Leica Geosystems TruStories
Monitoring

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Leica Geosystems TruStory
Track Monitoring
Traunstein, Germany

Munich-Salzburg railway line above the tunnel site

To reduce traffic through town the local authority for the German town of Traunstein decided to build a bypass road starting in spring 2009 and including a new tunnel under the Munich – Salzburg railway line. The track owner, Deutsche Bahn AG (DB), stipulated continuous monitoring of the stretch of rail affected by the tunneling operations. Lead consultant Bernd Gebauer GmbH decided to install a track position monitoring system and engaged consulting engineers ing Traunreut GmbH for the task. The system of freely combinable measurement sensors from Leica Geosystems in conjunction with the Leica GeoMoS or GeoMoS Web monitoring software proved to be perfectly suited to this task.

The installed measuring system not only uses Leica TCA1800 Total Stations but is also testing the new Leica TM30, a total station specially developed for monitoring. These motorized sensors ensure that measurements to 100 prisms attached directly to the structure are taken and recorded continuously, around the clock. Also installed are meteorological sensors, a webcam, and 38 tilt sensors. The total stations were set up on two pillars, each about three meters tall, in a settlement-free area and protected from the weather, vandalism, and theft by a specially manufactured housing.

The highly accurate total stations automatically measure the 100 prisms in specified measurement cycles from two positions per cycle. Two complete sets of meas-

ing TRAUNREUT GMBH

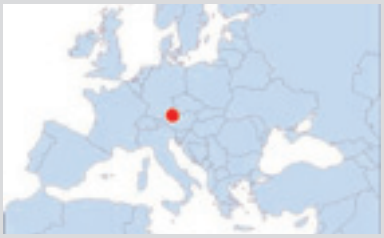
Company
ing Traunreut GmbH, Germany
www.ing-ingenieure.de

Challenge
Track monitoring of the Munich-Salzburg railway line during the construction of the Ettendorf Tunnel (crossing under the tracks)

Customer
Federal Republic of Germany (State Building Authority, Traunstein)

Project period
June 2009 to June 2010

Location



Project summary
Hardware
Leica TCA1800
Leica TM30
Leica GPR112 monitoring prisms
Leica GMP104 mini prisms
Tilt sensors
Meteorological sensors
Webcam (panTerra.tv)
Software
Leica GeoMoS Monitor
Leica GeoMoS Analyzer
Leica GeoMoS Web
Web service panTerra.tv
SMS delivery function aspsms.com

Leica GPR112, Leica GMP104 prisms and tilt sensor

urements are taken per hour. In addition to these measurements, tilt sensors mounted on the sleepers also monitored track movement. All the captured data were transferred almost in real-time to a GeoMoS computer and visualized for the customer with the help of GeoMoS Web.

General Requirements of the Monitoring System

The strict conditions imposed by DB required the monitoring system to meet very high demands. The installed tilt sensors had to ensure a measuring accuracy of +/-0.3 mm/m, while an accuracy of +/- 1.0 mm was required for total station measurements. Reliability of the system is very important, particularly with regard to storage and security of the measured data. One of the precautions taken by ing Traunreut GmbH was therefore to install a fallback system for data transfer over UMTS, in addition to the fixed data lines (DSL), in order to safeguard data transfer in the event of a failure. Another requirement was that the measuring system must have an independent power supply capable of bridging short-term outages. If the specified tolerances are exceeded, the system alerts the DB track manager by text message. In addition, there is also an optional notification by landline.

Comprehensive Service Concept

Client requirements and wishes could be complied with in real time thanks to the swift and excellent support from Leica Geosystems. The Leica Geosystems support team was not only able to advise the consulting engineers on design and installation of the systems, but was also actively involved on site and provided excellent support throughout the project by remote access. In addition, the Leica Geosystems programmers were always on hand to perform any requested adjustments to the graphics on GeoMoS Web.

Data Retrieval with Leica GeoMoS Web

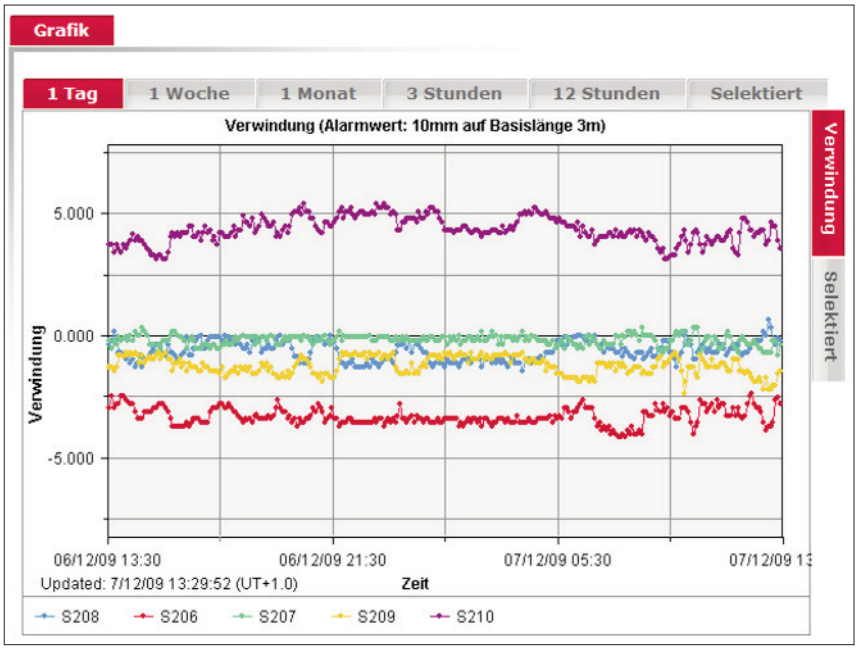
The engineers are able to display and analyze the captured monitoring data over the Internet using GeoMoS Web. The GeoMoS Monitor module uploads measured data to the GeoMoS web server via FTP. There the data can be configured individually and displayed graphically. Users with appropriate access codes can then access the information. The use of the Leica Geosystems host service ("Software as a Service") eliminates or minimizes costs for hard-

Communication
Fixed line data communications (DSL) backed up by a UMTS fallback system

Objective
Early detection of movements of the track during the works in order to minimize risks and hazards to rail traffic

Services
- Continuous measurement of changes in the position, level, and tilt of the Munich-Salzburg railway track
- Continuous monitoring of the position of the masts and overhead line equipment
- Visualization and evaluation of the measurement data using Leica GeoMoS Web
- Alerts by SMS and fixed line networks when tolerances are exceeded

Measurement pillar with Leica TM30 and webcam



Graphics Leica GeoMoS Web (track distortion)

ware, software, and IT. New features are always made immediately available to all users and do not require any further installation on the customer's computer, while the encrypted web service looks after the secure transfer of data over the Internet. The customer gains access to the graphics on GeoMoS Web from a login screen. Once logged in, he can analyze the data, e.g. by changing the time frame or extracting the results from one of more points or sensors. By installing a high-resolution webcam ing Traunreut offers customers the additional benefit of a quick overview of the actual site conditions through GeoMoS Web. By installing a high-resolution webcam from panterra.tv (German module partner of Leica Geosystems), ing Traunreut GmbH was also able to offer its customer the additional option of obtaining a quick overview of the actual conditions on site through GeoMoS Web.

Changes in Track Position

With GeoMoS Web, the client can get information about current changes in track position at any time during the works. Some of the larger movements were observed in particular during tunnel shield driving in Phase 2. On two occasions it was necessary to carry out track rectification after a depression with a vertical displacement of up to 25 mm appeared in a length of track. Since the start of track monitoring, the track has settled up to 5 cm. However, not just tracks are affected: movements were also observed in the overhead line masts. A tilt of almost 7 mm/m developed in a mast foundation, which translated into a displacement of the overhead line of 3 to 4 cm and meant that the position of the overhead line on the southern mast had to be corrected. All settlements were detected at an early stage by the monitoring system. This allowed appropriate early corrective measures to be implemented before reaching a stage where notification of the track maintenance manager would have been necessary - which would have triggered an expensive temporary closure of that complete section. Instead corrective work could be carried out between trains or required only a temporary closure of the track in one direction.

Test Phase with Leica TM30

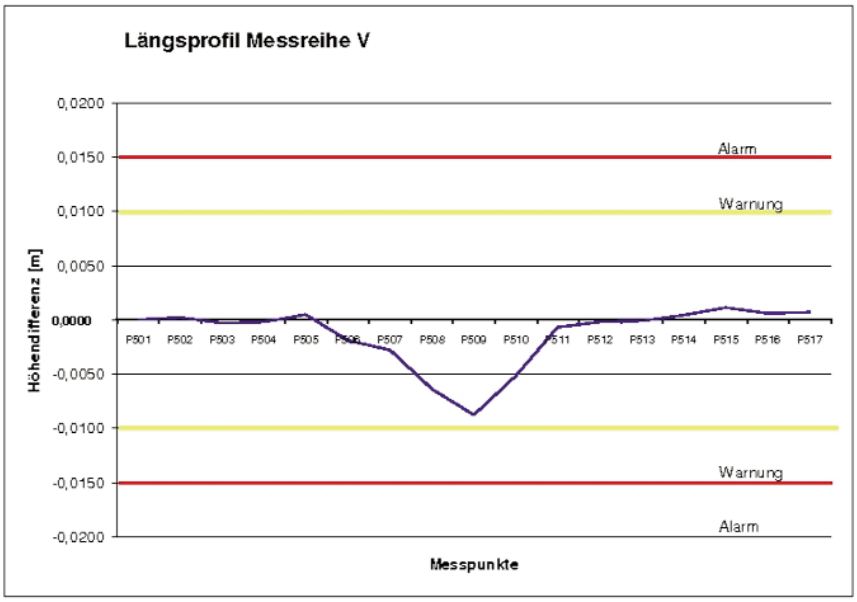
Since the start of the project the ing Traunreut engineers used two Leica TCA1800 total stations for monitoring. These traditional monitoring instruments impressed the engineers with their robustness and reliability. To prepare for future monitoring projects with similar or higher requirements, ing Traunreut GmbH decided to test the new Leica TM30 monitoring sensor in this role. After completion of the first monitoring phase, one of the TCA1800s was replaced by a Leica TM30. The new model remained in operation throughout the entire second monitoring phase, during which time it made a big impression, measuring almost silently with its new piezo drive capable of higher rotation speeds, whilst achieving improved accuracy over a longer range. It also offers two very use-

ful functions in TargetView and TargetCapture. Using TargetView, the instrument can select the correct prism from several others in the immediate vicinity. The TargetCapture function stores a digital image of the field of view for target-point documentation purposes. This not only allows the causes of obstructed visibility, such as mist, to be identified, it can also be combined with a web-cam. Compared with the TCA1800, in the same time the Leica TM30 measured twice as many points with a higher accuracy. Even though the TCA1800 total station fulfils the requirements of this project for the time being, in the future the Leica TM30 could take over this role on monitoring projects.

