DRIVEN TO THE CORE

“Partnership and cooperation are crucial to the success of every TBM project. Even today, Mother Nature represents a formidable opponent and requires the concerted effort of every party associated with a TBM project.”

GARY BRIERLEY
Dr. Mole Inc.

DIFFICULT GROUND REQUIRES
TOUGH SOLUTIONS

Even in the most well-planned projects, tough conditions can come up. It helps to have a team of experts on your side and Robbins Field Service teams are the most experienced in the business. With over 900 successful projects to their name, we can confidently say that experience is our greatest asset.

Everything from squeezing ground to fault zones to sudden inflows of water and mud can delay your project significantly. Find out how our field service teams have dealt with the most challenging conditions worldwide.

CAVERNS AND VOIDS

MIXED FACE CONDITIONS

HIGHLY VARIABLE GROUND CONDITIONS

SQUEEZING GROUND

UNFORESEEN SITE CONDITIONS

HIGH COVER TUNNELING

WATER INFLOWS

EXTREMELY HARD ROCK

CAVERNS AND VOIDS

Uncovering the Unexpected

THE CHALLENGE

While excavating the 2.8 km long Galerie des Janots tunnel in La Ciotat, France, contractor Eiffage encountered obstacles they weren't expecting. Ground conditions included limestone with powdery clays, and as they pressed on they hit a large cavern measuring 8,000 cubic meters in size.

