RESONANCE FREQUENCY OF MACHINE FOUNDATIONS RESTING ON SATURATED SANDS

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Abstract

Liquefaction is the rapid loss of shear strength in cohesionless soils subjected to dynamic loading, that it is a state of saturated cohesionless soil when its entire shear strength is reduced to zero due to pore water pressure caused by vibration. Liquefaction depends on the nature, magnitude and type of dynamic loading. An entire stratum may be liquefied at the same time under shock loading, or liquefaction may start at the top and proceed downward with steady-state vibrations.

The present research is concerned with predicting liquefaction potential and the pore water pressure under the dynamic loading in the dynamic analysis of foundations based on the fully saturated sandy soil using the finite element method by QUAKE/W computer program.

As a case study, machine foundations on fully saturated sandy soil in different cases of soil densification (loose, medium and dense sand) are analyzed. Two types of dynamic loads are chosen, these are harmonic and pulse loading. A parametric study is carried out to investigate the effect of several parameters including: the amplitude of the dynamic load, the frequency of the dynamic load and damping ratio. The equivalent linear elastic model is adopted to model the soil behaviour. Emphasis was made on zones at which liquefaction takes place, the pore water pressure and vertical displacements.

The results showed that liquefaction and deformation develop fast with the increase of loading amplitude and frequency. Liquefaction zones increases with the increase of load frequency and amplitude. Tracing the propagation of liquefaction zones, one can notice that, liquefaction occurs first near the loading end and then develops faraway. The soil overburden pressure affects the soil liquefaction resistance at large depths. When the foundation is constructed over loose saturated sand, liquefaction may take place at a frequency ratio equals 1.0. This finding highlights the importance of studying the liquefaction potential when

analyzing machine foundations on such soils. When the soil beneath the machine foundation is medium or dense, the frequency ratio at which liquefaction may occur is greater than 1.0. It can be noticed that the time of initial liquefaction decrease as the frequency of dynamic load increases.