Installation of pipe canopy tunnel lining (monitoring phase II)

Conclusion

This project shows yet again how important and worthwhile a monitoring system is for site supervision. The measurement and analysis of track deformation, including fast reactions to the changes, would not have been possible without such a system. Damage to existing infrastructure, and possibly to passengers and site staff, could have had grave consequences.



The graph shows the longitudinal profile with the measurement series V prisms.
The measurements from P506 to P511 clearly show the formation of the sag in the track.

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Leica Geosystems TruStory
Quarry Monitoring in Slovenia

Lipica II quarry. The underground entrance is 60 m below the surface.

During September 2008 the first monitoring project in Slovenia was initiated. The projects success was due to the joint cooperation of the University of Ljubljana, Faculty of Natural Sciences and Engineering (Slovenia), Geoservis and Marmor Sežana.

The Lipica II Quarry consists of a large underground mine, accessed via a 60 m deep open pit quarry.

The terrain around the quarry is compacted with a lot of cracks. There are also numerous caves and caverns. The region also experiences freezing temperatures and high rainfall, which have lead to erosion, rockslides and breakages of rocks around the edge of the open cut pit.

To ensure the long-term safety of mine employees, equipment and surrounding infrastructure the mine operators began investigating monitoring systems.
The mine operators required a system that could:

- Perform automatic and autonomous operation, providing results 24/7
- React on movements without an operator
- Allow access to monitoring data from anywhere in the world
- Determine the correlations between movements and other effects on the site such as, temperature, blasting and quakes.

Leica Geosystems Monitoring Solution was chosen as the only complete solution that could meet all the requirements.

Scope
Establish a 24/7 automatic monitoring system with remote access. Determine and monitor how anthropogenic and environmental effects, affect the structural integrity of the quarry

Customer
Marmor Sežana d.d, Lipica II Quarry, Slovenia.

Project Participants
Project Management: University of Ljubljana, Faculty of Natural Sciences and Engineering, Slovenia.
Installation setup and configuration, customer training: Geoservis, d.o.o.

Date
September 2008 - ongoing

Project Summary
Instruments
Leica GMX902 GG
Leica GMX901
Leica Nivel 210

Software
Leica GeoMoS
Leica GNSS Spider with Positioning
Other
Wireless device server and access point. Personal computer with UPS and internet connection.

Benefits:
• Safety of workers and equipment
• 24hr worldwide access to monitoring data
• Automatic operation, instant display of measurements
• Cost savings

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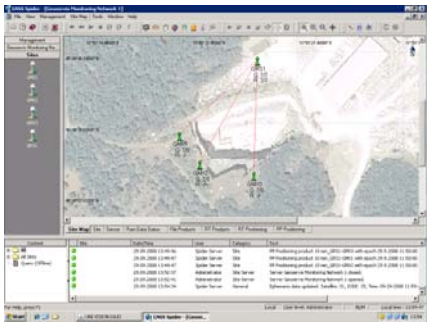
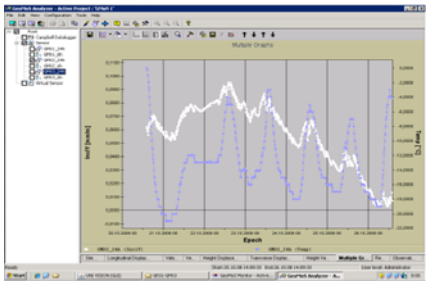
Leica Monitoring Solution
Three monitoring points were established around the mine perimeter, with a fourth outside the area of movement.

The monitoring equipment included Leica GMX901 and GMX902 GG receivers, Leica Nivel 210 tilt sensors and a communication box for remote control and data delivery via the wireless communication network. Dual axis inclination (X,Y) and 3D displacements measurements were recorded.



Leica GNSS Spider, site overview

Leica GNSS Spider provides GMX Sensor control, while Leica GeoMoS software manages the Nivel210, coordinates from GNSS Spider Positioning Products and complete database management. Leica GeoMoS also provides movement analysis and the alert functionality.



Leica GeoMoS, movement analysis

"*When the rock was removed we were shocked! The whole 150 ton block was completely separated from the rock face.*"
Prof. Dr Milivoj Vulić - Project Leader

Danger adverted
After three months of running the continuous monitoring system the single frequency GPS receivers were detecting movements at the mm level. The monitoring points 1 and 3 were determined to be stable, however point 2 had moved 7 mm.

The decision was made to remove the monitoring point and blast the area away. After blasting, the remaining rock surface was nearly smooth. The rock was completely separated from the slope, with only a small section at the base connected to the rock wall. The monitoring system ensured that a high movement area was located. This enabled corrective measures to be taken before a high-risk situation occurred.

The detection of this movement validated the mine operator's decision to invest in a complete Leica Monitoring solution. The safety of the workers and mining equipment was ensured and there were considerable cost savings. A one off investigation into the rock face would cost at least 20% of the initial set up cost of the complete monitoring system. The complete system on the other hand monitors three points continuously, it will operate for many years to come and will provide a long term history of all movements at the quarry. Classical geological monitoring also causes damage to healthy rock, which can result in more problems in the long term.

Before and after photos of the area around monitoring point 2.

Leica Geosystems TruStory
Monitoring of Rail Tracks and Construction Site

Reconstruction of the 100 year old railway bridge carrying two railtracks.

BSF Swissphoto AG has developed a powerful tool for permanent monitoring applications called DeTraS (Deformation Tracking System). Sensor control and database management is provided by Leica's GeoMoS Software.

During 2008 and 2009, a 100 year old bridge close to the Oerlikon Railway station was renovated. The old steel construction was replaced by restressed ferroconcrete and the span width was increased from 15m to 38m. In order to excavate the existing bearings, pillars, undercrossings and rail dam on the eastern side, assistant bridge elements were constructed. These temporary bridges lay 80 cm higher than the old tracks and created the required space to build the new bridge.

Torsion is the term used to describe the twisting of the tracks and it acts as one of the most critical factors in rail track geometry. During the first construction period rail settlement and the resulting torsion changes were manually measured each week. This was labor intensive and resulted in high costs due to the risk potential of the construction site.

Monitoring prisms on the temporary bridge for deformation tracking.

Due to the compact and fast installation possibilities of DeTraS, the entire automatic monitoring system was set up by 2 people, in 11/2 days and delivering its first results.

Company
BSF Swissphoto AG, Zurich

Challenge
Rail track, bridge and site monitoring under dense railway traffic

Customer
Swiss Federal Railways

Date
2008-2009

Location

Project Summary

Instruments
Leica TCA2003
Meteo sensor
Leica monitoring prisms
WebCam

Software
Leica GeoMoS Monitor options 1 & 2
BSF Swissphoto's client portal

Aim
To monitor settlement and torsion of tracks and 3D deformations of pylon and bulkheads

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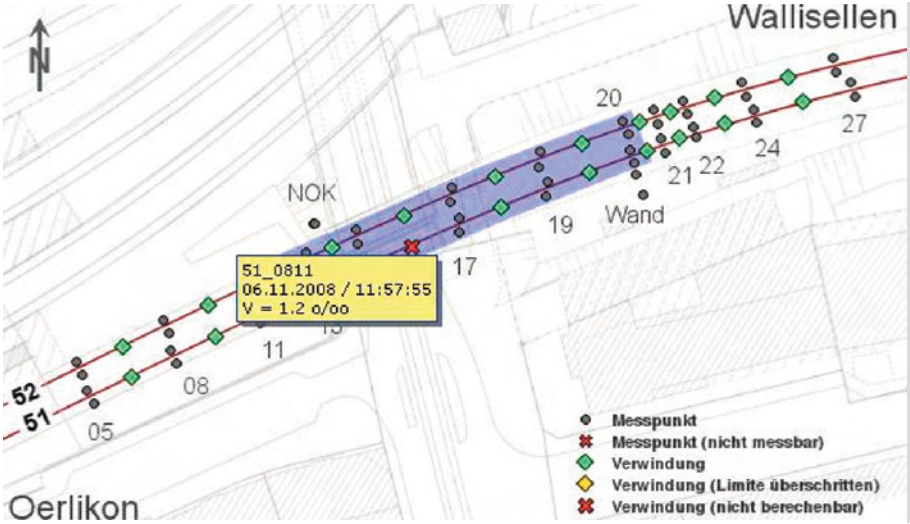


Start view of BSF Swissphoto's own client portal. The interactive map which comes up with all monitoring points and their actual state of measurements. The red lines represent the two rail tracks and the green diamondss indicate the specific torsion.

