International Workshop on Uncertainties in Nonlinear Soil Properties and Their Impact on Modeling Dynamic Soil Response
March 18-19, 2004

"The Seismic Response of Silts"

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The profession's understanding of soil response during earthquakes is largely based on the observed responses of clean sand and saturated clays. In particular, experimental studies that form the basis for a more thorough understanding of dynamic soil properties have largely focused on uniform sands and saturated clays. Recent earthquakes, however, have shown that the response of silts and other less studied materials can be critically important to understanding the ground shaking and ground failure hazards and their effects on the built environment. The poor performance of buildings that displaced downward, tilted, and slid horizontally on shallow deposits of saturated, loose, low plasticity silts that liquefied in Adapazari, Turkey during the August 17, 1999 Kocaeli earthquake is just one example of the need to better characterize and understand the seismic response of silts (e.g. Bray et al. 2000, and Sancio et al. 2002).

The results of a comprehensive subsurface investigation of many of the districts of Adapazari, which includes cone penetration tests (CPT), standard penetration tests (SPT), and shear wave velocity (Vs) measurements, are available to the research community at the PEER web site (http://peer.berkeley.edu/turkey/adapazari/). Additionally, the results of over hundred cyclic triaxial tests on carefully retrieved samples of Adapazari silt, as well as about ten cyclic simple shear tests on the silt, are available in Sancio (2003), which is summarized in Bray et al. (2004). Although these databases of in situ test and laboratory test results provide great insight, there remains a significant amount of uncertainty in their interpretation because of the inherent variability of samples of naturally deposited soils.

Much like the extensive laboratory testing of built test specimens of uniform sand performed by investigators such as the late Professor H. B. Seed and others provided the necessary insight toward advancing critical concepts of the dynamic response of clean sand, a comprehensive program of laboratory testing on silts is required. This is an important need in geotechnical earthquake engineering, because this "special soil" is not unique to Adapazari. Rather, silts and silty soils are widely encountered in practice in the U.S. and around the world. Many of the procedures currently employed in earthquake engineering practice, such as Seed et al. (1985), SHAKE (Idriss and Sun, 1992), Tokimatsu and Seed (1987), Youd et al. (2001), etc., are largely based on and calibrated for cases involving clean to slightly dirty sands. The profession cannot confidently apply these procedures to cases involving silts without adequate investigations of their applicability and limitations.

Hence, additional experimental work is warranted to advance the profession's understanding of "special soils" such as silt. Moreover, improved soil constitutive models that can be validated based on the results of these experimental studies are required for silty soils. Modification of existing analytical procedures and soil models for silts and development of new procedures and models, when necessary, to capture adequately the seismic response of silt are pressing research needs in geotechnical earthquake engineering.