

GEOSEMINAR

A Nonlinear Dynamic Macroelement for Soil-Structure Interaction Analyses of Pile Supported Wharves: From 3D FEM simulations to Practice

by

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Abstract

The seismic response of pile-supported wharfs is inherently a complex soil-structure interaction problem involving ground shaking, large ground displacements due to liquefaction of the fill, coupled transverse, longitudinal, and torsional response of the wharf, and the response of above-ground structures. This paper presents preliminary results of an integrated approach opting to develop geotechnical and structural mitigation strategies for improving the seismic performance of port facilities. In particular, we present the general framework for the development of simplified macroelement models for the analysis of the seismic response of pile foundations in remediated soil conditions against liquefaction. While the formulation presented describes the dynamic response of single piles, implementation of these models at the completion of this project is anticipated to be extended for the response prediction of 3D pile-supported waterfront structures subjected to vertically propagating seismic waves. The overarching goal of our contribution is to reduce the computational effort associated with the analysis of pile-supported wharfs at remediated sites, while it will be critical for the performance of statistically sound risk assessment studies that are based on a large number of alternative hazard, geotechnical and structural configuration scenarios. The nonlinear Winkler-type mechanical models are being developed to account for the multitude of soil resistance mechanisms mobilized at the foundation of pile-supported structures, as well as the soil-pile interface nonlinearities during transient loading. The characteristics of soil resistance mechanisms and corresponding complex resistance functions are being developed on the basis of finite element simulations.

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Varun received his MS in CE from Georgia Tech in Dec 2006 and his B.Tech in CE from Indian Institute of Technology Delhi (New Delhi, India) in May 2005. He has worked as a Junior Research Fellow in the Department of Civil and Environmental Engineering at IITD for two months after receiving his B.Tech. He also worked as an intern in Delhi Metro Railway Corporation and Larsen & Toubro, ECC. He is a student member of the ASCE, EERI and NEES. He is currently pursuing his Ph.D degree in the area of numerical methods in earthquake engineering and soil-structure interaction.