University at Buffalo
Department of Civil, Structural and Environmental Engineering
School of Engineering and Applied Sciences

ENGINEERING SEMINAR

Recent Developments in Characterizing Liquefiable Sandy Soils in the Field and Laboratory

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Abstract

A comprehensive set of field trials was conducted in the suburbs of Christchurch, New Zealand to investigate the natural sandy soils that liquefied during the 2010-2011 series of earthquakes. The field tests were performed in 2013 using a large mobile shaker, T-Rex, to perform a staged-loading sequence of increasing sinusoidal horizontal loads at the surface of six natural-soil test panels. Each test panel was instrumented with an embedded array of sensors and was characterized by direct-push crosshole seismic testing before shaking. The tests were used to identify the threshold strain at which pore pressure generation was initiated and to measure changes in pore pressure with increasing number of cycles and strain amplitude. The field results from testing at one site are discussed and refinements in the future testing and analysis procedures are presented. To better understand the nonlinear response of the sandy soils in Christchurch, a cyclic and dynamic laboratory testing program using reconstituted specimens of these soils is underway using combined cyclic torsional shear and dynamic resonant column equipment. Linear and nonlinear measurements of shear moduli over shear strains ranging from 10^{-5} to 0.2 % and confining pressures ranging from 0.25 to 5 atm have been performed with dry specimens. The laboratory and field results of the linear and nonlinear shear moduli are in good agreement when: (1) the field pore pressure measurements are used to adjust the confining pressures in the laboratory and (2) an improved set of G/G_{max} – log γ relationships are used. These nonlinear modulus-strain relationships with and without the associated pore pressures are used to develop nonlinear, shear stress vs. shear strain curves to further illustrate the change in these sandy soils during earthquake shaking.

Short Bio

Dr. Kenneth H. Stokoe, II has been working in the areas of field seismic measurements, dynamic laboratory measurements, and dynamic soil-structure interaction for more than 40 years. He has been instrumental in developing several small-strain field methods for in-situ shear wave velocity measurements. He has also developed two types of resonant column systems that are used to evaluate dynamic soil and rock properties in the laboratory. Most recently, he has led the development of large-scale mobile field equipment for dynamic loading of geotechnical systems, foundations and structures, an activity funded by the National Science Foundation. Dr. Stokoe has received several honors and awards, including election to the National Academy of Engineering, the H. Mooney Award from the Society of Exploration Geophysicists, the C.A. Hogentogler Award from ASTM, and the H. Bolton Seed Medal and the Karl Terzaghi Distinguished Lecturer from ASCE.

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