Investigating the influences of Various Complexity of Hydrogeological Models on Pore Water Pressure Buildup Triggered by Seismic Wave Propagation

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Abstract

Traditional studies on pore water pressure buildup triggered by seismic wave propagation commonly consider a homogeneous or a perfect soil layer system. However, the difference in material property leads to different propagation speeds and patterns of seismic waves. Therefore, the distribution of hydrogeological material and the integrative geological model may play an important role in seismic wave propagation and affect the distribution of pore water pressure buildup as well as inducing soil liquefaction. To assess the effect of uncertainty in hydrogeological model on pore water pressure buildup due to seismic wave propagation, various complexity of hydrogeological models was constructed using synthetic (i.e. perfect layer, pinch-out (fault dislocation), and lens (riverbed deposit)) and real case models. A UBC-sand model-based software, namely Midas GTS NX, was adopted to simulate seismic waves in a saturated porous medium. UBC-sand is an elastoplastic model for simulating the liquefaction phenomenon for the sand material. The study results show that the geological model significantly affects the transient behavior of pore water pressure, vertical displacement, and acceleration. The presence of the angles in the pinch-out, lens, and real case systems leads to an accumulation of pore water pressure in the corner area, which has a high potential to reach the liquefaction limit. The presence of layered soil altered the wave propagation which is decrease due to the soil liquefaction. Non-uniform ground settlement occurs in pinch-out system as well as lens system. The distribution of pore water pressure buildup obtained from the simulation of seismic wave propagation under various hydrogeological models can provide an important reference for the potential assessment of soil liquefaction.

Keywords: Hydrogeological model uncertainty, Seismic wave propagation, Excess pore water pressure, Vertical displacement, Soil liquefaction.