AGS(HK) Technical Visit to “Soil Mechanics Laboratory of the Hong Kong Polytechnic University” - Mr Yuet Hoi LAW

On 20 February 2016, the AGS (HK) organised a technical visit to the Soil Mechanics Laboratory of the Hong Kong Polytechnic University. This visit covers some of the latest, innovative technologies/techniques used in soil testing, physical modelling and monitoring.

The visit commenced with a presentation on the laboratory testing and physical model. The soil testing techniques discussed were: bender element test, large size direct shear box, Double cell triaxial test, Hollow Cylinder Apparatus (HCA), True Triaxial System (TTS) and soil nail pullout box.

Bender element measures the maximum shear modulus (Gmax) of a soil sample. A transmitter and a receiver are connected at both ends of the soil sample. Signal waves are passed through the soil sample and the travelled times are measured. The shear wave velocity is calculated and correlated to Gmax by shear wave propagation theory.

Large size shear box tests the frictional resistance between different structural elements with granular soils. Test results show the frictional resistance of geotextiles is higher than metallic strips due to interlocking effect with soil particles.

Double cell triaxial test can be used to improve the accuracy of measuring volume change in unsaturated soils. PolyU has installed bender elements to measure different ranges of shear modulus of the samples.

Hollow Cylinder Apparatus (HCA) is used for developing constitutive models and failure criteria. It allows the users to independently impose principal stresses to the specimen, control the rotation angle at the principal stress direction and operate at frequencies up to 20 Hz. It can be used for measuring the behavior of a hollow/solid specimen under pure shearing, plane strain and rotation of principal stress.

True Triaxial System (TTS) aims to duplicate in-situ conditions and determine the properties of the soil in plane strain conditions unlike the conventional

axisymmetric conventional triaxial test. The stresses and strains measured using the original loading plates are non-uniform due to the spacings requirement. PolyU has overcome this issue by an innovative sliding plates setup, where the loading plates would slide over another during compression with no spacings needed.

A soil nail pullout box is designed to study the mechanisms of soil nail pullout under different conditions. Earth pressure cells, LVDTs and tensiometers are installed to monitor the stress changes in the soil and soil nail during different stages of the construction.

On the second half of the visit, sensors and monitoring technology using optical fibres were presented. The theory and applications of Fiber Bragg Grating (FBG) sensors and Brillouin Optical Time Domain Analysis (BOTDA) were discussed.
FBGs and conventional strain gauges have been installed on soil nails at a construction site and the results compared show consistent trend.

These optical fibre sensing techniques offer high accuracy and stability. Also they could save costs when monitoring large structures like tunnels. However, these sensors are fragile and need to be well protected on-site.

This site visit has provided a platform for academicians and practitioners to discuss on the possibility of implementing the latest technology to the geotechnical industry.

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