A UNIFIED MICROSTRUCTURAL APPROACH FOR MODELING SOILS

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ABSTRACT

This paper presents an unified approach of an elastoplastic model for soils based on micromechanics considerations. Both coarse and fine grain soils are considered as an assembly of particle-elements. The stress-strain relationship for an assembly can be determined by integrating the behavior of the inter-particle contacts in all orientations and using a static hypothesis, which relates the average stress of the granular assembly to a mean field of particle contact forces. Thus, the stress-strain relationship can be derived as an average of the mobilization behavior of local contact planes. The local behavior is assumed to follow a Hertz-Mindlin's elastic law and a Mohr-Coulomb's plastic law. The influence of neighboring particles is taken into account by the interlocking effect, which is introduced using the critical state concept. Under critical state, the local particle-group remains a constant volume while it is subjected to a continuous distortion. Furthermore, the internal friction angle ϕ_μ is a constant for the material. However, the peak friction angle, ϕ_p, on a contact plane is dependent on the degree of interlocking by neighboring particles, which can be related to the state of packing void ratio *e*. Essential features such as continuous displacement field, inter-particle stiffness, fabric tensor are discussed. The predictions of the derived stress-strain model are compared to experimental results along drained and undrained triaxial loading. They demonstrate the ability of this model to reproduce accurately the overall mechanical behavior of sand and clay under the influence of key parameters such as void ratio and mean stress. A discussion is devoted to the modeling of unsaturated materials, which shows the capability of the model to take into account the influence of saturation on the stress-strain response during triaxial loading.