The monitoring equipment included a Leica TCA2003 total station, meteo sensor, 55 monitoring prisms and a communication box for remote control and data delivery via the mobile communication network.

Actual deformations of rail geometry (settlement, torsion, and longitudinal profile) were based on the positional change of each monitoring prism. Site measurements were automatically transmitted to Leica's GeoMoS Software located in the office. In the case that the restrictive limits of the railway company were exceeded, SMS and e-mail alarms were sent to the responsible persons. Possible problems with the rail alignment could also be determined and fixed quickly and efficiently.

Single point settlement and uplift after mechanical track alignments on the dam.

In order to monitor the torsion of the track, inclination values were computed from the settlement measurements. Using 2 settlement measurements at one cross section results in one inclination computation. Comparing this inclination to the next inclination value along the track you get the torsion value, indicating the change along the track axis.

Torsions at the different sections show when they exceed the two limit classes.

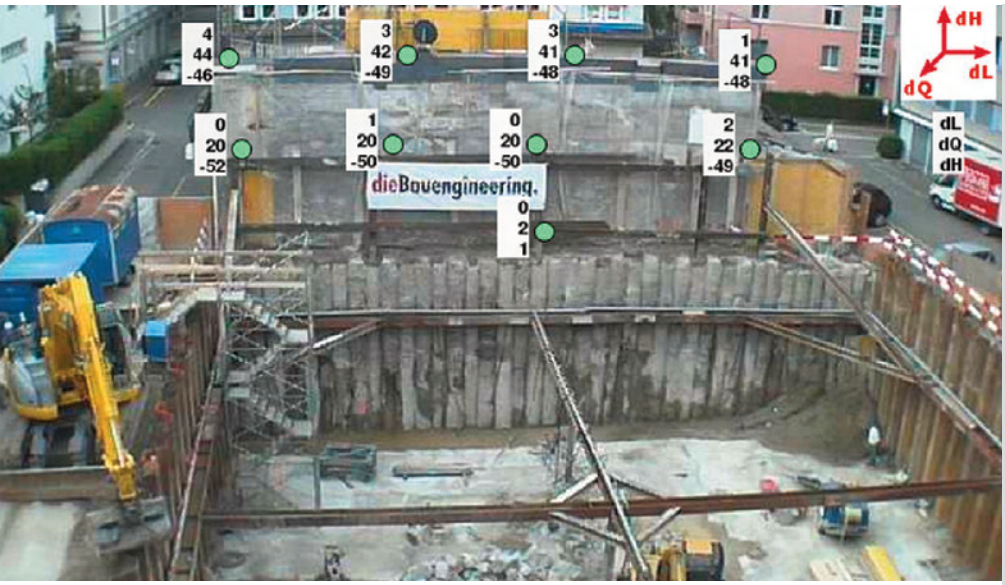
The main advantages of automatic monitoring compared to manual monitoring are increased safety, increased awareness of deformations, improved efficiency, and reduced costs.

Benefits

- Safety, SMS and e-mail alert for the railway traffic
- Efficiency, BSF Swissphoto client portal for 24h access to real time data
- Analysis, continuous 24h monitoring of the construction site and the impact on crucial infrastructure
- Safety, limited staff access to dangerous construction sites
- Cost reduction, from reduced labor costs
- Efficiency, coordination of rail alignment actions according to the torsion calculations

During demolition of parts of the foundation of the power line pylon, the monitoring systemwas used to detect 3D deformations and the resulting change in tilt.

Leica Geosystems TruStory
Permanent Monitoring during Urban Excavation



Company
BSF Swissphoto AG, Zurich

Challenge
Wall monitoring at excavation site

Date
2007-2008

Location

Project Summary

Instruments
Leica TCA1101plus
Meteo sensor
Leica monitoring prisms
WebCam

Software
Leica GeoMoS Monitor options 1 & 2
BSF Swissphoto's client portal

Aim
To predict accelerations of the wall tilt in order to protect personal and adjacent house

Benefits
- Safety of the residents in the bordering houses and detecting deformations for taking immediate action

BSF Swissphoto AG has developed a powerful tool for permanent monitoring applications called DeTraS (Deformation Tracking System). Sensor control and database management is provided by Leica's GeoMoS Software.

During 2007 and 2008 a new residential house was constructed in the middle of a built-up area. The construction project required the excavation of soil sediment layers as well as lowering of the surface groundwater. It was a concern that these actions might endanger the surrounding infrastructure and construction site.

Therefore, a permanent monitoring system was required to ensure the safety of surrounding buildings and construction workers.

Automatic monitoring, operating 24hrs a day was installed to monitor the adjacent wall. Measurements were taken twice an hour and automatic alert triggers were configured to alert engineers of exceeded thresholds. Additional manual leveling, inclinometer and water gauge measurements completed the deformation monitoring in the nearby area. Webcam images recorded a history of site construction and helped to record a claim of water penetration. Results and images were accessible via BSF Swissphoto's client portal.

Based on the long monitoring period immediate corrective measures could be initiated to protect the existing buildings and construction site before serious damage occurred. The effectiveness of the corrective measures was immediately visible due to the continuous monitoring.

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Slope Stability Monitoring at Kumtor Mine, Kyrgyz Republic

Company
Kumtor Operating Company, Kyrgyz Republic

Challenge
Slope stability monitoring of an open pit mine

Date
Installation in 2003

Location

Project Summary

Instruments
Leica Leica TCA2003
Leica TCA1201M
Leica Geosystems prisms

Software:
GeoMoS Monitor options 1 and 2
GeoMoS Analyzer

Communications:
Wireless LAN

Aim:
To predict failures in advance in order to protect personal and equipment

Benefits

- Less risk of injury to Kumtor personnel
- Reduced risk to Kumtor property and equipment
- Higher production due to less down tim caused by accidents
- Better prediction of failures

Since 2003 the Kumtor gold mine has been using Leica GeoMoS as their main automatic deformation monitoring system. Periodic manual monitoring and geotechnical instrumentation are still in use for added safety.

Kumtor gold mine is located in the Tien Shan Mountains at an elevation of more than 4000 meters. The main pit's dimensions are approximately 2000m x 1000m x 600m while the second pit's are 1000m x 700m x 400m. The mine extracts about 7600 tons of ore per year and 93000 tons of waste with a production of about 14 tons of gold.

In addition to the Leica GeoMoS system monitoring the pits, several prisms are installed on the surrounding glaciers and on the waste dumps for manual monitoring. Extreme weather conditions combined with the dusty environment make it necessary to do frequent cleaning of all the prisms.

In July 2006, the duty surveyor interpreted the warnings sent by Leica GeoMoS and decided to evacuate the site. Two hours later there was a major failure of one of the pit walls.

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Leica Geosystems TruStory
Slope Stability Monitoring at Venetia, South Africa

Company
De Beers Venetia Mine, Musina, South Africa

Challenge
Slope stability monitoring of an open pit mine

Date
Installation October 2002

Location

Project Summary

Instruments
Leica TCA2003, Leica prisms
STS meteo sensor
Leica TCA2003 on order

Software
GeoMoS Professional

Communications
PacificCrest PDL radios
PacificCrest PDL radios on order

Aim
To predict failures in advance to protect personal and equipment from harm

Benefits:
- Less risk of injury to Venetia personnel
- Reduced risk to Venetia property and equipment
- Higher production due to less down time caused by accidents
- Better prediction of failures

Venetia mine are long standing Leica Geosystems customers, having used Leica TC2002 for manual monitoring and then upgraded to Leica GeoMoS. The mine is situated 80km west of the town of Musina in the Limpopo province, far northern South Africa, close to the borders of Botswana and Zimbabwe.

Venetia mine consists of two major kimberlite pipes and numerous minor ones, mined as one pit. Venetia's Pit dimensions are approximately 1 600m x 1 200m x 200m. The mine moves about 25million tons of waste and 5.5million tons of ore baring material per annum, producing about 6.5 million carats per annum.

Temperatures often reach mid 40's in summer with "in-pit" temperatures soaring above the 50 mark. This creates a lot of atmospheric interference in the measurements and thus most monitoring is done at night.

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Leica Geosystems TruStory
Excavation Monitoring By-pass Ennetbaden

Company
Strago (NA) - San Ruffillo (BO)

Challenge
Straub AG, Ingenieure + Geoinformatiker
5405 Baden-Dättwil, Switzer-land

Date
Installation March 2004

Location

Project Summary

Instruments
Leica TCA1800
Leica Prisms

Software
GeoMoS Professional
GeoMoS Professional Remote

Communications
TCPS26 radios
RS485 cable connection
Autocall Messaging system

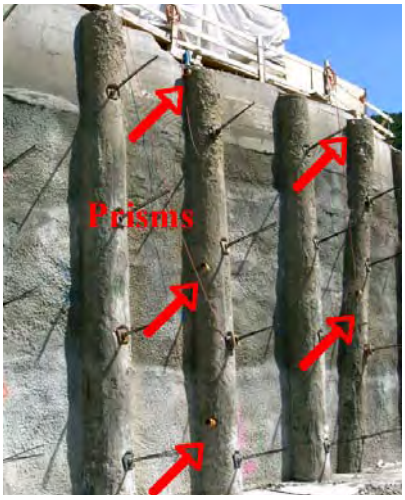
Aim
Monitor the excavation and guaranty the safety for residents and workers.

Benefits:
- Safety of the residents and the bordering houses and detecting deformations on the concrete wall.
- Facilitate quick reaction for the construction management

Straub AG is an engineering company with multiple offices in Switzerland and 40 years experience as experts in engineering surveying projects worldwide.

