

Next Dynamics Colloquium

SEISMIC BEHAVIOR OF HARBOR GRAVITY QUAY WALLS

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Abstract

Caisson and multi-block quay-walls have suffered disproportionately large damage during strong and moderate seismic shaking. Motivated by the failures of such caisson type walls in the Kobe 1995 earthquake, and the severe damage of a single-block and of multi-block walls in the Lefkada 2003 and Cephalonia 2014 earthquakes, the lecture will outline the key features of their seismic response. Finite-element and finite-difference analyses are utilised and several constitutive soil laws (including a modified plasticity Pastor-Zienkiewicz law) model the cyclic behavior of the sandy gravel and rockfill. Effective-stress dynamic analyses are performed using recorded relevant accelerograms as excitation. The evolution during shaking of lateral displacements, excess pore-water pressures, and plastic strains is presented. A number of simultaneously occurring phenomena are elucidated: (i) the development of oscillatory inertial forces on the wall, in-phase or out-of-phase with the backfill-soil and pore-water pressures; (ii) the simple-shear seismic deformation of the soil and the ensuing initial development of positive excess pore-water pressures in the backfill and the foundation soil; (iii) the extensional (due to seaward movement) deformation developing in the “active wedge”, with the ensuing generation of negative excess pore water pressures; and (iv) the continuous dissipation and redistribution of water pressures. Extensive comparisons are made between numerical analyses and performance observed in the aftermath of the aforementioned earthquakes. Caisson and multi-block walls are shown to have similar behaviour, despite the occurrence of some block-to-block sliding in the latter category. The sensitivity of all such gravity walls to earthquake shaking will be demonstrated. The occurrence of liquefaction in the free field is shown to have a rather negligible effect.

Bio and research area

GEORGE GAZETAS has been for 30+ years Professor of Geotechnical Engineering at the National Technical University of Athens, following an academic career in the US, where he taught at SUNY-Buffalo, Rensselaer (RPI), and Case Western Reserve University. His main research interests have focused on the dynamic response of footings, piles and caissons; the seismic response of earth dams and quay-walls; soil amplification of seismic waves; and soil–structure interaction problems. Much of his research has been inspired by observations after destructive earthquakes. An active writer and teacher, he has been a consultant on a variety of (mainly dynamic) geotechnical problems. He has received a number of awards for his research contributions, including the Walter Huber Civil Engineering Research Prize from ASCE, and the Excellence in University Teaching Award in Greece. He has delivered the 2009 “Coulomb”, the 2013 “Ishihara”, and the 2019 “Kenneth Lee” Lectures. Last March he delivered the 59th Rankine Lecture in London.

Date: Monday, May 13, 2019

Time: 5:00 pm

Place: HIL E 1, ETH Hönggerberg, Stefano-Francini-Platz 5

Host: Prof. Eleni Chatzi