PhD Final Defense – Sungwoo Moon

Integrated Computational-Experimental Soil Behavior Characterization from Direct Simple Shear Tests on Boston Blue Clay

Advisor: Professor Youssef Hashash

Date: Thursday October 17th, 9:00 am

Location: Newmark 3350 Conference Room

Abstract

A constitutive model that represents soil behavior under a wide range of loading conditions is necessary for the simulation of complex boundary value problems. However, most laboratory tests are interpreted with an assumption of uniform stresses and strains within the tested soil specimen even when the specimen is known to experience non-uniform stress-strain distribution as in the Direct Simple Shear (DSS) test. Numerous tests are often needed to fully characterize a soil's nonlinear and anisotropic behavior and to develop an appropriate soil model. This study utilizes an evolutionary inverse analysis approach to directly extract non-uniform stresses and strains within an undrained DSS test specimen, and applies it to K_0 consolidated-undrained direct simple shear (CK_0UDSS) tests on Boston Blue Clay (BBC). The extracted soil behavior is consistent with known behavior of BBC obtained under more complex loading modes including anisotropic stress-strain response in addition to small strain nonlinearity.

The developed material models from DSS tests on Boston Blue Clay (BBC) are directly applied to deep excavation case histories. The analysis results show that the global responses, such as lateral wall deflections and vertical ground surface settlements, can be successfully reproduced.

The proposed approach represents a major shift in our ability to efficiently bridge numerical modeling and laboratory testing and change the way we approach soil characterization and constitutive model development. We can use very few laboratory tests to directly develop versatile material models that can be used in the solution of geotechnical field problems without the need for complex formulations or long development or calibration process. This is something that we have not been able to do before.