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Modeling of the ductile fracture during the sheet forming of aluminum alloy considering non-associated constitutive characteristic

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Abstract

This research was aimed to predict the ductile fracture for aluminum alloy 5083-O sheet using a phenomenological Modified Mohr-Coulomb fracture (MMC) criterion. The plasticity anisotropy of sheet was described by a non-associated constitutive relationship whose yield function and plastic potential function were represented by two different Hill'48 functions. The parameters of Hill'48 functions were calibrated on the basis of yield stresses and Lankford r-value, respectively. The loading paths of critical points for six specimens were utilized to calibrate the parameters of MMC fracture model. The determined non-associated constitutive relationship and MMC fracture model were validated to be able to predict the tension-dominated fracture mode of a modified compact-tension (MCT) specimen as well as shear-dominated fracture of a simple shear specimen. Besides, the fracture forming limit curve expressed by major strain and minor strain was derived directly from the MMC fracture model and its advantages was evaluated by comparing it with the conventional forming limit curve.

Keywords:

Sheet metal forming; Non-associated flow rule; ductile fracture; Modified Mohr-Coulomb model.