

Dynamic soil-structure interaction in the presence of liquefaction

M.T. Manzari^{a*} and M. ElGhoraiby^a

^a George Washington University, Washington, DC, USA

* corresponding author: manzari@gwu.edu

Abstract:

Seismic performance of structures founded on or supported by potentially liquefiable soils continues to be a major source of concerns in many parts of the world. In many recent earthquakes, the catastrophic failure or poor performance of water-front structures that were designed based on traditional methods has underlined the need for development and validation of more rigorous methods of analysis that can be used in the design phase. In this work, the seismic response of a sheet-pile wall supporting a liquefiable soil is investigated. The system was first designed by conducting a series of finite element analyses that considered the coupled response of the pore fluid and soil skeleton and included an elastoplastic model of soil skeleton that was thoroughly calibrated against element test data performed on the selected soil. The seismic response of the designed sheet-pile wall was then predicted for a number of target seismic motions. Following these blind predictions, a scaled model of the system was tested in a geotechnical centrifuge. The measured response of the wall was found to be remarkably close to the blind prediction.

The computational model validated against experimental data was then used in a series of stochastic finite element analyses to assess the response of the system for a wide range of seismic motions and soil densities. The analysis results were compared to extensive experimental results obtained in the course of an ongoing international collaborative research project, Liquefaction Experiments and Analysis Projects (LEAP)¹. The capabilities and limitations the computational model in capturing the response of the sheet-pile wall structure over a wide range of densities and base motion intensities and frequency contents are discussed.

¹ Manzari, M.T. et al. (2020). *LEAP-2017: Comparison of the Type-B Numerical Simulations with Centrifuge Test Results*. In: Kutter B., Manzari M., Zeghal M. (eds) *Model Tests and Numerical Simulations of Liquefaction and Lateral Spreading*. Springer, Cham. https://doi.org/10.1007/978-3-030-22818-7_10