

Guiding WestConnex

TJ looks at VMT's technology and usage on Sydney's WestConnex Project

With forecasts predicting huge increases in population and traffic movements in Sydney, Australia, it became obvious that new road infrastructure was vital to support these growth forecasts, particularly along the M4 and M5 road transport corridors.

Plans to construct major new road ways have been developed and include two sections known as the NorthConnex and WestConnex. At around 30km in length, WestConnex comprises of the widening and extending the New M4, duplicating the New M5 and connecting the two motorways to provide a long overdue underground link to create a seamless free-flowing western bypass of Sydney's central business district for motorists.

On the WestConnex works, guidance systems and tunnel construction support software developer and provider, VMT won software and hardware supply and support contracts relating to Stage 1B M4 East and Stage 2 New M5.

Project requirements

The A\$16.8bn WestConnex has ground conditions along the route comprising Sydney Sandstone, a geological formation favourable for tunnelling. It was decided that due to accessibility difficulties and impact population, the tunnelling works would be completed utilising roadheader equipment as opposed to TBMs.

By early 2019 the widened section of the New M4 will open. On the 21 roadheaders and 11 Robodrill bolting vehicles were used for tunnelling activities across four construction sites.

Construction for the project also includes 50 cross passages connecting tunnels making a total tunnelling effort of around 14km. Across this Stage roadheader production has run at an average of around 25 to 30m per week.

For the rockbolting, VMT's positioning and guidance systems were required here too. With clusters of ground support bolts required to be positioned and installed each day/shift, quick and accurate location of the bolting point was vital in the production process.

The New M5 construction activity includes twin 9km tunnels are a major feature of the New M5 project which will run parallel to the existing M5 East. The project reached peak production with 20 roadheaders and eleven bolting rigs tunnelling from construction sites at St Peters Interchange, Arncliffe, Bexley and Kingsgrove on a 24/7 basis. Tunnelling began in November 2016 and includes some 75 cross passages, again utilising VMT's hardware and software packages.

Guiding the way

To ensure the roadheaders excavate the design tunnel profile and bolters position their tunnel support correctly, accurate and reliable navigation systems



VMT WestConnex 1.jpg – A roadheader at work on the WestConnex project in Sydney, Australia.

have been required. The challenge for VMT was to deliver, commission and support some 57 navigation systems between May 2016 and 2019.

The navigation equipment contracts required VMT to supply:

- TUnIS Navigation equipment for all Roadheaders and Bolters
- TUnIS Office servers and software for each site office for the collection, analysis and management of machine data.
- Permanent service on site for system commissioning and support, plus training of Surveyors, Site Engineers and Operators.

Practical challenges

While development processes try to take into account all feasible problems practical 'real life' situations often throw the proverbial 'spanner in the works'.

In terms of performance, the VMT engineers on site agreed that with the newly developed Tunis Roadheader software being used for the first time, the project was one of the biggest challenges faced to date. However, it was proven that the programmers had completed a great job to deliver the software before start of tunnelling.

Previous hardware used on Roadheaders had become obsolete, and needed to be updated. The extreme environment in tunnels and the continual vibration of the excavation machines had to be accounted for and again to date all hardware has proven to be most reliable.

Working on Australia's largest transport infrastructure project, one of the biggest challenges for VMT has been the sheer number of machines to install, survey and commission equipment and this was quite an intense operation including training



Positioning a rockbolt as part of the tunnel support operation.



A robotic unit spraying concrete.

the local engineers to use the systems.

Commenting on the progress to date VMT Project Engineer, Dan McPhail said: "As with all underground construction projects there have been difficulties and challenges, but the VMT equipment provided, installed and supported by the onsite team has worked extremely well in the challenging conditions of the WestConnex operations."

Other needs

The existing VMT system could not originally meet WestConnex requirements to collect, analyse and manage data from all roadheaders and bolters or integrate the data output of the navigation systems with the internet connected main office monitoring software. So, VMT needed to redesign the new navigation systems.

Involving virtually the company's whole staff, this development process was a significant challenge and required cooperation with the roadheader and bolter machine manufacturers to ensure the correct tunnel alignment and location for the rock bolt installations.

The type and range of information that the systems are required to collect and process include not only positional data and profile data but also operations data such as power consumption

hydraulic pressures and other operational factors that can be used to monitor machine performance remotely. Information such as the path of the cutterhead in relation to the face and the pre-designed profile of the tunnel cross-section was also collected for post-excitation analysis which would enable cutter effectiveness in relation to the local geology to be established and the accuracy of the cut to the required profile to be understood.

This information could also be used for operator training purposes.

Commenting on the WestConnex projects Alexander Höfer, VMT product manager for the contracts said: "The WestConnex projects have been very much the biggest challenge faced by the VMT staff to date. However feedback from the tunnelling teams has been excellent and our staff both in Australia and at the head office can be proud of our achievements." 



The finished tunnel profile with tunnelling operations having passed half way.



Holing of one of the roadheaders on the M5 road tunnel project.