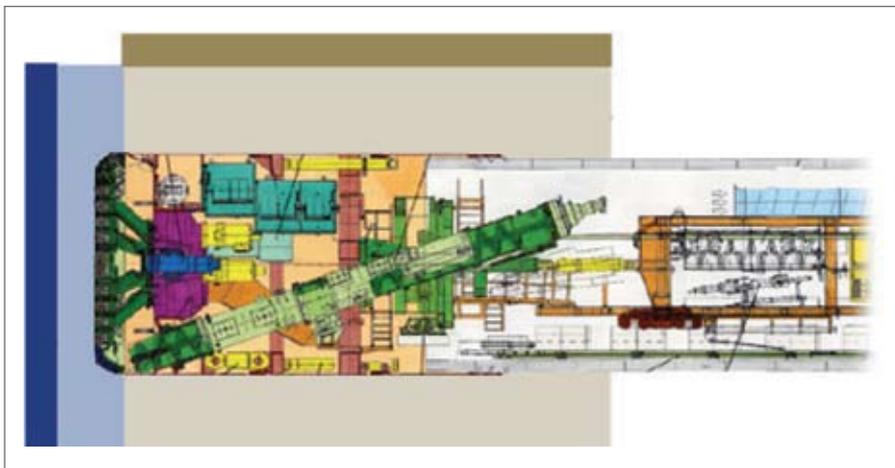


Giant tunnel borer to be dismantled



IT WILL TAKE three months to dismantle and remove Gautrain's giant 325 t tunnel-boring machine (TBM) and its 560 t of backup equipment after it has completed its 3 km drive underneath Oxford Road and onto Killarney.

This stretch of tunnelling started at Rosebank Station in January 2008. The TBM will finally come to a halt just short of Emergency Shaft 2, situated at The Wilds in Houghton, early in 2009.

The custom-designed mixed face earth pressure balance shield TBM is designed to cope with the challenging geology south of Rosebank. The tunnel borer is encountering complex conditions with a high water table passing through differing ground consisting of differing degrees of hard rock, sand and soft soil.

The TBM was built over a 12-month period in Germany at a cost of R300 million and was shipped to South Africa in the last quarter of last year.

When it reaches its final destination, dismantling of the TBM will take place in phases between March and May 2009. First the 145 m long back-up system comprising 13 gantry trailers will be removed. A diesel-powered locomotive with a 25 t pulling capacity will tow the trailers out of the 3 km tunnel back towards Rosebank Station where the TBM started.

TBM LARGE: NOT THIS ONE

When the trailers have been removed, dismantling of the front end of the machine (the main body) and cutter head can start inside the tunnel. The dismantled components and all the electric motors will also be taken out of the tunnel for reconditioning and use on other tunnelling projects. These include:

- The segment erector
- Screw conveyor
- Material locks
- Man locks

- Thrust jacks
- Articulation cylinder
- Steering cylinder
- Rotary coupling
- Main drive

The 6,8 m diameter cutting wheel, which houses 48 cutters, will be dismantled. The cutting wheel will have to be scrapped but the hubs of the cutters can be reused. The wheel is used for boring a 6,8 m diameter tunnel for a single-track rail line. As soon as a 1,5 m length of tunnel has been bored, a ring of pre-cast concrete tunnel lining segments is erected behind the cutter head. It leaves behind a watertight and smooth lining. However, the diameter of the lined tunnel is too small for the cutting wheel to be taken out of the completed tunnel in a single piece. Therefore, the cutting wheel needs to be dismantled before being transported out of the tunnel.

The 12 m outer steel skin of the front-end of the machine will remain where it is, in the tunnel. As it will be where the TBM comes to a halt, this short section of the tunnel is bigger than usual as it will not have been lined with concrete segments. The exposed steel skin over this short section will be covered with shotcrete to match the internal diameter of the precast concrete lining.

The remainder of the 15 km tunnel between Johannesburg Park Station and Marlboro Portal will be excavated using conventional drilling and blasting, as is done on the mines.

Tunnel borers are used on many

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when reaching the end of the tunnel

projects around the world. Urban tunneling requires that the ground surface is left as undisturbed as possible to protect underground municipal services and nearby buildings. This is facilitated by the use of TBMs which generally disturb the surrounding ground less than drilling and blasting does. Another advantage of TBM technology is its ability to produce a smooth tunnel wall.

GOOD PROGRESS ON THE TBM'S MAIDEN VOYAGE

By the end of February, Gautrain's TBM had successfully excavated 100 m on its maiden voyage, which started in January.

The TBM is progressing at about 9 m a day. When this moving factory is running to full capacity, it installs precast concrete tunnel lining rings at a rate of 12 per day. Each ring is 1,5 m wide and comprises six interlocking segments. A standard segment weighs 3,92 t.

When a ring of precast lining is to be installed inside the bored tunnel it requires the TBM to come to a temporary one-hour halt. As soon as the erection of the segments has been completed, the tunnel borer moves forward while the cutting wheel excavates the next section of the tunnel ahead. It advances a distance of 1,5 m at a time – equal to the width of the ring of precast concrete segments.

Work takes place 24 hours per day. The TBM functions on a 20 hour production shift with a four hour maintenance break. This includes the replenishment of equipment and stock such as foam or

grouting which are carried on the gantry trailers. The extension of the conveyor belts which remove the excavated ground to the access pit however does not delay the process. Maintenance of or replacement of the cutters can be done from behind the cutter head. Access to do this is via an airlock, as the cutter wheel chamber has to be pressurised when the machine is passing through water bearing ground.

In order to transport the necessary materials and supplies to the TBM as it bores its way further along the tunnel, service rails are laid behind it inside the tunnel. A man rider is also used to transport TBM workers in and out of the tunnel. The heavy precast concrete segments, which weigh 3,92 t each, are transported on flat cars drawn by a diesel locomotive.

The TBM is directed or driven by a pilot (or driver) who sits in a control cabin surrounded by an array of computer screens. His job is facilitated by a sophisticated electronic guidance system which displays a target he has to follow. It allows the pilot to steer the machine and to continuously monitor the actual three-dimensional position of the machine in relation to the theoretical centre line of the tunnel at any given location along its route.

ELECTRICITY REQUIREMENTS

The TBM requires a total of 3,2 MW of power to drive the 325 t giant. A substation dedicated to the needs of the TBM is situated at the Rosebank Station con-

struction site.

The cutter head is driven by seven motors and has 150 drag teeth for the soft ground mounted on it. It also has 40 single-disk cutters and four twin-disk cutters used for hard rock. The electric power rating of the cutting wheel is 2 450 kW.

The total thrust that the machine can develop against the ground is advances at a thrust of 4 000 t. □

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Source:

http://www.saice.org.za/downloads/monthly_publications/2008/CivilMay08/#/0