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Effects of Seismological and Soil Parameters on Earthquake Energy demand in Level Ground Sand Deposits

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Liquefaction has been a source of major damages during severe earthquakes. To evaluate this phenomenon there are several stress, strain and energy based approaches. Use of the energy method has been more focused by researchers due to its advantages with respect to other approaches. The use of the energy concept to define the liquefaction potential is validated through laboratory element and centrifuge tests as well as field studies. This approach is based on the hypothesis that pore pressure buildup is directly related to the dissipated energy in sands which is the accumulated areas between the stress-strain loops. Numerous investigations were performed to find a relationship which correlates the dissipated energy to the soil parameters, but there are not sufficient studies to relate this dissipated energy, known as demand energy, concurrently, to the seismological and the soil parameters.

The aim of this paper is to investigate the dependency of the demand energy in sands to seismological and the soil parameters. To perform this task, an effective stress analysis has been executed using FLAC finite difference program. Finn model, which is a built-in constitutive model implemented in FLAC program, was utilized.

Since an important stage to predict the liquefaction is the prediction of excess pore water pressure at a given point, a simple numerical framework is presented to assess its generation during a cyclic loading in a given centrifuge test. According to the results, predicted excess pore water pressures did not closely match to the measured excess pore water pressure values in the centrifuge test but they can be used in the numerical assessment of excess pore water pressure with an acceptable degree of preciseness.

Subsequently, the centrifuge model was reanalyzed using several real earthquake acceleration records with different seismological parameters such as earthquake magnitude and Hypocentral distance. The accumulated energies (demand energy) dissipated in any specified level were estimated by three several method including the strain energy in which is the areas of hysteresis loops, the arias intensity and the kinetic energy computed from the acceleration time histories at its corresponding level. Finally, the dependency of the demand energy to the soil and seismological parameters was shown by means of several diagrams.