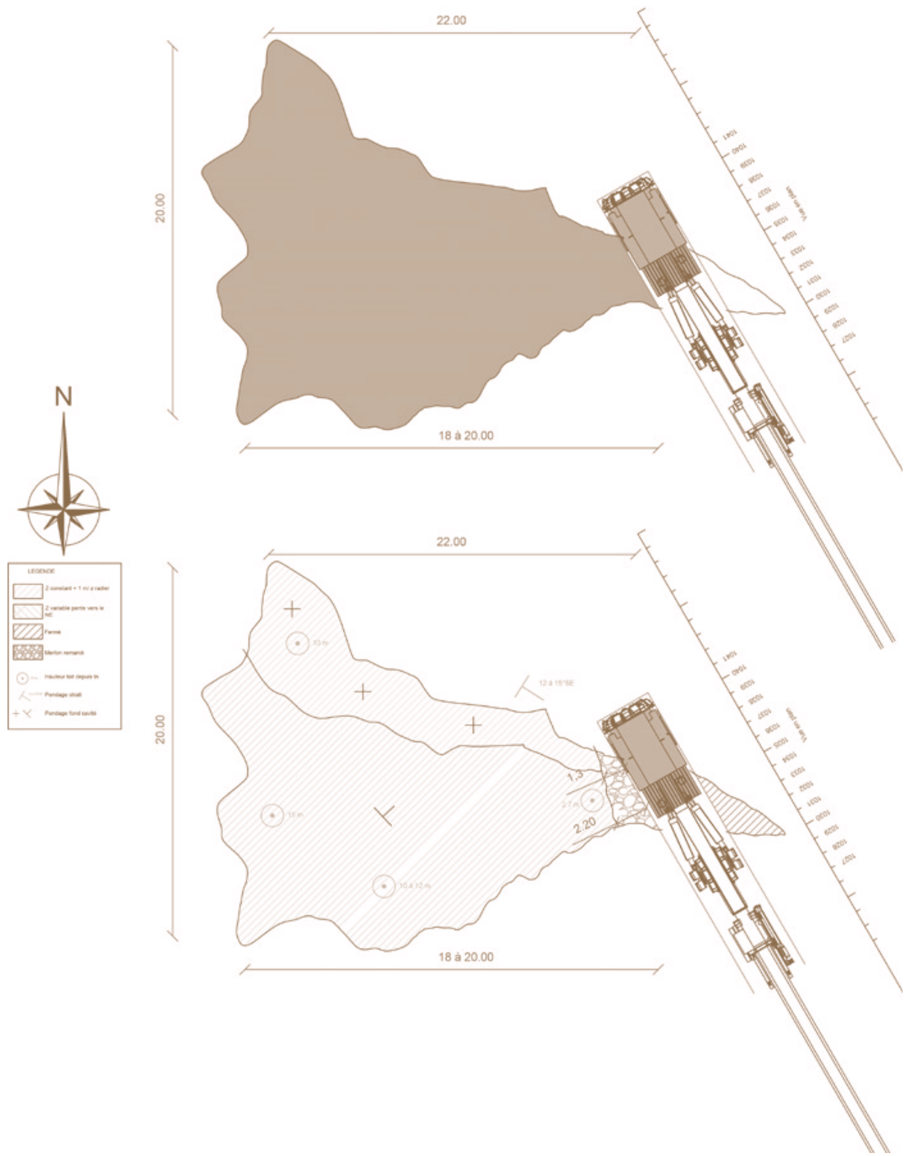
ROBBINS SOLUTION

Robbins Field Service assisted and advised Eiffage with the difficult ground conditions. When the cavern was encountered, a plan was put into effect that included erecting a 4 m high wall of concrete so the TBM would have something to grip against. A small door allowed access inside the cavity, which formed naturally at a point 60 m below the surface and was studded with stalactites and stalagmites. The TBM was started up and was able to successfully navigate out of the cavern in eight strokes without significant downtime to the operation.

LA CIOTAT, FRANCE

TUNNEL DRIVE	DIAMETER	TBM UTILIZED
2.8 km	3.5 m	Main Beam TBM

GROUND TYPES
Limestone, Powdery Clays, Karstic Formations



"When the machine is boring it does well. We have good production and it's a good machine for hard rock."

MARC DHIERSAT
Project Director of Galerie des Janots for Eiffage

A Strong Finish

THE CHALLENGE

Two EPB TBMs were stalled with only 750 m left in the drive. The machines were attempting to bore through mixed face conditions including hard granite and soil for the Namma Metro project in Bangalore, India. Although another manufacturer built the machines, Robbins came to the rescue.

