Field Application of Real-time Levee Monitoring for Health Assessment in Boston, UK

by

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ABSTRACT

Assessing the health of and maintaining civil infrastructure has been an increased concern in the wake of natural disasters such as Hurricane Katrina in 2005 and the summer 2007 flood events in the UK. The variability of properties within geotechnical systems makes predictions of soil behavior extremely difficult, especially when soil models are not calibrated with field-measured performance. Because of this, a need has arisen for a system capable of in situ, real-time monitoring of levees, dikes, and other earthen structures.

MEMS-based (Micro-Electro-Mechanical Systems) in-place inclinometer systems, such as Measurand's ShapeAccelArray (SAA) technology, have been developed to meet this need. The instrumentation uses MEMS accelerometers and digital temperature sensors to autonomously acquire spatially-dense three-dimensional profiles of ground deformations, accelerations, and temperature readings up to a depth of 100 m. The sensor array can be installed both vertically and horizontally, depending on the application. It is an alternative to the traditional manual inclinometer and is connected to a wireless earth station for remote access and configuration over the cellular network or internet. Multiple arrays at a project site can be integrated into a data acquisition system to be accessed remotely in this manner.

Combined with compatible piezometers, a multi-parameter system for thorough assessment of geotechnical assets is born. The SAAP is a traditional vibrating wire piezometer modified with the attachment of a microprocessor that converts vibrating wire data to digital data; this is all done downhole in real time. The microprocessor used in the SAAP is the same as those used in the SAA, which have survived five years of field installation to date. The system is fully integrated, and data from the instrumentation can be viewed side-by-side in Measurand's software.

A complete system of SAAs and SAAPs were installed at a test site in Boston, UK for assessment and validation of the sensor functions, in addition to geotechnical assessment of the site behavior. The test site is an unstable levee along the River Witham subjected to tidal loading from the North Sea. The field test in Boston included installation of GeoBeads sensors, another multi-parameter system for geotechnical

assessment, and GeoDetect, a geotextile using fiber optics to identify changes in temperature and strain.

The likelihood of the Boston levee to experience deformation and the density of instrumentation installed in the bank made this an ideal location to test the SAAP system. Five years of previous field data confirms that the SAA instrumentation system is a viable and reliable solution for use in monitoring and assessing levees and other earthen structures. The SAAPs show promise for future use with SAAs in other applications and for incorporation into early warning management systems for civil infrastructure.