The Donald M. Burmister Lecture
(20th Anniversary)

Department of Civil Engineering and Engineering Mechanics
Columbia University

Regional Ergodic Site Response for Seismic Hazard Applications

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2:45 - 3:45 pm (214 Pupin Lab)

ABSTRACT Ergodic site response models are used to estimate the difference between ground motion intensity measures at reference rock sites and intensity measures for other site conditions. Such models are typically conditioned on the time-averaged shear wave velocity in the upper 30 m of the site (V_{S30}) and are available for pseudo-spectral accelerations for oscillator periods between 0.01 sec (approximately PGA) and 10 sec. What makes a site response model 'ergodic' is that it is derived using a large database and/or a large inventory of simulation results, which are fit using various regression equations. The resulting predictions represent medians across many sites with different characteristics, but conditioned on V_{S30} and perhaps additional secondary parameters. Because such models do not include other site-specific characteristics, the resulting ground motions have large aleatory variability.

Past and current practice is that ergodic site response models derived for conditions in the western US are applied nation-wide (e.g., site factors in ASCE 7/16 and earlier editions). Recent research conducted as part of Next-Generation Attenuation projects demonstrates significant regional variations in site response, with weaker scaling of ground motions with V_{S30} in the Pacific Northwest and central/eastern portions of the US than in the western US. Such regional effects are being incorporated into a pending version of the US Geological Survey national seismic hazard maps and future versions of ASCE 7.

This presentation will describe the site response physics underlying ergodic models, how such models are derived, and their application in seismic hazard analyses. Trends in ergodic and non-ergodic (site-specific) site response model development, and the benefits of each type of modeling approach, will be explained.

About the Speaker Jonathan P. Stewart is a Professor of Civil & Environmental Engineering Department at UCLA, where he has been a faculty member since 1996. He previously served as department chair from 2012-2018. All of his degrees (BS, MS, PhD) are from UC Berkeley. Stewart's technical expertise is in geotechnical earthquake engineering and engineering seismology, with emphases on soil-structure interaction, ground motion characterization, performance of levees and other embankments, and ground failure. Several current areas of research focus include his leadership of the Next-Generation Liquefaction project, development of site amplification and ground motion models for NGA projects, development and application of non-ergodic site response analysis methods for use in probabilistic seismic hazard analysis, and development of soil-structure interaction-based procedures for evaluating seismic earth pressures on earth retaining structures. The work of his research group has impacted the US National Seismic Hazard Maps; the Global Earthquake Model; building code documents (NEHRP Provisions and ASCE-7); and guidelines documents for tall buildings (Tall Buildings Initiative project), existing structures (ASCE-41), soil-structure interaction (NIST, 2012), and landslide hazards (SCEC, 2002). He is a former Chief Editor for the ASCE Journal of Geotechnical and Geoenvironmental Engineering and is currently Past Editor of Earthquake Spectra.

The late Prof. Donald M. Burmister (1895-1981) is one of the pioneers in the field of Soil Mechanics and Geotechnical Engineering. He established the Soils Laboratory at Columbia University in 1933. He was a faculty member for 34 years before retiring in 1963. During his tenure at Columbia University, he investigated earthworks and foundations for over 400 projects. Most notably among these were the Brookhaven National Laboratory, the Throgs Neck, Tappan Zee and Verrazano Narrows Bridges, the First New York World Fairs at Flushing Meadows, and the reconstruction of the White House in 1950. He has developed several soil testing methods and his soil classification system is still widely used. He also contributed to the first use of digital computer in conjunction with his theory of the layered pavement system.

http://www.columbia.edu/cu/civileng/ling/burmister