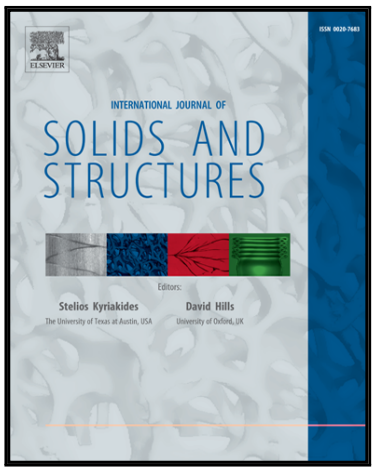

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Singular crack-tip plastic fields in Tresca and Mohr-Coulomb solids

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Abstract

This paper investigates the singular plastic fields at crack tips for Tresca and Mohr-Coulomb materials with power law hardening response. The singular values and the corresponding fields were determined over a range of material parameters. For Tresca and Mohr-Coulomb associative materials we verified that the dominant singularity is given by the HRR value. For non-associative Mohr-Coulomb materials we found consistent deviations from the HRR value which increase with the degree of non-associativity. The near-tip stress, strain, displacement and plastic zone profiles are illustrated for few representative cases. For the Tresca solid we found that the singular displacement and strain fields decrease with increasing hardening exponent before becoming undetermined at the limit of the perfect plasticity. For a Mohr-Coulomb material, with moderate pressure sensitive behavior, the strain and displacement fields are restored to values obtained for strong hardening behavior.

Keywords: singular, crack-tip, plastic fields, Tresca, Mohr-Coulomb, HRR singularity.

Introduction

Crack initiation and propagation is encountered in many engineering disciplines that involve advanced loading stages of broad class of solids and structures that may lead to failure. Further to the traditional solids which include metals, concrete and rocks, in recent years modern materials such as ceramics, toughened polymers, porous metals and metallic glasses attracted considerable research due to their attractive mechanical properties. There are also several engineering applications in Geomechanics, not related to safety of structures, where fractures are induced or naturally occurred. The most notable example is hydraulic fracturing, a technique