

EPBS EMBARK: EMISOR ORIENTE



The first of three 8.93 m (29.3 ft) Robbins EPBs for Mexico's largest infrastructure project was assembled in February 2010.

On February 2, 2010, a mix of contractors, reporters, and government officials gathered to mark the assembly of three Robbins EPBs. The ceremony, held in Corpus Christi, Texas, USA, culminated in the cutterhead turning of one fully assembled, 8.93 m (29.3 ft) diameter machine. The TBMs are headed to Mexico City's Emisor Oriente project, a 62 km (39 mi) long wastewater line that will prevent potential catastrophic flooding in the downtown area.

These machines are specially designed for the unique geology of Mexico. They have been engineered to handle a face of mostly clay with some basalt rock. Their flexible design is a great advantage to the project," said José Luis Luege Tamargo, director of the National Water Commission (CONAGUA), also the project owner.

Located in a drained lake bed, the geology of the capital consists of clays interspersed with volcanic rock and boulders from long dormant, buried volcanoes in the area. The TBMs will utilize clay spades and drag bits that can be

changed out for 17-inch disc cutters depending on geology. Two-stage screw conveyors will regulate high water pressures of up to 10 bar—some of the highest pressures EPBs have operated under. An initial 900 mm (35 in) diameter ribbon-type screw conveyor will accommodate boulders up to 600 mm (24 in) in diameter. Contractor CARSO Infraestructura y Construcción will utilize the TBMs on lots 3, 4, and 5, each between 9.5 and 9.7 km (5.9 to 6.0 mi) long. The Emisor Oriente line will utilize a total of six TBMs, and will operate in parallel with the city's aging main wastewater line, Emisor Central. The central line, built in 1964, was found to have severely degraded concrete and rebar walls, leaving the city at risk of flooding with up to 5 m (16 ft) of wastewater during the rainy season.

By March 2010, the second machine had been completed, with the third expected to be complete in the Spring. The machines will be shipped by freighter to a port in Veracruz then trucked to their respective launch shafts.



The Robbins Main Beam machine at East Side Access bores through a concrete plug to excavate one of four tunnels below New York's Grand Central Station.

HYBRID DOUBLE SHIELD WILL EXCAVATE KOREAN CABLE TUNNEL

An adaptable 3.65 m (12.0 ft) diameter Robbins Double Shield is set for a South Korean project in variable ground. The machine will be used to excavate the 2.3 km (1.4 mi) long Banghak-Dobong Electric Cable Tunnel, a high voltage conduit. Korean contractor Ajumental signed the contract for a complete supply of the machine, back-up system, field service, cutters, and spares with Robbins in September 2009.

The hybrid machine will begin the bore with a hard rock cutterhead fitted with 17 inch diameter disc cutters. Muck will be deposited onto a TBM belt conveyor and removed via single-track muck cars.

In soft ground, the disc cutters can be interchanged with tungsten carbide ripper teeth, while the belt conveyor can be replaced with a 350 mm (14 in) diameter shaft-type screw conveyor. In EPB mode, the machine operates like a Single Shield TBM, using thrust cylinders to react forces off of the concrete tunnel liner. The EPB system is capable of operation under 1 bar pressure, and includes foam ground conditioning capabilities.

The machine and back-up system were refurbished in the Solon, Ohio, USA manufacturing facility and shipped in February 2010. Tunneling is expected to begin in June.

ROBBINS TBM MAKES SWIFT ADVANCE AT EAST SIDE ACCESS

After completing three metro tunnels beneath downtown Manhattan in busy New York City, only one remains for a 6.7 m (22.0 ft) diameter Robbins TBM. The Main Beam machine is excavating the Westbound Running Tunnels for New York's East Side Access Project.

Two machines, including a rebuilt Double Shield, have been excavating multiple headings beneath Grand Central Station. The short headings will ultimately form departure and arrival tunnels for eight different rail lines in an underground cavern below the station.

As of February 2010, the Main Beam machine was averaging about 91 m (300 ft) per week, with a best month of 400 m (1,310 ft) in January. The TBM had excavated about 4.3 km (2.7 mi) of tunnel.

