Generalized Anisotropic Sliding and Rolling Model for Granular Materials

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Abstract

Based on an approximate microstructural model and considering interparticle sliding and rolling, recently a critical state theory was developed for granular materials in triaxial loading space (2004a, 2004b). In the present paper, this model is generalized in the stress invariant space for the simulation of the stress-strain behavior under three-dimensional loading conditions and for implementation into finite element programs for use in boundary value analyses. The theory involves a conical yield surface that undergoes rotational hardening, thereby simulating the evolution of anisotropy. The key feature of the model is an evolution rule derived from the analysis of the microstructural model. This rule permits the simulation of the behavior not only in loading, but also in stress reversal. This later capability allows the typical liquefaction behavior observed for sands to be simulated in a realistic manner, especially the large pore pressure build up during stress reversals. The capabilities of the model are demonstrated by comparison of numerical results with experimental data. Also discussed in the paper are the details of implementation of the model by an implicit technique.

References

Anandarajah, A. (2004a). Sliding and Rolling Constitutive Theory for Granular Materials. *J. Engineering Mechanics, ASCE*, 130(6):665-681.

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