Continuous control of M7 road project

The construction of the 40km M7 will provide the crucial link between the M2, M4 and M5 motorways of Western Sydney, Australia. Work started on the 1.5 billion dollar road project in June 2003, with plans to open the road by 2007. To maintain the tight schedule, a network of GPS reference stations were installed from the onset to provide continuous and validated control for the duration of the project.

Abigroup Leighton Joint Venture (ALJV) formed an alliance with Leica's Australia distributor, C. R. Kennedy & Company Pty Ltd, for them to provide the survey equipment for the project. C. R. Kennedy supplied a network of reference stations to provide control and a number of TPS1100 total stations and SR530 GPS survey rovers. It was essential that all the survey equipment used on the project was running TP Stakeout, the powerful road surveying software developed in Australia, and now licensed to Leica Geosystems. The M7 is the biggest urban road project in Australia, containing 146 and 38 over- and under-passes.

(Below): The Hoxton Park section of the Westlink M7 project

C. R. Kennedy provided four SR530 GPS systems for the reference network. The SR530 was installed so that it could also be used as a field reference or rover later on as the requirements of the project change. Each SR530 was installed as a semi-permanent base station, enabling easy relocation as site offices are re-established along the job, and AT503 antennas were used to provide effective multipath mitigation and good positioning.

Checking the stability of RTK base stations

Each base station was required to provide real-time corrections to the rovers on site and to log data for verification purposes. These data needed to be checked on a daily basis to make sure there was no movement of any of the reference stations. This is particularly important on the site as the reference stations are not permanent setups and are located within the working area close to machinery and earthworks.

C. R. Kennedy conducted extensive tests along the length of the job to identify what would be required to saturate the working area with real-time radio corrections. It was crucial to fully test the radios to ensure that there are no physical barriers that may impede the propagation of the signal and that there are no sources of radio noise in the area that may cause signal interference on the chosen frequencies. Radio licenses were obtained for two UHF frequencies running at 2 watts. Two Pacific Crest UHF radios were connected to each base transmitting on the two frequencies, with the transmit times staggered using time slicing so that the frequencies did not interfere with the neighbouring base station.

Installation of the reference stations was completed using Spider software from Leica Geosystems. Spider allows full remote control of the reference stations, enabling the survey manager to configure and run each reference station from the main site office. Due to the non-permanent location of

From Austria to Australia - C

Innovative projects in Australia and Austria are making use of Leica GPS Spider software to fully automate operation of GPS reference stations. In the first project presented, Spider controls a network of GPS reference stations and in the other it monitors a dangerous rockfall area. The purpose of these projects is quite different, nevertheless Spider, together with customized solutions by Leica Geosystems have fulfilled and exceeded the customer's expectations. Permanent GPS reference stations increasingly complement, and even begun to replace, traditional first order geodetic networks. In addition to delivering data for

GPS Spider nets the world

nationwide RTK (real time kinematic) services and post processing users, GPS reference stations allow fully automated monitoring of man-made or natural structures and the establishment of semi-permanent, local RTK services for big construction projects. In that respect, permanent reference stations form an infrastructure that can be used by many different user groups, and thus become even more economic. As an example for such projects, two innovative installations are presented which feature the Leica GPS Spider software that have been in operation since Autumn 2003.

the reference stations, wavecom GSM phones were used to communicate with each reference. This also enables the survey manager to 'dial up' the reference station from any phone-line to establish communication, change settings and to manually download static data. A routine was setup within Spider to download the static data every four hours for archive and verification.

Podium software, an auto-processing software from Leica Geosystems that uses the powerful SKI-pro processing engine, was used to automatically process baselines from the downloaded data and to email the survey manager with a report of the baseline results. Podium working with Spider ensures the survey manager is fully informed and in communication with the reference station control 24 hours a day.

Podium serves as an example of how quick project-specific solutions can be implemented, and is thus able to further broaden the field of application for the GPS Spider software.

Jane Cooke

(Above): GPS Spider installations available on the web: check www.nrs.leica-geosystems.com

A rockfall with severe consequences

On the morning of 7 July 1999, the 'Eiblschrofen', a rockface above the scenic town of Schwaz in Austria, experienced significant geological movement, causing huge boulders to crash down into the valley. Parts of the town had to be evacuated due to the considerable danger for the inhabitants and immediately following the evacuation, an intensive monitoring system was established in order to assess the ongoing movements of the rockfall area.

