. The TBM is the first of two 6.3 m (20.7 ft) diameter mixed ground machines for the city's Central Subway Project.

Once complete, the Central Subway will provide service between China Town and Mission Bay areas. The machines, nicknamed "Mom Chung" and "Big Alma", are being delivered for the Barnard/Impregilo/Healy JV in Spring/Summer 2013.

Each of the two EPBs was designed with a mixed ground cutterhead for excavation of parallel 2.5 km (1.5 mi) tunnels. Shaft-type screw conveyors will aid in boring through poorly consolidated silt and sand deposits below the ground water table. Both machines will also feature active articulation and back-up systems designed for excavation around tight turns down to 140 m (450 ft) in radius.

Robbins continuous conveyors will travel behind both EPBs for efficient muck removal. The segmentally lined, twin-bored tunnels will also require construction of five emergency cross passages.

Project owner San Francisco Municipal Transportation Authority (SFMTA) has set a planned launch date for both machines in mid 2013.

## EPIC BREAKTHROUGH

### AT SOUTHEAST ASIA'S LONGEST TUNNEL

#### A TBM HOLE THROUGH IN MALAYSIA

is just the first of many milestones for Southeast Asia's longest tunnel. On March 22, dignitaries, contractors, and honored guests celebrated the first of three Robbins TBM breakthroughs at the Pahang Selangor Raw Water Tunnel.

At 44.6 km (27.7 mi) in length, the tunnel will provide water from the state of Pahang to Selangor, which includes

closely with the contractor, a joint venture of Shimizu Corporation, Nishimatsu Construction, UEM Builders, and IJM Construction (SNUI). "Advance rates at maximum were over 650 m (2,132 ft) per month, that is 30 m (98 ft) per day advance," said Mr. Ohashi, Sr. Mechanical & Electrical Engineer for SNUI JV. The average monthly advance rates for the machine have been 475 m (1,560 ft).

"This is a day we all look forward to in the tunneling industry. It's a good feeling when you get through all of the hard work and break through. I'm very happy for this joint venture, we have an excellent safety record, and I think they are happy too," said Andy Birch, Robbins Field Service Manager. The two remaining machines are scheduled to meet inside the tunnel in the last half of 2013.

Once completed, the tunnel will transfer 27.6 cubic meters (7,300 gallons) of water per second to a new treatment plant. The drinking water will supply about 7.2 million people for project owner KeTTHA (Malaysian Ministry of Energy, Green Technology, and Water).

**"Advance rates at maximum were over 650 m per month, that is 30 m per day advance."**

-- Mr. Ohashi, Sr. Mechanical & Electrical Engineer, SNUI JV

the capital Kuala Lumpur. High cover tunneling using 5.23 m (17.2 ft) Main Beam TBMs with continuous conveyor systems has entailed blocky rock, over-break, power outages, and water inflows.

Robbins field service has worked



# ROBUST SLURRY MACHINE HOLES THROUGH WITH MINIMAL WEAR

**AFTER 2,700 M, NOT A CUTTER CHANGE** was in sight for a 6.26 m (20.5 ft) diameter Robbins Slurry machine. The TBM recently made a photo finish in China's Southernmost city of Zhanjiang.

After advancing up to 392 m (1,290 ft) per month, the speedy Slurry TBM broke through with minimal cutterhead wear, only 70 to 80% of normal in geology including abrasive sand, gravel, and silt.

The undersea pipeline recently became operational in March 2013. The Zhanjiang Bay Sub-Sea Tunnel runs 56 m (185 ft) below water level, and will provide fresh water to the Guangdong Steel Plant via twin pipelines.

The 2.7 km (1.6 mi) long conduit, constructed by contractor Guangdong No. 2 Hydropower Engineering Co., Ltd, required the use of a Robbins Slurry machine to excavate under 6 bars of water pressure in Zhanjiang Bay. The TBM, supplied and assembled by Robbins with key components and engineering from Mitsubishi Heavy Industries Mechatronics Systems, Ltd. (MHI-MS), was launched in September 2011.

"The cutterhead design, layout of the cutters and injection ports were the most important design factors in completing

this tunnel project," said Qinghua Shi, Chief Project Engineer for the contractor.

The high-powered Robbins machine featured a smooth flow cutterhead to allow for easier removal of stones and boulders while avoiding clogging at the face. The mixed ground machine with "smooth flow" cutterhead design utilized interchangeable knife-edge bits that could be switched out for disc cutters.

**"I am happy that we could operate the machine properly. The launch and breakthrough went very smoothly."**

—Qinghua Shi, Chief Project Engineer, contractor

During tunneling, the Robbins TBM excavated up to 27 m (89 ft) per day, with no interventions needed. "Throughout the project, I felt there were no significant problems that happened on the machine. I am happy that we could operate the machine properly. There were no cutters that needed to be changed, even though this was a long tunnel excavation project. The launch and breakthrough went very smoothly," said Shi.