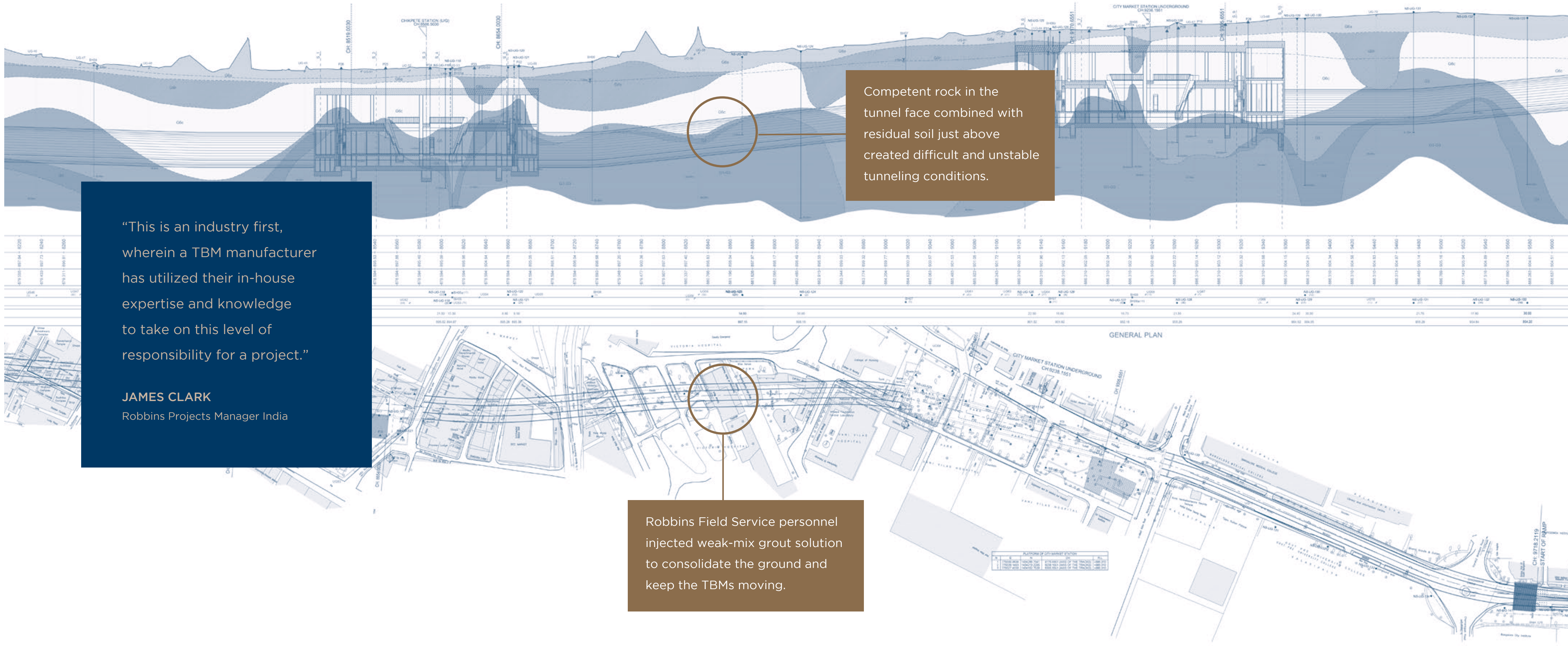
ROBBINS SOLUTION

Robbins Field Service refurbished the machines and took over operation of the parallel drives. Through face mapping, additive injection, and careful TBM operation, the team achieved rates of 50 mm per minute and finished the last tunnel in just nine months.

NAMMA METRO, BANGALORE, INDIA

TUNNEL DRIVE	DIAMETER	TBM UTILIZED
750 m x 2	6.4 m	EPB

GROUND TYPES
Mixed Face of Soil with Highly Weathered Granite, Full-Face Granite



Competent rock in the tunnel face combined with residual soil just above created difficult and unstable tunneling conditions.

"This is an industry first, wherein a TBM manufacturer has utilized their in-house expertise and knowledge to take on this level of responsibility for a project."

JAMES CLARK
Robbins Projects Manager India

Robbins Field Service personnel injected weak-mix grout solution to consolidate the ground and keep the TBMs moving.

HIGHLY VARIABLE GROUND CONDITIONS

No Job Too Tough

THE CHALLENGE

The Sleemanabad Carrier Canal in Madhya Pradesh, India, is a 12 km long water transfer tunnel that will bring water from the Narmada River to over 100,000 hectares of land. A Robbins Crossover XRE machine, 10 m in diameter, began boring the tunnel in 2011. Ground conditions were expected to be variable, but the conditions changed every few meters and water inflows were severe. By 2017, those tough conditions combined with commercial issues meant the contractor had only completed 1,600 m on their own.

