Misko Cubrinovski

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Holistic evaluation of liquefaction response

Abstract

Soil liquefaction during earthquakes is a highly dynamic process involving rapid development of excess pore water pressures (EPWP), reduction in soil stiffness and strength, and diffusion of EPWPs through water flow. In addition, the liquefaction response is characterized by strong cross-layer interactions that significantly influence the severity of liquefaction and overall system response of liquefying deposits. To emphasize the importance of dynamic interactions and provide an in-depth understanding of the liquefaction response, a framework for a holistic evaluation of the liquefaction response is presented. Three key aspects of the response are required to be concurrently considered in the holistic evaluation of the liquefaction response: element (soil) response, cross-layer interactions (system response) and intensity of the input motion. The proposed approach is applied to a comprehensive series of nonlinear dynamic analyses (NDAs) of well-documented case history sites from Christchurch to identify key interaction mechanisms and quantify effects of cross-layer dynamic interactions on the liquefaction response. As state-of-practice simplified liquefaction evaluation procedures ignore interactions within the deposit, results from simplified analyses substantially differ from those observed in NDA and show significant anomalies in the evolution of the liquefaction response throughout the depth of liquefiable deposits. A systematic approach for an NDA-based improvement of simplified analysis is proposed to incorporate interaction mechanisms and system response effects in simplified liquefaction evaluation procedures

Biography

Misko Cubrinovski is Professor of Geotechnical and Earthquake Engineering at the University of Canterbury, Christchurch, New Zealand. He holds a BSc degree in Civil Engineering (1982), MSc degree in Earthquake Engineering (1989), and a PhD degree in Geotechnical Engineering (University of Tokyo, 1993). His career involves over 40 years of work in the academia and the profession including seven years in Macedonia, 15 years in Japan, and 20 years in New Zealand.

His research focuses on problems associated with soil liquefaction, seismic response of earth structures, and soil-structure interaction. Cubrinovski has authored or co-authored over 350 technical publications and has worked as expert advisor on over 50 significant engineering projects. He had a leadership role in the research efforts supporting the recovery following the 2010-2011 Christchurch earthquakes. His honours include the Ishihara Lecture (ISSMGE), Ralph
B. Peck Award (ASCE), Norman Medal (ASCE), Ivan Skinner Award, New Zealand Geomechanics Lecture Award, several outstanding paper awards, and the University of Canterbury Research Medal.

https://www.youtube.com/watch?v=Um3zqnur6cE