

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 project's 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 led 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.

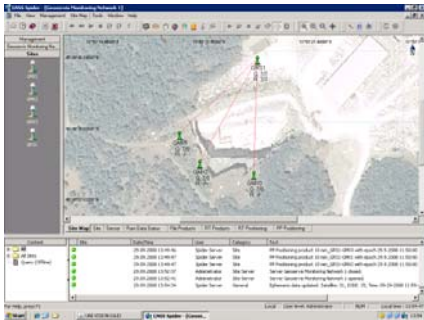
▪ Benefits:

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

Leica Monitoring Solution

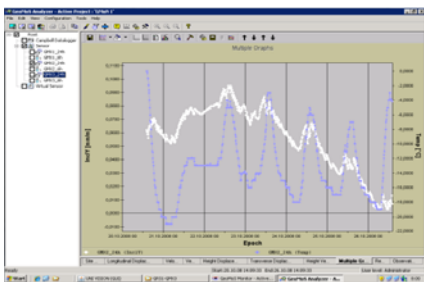
Three monitoring points were established around the mine perimeter, with a fourth outside the area of movement.

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.