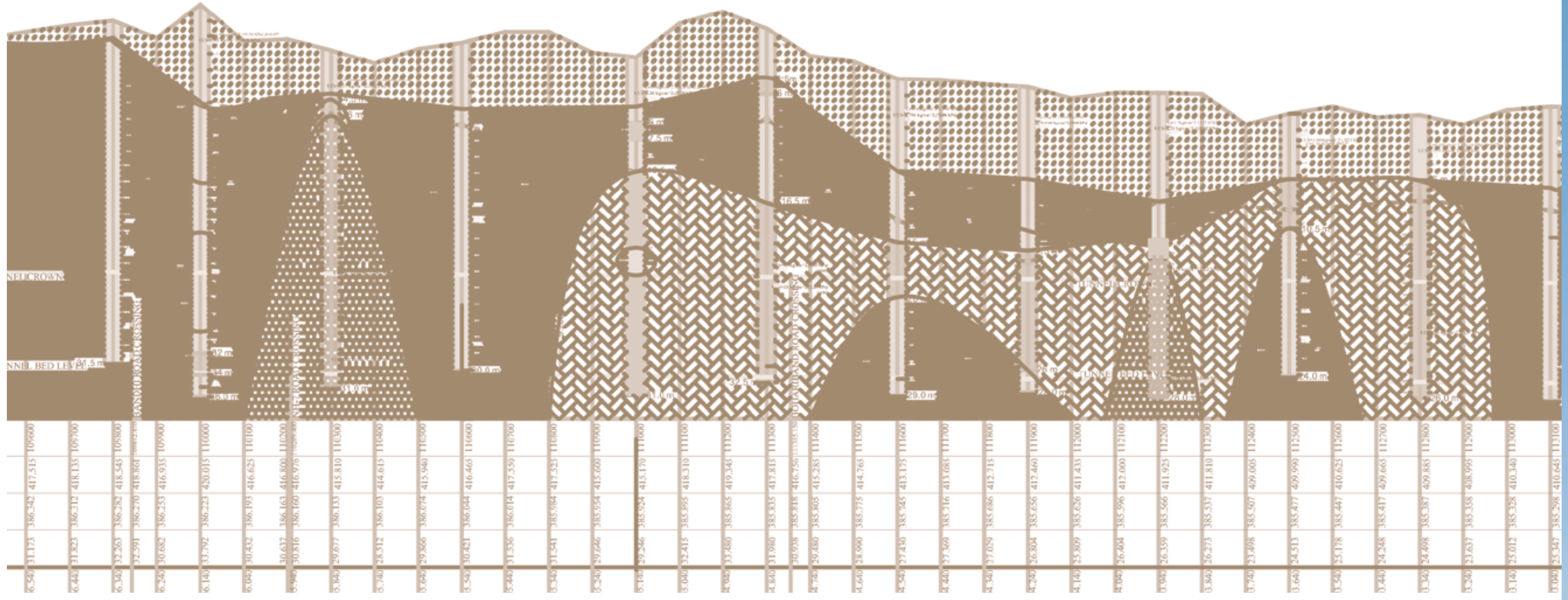
ROBBINS SOLUTION

In December 2017, Robbins Field Service personnel began operating the TBM. The field service team implemented a regular maintenance schedule, face mapping, and fine-tuned the additives used for ground conditioning. They were able to pass the 2 km mark in less than three months using this new strategy—a more than 1000% increase in advance rates.

