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A generalized backward Euler algorithm for the numerical integration of an isotropic hardening elastoplastic model for mechanical and chemical degradation of bonded geomaterials. (English) Zbl 1151.74427

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Summary: An extended version of the classical Generalized Backward Euler (GBE) algorithm is proposed for the numerical integration of a three-invariant isotropic-hardening elastoplastic model for cemented soils or weak rocks undergoing mechanical and non-mechanical degradation processes. The restriction to isotropy allows to formulate the return mapping algorithm in the space of principal elastic strains. In this way, an efficient and robust integration scheme is developed which can be applied to relatively complex yield surface and plastic potential functions. Moreover, the proposed algorithm can be linearized in closed form, thus allowing for quadratic convergence in the global Newton iteration. A series of numerical experiments are performed to illustrate the accuracy and convergence properties of the algorithm. Selected results from a finite element analysis of a circular footing on a soft rock layer undergoing chemical weathering are then presented to illustrate the algorithm performance at the boundary value problem level.

MSC:

74S20 Finite difference methods applied to problems in solid mechanics
74L10 Soil and rock mechanics
74C15 Large-strain, rate-independent theories of plasticity (including nonlinear plasticity)

Software:

IMSL Numerical Libraries

Full Text: DOI

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