The Double Shield TBM supplied by SELI in the Eastbound Running Tunnels is faring less well. The machine was launched in October 2007, about three months ahead of the Robbins Main Beam.

As of March 2010, the machine had just completed its second tunnel and was being backed out to start on its third. Plans for the fourth tunnel may switch to drill & blast rather than TBM excavation due to slow advance rates.

At the end of each short tunnel, the TBMs must be retracted past ground support including ring beams and rock bolts. To allow for the retraction process, the Robbins machine was designed with a segmented, bolt-on cutterhead for swift removal of outer components. The shielded front section of the TBM, designed as an "umbrella", is then retracted using hydraulic extensions. The extensions allow the bottom, side, and roof supports to move radially inwards, reducing the machine diameter from 6.7 m (22.0 ft) when fully extended to just 6.0 m (20.0 ft).

The East Side Access Project is expected to be operational by 2013. The tunnels, being constructed by the Dragados/Judlau JV, will relieve heavy traffic congestion between the boroughs of Queens and Manhattan, serving about 160,000 commuters daily.

ROBBINS EPB STARTS UP FOR MEXICO CITY METRO



Mexico's largest EPB (10.2 m /33.5 ft in diameter) was launched in February 2010.

Photo: Yazmin Reyes

Mexico's largest-ever TBM (10.2 m /33.5 ft in diameter) was launched in February 2010. The Robbins EPB is excavating Line 12 of the Mexico City Metro, also known as the 'Gold Line'.

The 7.7 km (4.8 mi) long tunnel consists of water-bearing clays for 70% of the length, with compacted sand and boulders making up the final 30%. The machine is currently operating using a sludge pump for muck removal--the first time a Robbins EPB has been designed with this feature. At the surface, muck is stored using a system of settlement pools to separate the liquid from solid muck.

By March 1, the machine had excavated 21 m (69 ft) and was building about four rings per shift. Contractor ICA Consortium expects that number to reach 15 rings per day as tunneling operations ramp up. All tunneling is scheduled for completion in 2012.



Left: The 7.6 m (25.1 ft) diameter Robbins Single Shield is the first ever TBM for the country of Laos.

Above: The Theun Hinboun Expansion Project includes a 5.5 km (3.4 mi) long headrace tunnel that will help generate power for neighboring Thailand.

SINGLE SHIELD LAUNCHED ON LAOTIAN HYDRO SCHEME

In February 2010, contractor CMC di Ravenna oversaw the launch of the first tunnel boring machine ever to excavate in Laos. The 7.6 m (25.1 ft) diameter Robbins Single Shield TBM is digging a new headrace tunnel for the Theun Hinboun Expansion Project, which will provide power to neighboring Thailand.

"We chose the Single Shield TBM based on ground conditions and the type of tunnel lining needed," said Luca Barbàra, Far East Manager for CMC di Ravenna. The Robbins TBM has been designed for squeezing ground conditions—an articulating cutterhead with overcutters makes the machine capable of excavating 100 mm (4 in) beyond normal tunnel diameter. Ground along the tunnel alignment consists of alternating strata of sandstone, siltstone, and mudstone. To support the ground conditions, 280 mm (11 in) thick, pre-cast concrete segments are being used in a 5+1 arrangement, making a finished tunnel diameter of 6.9 m (22.6 ft).

The machine was assembled in Robbins Solon, Ohio, USA manufactur-

ing facility and shipped to the jobsite along the Nam Theun River, largest tributary of the Mekong. "We are presently excavating at 20 m (66 ft) per day, but expect to reach 30 m (98 ft) per day as tunneling progresses," said Barbàra.

Other recent progress has included the initial phases of a new 70 m (230 ft) high reinforced concrete dam adjacent to the power station. Crews redirected the flow of the Nam Theun River through a diversion channel in preparation for dam building. Placement of reinforced concrete also began in February 2010.