MADHYA PRADESH, INDIA

TUNNEL DRIVE	DIAMETER	TBM UTILIZED
12 km	10 m	Crossover XRE

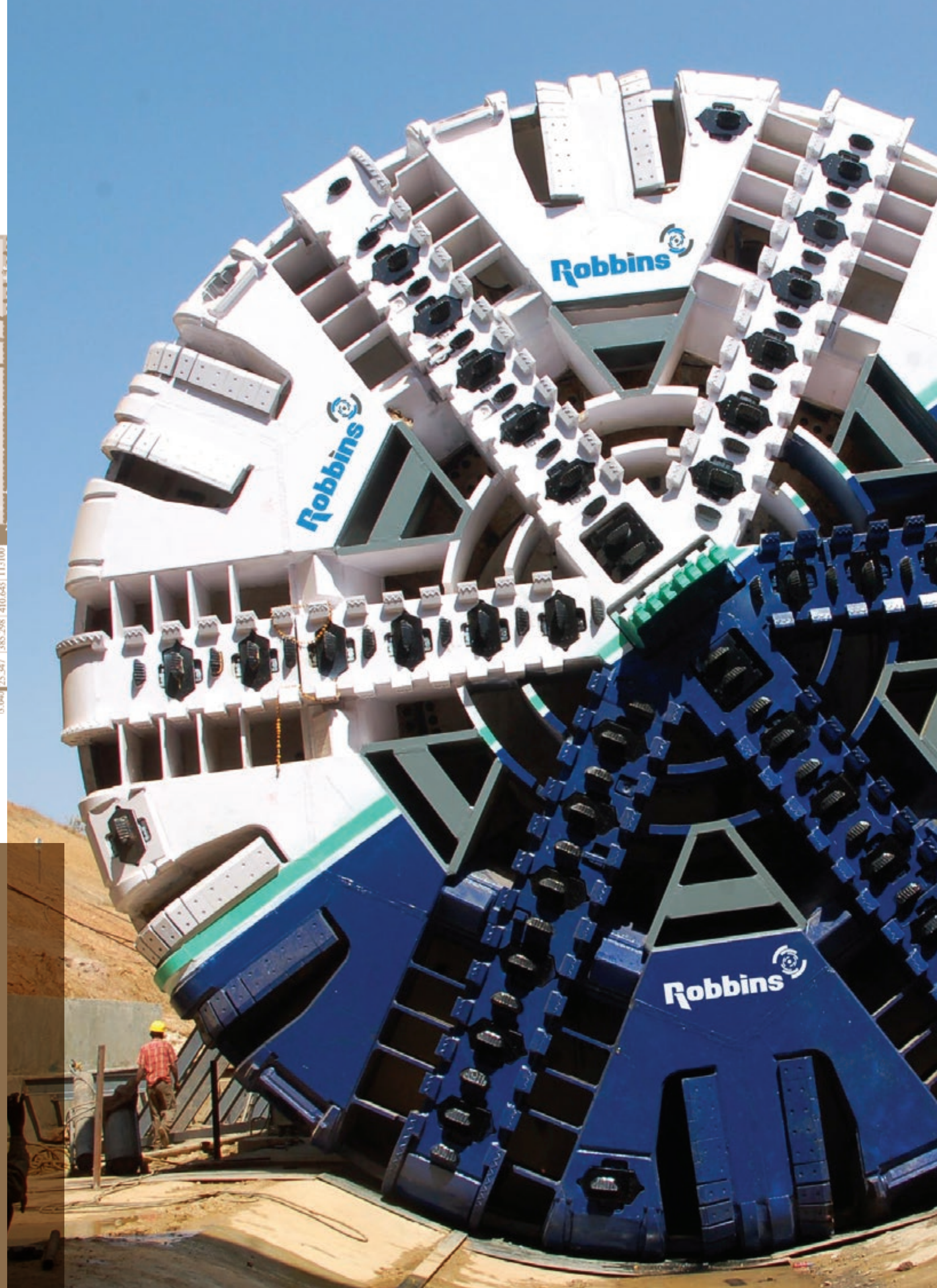
GROUND TYPES
Hard Rock (180 MPa UCS), Clay, Gravel, Marble



"We came with the knowledge and experience of operating a TBM of this size and with direct access to major TBM spares, cutters and wear parts."

JOHN SIMM
Robbins Field Service Project Manager at Sleemanabad

1000% INCREASE IN ADVANCE RATES



SQUEEZING GROUND

Getting Out Of A Tight Situation

THE CHALLENGE

Central Turkey's Kargi Kizilirmak HEPP is an 11.8 km long hydroelectric tunnel through the mountains of Central Turkey. A 10 m Robbins Double Shield TBM was supplied for the geology, which was expected to start out requiring segments, with about 8.5 km of the tunnel in self-supporting rock. Almost immediately after launch in early 2010, the machine encountered blocky rock, sand, and clays. About 80 meters into the bore the TBM became stuck in a section of collapsed ground. This was just the first of seven times the machine would become stuck and require a bypass tunnel within the first 2 km.

ROBBINS SOLUTION

The contractor, with the assistance of the Robbins field service team, installed a Robbins custom-built canopy drill and positioner to allow pipe tube support installation through the forward shield. As a result, the contractor was able to measure and back-fill cavity heights above the cutterhead in some fault zones to over 30 m. They were also able to help detect loose soil seams and fractured rock ahead of the face.

To further mitigate the effects of squeezing ground or collapses, Robbins' Torque-Shift System was retrofitted to the cutterhead motors. Once modifications had been made, advance rates soared to a high of 723 m in one month, and were more than double that of a drill and blast operation proceeding from the opposite end of the tunnel. The TBM bored 7.8 km of the tunnel in total, making its final breakthrough in July 2014.

ANKARA PROVINCE, TURKEY

TUNNEL DRIVE	DIAMETER	TBM UTILIZED
7.8 km	10 m	Double Shield TBM

GROUND TYPES
Volcanic Rock (140 MPa UCS), Sandstone, Siltstone, Marl, Multiple Fault Zones

"OHL was always determined to finish this project. After studying other options, we decided to proceed with the full refurbishment of the TBM with the help of The Robbins Company. The whole crew worked together to achieve that goal."

