GeoWatch

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Foreword from the CEO

Within this GeoWatch we present two projects recently finalised by GeoSIG. With the two GeoSIG product lines, the CR-4 central recording system and the GSR strong motion recorders virtually all applications can be covered. Given a detailed specification and the required performance criteria, an optimum solution is always attainable with the GeoSIG product line.

The Aktio-Preveza tunnel monitoring system illustrates lifeline instrumentation including structural and geotechnical aspects as well as earthquake monitoring. In addition to surveillance of this important transportation structure under operational and service loads, monitoring and capturing the seismic effects are the main targets in this project. The utilised CR-4 system is capable of performing both static and dynamic measurement, which suits perfectly for these needs.

The project summary outlining the Karkheh dam instrumentation is a typical GSR network application and is of special interest due to the large interconnection distances. Furthermore, this project demonstrates the perfect preparation both for foundation and protection by the contractor Sepasad Engineering Co.

Christoph Kündig

Structural and seismic tunnel monitoring system for Aktio-Preveza Immersed Tunnel, Greece

Completed in 2002, Aktio-Preveza immersed tunnel takes place on a two-lane road connecting Preveza and Aktio provinces in Western Greece. The tunnel consists of three sections; a 150 m long cut & cover tunnel on

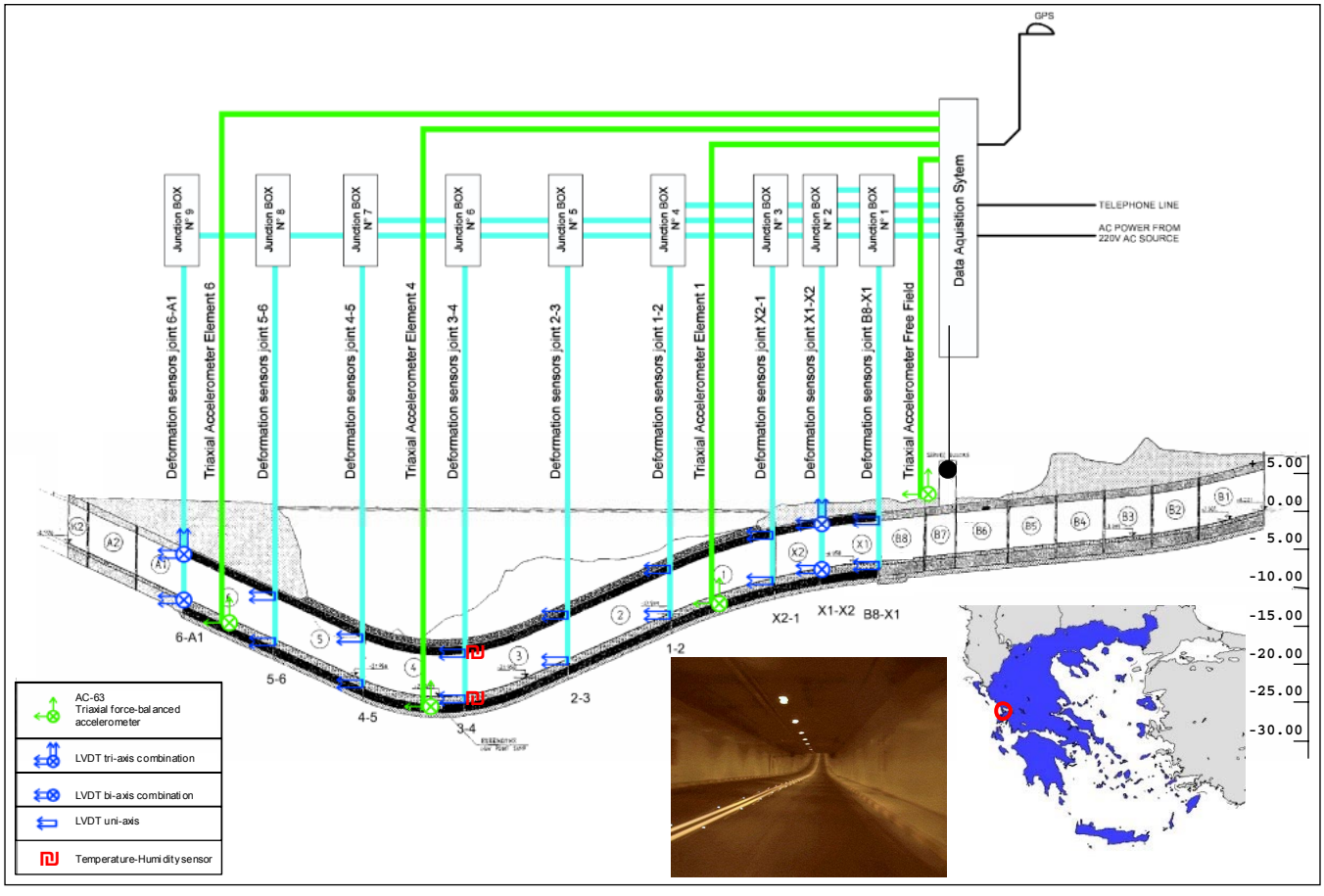

Figure 1. Aktio-Preveza Immersed Tunnel Monitoring Instrumentation

Aktio shore, an approximately 900 m long immersed tube concrete tunnel and a 500 m long diaphragm wall type cut & cover tunnel on Preveza shore. The immersed section was constructed of pre-cast rectangular concrete rings, each approximately 135 m long. The rings were submerged in a trench excavated in the sea bottom at a depth of approximately 25 m. The bearing-capacity of the sea floor was improved by using stone columns against the risk of liquefaction.

The tunnel is monitored with GeoSIG equipment against ambient static and dynamic loads as well as seismic effects, facilitating immediate response to detected emergency cases, at the tunnel service building at the Preveza shore. State-of-the art equipment is employed in this monitoring project consisting of 60 channels and a data acquisition and processing center.

Four triaxial AC-63 force-balanced accelerometers, 44 linear variable displacement transducers (LVDT) and two temperature-humidity sensors are implemented in the project. The AC-63 accelerometers are placed at three different locations inside the tunnel and one in the freefield at Preveza shore. LVDT's are installed at the sealing joints between the concrete rings in three different axial configurations to observe the behavior of these most critical sections of the tunnel. The observations are foreseen to be in terms of expansion or contraction due to environmental changes, or deflections or relative displacements due to other static and dynamic ambient effects, including seismic activity. Temperature-humidity sensors are also installed in the tunnel to correlate their data with static measurements. A brief summary of functionality of the installed sensors is given in Table 1.

