International Conference on Extended Finite Element Methods - XFEM 2013
September 11 – 13, 2013, Lyon, France
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NUMERICAL SIMULATION OF CRACK PROPAGATION IN A DUCTILE VISCOPLASTIC MATERIAL USING X-FEM

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Key Words: *X-FEM, viscoplasticity, damage, computational mechanics.*

ABSTRACT

The present work is devoted to the numerical simulation of crack propagation in engineering materials whose failure results from void initiation, growth and coalescence. The behavior of the plate material is described via a Gurson type model [1] accounting for the combined effects of strain hardening, thermal softening, viscoplasticity and void growth induced damage. The eXtended Finite Element Method [3] has been retained to describe the kinematic consequences of the crack propagation across the mesh. The crack is assumed to propagate as soon as the stored energy around the crack tip reaches a critical value. The propagation criterion based on the averaging of the stored energy over a patch allows for attenuating the mesh size dependence observed when dealing with softening materials. In a first approach the crack propagation direction is deduced from the plastic strain field near the crack tip, see [2]. The related crack length is estimated from the crack velocity considering the current time increment. The constitutive model and the extended finite elements were both implemented in the engineering FE computation code Abaqus as user subroutines. The numerical simulation of a notched plate under tension and shear loading has been conducted. While making some simplifications, the present work reproduces numerically the 2D propagation of a crack resulting from void growth induced damage.

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