LUIS ALONSO
Tunnel Manager for contractor OHL

UNFORESEEN SITE CONDITIONS

Storming In To Save The Day

THE CHALLENGE

When Superstorm Sandy hit in 2012 major damage caused an EPB to come to a halt. The launch shaft was inundated with seawater and stopped the TBM just 460 m into its 2.9 km long drive. All electrical components needed to be replaced and the machine was damaged by corrosive seawater. Despite the TBM being built by another manufacturer, the contractor turned to Robbins Field Service for help.

ROBBINS SOLUTION

While the TBM was in the tunnel and under earth pressure of 3 bar, the Robbins crew was contracted to guide on-site personnel in replacing corroded hydraulic components and installing all new electrical components. Robbins PLC technicians reverse engineered the TBM's control system and built the PLC system from the ground up. The refurbishment was finished on schedule in four months, and the TBM went on to have a successful breakthrough in February 2015.

NEW YORK CITY, USA

TUNNEL DRIVE	DIAMETER	TBM UTILIZED
2.9 km	3.6 M	EPB

GROUND TYPES
Clay, Silt, Sand, Glacial Cobbles

HIGH COVER TUNNELING

Solving A Century-Old Problem

THE CHALLENGE

The Olmos Trans-Andean water transfer tunnel in Peru is the second deepest civil works tunnel in the world with cover of up to 2,000 m. The project was more than 100 years in the making, with several attempts being made and thwarted by incredibly difficult volcanic geology with over 400 fault zones. In 2007, a new attempt was made using a Robbins Main Beam TBM. The ground was difficult, with rock bursting, large over-breaks, and cathedralling in fractured and unstable ground. About 16,000 rock bursting events were recorded during the project.

ROBBINS SOLUTION

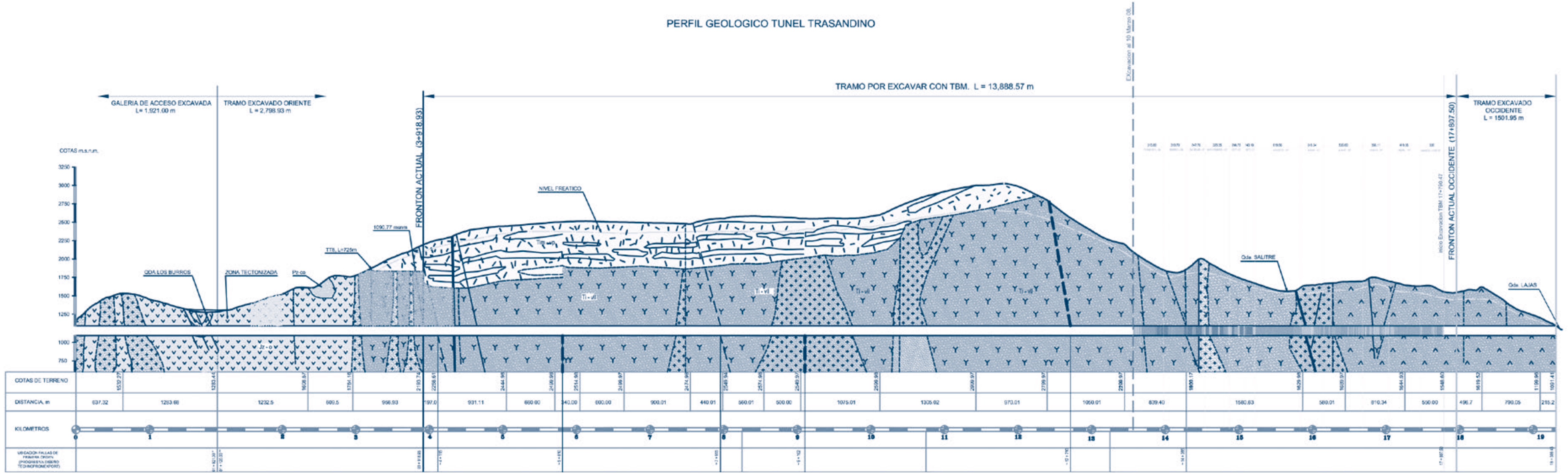
The contractor and Robbins made the decision to rework the TBM using the McNally Support System, which allows support to be installed directly behind the main roof shield using a system of pockets and steel slats bolted to the roof of the tunnel as the TBM advances. Incorporation of this system and other modifications to the TBM resulted in a steady increase in production rates in spite of continuous rock bursting events. The machine broke though in December 2011 having achieved production rates in excess of 670 m a month.

