UPDATE A SIMPLE HYPOPLASTIC CONSTITUTIVE MODEL

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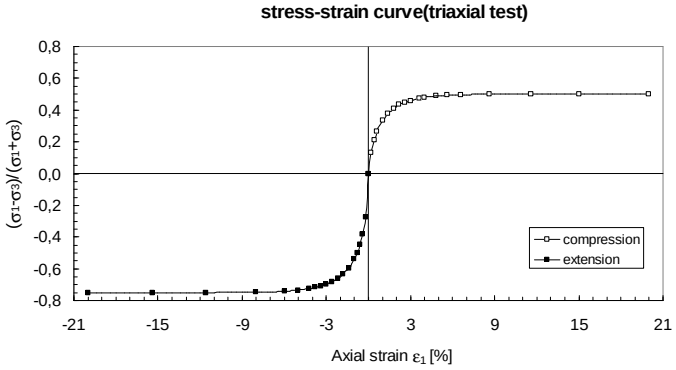
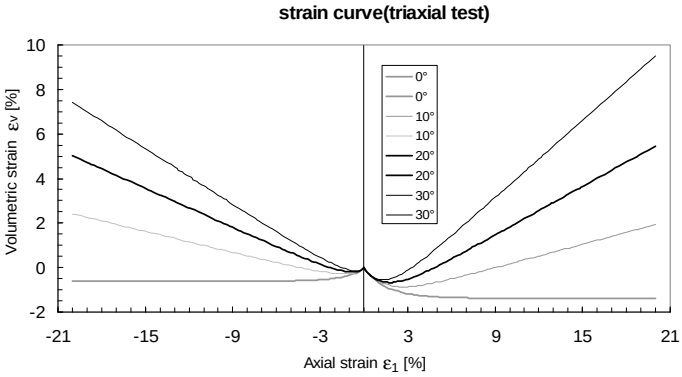
Granular materials possess some fascinating properties such as strong nonlinearity, dilatancy and pressure dependence. The mechanical behaviour of granular materials is usually modeled by plasticity theory. Recently, hypoplastic constitutive models have emerged as an attractive alternative to the prevailing plasticity theory for granular materials. Compared to plasticity hypoplastic models have some distinct advantages, e.g. simple formulation and easy calibration. Some recent developments in hypoplastic models include the critical state and internal state variables.

The critical state is characterized by simultaneously vanishing stress rate and volume change. Most hypoplastic models contain four parameters, which are to be calibrated based on triaxial tests. Usually, the parameters are identified for critical state in triaxial compression. The behaviour for triaxial extension remains untouched. The model proposed by Wu and Bauer (1994) shows excessive contraction (volume reduction). In the present paper, this model is updated by including a new term into the constitutive model. In the updated model, critical state can be reached for all stress paths other than hydrostatic stress. Some well known failure surfaces, e.g. Matsuoka/Nakai and Lade, can be integrated into this model. The model performance is compared to some laboratory tests. Figure 1 shows the numerical simulation of triaxial compression and extension tests (with different dilatancy angles).



(a)



(b)

Figure 1. Numerical simulation of triaxial tests (with different dilatancy angles)

(a)stress ratio vs. axial strain; (b)volumetric strain vs. axial strain

[1] Wu, W. and Bauer, E. (1994). A simple hypoplastic constitutive model for sand, *Int. J. Numer. Anal. Methods Geomech.*, 18: 833-862.

[2] Wu, W. (1999). On a simple critical state model for sand, Proc. of the seventh Int. Symp. on Numerical Models in Geomechanics—NUMOG , Graz, Austria, Balkema, 47-52, 1999.

[3] Wu, W., and Niemunis, A. (1996). Failure criterion, flow rule and dissipation function derived from hypoplasticity, *Mech. Coheisive-Frictional Mater*., 1:145-163.