## FREE ACCESS TO SMALL BORING UNIT ANIMATIONS

Have you ever wondered how Robbins Small Boring Units (SBUs) work? In diameters from 600 mm (24 inches) up to 2.0 m (78 inches), SBUs are ideal for utility crossings of many kinds. See how Robbins SBU-As, SBU-Ms, ABMs, and Rockheads work in our latest animation series, available for free viewing on our YouTube Channel:

<http://youtube.com/user/TheRobbinsCo>

## NEW AUSTRALIAN OFFICE COVERS ASIA PACIFIC

A new Robbins office, opened in the last quarter of 2012, is providing coverage for Australia, New Guinea, New Zealand, and Indonesia. The subsidiary, Robbins Asia Pacific Pty Ltd., joins a second Asia Pacific office based in Hong Kong.

"Australia is a market with a lot of potential, not only in the civil sector but also in the mining sector, particularly for coal and precious metals," said Doug Harding, Robbins Vice President-Sales.

The office is based in Brisbane and headed by General Manager Martin Rauer, who has over 13 years of experience in the tunneling industry. "Customers will benefit from faster response times and more extensive local assistance," said Harding.

The office will provide regional support for two new Robbins projects in Australia, both for use in mine development tunnels. Within the next five years, the subsidiary aims to further mine development using TBMs, and to increase sales for both hard rock and EPB machines. Office contact information:

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LEFT: Shop acceptance for the first of two Central Subway EPBs.  
TOP RIGHT: A Slurry TBM breaks through with minimal wear.  
BOTTOM RIGHT: Robbins Project Manager David Han inspects the slurry system in Zhanjiang, China.



LEFT: Saudi Arabian contractor Nahdat Al Emaar used a 50 inch (1.3 m) Robbins Motorized Small Boring Unit for ductile iron force mains.  
RIGHT: The Robbins SBU with mixed ground cutterhead holed through exactly on line and just 0.2 inches (5 mm) off of grade.

## MIDDLE EASTERN CONTRACTOR BRINGS **SBU**s TO SAUDI ARABIA

### **SBU**s IN THE KINGDOM OF SAUDI ARABIA.

The recent success of these machines in a new market highlights the global demand for small diameter machines capable of excavation in mixed ground or hard rock.

Saudi Arabian contractor Nahdat Al Emaar, an AL BAYAN Group Holding Company, needed a solution for a series of high pressure, ductile iron force mains. The pipelines, ranging from 12 to 63 in (300 mm to 1600 mm), required installation using steel casing as the primary liner below a new development area of Riyadh.

The contractor chose a 36 inch (900 mm) SBU-A and 50 inch (1.3 m) Motorized Small Boring Unit (SBU-M), to be used with Auger Boring Machines. Matt Weaver, Robbins Field Technician, helped with setup and training: "I did an explanation of operation and when to deploy certain techniques, not only for this job, but also the future bores to be done."

Crossing lengths ranged from 100 m to 180 m, and were in mixed geology including limestone from 20 to 80 MPa UCS, as well as interbedded hard clays and consolidated sand. To tackle

these conditions the SBU's were fitted with mixed ground cutterheads using both disc cutters and carbide bits.

Although the contractor did have experience with microtunneling, Robbins Field Service conducted 3-day training combining hands-on learning with question and answer sessions. "By the third day the trainee operates and I observe from topside. I watch for any minor mistakes to be discussed at the end of operation and any major mistake requiring immediate correction," explained Weaver.

Ultimately, the line and grade sensitive bores were completed ahead of schedule, in just 11 days at an average of 30 ft (9 m) advance per day. The first, 320 ft (100 m) bore holed through just 0.2 in (5 mm) off of grade and 0 mm off of line. Weaver attributed the outstanding results to the relationships on site: "The #1 reason this was a successful bore was having a customer dedicated to learning and who responded to any request for tools or equipment immediately. A very cohesive crew was supplied to the job and took great pride in their work."

### 2013 EVENTS CALENDAR

Robbins will participate in the following trade shows:

#### **Bauma**

April 15-21  
Munich, Germany

#### **World Tunnel Congress**

May 31-June 7  
Switzerland

#### *Robbins Technical Sessions:*

*Tunneling for Hydropower*

*The Latest Hybrid TBMs*

*Probe Drilling & Pre-Grouting*

#### *Muir Wood Lecture:*

*A Tradition of Innovation: The*

*Next Push for Machine Tunneling*

*By Dick Robbins*

#### **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*



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