ETH zürich

IGT-Kolloquium

Thursday, 4 April 2019

Physics-Informed Semi-Empirical Probabilistic Models for Predicting Building Settlement and Tilt on Liquefiable Ground

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10 - 11 am, ETH Zurich, Hönggerberg, HIL E8

This presentation introduces predictive models for the seismic settlement and tilt of shallow-founded structures on liquefiable ground based on an integrated observational, experimental, numerical, and statistical approach. Effective liquefaction mitigation requires an improved understanding of the consequences of liquefaction on structures. The state of practice typically involves estimating building settlement using empirical procedures for free-field conditions, which have been shown to be unreliable and inappropriate through previous case histories and physical model studies. To address this problem, first, a series of centrifuge experiments were performed to evaluate the dominant mechanisms of deformation near shallow-founded structures. Second, experimental results were used to evaluate the predictive capabilities of 3D, fully-coupled, nonlinear, dynamic finite element analyses of soil-structure systems in OpenSees. Third, a numerical parametric study (exceeding 63,000 simulations) was used to identify the most optimum Intensity Measures for permanent building settlement and tilt as well as the functional form of predictive models. And finally, a case history database helped validate and refine the models, accounting for field complexities not captured numerically or experimentally. This integrative approach yielded a set of procedures that are the first to consider variations in soil layering and geometry, foundation and structure properties (in 3D), soil-structure interaction, all mechanisms of deformation, and total model uncertainties—all of which are necessary to realize the benefits of performance-based seismic design in evaluating and mitigating the liquefaction hazard.

Shideh Dashti is an Associate Professor in Geotechnical Engineering and Geomechanics at the University of Colorado Boulder (CU). She obtained her undergraduate degree at Cornell University and graduate degrees at the University of California, Berkeley. She worked briefly with ARUP (New York City) and Bechtel (San Francisco) Geotechnical groups on several engineering projects in the US and around the world involving the design of foundation systems, slopes, and underground structures and tunnels. Her research team at CU studies: the interactions and interdependencies among different infrastructure systems during earthquakes and other types of disasters; the seismic performance of underground structures; and consequences and mitigation of the liquefaction hazard facing structures in isolation and in dense urban settings.