For the construction of a new tunnel through a densely populated region of Switzerland, an excavation of a 360m long section is required. The excavation is up to 17m deep and is, from a geotechnical point of view, highly critical. The protection of the excavation is done by a wall of concrete pillars held by rows of tie bars. Out of concern for the safety of the residents and the workers the decision was made to use a permanent monitoring system to observe the concrete wall during over a period of 18 months. As a supplement they have integrated a warning system, which will send the limit check information via SMS to the responsible people.
In the event of movement, the construction management can react immediately and define steps for counter measure.

In addition to the total stations, inclinometers and load cells monitor the excavation.



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Leica Geosystems TruStory
High Speed Railway Construction in Bologna, Italy

In recent years in Italy there has been growth in large infrastructure projects. One of the most active sectors is rail, with many works on the modernization of existing railway lines and on the realization of new lines for the High Speed trains.

One of the most crucial intersections is in the town of Bologna. In the future the Bologna station will be only connected by underground rail. Excavation of the tunnels started in 2003. The government authority requires that the construction companies to monitor in real time all the civil buildings (houses, streets, shops etc.) which may be affected by the excavation.

The San Ruffillo monitoring project employs 3 Leica TCA1800 (2 external and one inside the drugstore) scheduled to measure the monitoring prisms every hour, with the aim of detecting possible subsidence of the drugstore.
A pool of expert engineers has the task to analyze data in real time and to evaluate if there is no danger for people inside the drugstore.

Company
Strago (NA) - San Ruffillo (BO)

Challenge
Monitoring of the stability of a drugstore during excavation with a tunnel boring machine (TBM)

Date
Installation July 2003

Location

Project Summary

Instruments
Leica TCA1800
Leica prisms

Software
GeoMoS Lite, 1 x System_Anywhere, Analisys

Communications
3AS Radio-modem Satelline

Aim
To monitor pillars' subsidence during TBM's excavation

Benefits:
To prevent possible subsidences in the structure of the building due to the lost of field carrying capacity

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Leica Geosystems TruStory
Slope Stability Monitoring at Stromboli Volcano, Italy

Company
National Institute of Geophysics and Vulcanology of Catania (INGV)

Challenge
Slope stability monitoring of an active volcano

Date
Installation March 2003

Location

Project Summary

Instruments
Leica TCA2003
Leica prisms
Software
GeoMoS Lite, System Anywhere Analisys
Communications
LAN communications
Aim
To detect land slides in advance to protect people from the effects of a tsunami

Benefits:
- Continuous case of study of the extremely complex deformation system represented by the Volcano
- Risk prevention of landslide

INGV is one of the most important Italian scientific authorities in the study and monitoring of tectonic and volcanic events. One of its departments studies crustal deformation analysis in seismic and volcanic areas.

After a submarine landslide occurred on 28 December 2002 on Stromboli Volcano that caused a tsunami wave of more than 12 meters in height, the Civil Protection Department decided to install on the island several monitoring systems with the aim of preventing any kind of risk, potentially dangerous for people.

The system, linked in real time with a Control Room, has been installed in very prohibitive conditions (very oxidant atmosphere, strong winds, harsh sun irradiation, continuous exposure to atmospheric agents, very long distances, presence of dust due to rolling stones, dangerous conditions in target's positioning) continuously measures targets positioned in the Sciara del Fuoco in order to activate alarms.

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Leica Geosystems TruStory
Dam Monitoring in Carbonia, Italy

Company
Consorzio di Bonifica del Basso Sulcis

Challenge
Dam monitoring

Date
Installation December 2002

Location

Project Summary

Instruments
Leica TCA2003, Leica prisms, Nivel20

Software
GeoMoS Professional, GeoMoS Remote, Eyes on nivel

Communications
RS232 with signal amplifiers

Aim
To monitor the three coordinates movements of the dam

Benefits:

- Early detection of possible safety issues in the dam, acting as a safeguard to protect lives to personnel.

The Consorzio di Bonifica of Basso Sulcis is one of the numerous associations existing in Italy that manages the water resources. Carbonia's Dam is one of the biggest dams in Sardinia and allows water supply for thousands and thousands people.

The Central Government Authority (Servizio Nazionale Dighe) obliges such associations to monitor dams periodically or in real time in order to prevent eventual problems related with cracking or failure of the structures, ageing of materials with which dams are built and possible deformations caused by big hydraulic loads.

The system installed in Carbonia's dam uses Leica TCA2003 which measures every four hours a series of prisms positioned on the crest and on the face of the dam. Data from a chain of Nivel 20 installed inside the main underground tunnel are collected every five minutes with the aim to detect eventual rotations of the main body of the dam, caused by the growing mass of water in the dam.

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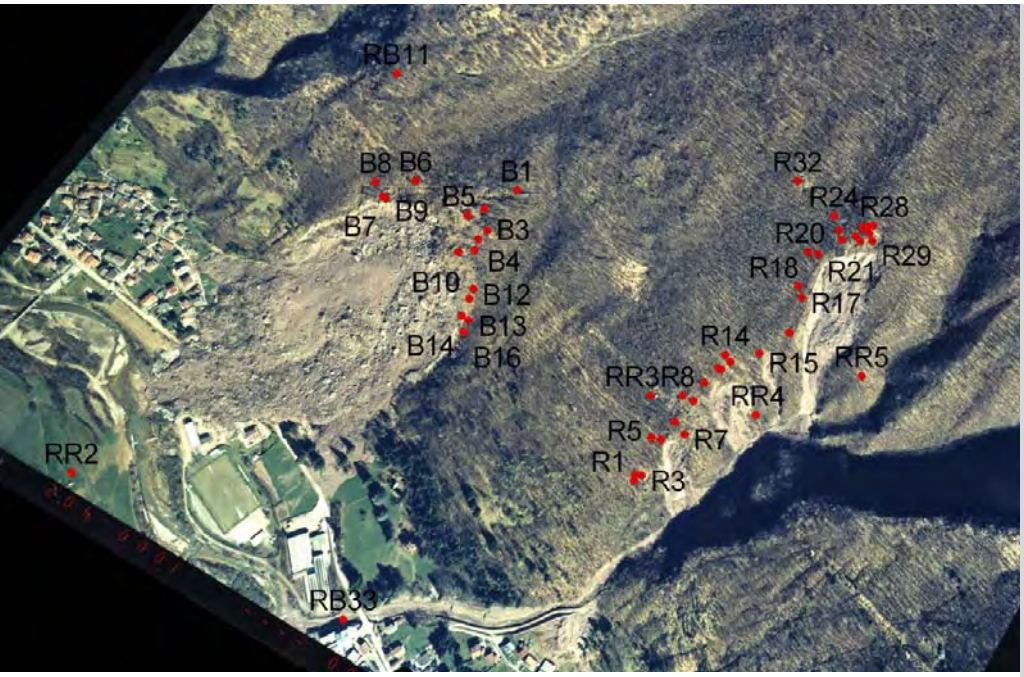
Leica Geosystems TruStory
Slope Stability Monitoring at Cortenova, Italy



During a significant, extremely violent meteorological event that occurred in Northern Italy on November 2002, many phenomena concerning environmental instability took place and caused a lot of landslides in different regions of the Alps.

One of the most important of them involved a whole mountain in Valsassina Valley which, during a night of intense rainfalls, collapsed into the main valley destroying part of a little city called Bindo and inciting other instabilities in a secondary valley leading to four smaller landslides that threatened the town of Cortenova in the valley below. During and after this event the local population was evacuated and the local authority decided to install a complex real time monitoring system (geodetic and geotechnical) that is able to activate on site alarms to alert local people.
Leica TCA2003 total stations have been installed to measure every hour a certain number of prisms located on the landslide. The data are collected in a central database and are analyzed in real time.

A sophisticated alarm system enables phone calls or GSM messages be sent to people whose main task is to manage the whole system and to care about the security of local population. A permanent GPS control network has also been installed with the aim to study the complex system of deformations located between the two main landslides. In fact one of the more important problems regards the supposition of an eventual coalescence of the two landslides that will provocate a big solid flow with terrible consequences for the local population.

Company
Mountain Community of Valsassina and Valvarrone

Challenge
Monitoring of a complex landslide above the city of Cortenova

Date
Installation June 2003

Location

Project Summary

Instruments
Leica TCA2003, Leica prisms, Leica SR520

Software
GeoMoS Lite, System Anywhere, Analisys, GPS Anywhere, NDA (Network Deformation Analysis)

Communications
3AS Radio-modem Satelline

Aim
To monitor landslides and to send timely alarms allow evacuation of the local

Benefits:
- Permanent monitoring to assure people safe life's condition
- Risk prevention of landslide

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Heerbrugg, Switzerland
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Leica Geosystems TruStory
Slope Stability Monitoring at Letlhakane Mine, Botswana

Company
Debswana, Letlhakane Mine, Botswana

Challenge
Slope stability monitoring of an open pit mine

Date
Installation May 2003

Location

Project Summary

Instruments
Leica TCA2003
Leica prisms
STS meteo sensor

Software
GeoMoS Professional

Communications
PacificCrest PDL radios

Aim
To predict failures in advance to protect personal and equipment from harm

Benefits:
- Less risk of injury to Letlhakane personnel
- Reduced risk to Letlhakane property and equipment
- Higher production due to less down time caused by accidents
- Better prediction of failures

Letlhakane mine is not an exclusive Leica Geosystems user and did not have an effective monitoring system in place before implementing Leica GeoMoS.
The mine is situated near Letlhakane, which is 190km west of the town of Francistown in Botswana and about 50km south east of Orapa.

