SAND LIQUEFACTION NEAR STRUCTURAL FOUNDATION[I]

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Liquefaction of sandy soils during earthquake ground shaking has caused collapse of many structural foundations. The objective of the present paper is to investigate experimentally sand liquefaction in the vicinity of structural foundation and resulting tilting and settlement of the structure. Focus is placed on the influence of soil-structure interaction.

In the experiment of tilting, a model foundation with a square section and a hinge at bottom was used in order to simplify the phenomena; i.e., the settlement of the model was not allowed to occur. From the shaking table tests, it was demonstrated that the surface layer is liquefied easily when the model foundation and surface layer system is excited at the resonant frequency of the system. This may be attributed to the large shear strain of sand in resonance. It was also shown that the liquefaction occurs first in the surface layer near the foundation, and then propagates to the surrounding soil. Behaviors of excess pore water pressure, dynamic earthpressure acting on the foundation, and displacement amplitude and plastic displacement of the foundation during liquefaction can be explained from elongation of the natural period of the system and decrease in the capacity of transmitting shear force in sand layer. Large plastic displacement occurs when the surface layer is liquefied completely. Such displacement may cause the collapse of structural foundation.

In the experiment to investigate the settlement, the foundation model was embedded in saturated sand layer without any hinge at bottom. Considering that the vertical vibration was not negligible in recent earthquakes, several tests were made under two directional shaking; i.e., horizontal motion was given by a shaking table and vertical motion was made by mounting a small vibration generator on the sand box. It was found that settlement of the foundation under two directional shaking is almost same as that under horizontal shaking. Generally the excess pore water pressure under two directional shaking is higher than that under horizontal shaking, wheras the rate of liquefaction is not always high and settlement of the foundation due to liquefaction is not so large as may be expected from the value of the excess pore water pressure. For, the density of sand layer increases with shaking time in vertical direction. However, in some cases there are test data which imply that the settlement under two directional shaking is larger than that under horizontal shaking. To clarify this point, further study is needed with consideration on the phase lag and the excitation frequrncy ratio between horizontal and vertical motions.

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