SANISAND: A SIMPLE ANISOTROPIC MODEL FOR SANDS ACCOUNTING FOR CONSTANT STRESS-RATIO LOADING

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SANISAND models are a family of simple anisotropic constitutive models for sands developed over the past few years [1,2,3,4], within the framework of critical state soil mechanics and bounding surface plasticity. The present member of the SANISAND family, introduces a number of modifications in order to extend the range of application to constant stress ratio loading paths.

So far the SANISAND models had a narrow wedge-type yield surface in the triaxial p-q space which implies that only changes of the stress-ratio $\eta = q/p$ can cause the necessary relative shearing and rolling of sand grains which are macroscopically modeled as plastic shear and volume changes. Increase in stress under a constant stress ratio is assumed to cause approximately only elastic strain, as long as no crushing of grains takes place. This was corroborated by the very small change of void ratio observed over significant changes of confining pressures under constant stress ratio loading for sand samples which at least are not very loose.

By contrast, in the formulation of the new model a very thin ellipse in the p-q space has been adopted as the yield surface, substituting for the narrow wedge. This feature enables the prediction of plastic strains during any type of constant stress ratio loading, a feature lacking from the previous SANISAND models, without loosing the well established predictive capability of SANISAND for all other loading conditions. The elliptical yield surface evolves according to a combined distortional and rotational hardening rule, simulating the evolving anisotropy. With some hint from a recent publication [5], the plastic volumetric strain rate has two parts: the first is associated with the dilatancy response, and can be positive or negative, while the second is mainly induced by constant stress-ratio loading and it is positive (contractive) owing to rearrangement of grains accompanied possibly by their crushing. It is only this second contribution of the plastic volumetric strain rate that controls the size (isotropic hardening) of the thin elliptical yield surface, and it is believed to represent an original proposition. The model can be used for a wide range of stress levels, including those sufficient to cause particle crushing. The multiaxial stress space generalization follows the approach used for the other SANISAND models.

References:

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