ANALYSIS OF DAMAGE AND FRACTURE FORMULATIONS IN COLD EXTRUSION

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ABSTRACT

In forming processes, components generally undergo large deformations. This induces the evolution of damage, which can influence material and product properties. Finite element simulations are carried out to predict damage and fracture. To capture these effects, a constitutive elasto-plasticity model coupled with damage, as proposed by Lemaitre [1] as well as different fracture criteria according to Cockcroft and Latham [2], Freudenthal [3] and Oyane [4] are implemented and investigated. While the fracture criteria only take material failure into account, the constitutive model considers the evolution of damage and the associated softening.

Tensile tests with cylindrical and notched specimens are performed in order to obtain the material parameters associated with these models by inverse parameter identification processes. The optimized set of parameters is finally applied to the damage and fracture models used for the FE simulations of the forming processes, which are investigated in terms of damage evolution and material failure. It is demonstrated that the Lemaitre model predicts the evolution of damage observed for different process parameters in cold extrusion quantitatively. In particular, the evolution of damage in parts with a smaller extrusion ratio is larger. The prediction of the failure by the fracture criteria does not agree well with the experiments.

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