MODELLING OF MATERIAL BEHAVIOUR AND FRACTURE FOR ALUMINIUM ALLOYS WITH APPLICATIONS TO PLASTIC FORMING AND CRASHWORTHINESS

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ABSTRACT

Constitutive models and failure criteria for aluminium alloys have been formulated and implemented in LS-DYNA for corotational shell elements. The applications are large-scale simulations of plastic forming and crashworthiness. The constitutive models include plastic anisotropy, non-linear isotropic and kinematic hardening, strain-rate effects and simple fracture criteria. A non-local instability criterion is used to determine the onset of strain localization. Predictions of plastic instability and fracture are mesh dependent. To reduce this problem, non-local thinning has been introduced. Some aluminium alloys exhibit the Portevin-Le Chatelier effect or serrated yielding. This is caused by negative steady-state strain rate sensitivity. A simple model for dynamic strain aging is included in the models to account for this phenomenon. Examples of the use of the models in prediction of formability, plastic forming, welded connections and crashworthiness are given.