EARTHQUAKE GENERATED SETTLEMENTS IN SATURATED SANDS

by

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SYNOPSIS

An effective stress method of analysis is presented for the direct analytical computation of the settlements induced in a saturated horizontal sand deposit by a given earthquake loading.

INFORMATIVE ABSTRACT

Settlements in sands during earthquakes result from volume compaction caused by the dynamic shear strains generated by the three components of earthquake acceleration. Pyke et al (2) have shown experimentally that the settlements caused by the horizontal components are approximately equal and that the additional settlement generated by the vertical component in most cases is not more than 50% of that from one horizontal component. Therefore an estimate of the possible maximum settlements can be obtained by multiplying those caused by one horizontal component by 2.5.

The time-history of volumetric compaction strains in a horizontal saturated sand deposit due to the horizontal component of an earthquake can be obtained using an effective stress method of dynamic response analysis developed by Finn et al (1). The analysis also gives the time-history of porewater pressure distribution and takes into account any drainage that takes place during shaking. In this method the sand deposit is divided into a number of horizontal layers and each evaluated response parameter is associated with the middle of its respective layer.

In a horizontal deposit the volumetric strains are equal to the vertical strains and therefore the distribution of settlements with time in any layer are obtained by multiplying the vertical strains by the thickness of the layer. When the earthquake-induced motions have ceased, the additional settlements due to the dissipation of residual porewater pressures are obtained by solving the standard one-dimensional consolidation equation.

REFERENCES

1. Finn, W.D.L., Lee, K.W., and Martin, G.R., "Constitutive Laws for Sand in Dynamic Shear," Proceedings, 2nd International Conference on Numerical Methods in Geomechanics, June 1976, Blacksburg, Virginia, pp. 270-281.
2. Pyke, R., Seed, H.B., and Chan, C.K., "Settlement of Sands under Multidirectional Shaking," Journal of the Geotechnical Engineering Division, ASCE, Vol. 101, No. G74, April 1975, pp. 361-378.

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