A NUMERICAL INVESTIGATION OF THE SEISMIC RESPONSE OF THE AGGREGATE PIER FOUNDATION SYSTEM

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ABSTRACT

The response of an aggregate pier foundation system during seismic loading was investigated. The factors and phenomena governing the performance of the aggregate pier and the improved ground were identified and clarified. The key factors affecting the performance of the aggregate pier include soil density, stiffness modulus, and drainage capacity. The improved ground is influenced by soil stratification, soil properties, pore pressure dissipation, and earthquake time history.

Comprehensive numerical modeling using FLAC were performed. The focus of the study in this research was divided into three parts: the studies of the ground acceleration, the excess pore water pressure ratio and the shear stress in soil matrix generated during seismic loading. Two earthquake time histories scaled to different peak acceleration were used in the numerical modeling: the 1989 Loma Prieta earthquake (pga = 0.45g) and the 1988 Saguenay earthquake (pga = 0.05g).

The main results of the simulation showed the following effects of aggregate pier on liquefiable soil deposits: 1) The aggregate pier amplifies the peak horizontal acceleration on the ground surface (a_{max}), 2) The aggregate pier reduces the liquefaction potential up to depth where it is installed, 3) Pore pressures are generally lower for soils reinforced with aggregate pier than unreinforced soils except for very strong earthquake, 4) The maximum shear stresses in soil are much smaller for reinforced soils than unreinforced soils.

The excess pore water pressure ratio and the shear stress in the soil matrix calculated by FLAC were generally lower than those predicted by available procedures.