

Case Study

Customer:
Academy Geomatics Ltd

Project:
Monitoring a Metro tunnel during overhead construction works

Solution:
Trimble S7 Total Station, Setup M1, Trimble T4D Monitoring Software



- Need for additional sensors - the tunnel was a cast iron ring section which meant heat could trigger movement through expansion which would need to be recorded.
- Covid, cost and time - restricting the number of site visits to an absolute minimum would be beneficial to all involved especially with these visits restricted to the night

Tailor-made solution

Responsible for finding a solution to the site's complex demands was Academy Geomatics Ltd Director, Mark Anderson. Having managed many of the previous Metro monitoring jobs, Mark ensured that his initial investigation of the site included a 3D laser scan of the affected tunnel. The scan revealed

“The system will deliver exactly what the client and Nexus (who provide, plan and promote public transport in the NE) specified for this complex project.”

Mark Anderson,
Academy Geomatics Ltd

that through careful positioning, there would be room within the tunnel to place a total station and consequently Mark was able to suggest two potential solutions to the client, one involving the total station and an alternative method using tilt sensors. The client elected to use the total station method favouring the ability to

generate absolute displacement values over the extra cost of using a total station.



▲ Custom built housing for the Trimble S7

Whilst you were sleeping – A tailor-made monitoring solution is set up remotely

As construction work gets underway above ground, a tailor-made, automated monitoring programme protects the live Metro tunnel below thanks to a system designed specifically to overcome a unique set of challenges and bring a new level of automation through remote set-up.

Whilst the development of Newcastle city centre continues apace, there have been many construction projects completed within the vicinity of the underground sections of its Metro. These works often require careful monitoring of the relevant sections of the network and several of these monitoring schemes have been managed by the highly experienced team at Gateshead based Academy Geomatics Ltd. With a further construction project just beginning in the city centre, Academy Geomatics Ltd was recommended to design and install a system for a tunnel that may be affected by the works, a job with many complex demands:

Complex site challenges

- Lack of access - the site was within a live metro tunnel so could only be accessed for a short period of time during the night.

- Restricted site - in previous locations within the Metro tunnel, there had been insufficient room to install a total station so a laser scanning method was used on a weekly/two weekly basis. However Academy Geomatics advised the client that during critical phases of this job, such as piling, more frequent measurement would be required.
- Requirement for client assistance – the construction company undertaking the work would need guidance in both the system set up and in understanding the generated results and long-term logistics for the site.
- Communications – if data was to be transmitted from the tunnel, robust transmission of this data would be imperative with a possible requirement for 280m of fibre optic cable up a vent shaft.



▲ A 3D Laser Scan was used to model Academy's set up of the 100 prisms

own knowledge and that of the KOREC monitoring team to create a tailor-made system that would suit all of the client's requirements and the dictates of the site. His final solution comprised a Trimble S7 1" Total Station (chosen for its reliability), a KOREC supplied Trimble Settop M1 box (see side panel), back up battery and charger and Trimble T4D Control real-time monitoring software (T4D). T4D controls the measurement rounds, manages and analyses the data and alerts and additionally allows for extra sensors to be supported, in this case a temperature probe attached to the M1 box because temperature would be an important variable to monitor due to the possibility of expansion of the tunnel's cast iron ring sections.

Meeting the challenges

A walk over of the site revealed that there was sufficient mobile phone coverage to ensure seamless communication simply by placing the relevant SIM card in the Settop M1 box. Meanwhile, power was provided to the instrument via 150m of armoured cable that was pulled and then installed in cable trays - one of the most problematic parts of the project that involved the Academy team crawling under platforms.

With communications and power in place, Mark addressed the limited access times and restricted instrument area by using the 3D laser scan that he had carried out

during the earlier visit. The scans enabled him to plan the exact position he required for the instrument's installation, to design and order a customised casing that would protect it for the duration of the project, that it would fit within the restricted area and additionally ensure full line of site to the prisms. The scan was also used to model Academy's set up of the 100 prisms, a number dictated by the extents of the site and the piling plan. The scan confirmed that the prisms would not be placed too close together, that they were all visible by the Trimble S7 and were a safe distance away from the tracks. By carefully planning their locations in advance, Mark could make best use of his limited time in the tunnel.

Automated set up – safe, efficient and cost-effective

Whilst Mark was sleeping after a night shift, KOREC monitoring expert, Julian Gray, was able to remotely configure the Trimble M1 Settop Box using no on-site staff at all, and get the monitoring system fully operational, all from the safety of his home office. Not only did this ensure that the system was up and running almost immediately and was checkable on the next nightshift, it also removed the need for access to the tunnel, additional travel expenses and the cost of having KOREC personnel on-site during five night shifts and of course was the most Covid safe method possible.

Communication is key

The T4D project was set up by Mark to include automated alarms

for any movement outside the pre-determined tolerances along with automated reports, analysis charts, custom views and composite views. All the

information and visuals were designed for clear and easy interpretation of the tunnel's behaviours by the client via T4D running on Academy's server through the web portal.

For Mark, it was an important aspect of the project that the client understood both the long term logistics of the site and how best to interpret the data. A project specific guide was therefore created which outlined how to use T4D highlighting the



▲ Easy understanding of generated results

various functions and best practices when viewing the data and also pointing out some of the better analysis charts to look at and the rationale behind them. Daily and weekly reports would also be issued automatically to interested parties via email. The automated alarms, if triggered, would report via email and SMS to all relevant parties, so that site activities could be investigated.

Mark reports that the system is up and running and has been fully tested in preparation for the beginning of the construction work. The system will deliver unrelenting and constant monitoring (rounds every 30 minutes) with the live data reassuring the client that their building activity is not unduly affecting the tunnel and therefore the safety of passengers. The system will deliver exactly what the client and Nexus (who provide, plan and promote public transport in the NE) specified for this complex project.

Our thanks to Mark Anderson, Director, Academy Geomatics Ltd for supplying the information and images for this case study. www.academyg.com



About the Settop M1 – bringing new levels of automation

The M1 total station controller has recently been relaunched with new software and is an extremely robust communication hub. When combined with Trimble 4D Control (T4D) software, the Settop M1 enhances the operation of a Trimble total station, combining the functionality of a field computer, device server, router and remote switch all into one device. This streamlines the number of components needed in the field and provides a level of remote installation unrivalled by any other system.

Remote installation greatly improves site safety and also significantly reduces set up costs that can be factored into tenders in order to be strongly competitive on price with no compromise to service. Additionally, KOREC's Julian Gray has developed software to feed total station raw data directly into 3rd party monitoring software as well as Trimble T4D making it a viable solution for all.

Contact us:

Please do get in touch for further information on any of the products or services mentioned in this case study, a demonstration, support or just a chat about your requirements.

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