# ON STANDARD AND VECTOR FINITE ELEMENT ANALYSIS OF A STRICT ANTI-PLANE SHEAR PLASTICITY MODEL WITH ELASTIC CURVATURE

RICHARD REGUEIRO* AND PARAG DIXIT † AND KRISHNA GARIKIPATI †

* Department of Civil Engineering
University of Colorado at Boulder
Boulder, CO 80309, USA
regueiro@colorado.edu

† Department of Mechanical Engineering
University of Michigan, Ann Arbor
Ann Arbor, MI 48109, USA

A finite deformation plasticity model with plasticity driven by curvature of the elastic deformation [1], is formulated for strict anti-plane shear kinematics and implemented by coupled standard and vector finite element (FE) methods [2,3]. The curl of the elastic part of the deformation gradient $[\text{curl}(\boldsymbol{F}^e)^{-1}]^T$ represents the elastic lattice curvature that a grain or subgrain cell experiences as a result of the presence of geometrically necessary dislocations (GNDs) at grain or subgrain cell boundaries [4]. "Strict" anti-plane shear implies that the form of the elastic and plastic parts of the deformation gradient are the same as the total deformation gradient [5], which is the unity tensor plus the dyadic product of the out-of-plane normal and a gradient vector. The plasticity model with a curl term leads to a partial differential equation (PDE) for the plastic evolution, rather than an ordinary differential equation for standard plasticity without the curl term. Along with the linear momentum balance, this leads to a coupled system of PDEs for which to solve numerically by a coupled FE implementation. Aside from the out-of-plane displacements, a plastic gradient vector is solved for at the nodes. Numerical examples demonstrate the effect of the curl term for anti-plane shear kinematics and the similarities and differences for using standard finite element shape functions versus vector finite element shape fuctions.

**References**

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