

AlpenParks Hotel, Austria – Geotechnical Monitoring

CLIENT: MAXGEO / MJP ZIVILTECHNIKER GMBH

A comparison of traditional monitoring and Senceive’s InfraGuard™ intelligent monitoring technology to monitor slope stability during the construction of a hillside hotel

Challenge

Tourist demand in Austria has risen sharply over the last 10 years, with Salzburg, a picturesque city on the northern edge of the Alps, being a particularly popular destination for holiday makers all year round. The area is home to several ski resorts, beautiful lakes and hiking paths. The growth in tourism has resulted in a growth in construction activity.

The construction of AlpenParks Viehhofen – a hotel with 29 apartments – was an ambitious project by development company AlpenParks on a hillside site 856 m above sea level in Glemmtal, Salzburg. Evidence of slope movement had been noted on nearby properties prior to construction so there was a requirement to stabilise the site prior to construction; this was achieved using a combination of bored and sheet piles and deep anchors. To verify the effectiveness of these works, a comprehensive monitoring programme was specified with the aim of detecting ground movement during the construction programme.

Solution

Austria-based monitoring experts maxGEO were called in at the beginning of the construction works in April 2021. They installed a combination of traditional monitoring methods – including manual levelling, robotic total station, inclinometers, and well levels.

In September 2021 they also installed a trial Senceive wireless intelligent monitoring system – InfraGuard™. This consisted of 15 Triaxial Tilt Sensor Nodes – including nine on stake mounts on the slope above the bored piles, four fixed to structures, and two on rock surfaces.

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Picture 1: Site location



Picture 2: Stake mount with Triaxial Tilt Sensor Node and prism

infraGuard

Responsive critical asset protection

InfraGuard™ is a near real-time intelligent monitoring system that has been used since 2018. The proven technology has successfully detected numerous slope failures affecting assets such as railways. The InfraGuard™ system requires no fixed power supply - the long-life Triaxial Tilt Sensors are battery-powered and can last more than 10 years (depending on sampling frequency).

The highly sensitive tilt sensors respond to movement and automatically send a data sample via solar-powered 4G cellular Gateway to Senceive's web-based visualisation software WebMonitor™. Pre-defined parameters and trigger levels can be programmed into the software, which instruct the system to change reporting rates in response to the degree of movement measured by the sensors.

In addition to the tilt sensors, the InfraGuard™ system installed on this project also included a 4G camera. This was programmed to take a picture of the construction site every 6 hours but was also set up to be triggered to automatically take a picture in the event of any sudden movement, in line with the sampling rates and thresholds of the tilt sensors.

Key Points:

- Evidence of slope movement prior to construction meant a comprehensive monitoring programme was needed
- Both traditional monitoring and Senceive's wireless InfraGuard™ system were installed
- When micro-pilling and excavation works started, movement data from prisms corresponded to the InfraGuard™ system
- InfraGuard™ had advantages including: continuous data regardless of weather or construction activity, variable and responsive reporting rates, and the ability to trigger cameras for visual verification without visiting site



Picture 3: Total station and Senceive Triaxial Tilt Sensor Node



Picture 4: Senceive 4G Camera

Figure 1 below: Geodetic measurement of prisms on stake mounts

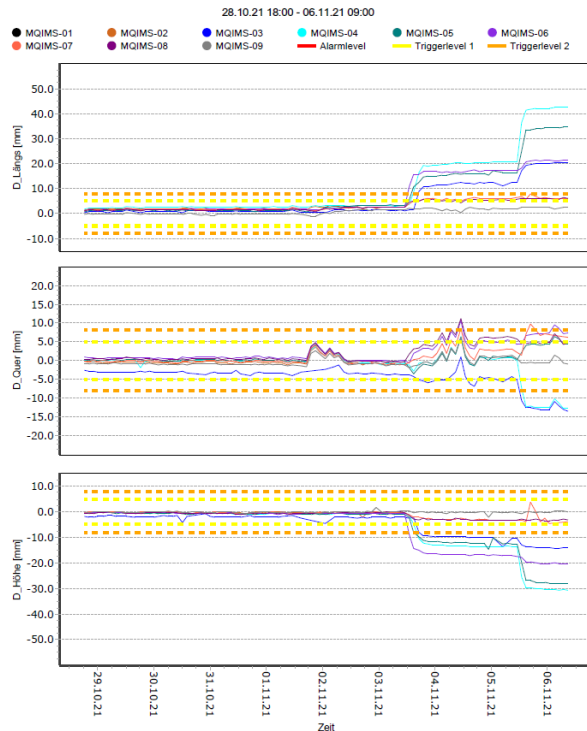


Figure 2 on right: InfraGuard™ tilt sensors and derived displacement in the longitudinal direction (x-axis)



Outcome

Excavation and micro-piling commenced in November 2021. Data from both the geodetic measurement system prisms (Figure 1) and the InfraGuard™ tilt sensors (Figure 2) showed corresponding longitudinal displacement and settlement in the central area of the slope during this site activity.

The tilt sensors on the stakes showed an increase in tilt in the x-direction, which could be correlated in time with the measurements of the geodetic measurement system (prisms on the same stakes). Tilt sensors E4DF, E4FO and E500 showed the highest level of movement, which corresponded to geodetic measuring points MQIMS04, MQIMS-05 and MQIMS-03.

One of the advantages of the InfraGuard™ tilt sensor system is that it can detect displacement events and trigger the camera regardless of weather and construction activity, allowing for immediate visual verification.

InfraGuard's dynamic reporting rate means data sample frequency directly responds to the severity of movement. This helps users to spot early signs of movement, to track ongoing movement and to identify false alarms.

Because sensor batteries last several years InfraGuard™ is an ideal long-term solution for detecting sudden events such as landslides and slope failure, as the technology provides assurance that stakeholders will be notified of ground movement and can provide an instant view of potential problems, all without visiting site.

For this Austrian AlpenParks development, both the traditional monitoring and wireless InfraGuard™ system remain on site and have detected up to 5 mm of movement since the November 2021 activity. The InfraGuard™ system will likely be moved to a new site following completion of the construction programme.

