Abstract to Symposium E4 of European Union of Geosciences XI Meeting, April '01, Strasbourg - France

Laboratory investigation on the effect of fines on cyclic resistance

J.-M. Konrad*, A. Eliadorani*, P. Byrne**

* Department of civil engineering, université Laval, Québec, G1K 7P4
** Department of civil engineering, University of British Columbia, Vancouver

The addition of fines to a sand (fine Ottawa) is investigated with respect to its cyclic resistance and post-liquefaction behaviour. Three sets of tests involve using the same sand with adding different percentage of a plastic type fine, a non-plastic type fine and a non-plastic type sand. The first two sets of tests involve materials of varying coefficient of uniformity (C_u) with fines below 74μm (#200 sieve) size being varied. The last set of tests involve a material of approximately equal C_u but with no change in the fines below 74μm.

For this research, the sand is a clean, uniform, sub-rounded quartz sand (Ottawa sand, C-109). The plastic-type fines are kaolinite and the non-plastic-type fines are crushed quartz sand. The non-plastic sand is a clean, sub-rounded quartz sand with gradation between 0.25 to 0.075mm (#70 to #140 sieve sizes). To study the effect of adding fines and changing gradation, each of the three sets of tests involves adding 10, 20, 30, and 40% of kaolinite, crushed silica sand fines and 70-140 silica sand to Ottawa sand.

Undrained cyclic loading causes a progressive pore pressure increase that eventually may lead to the development of large shear strains. The strain can develop either due to liquefaction or limited liquefaction during cyclic loading or on account of the occurrence of cyclic mobility (Castro, 1969). The cyclic resistance in simple shear (τ_{cy}/σ'_{vc}) is regarded as the ratio between the applied cyclic shear stress amplitude (τ_{cy}) and the initial normal effective stress σ'_{vc}.

Liquefaction in cyclic simple shear can be defined as the development of single amplitude shear strain in excess of 3.75%. This corresponds to the common definition of liquefaction as 2.5% single amplitude axial strain in cyclic triaxial tests suggested by Silver and Park. Cyclic tests will be performed at different void ratios and confining stress levels. At each confining stress several cyclic resistance curves e_c vs. cycles to liquefaction N_L are developed at several cyclic stress ratios.

It is planned to extend the above findings to the effect of layering as it is the case in most of the field situations. Liquefiable soil deposits are often overlain by less permeable soils which can restrict the escape of pore water from the liquefiable layer. The less permeable layer could contain a parent sand with fines content of non-plastic to plastic. In the simple shear apparatus, the layering can be simulated having the known characterization of above investigation of parent sand and the less permeable layer either with a parent sand layer with fines contents (sandy silt) or a silty clay.