OLMOS, PERU

TUNNEL DRIVE	DIAMETER	TBM UTILIZED
13.9 km	5.3 m	Main Beam TBM

GROUND TYPES
Quartz Porphyry, Andesite, Tuff (60-225 MPa UCS)

400 FAULT ZONES
16,000 ROCK BURSTING EVENTS
ONE INNOVATIVE SOLUTION



WATER INFLOWS & EXTREMELY HARD ROCK

The Power To Push Through

THE CHALLENGE

At Vietnam's remote Thuong Kon Tum Hydroelectric Project, a Robbins Main Beam TBM was launched in 2012 to bore a section of what will be Vietnam's longest tunnel once complete (17.4 km). Commercial circumstances for the original contractor, combined with incredibly difficult geology, left the project at a standstill. In 2015, the revitalized project and its new contractor called on Robbins to lead the refurbishment and operation of the TBM.

ROBBINS SOLUTION

Robbins Field Service crews assessed and refurbished equipment and launched it again in 2016. They have overcome 300 MPa UCS rock, fault zones gushing water at 600 liters per second, and difficult site conditions. The Robbins crew trained local personnel in optimal ground support techniques to minimize downtime and worked with the contractor on a successful water control strategy. In less than two years, the highly skilled personnel at the site have taken the 4.5 m diameter Main Beam TBM from a near standstill at 15 percent project completion to 85 percent complete.

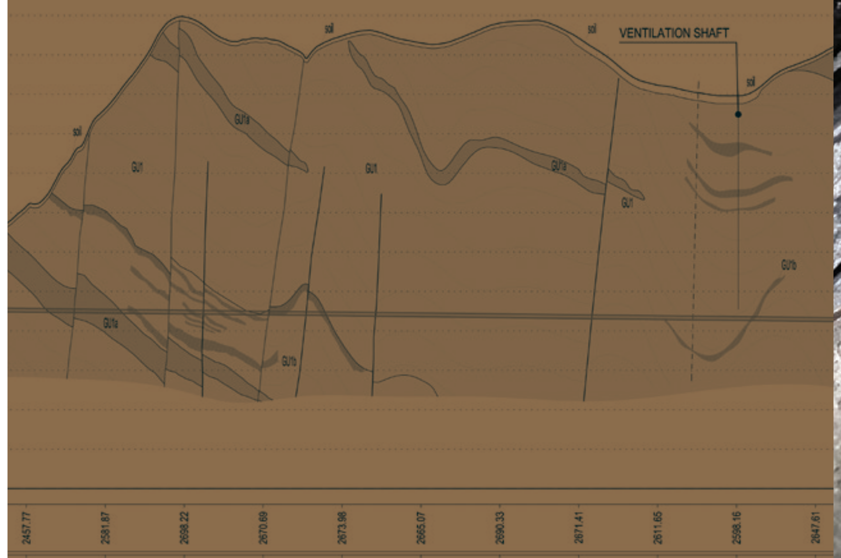
THUONG KON TUM HYDROELECTRIC PROJECT, VIETNAM

TUNNEL DRIVE	DIAMETER	TBM UTILIZED
10.5 km	4.5 m	Main Beam TBM

GROUND TYPES
Massive Granitic Rock up to 300+ MPa UCS

"We worked with local crew members on faster ring beam building methods, reducing time from seven to eight hours per ring beam build to three hours per ring beam. Because of this we get more utilization time for boring and less downtime."

PN MADHAN
Robbins Engineering Geologist for Field Service



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