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A systematic procedure for constructing critical state models in three dimensions. (English)

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Summary: A general procedure for developing constitutive models for frictional materials possessing a critical state is developed in a three-dimensional context. The procedure starts from the laws of thermo-dynamics, so that the first and second laws of thermo-dynamics are automatically satisfied. There is hence no need to invoke any extraneous stability postulates. The models involve a number of parameters, which can be interpreted in terms of micro-mechanical energy storage and dissipative mechanisms. In most cases non-associated flow rules are predicted and in some cases the yield surfaces are seen to have concave segments. The procedure is more general than that traditionally used for materials with non-associated flow rules, in that plastic potentials are not needed and not presumed to exist. In illustration, examples of families of models are given in which the critical state surface is either the Drucker-Prager or the Matsuoka-Nakai cone.

MSC:

74A20	Theory of constitutive functions in solid mechanics
74C05	Small-strain, rate-independent theories of plasticity (including rigid-plastic and elasto-plastic materials)
74C15	Large-strain, rate-independent theories of plasticity (including nonlinear plasticity)

Keywords:

Elastic/plastic; Thermo-mechanics; Hyper-plasticity; Non-associated flow rule; Critical state

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