The local surveying company Weiser-Kandler was given the task for daily measurements. For this demanding project, Weiser-Kandler, a company which has a long tradition in monitoring and engineering geodesy, teamed up with Vermessung OPH (Obex-Pfeifer-Haas). OPH has been using Leica GPS for many years and is one of the pioneers of GPS surveying in the mountains of western Austria. During the initial phase of the project, all measurements were repeated on a daily basis. Weiser-Kandler focused on terrestrial measurements using the TCA1800, whereas OPH concentrated on the control of the reference frame using SR530s and SKI-Pro.

Immediate measures

After some time, when a noticeable decrease in the movements was detected, a huge dam was erected to provide future protection to the inhabitants who were then allowed to return to their houses. The tension further relaxed, and the measurement interval was reduced to four months. In the summer of 2003, it was decided to review the monitoring program to get a clearer picture of the still ongoing, creeping movements of the "Eiblschrofen".

(Below): The"Eiblschrofen" rock fall shortly after the collapse

(Above): Permanent GPS station with Wireless-LAN antenna after completion

As part of this project, Weiser-Kandler and OPH developed a concept for a continuous GPS monitoring system.

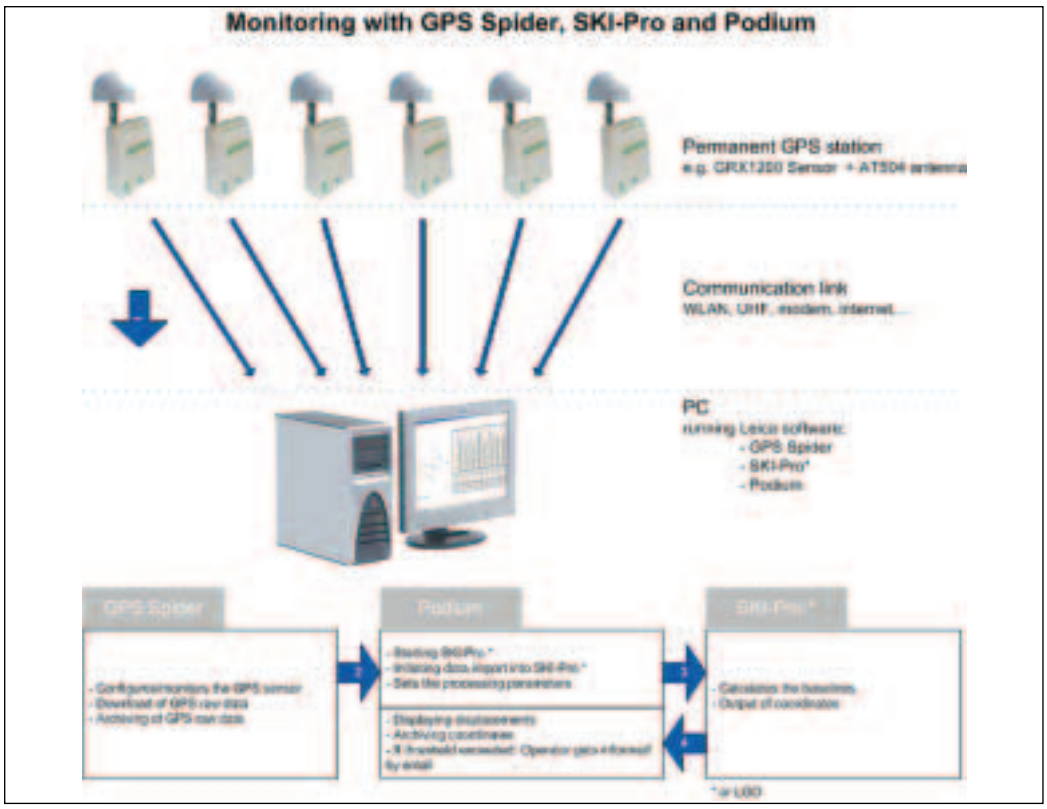
Permanent GPS monitoring of the "Eiblschrofen"

The large size of the deformation area, as well as dense vegetation and difficult terrain did not allow monitoring using total stations. Consequently, the surveying companies and their client, the town of Schwaz, agreed to establish a pure GPS monitoring network, which would run continuously, providing 24/7 coverage of deformation control. To solve this application challenge, two solutions were examined: Leica's GeoMoS monitoring platform, or a combination of GPS Spider with SKI-Pro scripting. After discussions, GPS Spider with SKI-Pro scripting was chosen, one reason being that it was clear from the very beginning that the system would remain a GPS-only setup meaning that the sophisticated GPS-TPS combination that GeoMoS allows was not needed. On the other hand, short baselines and long processing intervals allowed the usage of single-frequency sensors. In addition, there were only limited requirements for analysis tools, which favoured the customized SKI-Pro scripting solution.