Table 1. Summary of installed sensors

Qty	Total channels	Model	Type	Measuring Range	Dynamic	Static
4	12	AC-63	Triaxial force-balanced accelerometer	±2 g	YES (200 sps)	NO
44	44	LVDT	Uniaxial displacement sensor	–50 ~ +100 mm	YES (200 sps)	YES
2	4	HU-TE	Temperature-Humidity sensor	–40 ~ 60 °C 0 ~ 100 %RH	NO	YES

Data from all sensor types (dynamic only, static and dynamic or static only) are recorded with a single CR-4 PC-based recording system installed in the service building.

The system delivers the following data for the sensors:

- Static: One value is stored at every specified interval, programmable from 5 minutes to 1 day.
- Dynamic: Data is stored on event basis in case a dynamic event is detected.

Utilising appropriate harddisk capacity, the system is also capable to store continuous data in the form of files for a certain period of time (e.g. one file every 5 minutes).

Seismic instrumentation network for Karkheh Dam, Iran

The Karkheh dam is owned by the Iran Water and Power Resources Development Company (IWPC). It is located in the province of Khusestan at the South West of Iran, in the northwest of Andimeshk city. The Karhkeh dam is situated on the Karkheh River, which is the third largest river in Iran as far as the water yield is concerned.

With a gross reservoir capacity of 7'795 Mio m^3, the dam serves for storage and regulation of water for irrigation of more than 320'000 Hectares of downstream plains, and flood control in the upstream, as well as production of hydroelectricity with an installed capacity of 400 MW.

The Karkheh dam is an earthfill dam with impervious clay core. The height above the foundation is 127 m with an impressive 3'030 m crest length. The regulated water of the Karkheh River is 3'300 Mio m^3 per year. Engineered by Mahab Ghodss consulting engineering company, the dam was contracted to Sepasad Engineering Co.

GeoSIG was selected as the supplier of the strong motion instrumentation for Karkheh Dam. A total of six GSR-18 stations are installed including AC-63 force balance accelerometers. Access to the network is through the central station module directly to the station A1. Alternatively access can be achieved also through a modem connection. An AC supply cable leads to all stations. In parallel an interconnection cable provides common timing, common trigger and communication to all stations.

Due to the immense distance between the A2 and A1 stations (over 3 km) two repeaters were installed as illustrated in Figure 2. All the stations are installed on a strong concrete foundation. Since the recorders are exposed to the environmental effects, the specialists of Sepasad designed a steel cover, providing full protection while maintaining easy access. Special care was taken for a proper grounding of all the stations.

