

Crossing the tracks



Situated on the banks of the River Chambal, Kota is primarily an industrial city and one of the largest municipalities in the state of Rajasthan. Much of the city's water supply is contaminated or inadequate, necessitating a new system and up to 15 pumping stations.

The Rajasthan Government plans to address these problems and others with the Rajasthan Urban Infrastructure Development Project (RUIDP), a large scale water supply, waste management, and urban improvement scheme.

Part of the RUIDP will involve a new water line travelling 13 km from the Kota Barrage on the River Chambal to the Govindapura area of Kota, servicing about 70,000 people. Once complete, the pipeline will add 24 million litres per day to the current water supply. Though much of the pipeline has been excavated by cut and cover, the government mandated that all rail crossings had to be excavated by Trenchless Technology with casings.

Work on Kota Water Supply Project 16 started in 2000, utilising cut and cover methods to install 700 mm diameter steel pipe from the river into the city. Numerous

attempts to complete several crossings across high-traffic rail lines were unsuccessful. In 2007, Vichitra Constructions was contracted to complete the crossings, which could not be open cut.

Choosing technology: the Small Boring Unit

When Vichitra agreed to construct the massive water line snaking through hard quartzite rock, they knew it would be tough. After eight years and multiple attempts with various excavation methods the company needed a new kind of technology.

"We were looking for a completely different method, and found that disc cutter technology would likely work best in the very hard, abrasive rock we had," said Vichitra Executive Director Sudhir Agrawal. The company has now success-

fully utilised a Robbins Small Boring Unit and Auger Boring Machine to excavate three rail crossings in India's first ever use of disc cutter boring attachments.

Crews first hand-mined an 11 metre long by 4.5 metre wide launch pit, which took four months at rates of 200 to 300 mm per day in extremely hard quartzite up to 200 MPa UCS. The first attempt at the crossings in 2000 used a small pipe jacking system and hand mining, which was abandoned after several months of low production rates. Subsequent attempts utilised HDDs with rock heads, but both times the drills failed in the hard rock.

In 2007 after researching various methodologies, Vichitra purchased a 1.5 metre diameter Robbins Small Boring Unit (SBU-A) with 11.5 inch disc cutters and a Robbins 60-1270 Auger Boring Machine (ABM). The technology was supplied



Left: The 1.5 metres Robbins SBU-A excavated two 50 metre crossings after three unsuccessful attempts with other methods.

Below: The Robbins SBU utilised in Kota City is India's first-ever use of disc cutting heads.



The three crossings using a Robbins SBU-A and ABM completed a water line which will service 70,000 people in Kota City.



The Robbins SBU-A completed two rail crossings and one road crossing.

by Robbins Tunnelling and Trenchless Technology (India), a local subsidiary based in New Delhi who also provided the contractor with technical support, crew members, and cutter rebuild services.

How it works: SBU technology

Small Boring Units, available in diameters from 600 mm to 1.8 metre, are typically used on crossings up to 150 metre in length utilising a standard Auger Boring Machine (ABM) and steel casing. During excavation, the SBU-A is welded to the lead casing while the ABM provides both torque and forward thrust to the cutting head. The circular cutterhead is fitted with single disc cutters to excavate hard rock, or a combination of single disc cutters, two-row tungsten carbide insert cutters, and carbide bits in mixed ground. Disc cutters penetrate the rock face, creating a 'crush zone' through which fractures propagate. Material between adjacent crush zones then falls from the face. Muck scrapers scoop the muck into openings on the cutterhead. Muck is then transferred through a full-face auger for removal.

Crossing excavation

Both rail bores were completed in abrasive, hard rock. The 100 metre crossings, were excavated in two 50 metre long passes from either side of the tracks. During the first bore, the machine holed through into a center pit between the two tracks. Typical advance rates were up to 1.5 metre per hour. "We have shown the railway authorities that crossings can be effectively excavated with Robbins SBUs. Owners are now becoming more familiar with the technology and confident with its capabilities," said Mr Agrawal. A third 14 metre long bore was added underneath a roadway after difficulties with open cut operations in the rock.

Future potential in India

Robbins India hopes, through this project, to familiarise contractors not only with the efficacy of SBUs, but with mechanised underground construction in general. Most Indian contractors still consider hand-mining the standard, with typical advance rates of 300 mm per day. Drilling and blasting of crossings is also

prohibited in India. "Our aim is to provide turn-key solutions, consisting of ABM and pipe jacking systems, for hard rock areas including Hyderabad and Bangalore," said Paul Nicholas of the Robbins SBU Division. Typical SBU-A advance rates are some 20 to 30 times those of hand mining – around six metres per day on average.

Vichitra plans to re-use the Robbins SBU-A and ABM on several projects in the future. "Given the success of the SBUs after an eight year wait, combined with the size of India and the number of infrastructure projects, we believe there will be many opportunities for this technology," said Mr. Sudhir. The contractor's next project will utilise a 1.8 metre diameter Robbins Double Shield Rockhead (SBU-RHDS) – a type of self-propelled, manned entry boring machine utilising disc cutters. The machine will excavate several crossings up to 400 metre in length in hard granite up to 250 MPa UCS at the Mount Abu resort in Rajasthan. Construction is scheduled to begin in January 2009. ♣