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Probabilistic Model for Evaluating Seismic Soil Liquefaction Based on Energy Approach

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Abstract : The energy-based method for evaluating seismic soil liquefaction has two main sections. First is the demand energy, which is dissipated energy of earthquake at a site, and second is the capacity energy as a representation of soil resistance against liquefaction hazard. In this study, using a statistical analysis of recorded data by 14 down-hole array sites in California, an empirical equation was developed to estimate the demand energy at sites. Because determination of capacity energy at a site needs to calculate several site calibration factors, which are obtained by experimental tests, in this study the standard penetration test (SPT) N-value was assumed as an alternative to the capacity energy at a site. Based on this assumption, the empirical equation was employed to calculate the demand energy for 193 liquefied and no-liquefied sites and then these amounts were plotted versus the corresponding SPT numbers for all sites. Subsequently, a discrimination analysis was employed to determine the equations of several boundary curves for various liquefaction likelihoods. Finally, a comparison was made between the probabilistic model and the commonly used stress method. As a conclusion, the results clearly showed that energy-based method can be more reliable than conventional stress-based method in evaluation of liquefaction occurrence.

Keywords : energy demand, liquefaction, probabilistic analysis, SPT number
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