# EFFICIENT IMPLICIT INTEGRATION OF AN ELASTIC-PLASTIC DAMAGE MATERIAL MODEL

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An intrinsic hybrid composite is fabricated of a continuous fibre reinforced polymer, in which a metallic insert is integrated. On the one hand, the connection between these two components is based on a form fit. On the other hand, a sol gel process is applied to generate an interface and, thus, adhesive bonds (see [1]). Within finite element simulations of this hybrid composite, the mechanical behaviour of each component is described by a material model at large strains. This contribution focuses on the formulation of a material model for the interface and on the development of an efficient implicit integration procedure. The mechanical behaviour of the interface is supposed to be elastic-plastic with damage. Yielding and softening are initiated by deviatoric as well as hydrostatic stresses. The material model is formulated utilising a concept which enables material modelling at large strains by directly connected rheological elements (see, for details of the concept, [2]). To this end, a rheological model is introduced first. Secondly, kinematic and kinetic relations are defined. Afterwards, the rheological elements are specified by individual material models at large strains. Finally, the connection relations are combined to formulate the multiplicative material model. To numerically evaluate the developed material model, a predictor-corrector procedure with implicit time integration is applied. Having regard to [3], the constitutive equations are reformulated in such a way that only two scalar equations have to be iteratively solved within the corrector step. It is shown, that the obtained procedure is more efficient and more robust compared to a straightforward approach in which a tensorial equation and a scalar equation are numerically solved. Applying the developed algorithm, the material model is implemented into Abaqus via the user material routine. A tension-torsion test of two butt-bonded hollow cylinders is simulated. In continuation, this experimental test will be utilised to identify the parameters of the developed material model.

## REFERENCES

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