The ore body at Letlhakane mine consists of one intrusive kimberlite pipe with no overburden. Letlhakane's Pit dimensions are approx 1200m diameter x 260m. The mine extracts approximately 4m tons of ore per year and 16m tons of waste with a production of about 26 carats per 100 tons of ore. Letlhakane produced approximately 1.4m carats in 2003.

Temperatures often reach mid to high 40 deg C in summer with "in-pit" temperatures reaching the upper 40's to lower 50's. It is a dry arid region with very low rainfall thus heat and dust are limiting factors for the monitoring of the slopes.

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Leica Geosystems TruStory
Slope Stability Monitoring at Limone Piemonte, Italy

Company
GDTest (Turin) - RFI (Turin)

Challenge
Monitoring of a slow landslide above a railway station

Date
Installation February 2003

Location

Project Summary

Instruments
Leica TCA2003
Leica prisms
Software
GeoMoS Lite
System_Anywhere
Analisys
Communications
RS232
Aim
To monitor the slow deformation process of a part of a hill just above a railway station

Benefits:
The system enables the railway station to be operated safely in an area subject to land slides

GDTest is one of the numerous engineering societies placed in Italy with which Leica Geosystems is co-operating more and more in the installation of real time monitoring systems. In 2003 we have jointly installed a complete monitoring system in the railway station of Limone Piemonte.

The mountain side just above the railway station is the subject of a slow landslide. During strong meteorological events this part of the mountain slides down towards valley, endangering the safety of the below railway station and tracks.

The system installed in Limone Piemonte is based around Leica TCA2003 which measures a series of prisms positioned all over the hill every four hours. The data are stored in the Leica GeoMoS database are analyzed just after the cycle and if limit classes are exceeded an alarm system (phone and GSM message) is automatically activated to alert people and to prevent possible railway disasters.

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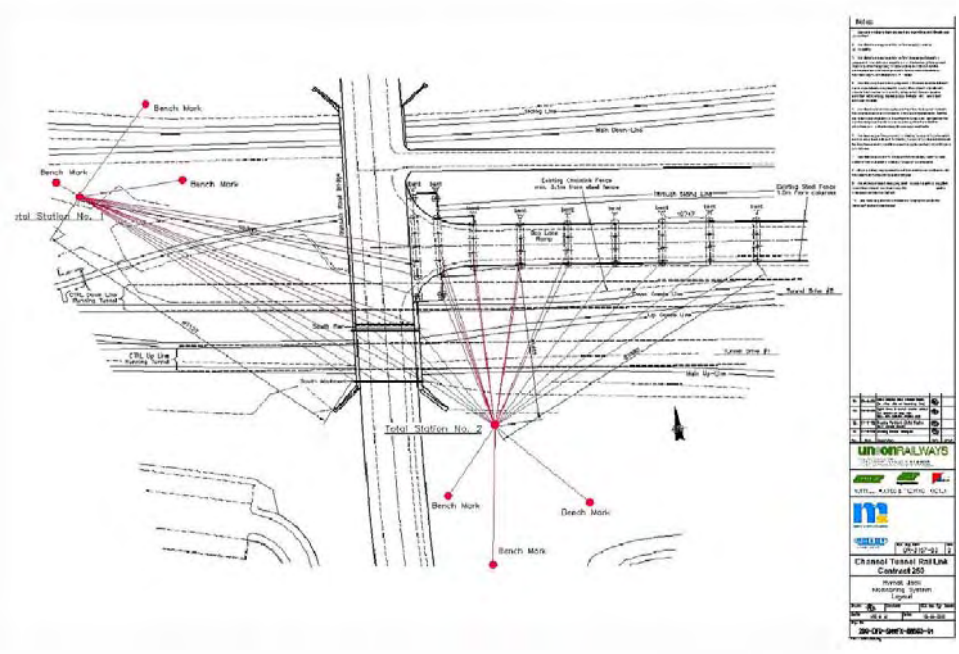
Leica Geosystems TruStory

Bridge Jacking, CTRL250, East London, UK



Company
Nuttall, Wayss, Freytag and Kier Joint Venture - CTRL Contract 250

Challenge
Bridge and Road Monitoring during Tunnel Construction

Date
Installation January 2003

Location

Project Summary

Instruments
Leica TCA2003,
Leica prisms,
Software
GeoMoS Professional
Communications
TCPS26B Radio Modems
Aim
To monitor a bridge and section of road during tunnelling activities. System produced height displacement values to allow hydraulic jacks to correct for movements.

Benefits:

- 24 Hour monitoring and feedback to corrective jacks.
- Automated Messaging
- Area to be monitored was in an active railway zone - no personnel permitted without special permits, look outs etc.

Phase 2 of the £3.3Bn Channel Tunnel Rail Link program incorporates extensive tunneling under existing infrastructure in London. Nuttall, Wayss, Freytag and Kier JV who are the main contractor on CTRL250 subcontracted Mabey Support Systems and Test Consult to monitor an area near Dagenham and Barking in East London.

This particular project focused upon the impact of two 7.2m diameter tunnels that were to be bored under a section of rail, and under an associated bridge and ramp down to a major freight terminus. A predicted 60mm to 65mm of movement was to be measured and fed back to a control system operating hydraulic jacks. As a result of any detected movement the pressure in the jacks was to be increased automatically to maintain the height of the bridge and ramp.

GeoMoS was installed to operate the Leica TCA2003 instruments and to provide the detected movement from each prism. An SQL query was generated every five minutes, twenty-four hours a day for a period of 5 months to generate the required information for the jacking system.

SMS messaging was used to inform the operators of any excessive movement and data was published to a website for general viewing.

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Leica Geosystems TruStory
Railway Monitoring at Sheung Shui Station, Hong Kong

Company
Surtech Engineering Surveys

Challenge
Monitor and display the movement of the railway in real time

Date
2003 - 2006

Location

Project Summary

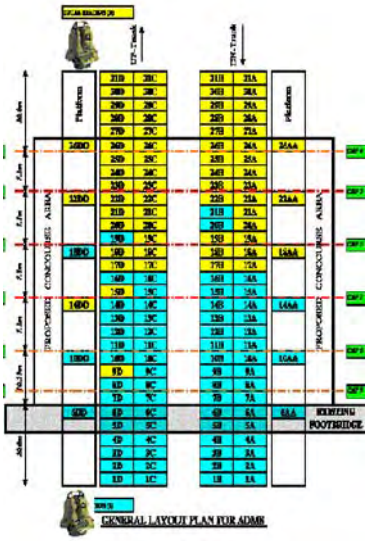
Instruments
Leica TCA2003
Prisms
Software
GeoMoS Professional
Communications
PacificCrest PDL radios
Aim
Line Driver
Internet Broad Band

Benefits:

- Automatic & continuous monitoring of the railway in real time
- All related parties can share the measuring result through customer's Web Site
- Initial alarm system to reduce risk

KCRC has commenced the construction of Lok Ma Chau Spur Line to ease the congestion at Lo Wu Terminus. Sheung Shui station is an intersection for these two terminuses.
It handles about 180,000 passengers a day. In June 2003, an improvement project for Sheung Shui Station has been started. It includes the extension of station concourse, widening of the platform and construction of a new entrance.
These construction works may cause the movement of the existing railway in Sheung Shui Station. In order to minimize the risk caused by the movement of the railway, the Customer has decided to setup an ADMS to monitor the railway.

Leica GeoMos with Leica TCA2003 can achieve the accuracy of 1mm in 100m. All points are measured and stored in SQL database. A web interface is used to provide a real time data report. Any movement which exceeds the predefined limits will activate the alarm system. SMS and email will be sent out. Those moving points will be highlighted in the data report too.



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Leica Geosystems

Leica Geosystems TruStory
Slope Stability Monitoring at PPL Mine, South Africa

Company
Anglo Platinum, Potgietersrust, South Africa

Challenge
Slope stability monitoring of an open pit mine

Date
Installation October 2003

Location

Project Summary

Instruments
Leica TCA2003
Leica prisms
Software
GeoMoS Professional
Communications
PacificCrest PDL base radios
Aim
To predict failures in advance to protect personal and equipment from harm

Benefits:
- Less risk of injury to PPL personnel
- Reduced risk to PPL property and equipment
- Higher production due to less down time caused by accidents
- Better prediction of failures

PPL are long standing Leica Geosystems customers, having used TC2002 for manual monitoring and then upgraded to Leica GeoMoS. The mine is situated near the town of Mokopane (formerly known as Potgietersrust) in the Limpopo province, Northern South Africa.

PPL mine consists of two open pits called Sandsloot and Zwartfontein. Sandsloot mine is approximately 2km in length, 600m wide and over 200m deep. Zwartfontein is a new pit, which has been in operation for less than 2 years. About 150 000 tons of material is extracted each day of which more than 20 000 tons makes up the platinum group metals.

The mine gets about 330mm of rain per year and summer temperatures often reach the low 40 degrees. This, coupled with fairly dusty conditions makes visibility and therefore monitoring very difficult.

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Leica Geosystems TruStory
Ski Lift Monitoring in Zermatt, Switzerland

Company
Zermatt Bergbahnen, CH-3920 Zermatt

Challenge
Monitoring of the pylons of a glacier chair lift

Date
Installation February 2004

Location

Project Summary

Instruments
Leica TCRA1103
Leica prisms

Software
GeoMoS Professional

Communications
Radios Sateline 3Asd (Distance 1200m)

Aim
To monitor the position of the ski lift supports so that they may be adjusted to compensate for movement of the glacier

Benefits:
- Makes maintenance for the geometry of the ski lift more effective.

