

Hydro 2010
Portugal
Sep 27-29, 2010

International
Society of Rock
Mechanics
Delhi-India
Oct 24-27, 2010

FMGM
Berlin, Germany
Sep 12-16, 2011



AUGUST 2010

Chairman's Note

Incorporated in 1966, Encardio-rite is World leader in the field of Instrumentation and Monitoring of Civil Structures during construction and post construction.

This is our second newsletter. In addition to giving Company news, we will also provide information on useful field experiences on Instrumentation and Monitoring. In this newsletter, we are giving information on instrumentation of Monuments and installation of multi-level piezometers in soil using fully groutable method. Pictures above are of Cabo fort, Goa and Al Mirani fort, Oman instrumented by Encardio-rite



SCAFFOLDING FOR INSTRUMENTATION & PRESSURE GROUTING

INSTRUMENTATION AND MONITORING OF MIRANI FORT, OMAN

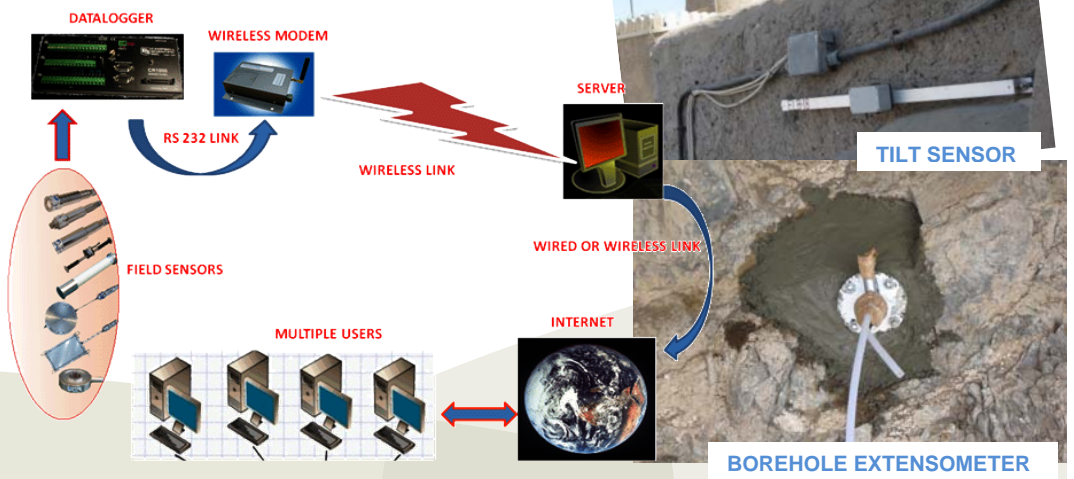
Al Mirani fort along with Al Jalali fort, flank Sultans Al Alam Palace. In olden days, these more than 600 year old forts served as bastions in defence of Muscat harbour & the old city. Al Mirani fort is now being restored to its original majesty as part of a concerted renovation programme. The fort stands on the contours of a 30 - 40 m high rock mass which was showing signs of decay and distress. With passage of time, the rock mass has undergone weathering and has formed several cracks, fissures and cavities at places. Saline weather conditions and rain water discharge points at various locations on the surface of the hill has caused adverse weathering and erosion with time.

The Sultanate commissioned Atkins International and later Constell Consultants India to prepare a report on protection of the fort and suggest long term performance monitoring. The purpose was to identify weak

rock conditions in the foundation that require rock stabilising work. Al Manar of Oman were entrusted the work of rock stabilising of the rock foundation using various methods including pressure grouting and rock bolting etc.

Instrumentation work in rock foundation and roof of fort entrusted to Encardio-rite Electronics Pvt. Ltd. consists of 14 in-place inclinometer systems, 28 horizontal borehole extensometers, 21 tilt sensors and 6

temperature sensors, connected through several junction boxes and multi-core cables to 3 automatic data acquisition systems on top of the roof of the fort. Around 200 sensors have been installed. The instrumentation is a Web Data Monitoring System in which the data is available online with automatic message to mobile phones under alarm conditions.



VIBRATING WIRE PIEZOMETERS INSTALLATION AT MULTILEVELS USING THE FULLY GROUTED METHOD

Encardo-rite successfully installed piezometers at four levels in a borehole at several sites on a project in the UAE using the fully grouted method as proposed by P E Mikklesen and G E Green in their presentation at FMGM at Oslo in September 2003. Vibrating wire piezometers are well suited for the fully grouted method, as a very small volume of water is required to register a change in reading.