Generally in almost all engineering structures specifications with respect to seismic safety either depend on general assumptions or theoretical studies. Such a strong motion instrumentation allows to monitor the behaviour of the structure during an earthquake. Such earthquakes would facilitate to review and verify the design specifications of the dam under real seismic conditions.

The vulnerability and respective security measures of this and similar important structures may then be based on a more realistic assumptions established on the extensive knowledge that is gathered from the state of the art seismic instrumentation that GeoSIG provides.

Karkheh Dam technical information, drawings and aerial view are courtesy of Iranian National Committee on Large Dams (IRCOLD).

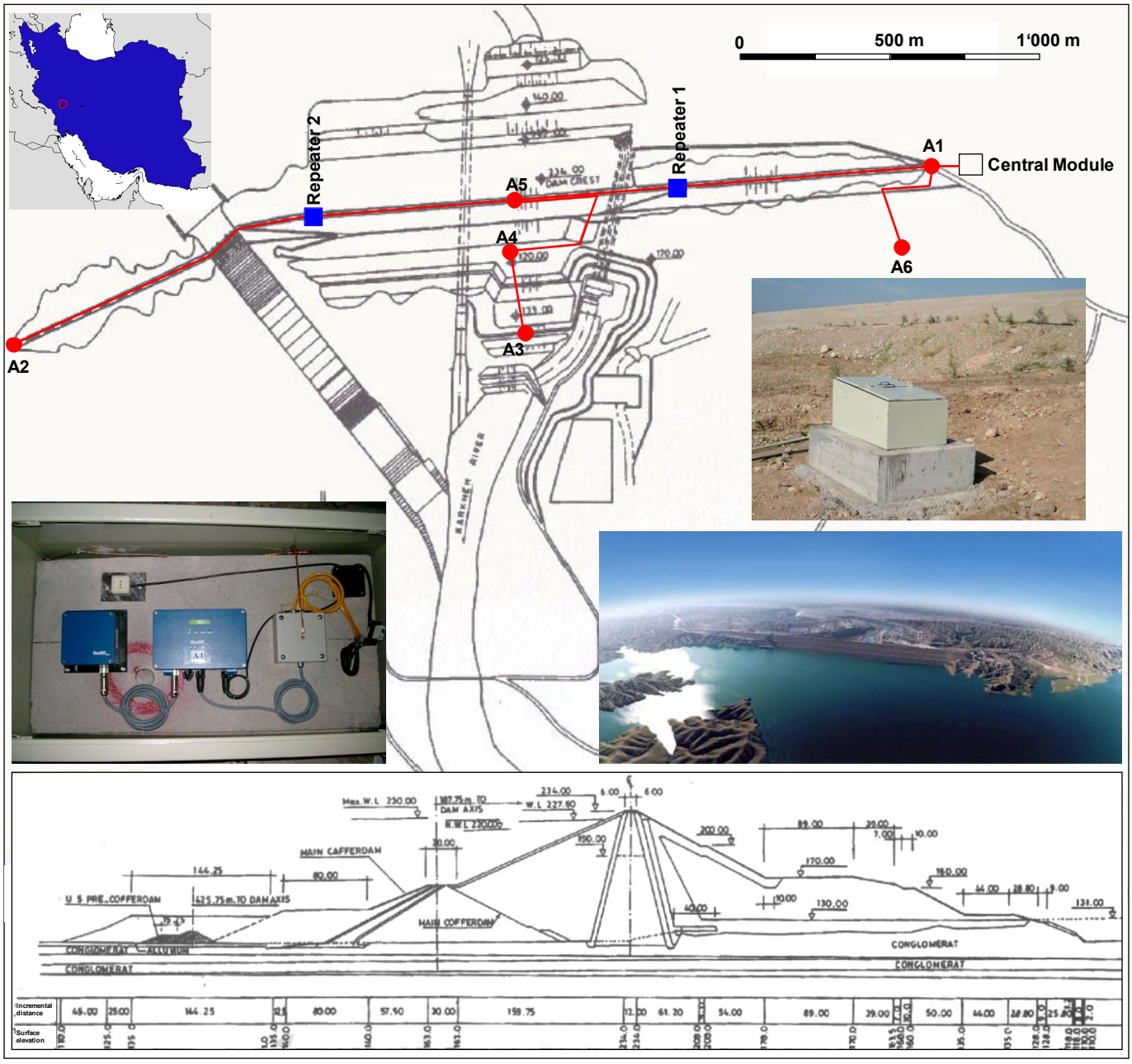

Figure 2. Karkheh Dam Seismic Instrumentation Network

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