Zermatt is one of Switzerland's most popular ski resorts. The Furggsattel glacier chair lift transports a maximum of 2400 persons per hour during summer and winter.

Furggsattel, which is at an altitude of 3365m, is the longest chair lift in Europe with a length of 2600m. The chair lift is built on a glacier that is constantly moving. To compensate for the movement of the glacier, the pylons of the chair lift must be regularly adjusted. The supports on the ice are designed so that they can be displaced by 75 cm on their steel foundations.
There are two prisms mounted on each of the 12 supports. On the top station building there is a reference point that is used to adjust the orientation of the system. An Excel Macro is used to analyze the displacement of all supports in plane, height and rotation. All the equipment is powered by one solar panel. All points are measured in the ATR mode for highest accuracy, with the furthest point at a distance of about 1200m. In the near future, a new window will be installed with integrated heating to eliminate ice and snow on the glass.

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Leica Geosystems TruStory
Slope Stability Monitoring at Jwaneng, Botswana

Company
Debswana, Jwaneng Mine, Botswana

Challenge
Slope stability monitoring of an open pit mine

Date
Installation May 2004

Location

Project Summary

Instruments
Leica TCA2003
Leica prisms
STS meteo sensor
Leica TCA2003 on order
Leica prisms on order

Software
GeoMoS Professional

Communications
PacificCrest PDL radios
PacificCrest radios on order

Aim
To predict failures in advance to protect personal and equipment from harm

Benefits:
- Less risk of injury to Jwaneng personnel
- Reduced risk to Jwaneng property and equipment
- Higher production due to less down time caused by accidents
- Better prediction of failures

Jwaneng mine is not an exclusive Leica Geosystems user and did not have an effective monitoring system in place before implementing Leica GeoMoS. The mine is situated near Jwaneng, which is 170km west of the capital of Botswana, Gaborone.

The ore body at Jwaneng mine consists of three kimberlite pipes with no overburden. Jwaneng's Pit dimensions are approx 1500m x 1000 x 260m. The mine extracts approximately 10m tons of ore per year and 40m tons of waste with a production of about 125 carats per 100 tons of ore, which makes it the richest diamond mine in the world. Jwaneng produced more than 14m carats in 2003.

Temperatures often reach mid to high 40 deg C in summer with "in-pit" temperatures reaching the upper 40's to lower 50's. It is a dry arid region with very low rainfall thus heat and dust are limiting factors for the monitoring of the slopes. As with Orapa, long distances are also a limiting factor to the ATR.

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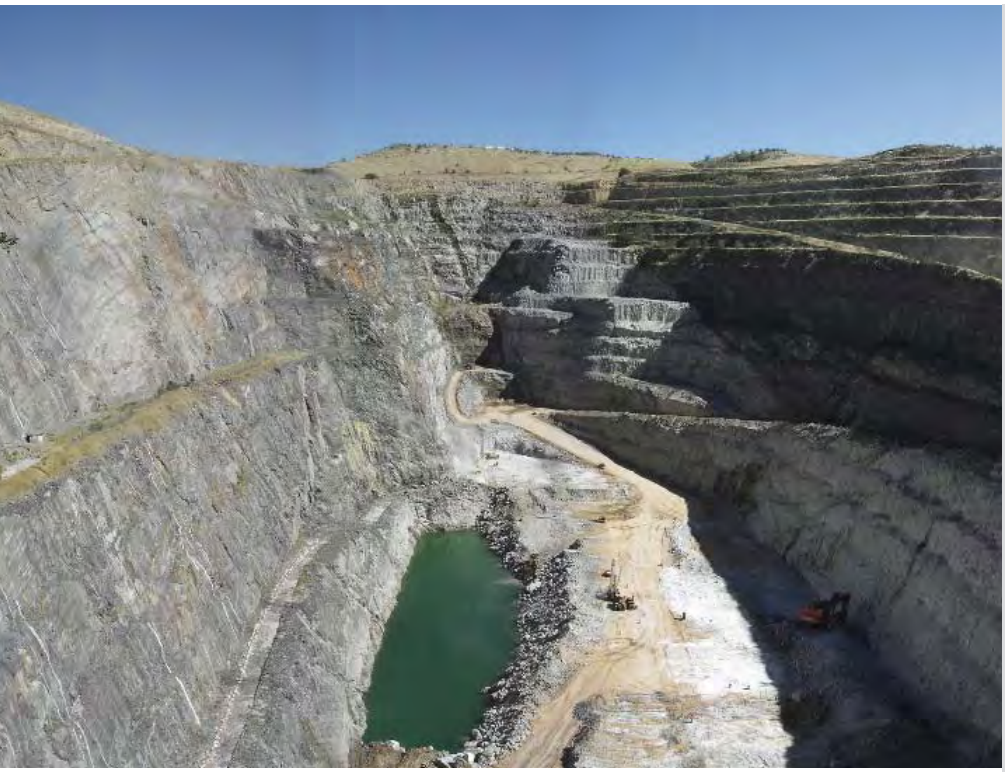
Leica Geosystems Trustory
Slope Stability Monitoring at Navachab, Namibia



Task
Slope Stability Monitoring of an open pit mine

Customer
Anglogold-Ashanti, Navachab Gold Mine, Karibib, Namibia

Location
21° 59′ S. 15° 46′ E

Date
Installation April 2005

Project Facts

Software	GeoMoS professional
Instruments	Leica TCA2003
	Leica prisms
	STS meteo sensor
Communications	Pacific Crest EDLII radios
Aim	To predict failures in advance in a special deepening project at the mine in order to protect personal and equipment from harm

Benefits:
- Reduced risk of injury to Navachab personnel
- Reduced risk to Navachab property and equipment
- Higher production due to less down time caused by accidents
- Better prediction of failures

Navachab mine is not an exclusive Leica Geosystems user but have been using a Leica TCA2003 Total Station to monitor the slopes manually before deciding to implement Leica GeoMoS, after a two week trial period and a recommendation by SRK to implement Leica GeoMoS.

The mine is situated near Karibib, which is approximately 170km North West of Windhoek in Namibia and about 170km North East of the coastal town of Swakopmund.

The Gold at Navachab mine is hosted in marble and the host rock dips at 70 degrees to the west. Grades at Navachab are approxi-mately 2 grams/ton. Pit dimensions are approx 1300m x 800m x 200m.

Temperatures often reach low to mid 40 deg C in summer with "in-pit" temperatures reaching the upper 40's. It is a dry arid region with very low rainfall thus heat and dust are limiting factors for the monitoring of the slopes.

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Leica Geosystems

Leica Geosystems TruStory
Motorway Surface Monitoring, Northamptonshire, UK

Company
Edmund Nuttall / Highways Agency / ITM Ltd

Challenge
Monitor a live motorway while a box jack was installed

Date
Installation January 2003

Location

Project Summary

Instruments
Leica TCRA1105
Leica prisms
Software
GeoMoS Lite
Communications
TCPS26B Radio Modems
Aim
To monitor the carriageway surface of the M1 during the installation of a box jack.

Benefits:
- 24 Hour monitoring and feedback.
- Automated Messaging
- Monitoring had to be non-intrusive as the motorway was to be kept open and operational at all times.

In 2002, Edmund Nuttall won the contract to improve the interchange of the M1 motorway and the A43 trunk road at junction 15a in Northamptonshire. The primary element of the project comprised a boxjack through the current motorway embankment, in order to upgrade the existing A43, running beneath the M1, to dual-carriageway status.

The Highways Authority would allow no closure of this arterial route and imposed maximum allowable carriageway heave and settlement contour limits throughout the jacking period. In addition, they required observational verification of the results in real time.

ITM proposed an innovative solution, using Leica TCRA1105 Total Stations operating in reflectorless mode. Each instrument was installed on a column 15m above the carriageway, cycling automatically, every 30 minutes, through a 1-2m grid of virtual points coordinated three-dimensionally across both carriageways throughout the whole zone of influence.

Data was transmitted via radio modem where it was displayed in real time using ITM's own software. This gave both the engineers on site and staff at the ITM head office, via a remote link, immediate access to up-to-date, real-time data. All the data could be viewed remotely, 24 hours a day, through a secure, real-time web site, and an automated "ALERT" program contacted nominated personnel should any predetermined trigger levels be exceeded outside normal working hours. Thus, in the event of an alert, an action plan could be initiated by authorised personnel at any time, without the need to attend either site or office. As a result of this monitoring regime, all six lanes of the motorway at this bottleneck junction remained operational throughout the six-month monitoring period.

- when it has to be **right**

Leica Geosystems

Leica Geosystems TruStory
Slope Stability Monitoring at Orapa Mine, Botswana

Company
Debswana, Orapa Mine, Botswana

Challenge
Slope stability monitoring of an open pit mine

Date
Installation April 2004

Location

Project Summary

Instruments
Leica TCA2003
Leica prisms
STS meteo sensor

Software
GeoMoS Professional

Communications
PacificCrest PDL radios

Aim
To predict failures in advance to protect personal and equipment from harm

Benefits:
- Less risk of injury to Orapa personnel
- Reduced risk to Orapa property and equipment
- Higher production due to less down time caused by accidents
- Better prediction of failures

Orapa mine are long standing Leica Geosystems customers, having used Leica TCA2003 for manual monitoring and then upgraded to Leica GeoMoS. The mine is situated near Orapa, which is 240km west of the town of Francistown in Botswana.

The ore body at Orapa mine consists of two intrusive kimberlite pipes with no overburden. Orapa's Pit dimensions are approx. 1500m x 1000m x 240m. The mine extracts approximately 20m tons of ore per year and 40m tons of waste with a production of about 85 carats per 100 tons of ore. Orapa achieved record production in 2003 of approximately 30m carats.

