Behavior of a Loosely Compacted Unsaturated Volcanic Soil

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Abstract

In this paper, the stress-strain relationship and volumetric behavior of a loosely compacted unsaturated decomposed volcanic soil (fill) were studied by conducting three series of triaxial stress path tests: (1) consolidated undrained on the saturated fill; (2) constant water content; and (3) a reducing suction under constant deviator stress on the unsaturated fill. The last two series of tests were designed to simulate the effects of undrained response and rainfall infiltration in initially unsaturated slopes, respectively. It was found that the saturated loose volcanic soil behaves like clay under isotropic compression but it resembles sand behavior when it was subjected to undrained shear. For isotropically consolidated unsaturated specimens sheared under a constant water content, a hardening stress-strain and a nonlinear shear strength-suction relationship are observed. At relatively high suctions, both angle of friction and apparent cohesion appear to be independent of suction. Volumetric contraction during shear is observed in this series of tests. On the other hand, anisotropically consolidated loose unsaturated specimens subjected to a reducing suction change from contractive to dilative behavior as the net mean stress increases. This observed volumetric behavior, unlike the shear strength, is stress path-dependent and cannot be explained by using the existing elastoplastic critical state theoretical framework extended for unsaturated soils.