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Case Study

Tsakona Bridge | Structural Health Monitoring (SHM)

The Tsakona Arch Bridge is the second largest in Greece, after the Rio-Antirrio bridge, and one of the world's longest multi-span arch bridges. It crosses the Tsakona Valley and spans a dangerous location near Megalopolis in Peloponnese, southern Greece, where there have been severe landslides in recent decades.

The bridge reaches 400 meters in length and is a structure of extraordinary complexity, in terms of both foundation and superstructure. It comprises of two abutments and a pier. The 300-meter crossing is partially bridged (40m) with a prestressed segment, and the rest (260m) is covered with two steel arches from which the bridge's composite deck hangs. The bridge was opened for traffic in January 2016.

The Project

As a subcontractor of the main contractor TERNA SA, Set Point Technologies was responsible for the supply, installation and commissioning of the bridge's Structural Health Monitoring system. The aim of this system is to assess the structural stability of the bridge and to monitor its dynamic response to ambient excitations (wind, traffic, accidental events,..), or earthquakes.

Data collected from the system provide bridge owners and stakeholders with diverse information on bridge structural health, such as overstrain, changes in load conditions, deformation and excessive vibration, so that necessary maintenance and repairs can be planned to ensure the bridge's safety and longevity.

System Architecture

The system supports 100+ channels and is designed around Gantner Instruments (GI) Q.series distributed measurement and control system. Q.series innovative design offers the maximum flexibility; each Q.series module may be randomly installed close to the actual point of measurement and connected via high-speed serial interfaces. This not only reduces cabling complexity, but also allows a highly synchronized measurement that is less prone to noise due to shorter sensor cables runs. Q.series data acquisition modules are controlled by a GI Q.station 101 high-end controller.

System Highlights

- Synchronization and time stamp of all measurement values
- Multiple sample rates for static & dynamic measurements
- Common trigger for dynamic signals
- Support of multiple data logging configurations with selectable medium (internal Flash, USB or SD-Card), logging rates, storage duration, start and stop trigger, as well as pre- and post-trigger
- Remote monitoring and control
- Alarm handling

Sensors

A large variety of sensors were installed at different locations to record the response of various structural elements under different loading conditions. Measured variables and respective sensors are:

- Strain of the arches (27 electrical resistance strain gages from Micro-Measurements)
- Temperature of the arches (20 thermocouples from THERMO SENSOR)
- Strain of the hangers (8 electrical resistance strain gages from Micro-Measurements)
- Vibration of the hangers (12 piezoelectric accelerometers from Endevco-Meggitt)
- Ground, deck and pier acceleration (6 triaxial MEMS low noise acceleration sensors from BDI)
- Wind speed and wind direction (2 ultrasonic anemometers from LUFFT)
- Tilt of the deck and of the pier (4 biaxial MEMS tiltmeters from Geokon)

Data Processing and Alarm Handling

The controller is connected to the Traffic Management Centre of the Highway (MOREAS) for real-time monitoring. The measured data are processed and analyzed in real time against several trigger and alarm criteria, such as strong winds, earthquakes, or accidental events. Alarm events are also automatically forwarded via email to chief engineers in charge of bridge maintenance.

Set Point Technologies is responsible for the data analysis and reporting to the bridge's stakeholders and for system maintenance.