CMC di Ravenna is constructing the tunnel for project owner Theun Hinboun Power Company, Ltd.—a joint venture of the Laos Government, Norwegian contractor Statkraft, and GMS Power of Thailand. Once complete, the Theun Hinboun Expansion Project will double generating capacity of the current scheme from 220 MW to 440 MW. The station will draw water from the Nam Theun River in conjunction with the existing Theun Hinboun power station built by CMC di Ravenna in 1998.

ROBBINS PRESENTS REAL TUNNELING STORIES AT BAUMA

Stories of today's landmark projects often center on launches and breakthroughs, but the real story in between is usually much grittier. Conditions including squeezing ground, water inflows, rock falls, and variable geology, are found on most projects, but remain largely undocumented in the public sphere.

The Robbins exhibit in Hall C2, Booth 401 at Bauma aims to encourage discussion about these obstacles in the tunneling community. Daily presentations will focus on common issues throughout the industry, from maximizing advance rates to preventing subsidence and disturbance in urbanized areas to removing muck efficiently in difficult ground. The booth will also feature written materials about tough projects, and will be staffed by international employees.

Several presentations will discuss high cover tunneling, using recent examples such as the Jinping-II Hydroelectric project and Olmos Trans-Andean tunnels. Other presentations will focus on soft ground excavation in mixed conditions while maintaining high rates of advance.

For more information and a presentation schedule, visit our website. For a list of other trade shows, see back.



Left: A 1.7 m (66 in) Robbins Rockhead was launched in December 2009 to bore a Calgary trunk sewer. Top: The Bauma trade show in Munich, Germany is the largest trade show on earth, with over a half million square meters of exhibit space.

ROCKHEAD BATTLES BITTER COLD ON CALGARY TRUNK SEWER

With typical daily temperatures barely topping minus 15 degrees Celsius (5 degrees Fahrenheit), winters in Calgary Alberta, Canada, can easily hinder trenchless operations. Liquids in machinery can freeze solid, while expanding groundwater can potentially warp rails and other equipment in launch pits. Local Edmonton sub-contractor In-Line Contracting needed a durable, cold-resistant solution to effectively dig through the mudstones and clays common to the area, while maintaining line and grade.

The contractor used a 1.7 m (66 in) diameter Robbins Double Shield Rockhead to excavate 210 m (690 ft) of gravity sewer beneath a busy roadway. Once finished the new pipeline, known as the Confederation Sanitary Sewer Trunk Upgrade, will increase capacity to overused lines in northwest areas of Calgary.

"The Rockhead was the most economical option for us. Though we believe microtunneling would have worked here as well, the microtunneling setup is much more costly," said Ali Rafih, Superintendent for general contractor Volker Stevin.

The Robbins Double Shield Rockhead (SBU-RHDS) is a tunneling machine for use on longer utility installations (usually over 180 m / 600 ft) and in unstable ground. It is also typically used for line- and grade-critical installations such as gravity sewers, as the machine can be continuously steered from an in-shield operator's console.

A 7 m (23 ft) deep pit was excavated for the launch of the Rockhead in Calgary. The machine started up using an abbreviated configuration and a Robbins-supplied pipe jacking system to supply forward thrust. As the Rockhead advanced, the gripper shield was added, making the machine self-propelled. A TBM belt conveyor and single-track muck car removed mudstone spoils.

As of March 2010, approximately 180 m (588 ft) had been excavated in mudstone with some groundwater. Crews pumped heat into the pit nightly, in order to prevent water in the pit bottom from freezing and warping the rails or pipe jacking system. Tunneling is expected to be complete in April.

EVENTS CALENDAR

Robbins will exhibit at the following trade shows:

2010

World Tunnel Congress China
April 8 - 9
Shanghai, China

Bauma
April 19 - 25
Munich, Germany
Hall C2, Booth 401

NASTT
May 2 - 7
Schaumburg, Illinois, USA
Booth 421

World Tunnel Congress
May 14 - 20
Vancouver, BC, Canada
Booth 115

INTERtunnel
June 8 - 10
Torino, Italy
Booth 1431

NAT
June 16 - 23
Portland, Oregon, USA
Booth 405

