RITE GEOSYSTEMS

ENCARDIO RITE METASENSING FOR MEGA STRUCTURES

Project dossier

PROJECT DOSSIER

El Espígol Rock Stability Project, Spain

PROJECT OVERVIEW

Located right over the village of Gerb (Lleida, Spain) the El Espígol boulder (rock) has a total height of 32 meters and width of 24 meters. The hill, popularly known as Penya de l'Espígol, threatens to collapse and cause a disaster. In 2019 the rock was cataloged as "potentially unstable".

Project	El Espígol Rock Stability Monitoring Project
Location	Gerb, Catalonia, Spain
Client	Provincial Council of Lleida
Contractor	Kuroba Quatre SL
Duration	December 2021 – Ongoing (as of Feb 2023)

WHY MONITORING?

When deep cracks in the rock face were noticed, it developed fear amongst the residents of Gerb, that at any moment the whole rock could tumble down on them. The town council initiated an investigation.

Kuroba Quatre, the company specialized in Natural Hazards, proposed an instrumentation and monitoring plan for the boulder with the aim to collect data for at least one year before taking any decisions about the next steps to follow.

MONITORING SOLUTION

Kuroba Quatre selected Encardio-Rite as the supplier of the instruments to monitor de El Espígol Boulder. Initially it was decided to use crack meters and inclinometer.

However, the monitoring solution initially deployed for one year of data collection had to be improved after two weeks of installation, as the sensors started to detect movements in the rock. Load cells and piezometers were also installed to monitor the remedial action taken at site.

INSTRUMENTS USED

Crack meter	to monitor width of existing crack in rock
Wireless tilt meter	to monitor tilt in the rock
Load cells	center hole load cells used to monitor force on the rock bolts
Piezometers	to monitor sub-surface water pressures

In the first stage, two crack meters and two wireless tilt meters were installed. The crack meters were automated using wireless RF dataloggers (nodes). Wireless tilt meter had in-built RF datalogger.

The dataloggers transmitted the recorded data via low power radio frequency to the gateway, installed in line of sight of the nodes. Gateway transmitted the data to central server via cellular network.

The central server had database management software to process, analyses and present the data collected from installed sensors. The data was available to all concern stakeholders in near real-time.

An acoustic alarm device activated by an extensometric sensor was also installed (not in scope of Encardio-Rite), with the purpose to transmit an immediate alarm to the general population in case of a movement event being triggered.

In the second stage, 4 numbers of anchor load cells and 4 numbers of vibrating wire piezometers were installed in addition to the sensors deployed in the first stage. These were also connected to RF nodes and gateway network.

The acoustic alarm device installed in phase 1 was replaced by a system in which the alarm was activated directly from the Data Management System.

Wireless tilt meter with in-built RF datalogger, installed on the rock

Crack meter installed across the crack on the rock

This improved system allowed alarm to be triggered in case data of any of the installed sensors crossed alarm limit. This avoided being dependent of a single sensor located in a specific point. The alarm system was equipped with a siren.

RESULT

The idea of initial instrumentation and monitoring plan was to carry out a study over a course of a year. But to the surprise of all, within two weeks the instruments showed movement (December 2021), indicating that the rock was cracking. The installed tilt meters recorded a total tilt variation up to 18 degree, and the crack meters recorded a displacement up to 4.89 mm.

Looking at the alarming situation, remedial measures were immediately taken. Metal mesh was raised and rock bolts were installed to restrain the rock movements. Extra instrumentation including load cells and piezometer were installed to monitor the rock as well as the stabilization measures taken.

The installed instrumentation provided data in real time, providing prompt alert on alarming situation. This allowed the stakeholders to take corrective action in time.

Load cells installed with RF datalogger on the rock bolts installed for the rock stabilization

The alarm and siren system installed on the cliff

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