Double prism solves curves in tunnel monitoring

In today's big cities, there is often new construction under already existing infrastructure. This raises a big safety issue, making it necessary to stringently monitor the stability of existing buildings and also for signs of movement or distortion during construction. Specific requirements of projects are always creating new challenges for surveyors, and in Singapore the new tunnel construction at Dhoby Ghaut station has done just that - necessitating the use of bi-directional prism to enable monitoring along the curved tunnel.

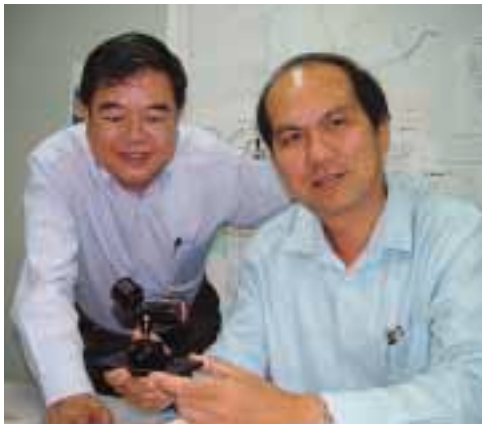
The Mass Rapid Transport (MRT) underground train system in Singapore is constantly being improved with new tunnel additions. The Land Transport Authority (LTA) first commissioned the installation of an automatic tunnel monitoring system at Bugis Junction over eight years ago - the first system in the world to monitor in a live tunnel.
The latest project involves the building of the Singapore Management University City Campus, over two tunnels of the Dhoby Ghaut Station. In addition, the new Marina Tunnel, phase one of the Circle line, is being constructed alongside these existing tunnels and extend into the back of the Station where monitoring is also required.

Installation of monitoring system

With such jobs, it is always necessary to make sure that the monitoring system works before construction commences. If the excavation is anticipated to reach what is defined as the first and second reserves (zones that are defined by the distance they are away from an existing tunnel), then monitoring for movement or distortion must be undertaken. The project team can then be forewarned if any preventative measures are needed. Wisecan Engineering Services Pte Ltd were selected as the surveyors for the project in February 2002. "We first completed the tunnel geometry and then started to do the planning in accordance for authority requirement," Managing Director, Mr Chua Keng Guan said.
Wisecan was formed in 1992 and begin by providing survey work for cable laying in Singapore. Prior to that Mr Chua worked for the MRTC and had a particular interest in tunnel projects. They began cooperation with Leica in 1994 and have worked together on many projects since then.
"The monitoring zone is a 500-metre long tunnel and this is too big for one instrument, making it necessary to use four total stations to cover its length for southbound, and another four for the northbound," said William Tang, Sales and Project Manager for Leica Geosystems' Singapore agent SiberHegner (SEA) Pte Ltd. "It is also on a curve, creating the need for the bi-directional prism."
Over 2000 prisms, including sixty bi-directional prisms were needed to cover the roof, walls and floor of the tunnels.

Installation in live tunnel

Because the tunnel is live - a train passes every four minutes - and it is very costly to have the tunnel closed during the day, the team had to install the prisms and monitoring system at night. Due to continual maintenance and repair activities also during this time, the team were lucky to be granted one or two nights per week for tunnel access, and then are only allocated three hours to undertake their work. Only a total of 30 access nights - 15 for each tunnel - have been approved so the schedule is very tight.
"The train stops at 1am and starts again at 5am," William Tang said. "Because it is a high voltage area, safety is a high issue and the power needs to be turned off and signals need to be working properly."
It takes 16 people working in three teams to install up to 200 prisms per night. Leica TCA2002 total stations were used for the measurement. "There is only three metres between each prism which is extremely dense and therefore quite a challenge," said William Tang.
Monitoring of this particular project will continue for three years until 2005. However, despite installation of the automatic monitoring system, manual checking will also need to continue as a backup every one to two months.



William Tang and Ghua Keng Guan with the purpose-designed bi-directional prism

Data flow

The four TCA2003 measure simultaneously and after each measurement cycle the raw data is being transmitted via GSM modem to a Server at Wisescan office. The data will be automatically processed and transmitted to the client almost instantly.
Should the measurement exceed the trigger levels, SMS warning messages will be automatically generated and broadcast to the responsible people. This proc-ess ensures that client gets the data on time for corrective action to be taken.
"If anything is found to be moving, we need to be able to provide convincing answers to the authority," Mr Chua said. "We are very confident that Leica instruments are able to provide consistency, and that is what we want for the important jobs - especially government authorities - we are able to tell the LTA that we are using a reliable instrument."
He added: "We have always believed in accuracy, performance and reliability. I liken Leica to a Mercedes - it lasts a long time and at the end of the day Leica outperforms the rest."

Bt

> ***"We have always believed in accuracy, performance and reliability. I liken Leica to a Mercedes - it lasts a long time and at the end of the day Leica outperforms the rest."***
> ***Chua Keng Guan***
> ***Managing Director***
> ***Wisecan Engineering Services Pte Ltd***

Over 2000 prisms - over the roof, walls and floor were intalled in the tunnel