SEISMIC RESPONSE OF A SANDY STRATUM WITH A SILT LAYER UNDER STRONG GROUND MOTIONS

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ABSTRACT

The presence of silt layer with small permeability may exist in the liquefiable sandy ground and can produce the water film beneath silt layer with high pore water pressure under earthquakes. From the geotechnical point of view, the water film can cause instability of ground especially for slope ground. The objectives of this study is to clarify the effects of interval of P-wave and S-wave arrival, input motions with different of characteristics and crack inside the silt layer at certain time on the seismic responses of ground of liquefiable sand stratum with a silt layer through numerical simulations.

A nonlinear 3D effective stress finite element program was used in this study. Its validity was first validated by comparing with centrifuge results. Then, a total of 14 models were constructed; eight of the models were used to gain a better understanding the effect of interval of P-wave and S-wave arrival and input motions with different characteristics and the remaining six models were used to investigate the effect of possible crack inside silt layer at certain time on the seismic responses of ground of liquefiable soil sand stratum. Three real earthquakes with different characteristics and one harmonic loading measured in a centrifuge test were used in this study. Horizontal
displacement and settlement on the surface and excess pore water pressure were presented for all models.

For 3D model with 1D input motion, in general, the response behavior of liquefiable soil stratum by using Harmonic input is much larger than that by using the real earthquakes, meaning that the prediction by using Harmonic input is very conservative. The crack in the silt layer can lead to the larger settlement due to the faster dissipation of EPWP beneath the silt layer and the breakage of silt layer can lead to the sudden decrease in EPWP in the soil beneath the silt layer and sudden increase in EPWP in the soil above the silt layer; such a phenomenon may cause the soil above the silt layer to have the larger EPWP and that below the silt layer to have smaller EPWP. Sometimes the upward movement of pore water may cause the soil to liquefy, which will not occur without the breakage of silt layer. The crack in the silt layer leads to the faster dissipation of EPWP below the silt layer; such faster dissipation progresses from the location beneath the silt layer to the bottom of the soil stratum.

**Keywords:** liquefaction, numerical simulation, effective stress analysis, silt layer, crack