

UNDRAINED STRESS-STRAIN BEHAVIOUR OF A SRI LANKAN RESIDUAL SOIL

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Residual soils are created by insitu weathering of various types of igneous, sedimentary, and metamorphic rocks. In Sri Lanka, more than 90% of the land is made up of highly crystalline rocks. The tropical weathering environment accelerates the formation of residual soils, which are found almost everywhere in the island. Understanding the mechanical behaviour of these residual soils would enable engineers to use them economically, and to predict their behaviour under field conditions with sufficient accuracy. However, literature leaves little evidence on work carried out to characterise the mechanical behaviour of residual soils, partly due to their inhomogeneity, anisotropy, and difficulties in sampling and testing. A research programme on a local residual soil and the present study concentrates on the undrained shear characteristics of a Sri Lankan residual soil using the known behaviour of the same soil in reconstituted form as the frame of reference.

A sampling location consisting of a totally decomposed and almost uniform material was identified in Kandy District of Sri Lanka. A series of undrained triaxial compression tests with measurements of pore water pressure was performed on undisturbed specimens and reconstituted specimens prepared in the laboratory. Undisturbed specimens were prepared from block samples whilst reconstituted specimens were prepared from slurry. Specimens were sheared after isotropic consolidation to effective cell pressures of 100, 200, 300, and 400 kPa. The experimental behaviour was predicted by a single point analysis using the Modified Cam-Clay model. One dimensional consolidation tests were also carried out on undisturbed and reconstituted samples of the same soil.

The experimental behaviour in triaxial compression tests illustrate that the residual soil in the undisturbed state behaves as if heavily overconsolidated showing dilatatory behaviour though it was found to fall in the lightly overconsolidated region according to one dimensional consolidation test results. Here the degree of consolidation was interpreted using the amount of virtual pre-consolidation pressure. Residual soil in the reconstituted state, which was sheared undrained after normal consolidation, exhibits contractive behaviour as expected. Reconstituted specimens also followed geometrically similar undrained stress paths which is consistent with the possible existence of a unique state boundary surface. In contrast, stress paths followed by undisturbed specimens were not geometrically similar. The stress ratio q/p' at failure remained almost the same for all reconstituted and undisturbed specimens irrespective of the consolidation pressure thus giving a unique critical state line for the soil.

Up to the critical state, the experimental behaviour of reconstituted specimens was predicted very well by the Modified Cam-Clay model. However, the stress- strain behaviour of the undisturbed specimens was not well predicted by the analysis. A numerical model which may account for breakage of structure and also incorporate plastic shear behaviour below the yield surface may improve the latter predictions. Moreover, the concept of 'virtual pre-consolidation pressure' was found to be inadequate in describing the experimental behaviour at high Over consolidation ratios.