The final setup consisted of Leica GPS Spider software controlling SR510 sensors for the monitored points, as well as an RS500 on the control point. The communication between the PC in the data center and the reference stations, uses the latest WirelessLAN technology over a distance of a few kilometres. Spider automatically downloads raw measurement data files from the sensor every twelve hours, and archives them to the processing PC. The GPS processing is completed by SKI-Pro and steered by the VisualBasic application "Podium". Podium makes use of SKI-Pro's scripting capability and automatically imports the data into SKI-Pro, controls the processing and exports the data to customized ASCII files. Furthermore, it shows both graphically and numerically the recorded movements and informs via email if any threshold is exceeded.
The system went operational in November 2003, and since then, has been providing seamless deformation data, which is vital for a comprehensive analysis of the geological processes. "The first results fully meet our high requirements," said Martin Obex, Manager of OPH.
Furthermore, an additional use of the station as RTK base station equipped with the dual-frequency and RTK-enabled RS500 is planned. After attaching a proper communication device such as a modem to the reference station, and using Spider, the sensor can be remotely configured to send RTK corrections by the press of a button.
Both surveying companies have used Leica Geosystems' products for years, and have worked closely together with Leica's Austrian partner Rost. "In addition to the outstanding product quality, the highly professional support from Leica has allowed us to lead this innovative project to a full success," said Christoph Kandler, Manager of Weiser-Kandler.

Lienhart Troyer

(Below): Erwin Truttmann (Rost) and Christoph Kandler, Manager of Weiser-Kandler, installing the GPS antennas. Despite the dense vegetation that formed significant obstructions for GPS signals, Leica SmartTrack technology provided the high accuracy data needed for monitoring applications.



(Left): Monitoring with GPS Spider, SKI-Pro and Podium

Leica GPS SPIDER takes over management of the Portuguese National GPS Network

The Portuguese Geographic Institute (IGP) - www.igeo.pt, has chosen Leica Geosystems' GPS SPIDER Software to manage the National GPS Network in Portugal (ReNEP/GPS).

IGP has not only purchased five remote licenses of GPS SPIDER Software, but have also placed an order for an additional four RS500 GPS receivers in order to completely upgrade the hardware equipment of the existing Network. At present, eight units are permanently in operation throughout the country, delivering data and services for post processing users.

Currently, the Network has the capability to log GPS raw data, 24 hours per day, 7 days per week, and this data is available free of charge from the IGP website. However, the infrastructure installed is already capable of broadcasting DGPS and RTK as soon as IGP needs real-time data.

GPS reference stations allow fully automated monitoring of man-made or natural structures and establishment of semi-permanent, local RTK services for big construction projects.

"Permanent reference stations form an infrastructure, which can be used by many different user groups," Helena Ribeiro, ReNEP/GPS Manager of IGP said. "We are confident that Leica Geosystems' reference station solution will provide us with an accurate system that will increase productivity, and provide a reliable network for all these users."

The Portuguese ReNEP/GPS Network currently includes Leica Geosystems' receivers that are working for the EUREF Permanent GPS Network in Europe and the International GPS Service (IGS) GPS Networks. The permanent tracking stations involved in these networks provide Global Positioning System (GPS) orbits, tracking data, and other high-quality GPS data and data products online in near real-time to Local, Regional and International Data Centres.

The Portuguese GPS Network is expected to keep growing in the near future in order to cover the major areas of Portugal.

"We are very pleased to collaborate with IGP in this national project," said Joël VanCranenbroeck, Business Development Manager for GNSS Reference Stations and Structural Monitoring with Leica Geosystems. "It confirms Leica's ability to provide not just the best equipment but also the best overall solution for reference station networks."

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