Temperatures often reach mid to high 40 deg C in summer with "in-pit" temperatures reaching the upper 40's to lower 50's. It is a dry arid region with very low rainfall thus heat and dust are limiting factors for the monitoring of the slopes. A compounding factor is the long distances, which have to be measured to some of the monitoring points. Distances in some cases are as much as 1400m, which make it extremely difficult for the ATR to find some points. These points are generally monitored during the night.

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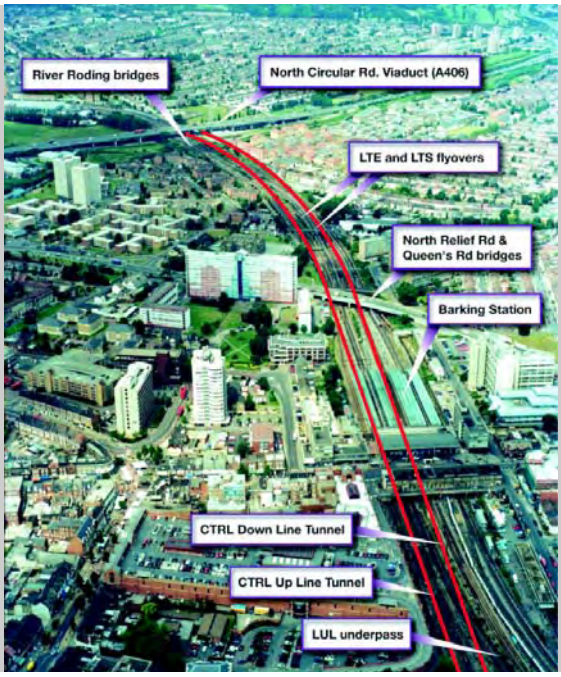
Heerbrugg, Switzerland
www.leica-geosystems.com

Leica Geosystems TruStory
Rail Monitoring, CTRL250, East London, UK



Company
Nuttall, Wayss, Freytag and Kier Joint Venture - CTRL Contract 250

Challenge
Monitor a live rail complex during tunnel construction

Date
Installation November 2003

Location

Project Summary

Instruments
Leica TPS1000, TPS1100 and TPS2000
Leica prisms

Software
GeoMoS Professional Multiple Sensors

Communications
TCPS26B + Pacific Crest
PDL Radio Modems

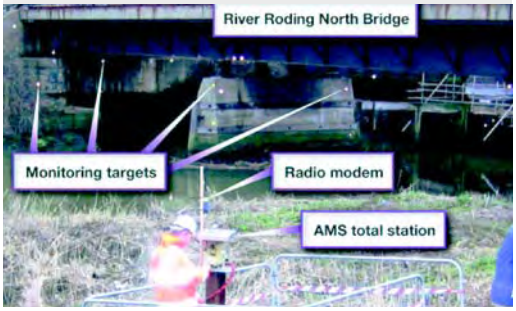
Aim
To monitor the Barking railway complex, a strategic railway junction in East London, which is used by London Underground Limited (LUL) and Network Rail (NR) 24hrs/day

Benefits:
- 24 Hour monitoring and feedback to TBM operators and interested parties.
- Automated Messaging.
- Area to be monitored was in an active railway zone - no personnel permitted without special permits, look outs etc.

Nuttall, Wayss, Freytag and Kier JV, main contractor for the Channel Tunnel Rail Link Contract 250, had to give assurances to Network Rail and London Underground Ltd that their tunnelling activities would not jeopardise the existing rail infrastucture. This was particularly important through the strategic rail complex at Barking, which is in operation 24 hours a day. A number of different methodologies were considered, but following the success of the Bridge Jacking exercise, at Renwick Road, using Leica GeoMoS and Leica TCA2003s, they decided to employ similar techniques for the last 1.4km of the TBM drive.

A rolling program of instrument installations on pillars running alongside the existing surface railways was employed in order to establish base readings prior to the passing of the Tunnel Boring Machines underneath. Two Leica GeoMoS installations were operated controlling, an assortment of motorised Total Stations with Auto Target Recognition. Communications were provided by both TCPS26 and Pacific Crest PDL modems, the latter being used where increased range was required.

SQL query statements were used to extract data from the GeoMoS database and a series of macros within MicroSoft Excel were used to display trends graphically for analysis.



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Leica Geosystems

Leica Geosystems TruStory
Slope Stability Monitoring at Kalgold Mine, South Africa

Company
Harmony, Kalgold, Mafikeng South Africa

Challenge
Slope stability monitoring of an open pit mine

Date
Installation August 2002

Location

Project Summary

Instruments
Leica TCA2003
Leica prisms
STS meteo sensor

Software
GeoMoS Professional

Communications
PacificCrest PDL radios
PacificCrest PDL radio repeater

Aim
To predict failures in advance to protect personal and equipment from harm

Benefits:
- Less risk of injury to Kalgold personnel
- Reduced risk to Kalgold property and equipment
- Higher production due to less down time caused by accidents
- Better prediction of failures

Kalgold mine are long standing Leica Geosystems customers, having used Leica TC1800 for manual monitoring and then upgraded to Leica GeoMoS. The mine is situated 80km south west of the town of Mafikeng in the North West province, far northern South Africa, close to the border of Botswana.

Kalgold mine consists of an almost vertical ore body with an average width of 45m and an average grade of 1.5g per ton. Kalgold's Pit dimensions are approximately 1200m x 800m x 240m. The mine produces approximately 250kg of gold per month from a low grade ore body. Costs are kept to a minimum by increasing the angle of the pit slopes, up to 78deg and a 100m deepening cut with vertical slopes. This makes monitoring a critical part of the operation.

Temperatures often reach low to mid 40 deg C in summer with "in-pit" temperatures reaching the upper 40's. Summer rain storms create an extra hazard with slip planes being lubricated by water ingress into cracks behind the pit faces.

Leica Geosystems AG
Heerbrugg, Switzerland
www.leica-geosystems.com

Leica Geosystems TruStory
Rock Stability Monitoring in Interlaken, Switzerland

In January 2003 there was a fall of approximately 150 m³ of rock from above the Chüebalm tunnel in Iseltwald/Interlaken. The falling rock punctured the tunnel near the western entrance and blocked the highway.

After this event two instable rock masses were blasted to help prevent a recurrence of the rock fall. In addition the tunnel roof was repaired and reinforced and a protective dam was constructed above the exposed village. During the reconstruction work two monitoring systems (Leica GeoMoS and a geotechincal system) were used to measure the movements of the rock face. The monitoring systems were used to ensure the safety of the motorists on the highway and the construction workers. If a tolerance is exceeded or a system error occurred, warnings were sent to the responsible authorities via SMS. After all of the rebuilding works were put in place the automatic monitoring system was deinstalled. Currently the rock face is monitored periodically with manual measurements.

Company
Department of Transportation, Canton Bern

Challenge
Monitoring of a rock wall after a rock fall in order to protect works for rebuilding and traffic

Date
Operated: January 2003 - November 2003

Location

Project Summary

Instruments
Leica TDA5005
Leica prisms
Software
GeoMoS Professional
Communications
Fixed phone line for remote access
Mobile phone for SMS messaging
Aim
Early warning of rock falls.

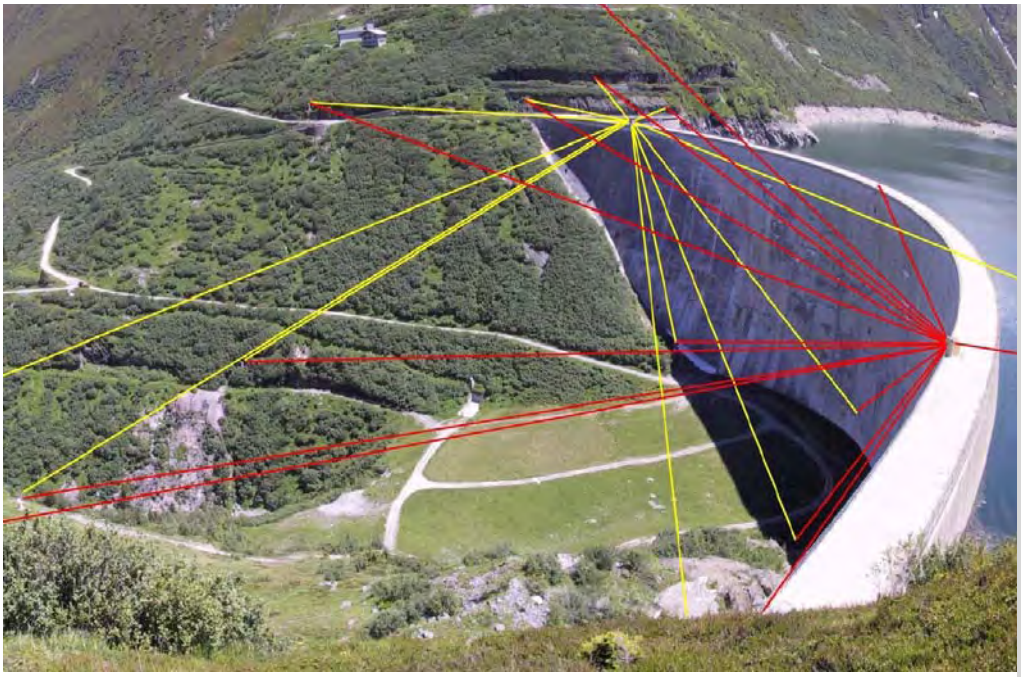
Benefits:
- Ensure safety of the motorists and workers.
- Monitoring of the dangerous section of the rock face.

