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Title

Pore Pressure Parameters and Cyclic Resistance under Generalized Loading

Abstract

A systematic study was undertaken to assess the effects of the magnitude and nature of principal stress rotation on the cyclic resistance of sands. Fraser River sand specimens reconstituted using water pluviation were subjected to cyclic loading at a given CSR but with different magnitudes of stress rotation ($\Delta\alpha_\sigma$) about different initial inclinations ($\alpha_{\sigma c}$). Most of the tests were conducted at plane strain conditions and a limited number under axisymmetric conditions.

Test results over a range of $\alpha_{\sigma c}$ and $\Delta\alpha_\sigma$ indicate that that the weakest cyclic resistance at a given initial $\alpha_{\sigma c}$ always correspond to $45°$ stress rotation, and for a given magnitude of stress rotation (fixed $\Delta\alpha_\sigma$) the liquefaction resistance generally depends on the magnitude of the torsional shear stress applied on the horizontal plane. These tests indicate that in addition to the orientation of the major principal stress (which is recognized in the literature), the magnitude and time history of the shear stress on the bedding plane (not considered in the literature) plays a critical role in the cyclic strength of the soils.

A limited number of experiments were carried out to investigate the applicability of the Skempton & Henkel pore pressure formulations for generalized 3D initial stress states. Skempton's pore pressure parameter formulations for isotropic material have been extended to cross anisotropic materials, and it was shown that the principles are applicable even for cross anisotropic materials under generalized initial loading conditions. Further, it is shown that shear induced excess pore water pressure decreases with the magnitude of initial shear stress (i.e., inversely related to k_c) and increase with the inclination of the major principal stress with respect to the deposition direction.

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