COMPARATIVE EVALUATION OF A CONVENTIONAL PLASTICITY MODEL FOR GEOMATERIALS AND ITS GRADIENT-ENHANCED VERSION

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A gradient enhanced elastoplastic constitutive model for geomaterials is presented. Formulated for small strains, the model features a pressure-dependent, two-invariant, yield function with nonlinear isotropic hardening/softening laws for the evolution of its four primary internal variables, namely, friction angle, dilation angle, cohesion, and tensile strength. The gradient enhancement is achieved by incorporating higher order gradients in the hardening law. Two pairs of length scales are introduced to represent the microstructure of the material. The gradient enhanced version of the model results in coupling of the equations of linear momentum and consistency condition which will both be satisfied in a weak sense. Consequently, plastic multiplier becomes an additional field variable to be solved for. Using a suitable window function in the reproducing kernel particle method (RKPM) the higher order continuity required owing to the gradient terms in the constitutive relations is met. The numerical difficulties encountered in finite element implementation associated to C^1 element are thus avoided. The conventional model and its gradient enhanced version are used to study stability of soil structures. Several numerical examples are presented to demonstrate the superiority of the performance of the gradient enhanced version in the analysis of soil structures in the near-instability and post failure regimes.

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