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Date & Time

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Prof. George GAZETAS

National Technical University, Athens

Design of Rocking Foundations for Seismic Safety and Resilience

Abstract

Current seismic geotechnical practice has embraced concepts inspired by pseudo-static thinking and force-based methodologies. The result is often over-designed foundations that, in addition to being uneconomical and difficult to implement, might unexpectedly lead to poor technical performance of foundation–structure systems.

The lecture will address the benefits of drastically changing the established philosophy in seismic foundation design. Emphasis will be given to “foundation rocking and soil failure” of tall slender structures, the foundations of which are deliberately under-designed to ensure that, during strong shaking, substantially nonlinear and inelastic soil–foundation interaction takes place — uplifting of footing from the supporting soil, along with mobilisation of bearing-capacity failure mechanisms in the soil. Thanks to the kinematic nature of seismic shaking, allowing such unconventional response limits the accelerations transmitted up into the super-structure, thereby reducing the inertia loading, and hence the overturning moments and shear forces onto the foundation. Owing to its cyclic nature, the inelastic response generates substantial damping, while exceedance of the ultimate capacity acts (only) momentarily and alternately. The two phenomena contribute towards decreased response intensity and acceptable levels of residual deformations (displacements and rotations). Deformations are further diminished by the beneficial contribution of gravity to re-centering of the foundation. It is shown that the resulting design leads to safer and more resilient performance than the conventional conservative design.

To analyse the inelastic and nonlinear response of systems undergoing such unconventional modes of deformation, in addition to rigorous finite-element methods, a simplified equivalent-linear approach is highlighted in the presentation.

About the Speaker

GEORGE GAZETAS has served for 33 years as 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, caissons; the seismic response of earth dams and quay-walls; and soil–structure interaction.

Much of his research has been inspired by observations after destructive earthquakes, being actively involved in reconnaissance expeditions of the earthquakes in Northridge (1994), Kobe (1995), Kocaeli (1999), Christchurch (2011), and Cephalonia (2014) among others. He established an annual 9-day educational trip to Kobe with his soil dynamics class, in the aftermath of that destructive earthquake.

He has received awards for his research and teaching, including the first Shamsheer Prakash Foundation Prize, the Walter Huber Civil Engineering Research Prize and James Croes Medal from ASCE, the Alfred Noble Prize from the Engineering Societies of America, the Prakash-ISET Award from the Indian Society for Earthquake Technology, and the Excellence in University Teaching Award from the Institute of Research & Technology in Greece. He has been the Coulomb (2009), Ishihara (2013), Maugeri (2019) and Kenneth Lee (2019) Lecturer. He was honored in 2019 as the 59th Rankine Lecturer by the ICE in London, and recently as Geo-Legend by the Geotechnical Institute of ASCE.

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