A14

Rate Effect on Soil Shear Strength Using Ring Shear Apparatus on Sand -clay Mixtures

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The residual strength of a soil is important parameter in slope stability of reactivated landslides. It also characterizes movements that will follow the failure. Specifically, the landslides mobilized with lower friction angle usually have longer run-out distances and consequently, higher impact.

The residual strength of cohesive soils, measured at slow drained rates in ring shear tests, has been studied extensively in the past (Lupini et al, 1981; Skempton, 1985; Tika et al, 1996; Tiwari and Marui, 2005). Some of those studies resulted in various correlations between the slow residual strength and index properties (Lupini et al, 1981, Tiwari and Marui, 2005). Although the effect of shear rate on the residual strength of granular soils is minimal, the residual strength of cohesive soils depends appreciably on this factor. The rate effect will be affected by the clay content, that is, higher content of clay fraction in soil, the higher the shear rate effect will be.

Although numerous experimental works on this subject has been published, the mechanism of the rate effect on the residual strength is not clarified yet.

All the previously mentioned ring shear tests have been conducted at slow shearing rates to prevent generation of excess pore water pressure during shearing. This was done due to the limitations of previous ring shear apparatuses that were unable to measure pore pressure.

We performed a series of tests in new, undrained portable ring shear apparatus, ICL-1. The tests were conducted on pure silica sand and silica sand and 20 % bentonite –sand mixture. We performed two series of undrained speed controlled ring shear tests; single- stage shearing and multi- stage shearing, total of 10 tests. We conducted one multi-stage test for each specimen, in which we sheared the specimens with 2 shear speeds in 4 stages, each stage until 1 m of shear displacement. We also conducted 4 tests of single-stage shearing for each specimen, in which we sheared in one shear speed until at least 3m of shear displacement. In single- shear tests we used shear speed of 0.01, 0.1, 1 and 10 mm/ sec and in multi-stage shearing 0.1 and 1 mm/ sec.

The results show no rate effect in pure silica sand specimen in all tests. However, in 20 % bentonite –sand mixture, rate effect was observed. Higher shear rates resulted in lower shear resistance and lower friction angles. The slower rates showed similar results like in pure silica sand specimen.

References:

Lupini JF, Skinner AE, Vaughan PR, 1981, “The drained residual strength of cohesive soils“, Géotechnique Vol. 31, No. 2, pp.181-213.

Tiwari, B. and Marui, H. (2005). ”A New Method for the Correlation of Residual Shear Strength of the Soil with Mineralogical Composition.” J. Geotech. Geoenviron. Eng., 131(9), 1139–1150.

Tika, T. E., Vaughan, P. R., and Lemos, L. J., 1996, “Fast Shearing of Pre-existing Shear Zones in Soil,” Geotechnique, Vol. 46, No. 2, pp. 197–233.

Skempton. A. W., 1985, "Residual Strength of Clays in Landslides. Folded Strata and the Laboratory." Géotechnique, Vol. 35. No. L pp. 3-18