Leica Geosystems AG
Heerbrugg, Switzerland
www.leica-geosystems.com

- when it has to be **right**

Leica Geosystems

Leica Geosystems TruStory
Monitoring Land Forms in the Swiss Alps



Company
Swissphoto Group AG, Regensdorf (CH)

Challenge
Monitoring of land forms in the area of three major dams during the construction of the 57km long Gotthard base tunnel under the Swiss Alps.

Date
Installation June 2000-2015

Location

Project Summary

Instruments
Leica TCA2003
Meteo sensor
Leica GPR121 PRO prisms

Software
GeoMoS Professional

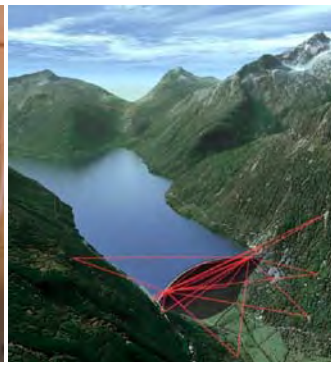
Communications
Satelline 3AS Radio Modems

Benefits:
- Less risk that the tunnelling is interrupted
- Minimise the risk that the dams are damaged by movements in the terrain caused by the tunnelling

The Gotthard base tunnel will be the longest rail tunnel in the world upon its completion. There is a small risk that construction of the tunnel will cause movements in the land above because of water being drained from the rock mass. Above the area of the tunnel are three of the largest dams in Switzerland.

The awarding authority, "AlpTransit Gotthard AG", decided that it is necessary to continuously monitor the dams and the nearby valleys and mountain peaks. Realization of the monitoring system has been complicated by the altitude (~2000m), harsh winter conditions and remoteness of the site. The system uses solar power and data communication via GSM phone to power and communicate with the sensors.

The monitoring system has been running successfully all year round for several years and produces millimeter accurate measurements of the movements.



Leica Geosystems AG
Heerbrugg, Switzerland
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Leica Geosystems

Leica Geosystems TruStory
Control of convergences in M-111 tunnels, Spain

Company
OHL - Indra Sistemas.

Challenge
Control of convergences in the tunnels of the M-111 highway, Barajas-Madrid airport.

Date
Installation May 2003

Location

Project Summary

Instruments
Leica TCA2003
GPR112 Monitoring-Mining Prisms

Software
GeoMoS Professional. Option 2
(>3 sensors)

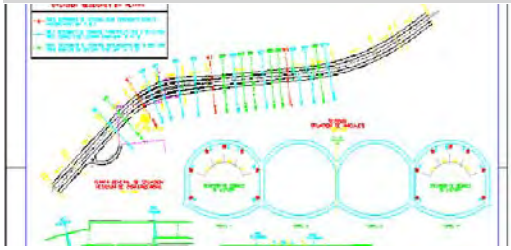
Communications
Ethernet Converters with two COM ports Hubs
Control Center connection via intranet with optical fiber. Controlled remote about of 4 km

Aim
In order to control the deformations and detect low range movements.

Benefits:
- Less time and money for control of deformations in order to guarantee the security.
- It avoids the use of more complex technology and more expensive equipment to obtain the same final results.
- Automatic system that avoids made dispersed and less precise manual measurment.

The tunnels of the M-111 road, to its passage under the runway of Madrid - Barajas airport, must be monitored for deformation of the pre-fabricated structure. The monitoring is necessary because of the weight of 20 meters of ground and other materials that must be supported, in addition to the transit of airplanes.

Both external tunnels are being monitored in order to control the 4 tunnels structures. There are four Leica TCA2003 in each tunnel measuring in one hour cycles, 24 hours per day. There are seven targets (mining prisms) placed in each section of the tunnel that should be monitored. In total there are more than 20 sections in each tunnel for which convergences must be measured with millimeter accuracy. This means that there are about 300 positions monitored continuously with the highest accuracy and reliability.
The communications between the Leica TCA2003 and the PC running Leica GeoMoS, located in the control and security center of the tunnels, is established via IP address from 4 km away.
The control of the system can be made remotely from anywhere with access to the Internet.



Leica Geosystems AG
Heerbrugg, Switzerland
www.leica-geosystems.com

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Leica Geosystems

Leica Geosystems TruStory
Messung von Böschungsoberflächen, Deutschland

In den drei großen Tagebaubetrieben Hambach, Garzweiler und Inden der RWE Power AG werden jährlich rd. 100 Mio t Braunkohle gefördert. Der Hauptanteil der Braunkohlenförderung wird zur Stromversorgung eingesetzt.

Insgesamt werden jährlich rd. 77 Mrd KWh (entspricht 15 % des deutschen Stromverbrauchs) erzeugt. Mit einer Förderleistung von rd. 40 Mio t Braunkohle - dies entspricht etwa einem Anteil von 20 % der gesamtdeutschen Braunkohlenjahresproduktion - ist der Tagebau Hambach einer der leistungsfähigsten Braunkohlentagebaue der BRD.

Die durchgeführten Messungen geben Aufschluss über die Bewegung der Böschungsoberfläche. Am zeitlichen Verlauf der Messwerte kann in einem Weg-Zeit-Diagramm erkannt werden, ob es sich bei den gemessenen Bewegungen um normale Entlastungsverformungen oder möglicherweise beginnende Bruchverformungen handelt. Bruchverformungen gefährden die Standsicherheit von Böschungen und erfordern angepasste Sicherungsmaßnahmen. Die Beobachtung bzw. Kontrolle von Böschungsverformungen sind ein unverzichtbarer Teil der Standsicherheitsbeurteilung von großen Tagebaurandböschungen und sind daher wichtige Komponenten einer modernen Tagebautechnologie.

Kunde
RWE Power (Tagebau Hambach), Bundesrepublik Deutschland

Aufgabe
Automatisches Messsystem zum Messen von Böschungsoberflächen

Datum
Installation 2002

Ort

Projektfakten

Instruments
Leica TM1100 plus DI3000S
Leica prisms
GPS
DTM Meteo Sensor

Software
GeoMoS Professional
GeoMoS Server
GeoMoS Analyzer
GeoMoS Remote

Kommunikation
Satelline 2AS Funkgeräte
Datenkabel, Länge >1 km

Nutzen
Erkennen von Entlastungsverformungen

Vorteile
- Kontrolle der Böschungsverformungen
- Information über die Messwerte in Weg-Zeit-Diagrammen

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Leica Geosystems TruStory
Bauwerksüberwachung A2 Südautobahn, Österreich

Kunde
Dipl.Ing. Chritian MALETZ
Ingenieurkonsulent für Vermessungswesen (Villach)

Aufgabe
Überwachung der Hilfskonstruktion einer Bogenbrücke während der Bauphase.

Datum
Temporärer Aufbau im Winter 2002/03

Ort

Projektfakten

Instrumente
Leica TCA1800
Miniprismen

Software
GeoMoS Professional

Kommunikation
Telefonleitungen mit Modem vor Ort

Nutzen
Beschleunigung des Baufortschritts

Für die Überwindung eines tiefen Taleinschnitts auf der Autobahn A2 im Packabschnitt* wurde eine Bogenbrücke geplant.
Die dafür notwendige Holzhilfskonstruktion wurde während des Betonierens permanent überwacht um die Menge des eingebrachten Betons regeln zu können.

Betoniert wurde in Abschnitten, wobei am Rand des Bogens begonnen wurde. Durch die Last des Betons ergaben sich dort die größten Bewegungen. Sowohl vertikal als auch horizontal (in Richtung der Brücke) wurden an diesen Stellen Bewegungen bis zu 18cm beobachtet.

* (Steiermark, Österreich

Die Steuerung des Systems erfolgte über Fernwartung von Villach aus. Excel-Tabellen mit den Bewegungen der beobachteten Punkte wurden automatisch als E-Mails an alle Verantwortlichen geschickt.

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Leica Geosystems TruStory
Erdfallüberwachung
RODUND Austria

Kunde
Vorarlberger Illwerke AG, Schruns (A)

Aufgabe
Überwachung von Dämmen dreier Pumpspeicherseen der Werke RODUND. (Vorarlberg)

Datum
permanent

Ort

Projektfakten

Instrumente
Leica TCA1800
Leica Rundprismen

Software
GeoMoS Professional

Kommunikation
fixe Datenleitungen

Nutzen
- Risikominimierung von Personen- und Sachschäden
- Erfüllung amtlicher Auflagen

Auf Grund des speziellen geologischen Aufbaus (Illschotter über wasserlöslicher Schicht) besteht im Bereich der Speicherseen beim Kraftwerk RODUND Gefahr des plötzlichen Einbruchs der Erdoberfläche.

Durch solche Ereignisse können zwei Häuser und die Dämme der Seen gefährdet werden. Da die Erdfälle, wie diese Einbrüche genannt werden, mit Geschwindigkeiten von bis zu einigen Metern pro Stunde erfolgen können, ist eine permanente Beobachtung aller Punkte notwendig, um im Ernstfall rasch reagieren zu können.

Die Daten werden an eine Zentrale weitergeleitet wo sie ausgewertet und analysiert werden. Sollten Toleranzwerte überschritten werden, setzen Warneinrichtungen Meldungen an verantwortliche Personen ab.

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Whether you monitor the movement of a volcanic slope, the structure of a long bridge or track the settlement of a dam; whether you measure, analyse and manage the structures of natural or man-made objects: the monitoring systems by Leica Geosystems provide you with the right solution for every application.

Our solutions provide reliable, precise data acquisition, advanced processing, sophisticated analysis and secure data transmission. Using standard interfaces, open architectures and scaleable platforms, the solutions are customizable to meet individual requirements - for permanent and temporary installations, for single sites and monitoring networks.

When it has to be right.

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