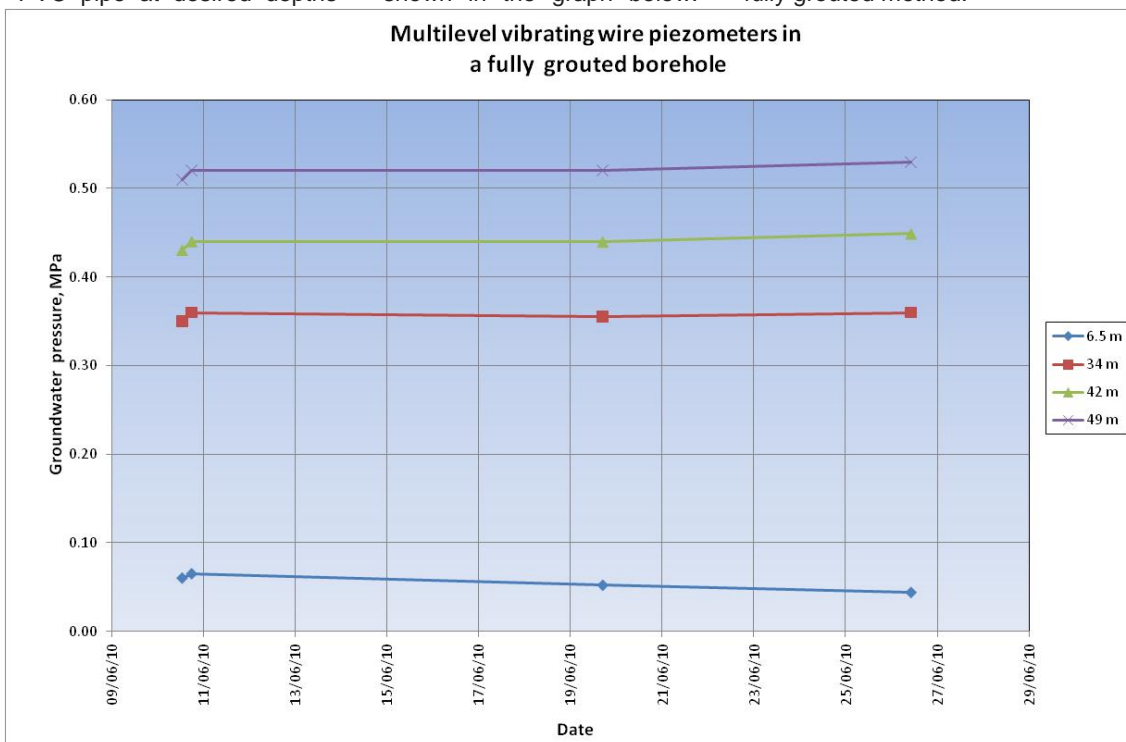
Encardo-rite EPP-30V VW piezometer were attached to the outer surface of a 20 mm PVC pipe at desired depths

and lowered down the borehole. Tip of sensors were pointed upwards to avoid escape of deaired water filled between the ceramic filter and the sensing diaphragm. Cables from the piezometers were secured to the pipe itself. The borehole was fully grouted from the bottom, using the same 20 mm PVC pipe, with cement bentonite grout. Ratio of cement, bentonite and water used was 1:0.3:2.5 by weight. Readings from piezometers at various levels in one of the boreholes are shown in the graph below.



The installation time which could have been substantial using conventional method with placement of 18 different layers of material (sand and bentonite seals) was drastically reduced using the fully grouted method.

Multilevel vibrating wire piezometers in a fully grouted borehole



SLOPE MONITORING KIMI POWER HOUSE KAMENG HEP



KIMI semi underground power house of Kameng (NEEPCO) is being constructed on an unstable slope. Protection measures are being taken to prevent slope failure. To monitor slope stability, inclinometers were installed at 19 locations in different benches. The maximum movement recorded by the inclinometers was up to 150 mm.

Due to land movement, cracks also developed in benches. The cracks directions were co-relating with inclinometer data. Inclinometers gave very good data to take corrective actions for the stability of the slope.

Piezometers were also installed to monitor the hydrostatic pressure being developed in slope.

An application note on landslide monitoring is available on our website www.encardo.com.



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