Mixed hardening, three-invariants dependent cap model

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Abstract: This paper presents a modification to the classical cap model by including the third stress invariant and the kinematic hardening rule in the formulation. An isotropic-kinematic hardening rule for cohensionless soils is proposed that is applicable to both monotonic and cyclic loading conditions. For characterizing strength variations along compression and extension paths, the shape of the failure surface on the octahedral plane is assumed to be triangular with rounded corners. A linear kinematic hardening rule is considered in the formulation, in conjunction with the isotropic rule to account appropriately for the Bauschinger effect during cyclic loading. The model incorporates 12 parameters that can be determined from simple experiments, e.g., isotropic compression, cyclic triaxial, triaxial compression, and triaxial extension testing. The model is shown to realistically predict the soil response for triaxial experiments in both compression and extension. Thereafter, the model is used in a finite element formulation to solve a boundary value problem of a rigid model footing resting on sand. A comparison between the model prediction and experimental observations is presented.