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Modification of the conventional laboratory tri-axial testing apparatus to test unsaturated soils

In many tropical regions, including the hill-country of Sri Lanka, slope instability during rains poses a major problem. In the partially saturated zone of the soil cover in these regions during dry seasons, negative pore-water pressures are set up due to surface tension, giving rise to high matric suction values. The term matric suction refers to the difference between the pore-air and pore-water pressures. High matric suction gives rise to high apparent cohesion, resulting in higher safety margins against slope instability

during dry season. Saturation during rainy season destroys the high matric suction, thus lowering the safety margins and triggering landslides.

In order to investigate the variation of shear strength with moisture content of a partially saturated soil, it is necessary to carry out tri-axial testing with separate pore-air and pore water pressure measurements. The existing conventional tri-axial apparatus was modified for this purpose, by introducing means of applying distinctly different pore-water and pore-air pressures to the soil sample, along with the use of high air-entry disks to prevent air in the sample from migrating to the pore-water pressurizing system.

The efficiency of the modified tri-axial test apparatus was tested by using soil obtained from Dambulla International Stadium site. Two specimens were prepared for tri-axial testing from the above soil under density and optimum moisture content (as determined by the Proctor Compaction Test). The results obtained by tri-axial shearing of the two specimens are identical for all practical reasons, indicating the repeatability of the shearing testes. This result verifies the reliability of the modified tri-axial apparatus, which can hereafter be made available for developing shear strength functions and soil-moisture characteristic curves of local soils.