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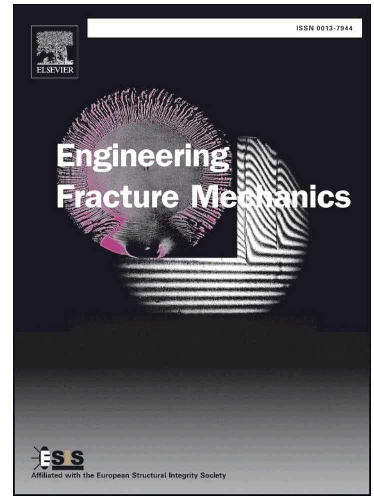

Essential Work of Fracture Assessment for Thin Aluminium Strips Using Finite Element Analysis

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Essential Work of Fracture Assessment for Thin Aluminium Strips Using Finite Element Analysis

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Abstract:

The fracture toughness of a commercial thin aluminium sheet (1.2 mm) is measured by the essential work of fracture (EWF) method using a double-edge notch tension specimen. The EWF method is implemented at room temperature at a deformation speed of 2 mm/min. The basics of the EWF method and its relation with J-integral are described in this paper. Ligament yielding is observed to occur at the peak of the load-displacement curve. Following this, necking and tearing occur in the softening region. The EWF for the thin aluminium sheet is measured as 51.5 kJ/m^2. However, the non-essential work of fracture is dissipated in the tearing process after yielding, causing expansion of the plastic region. In this work, two advanced finite element models, namely, non-linear and linear J-Integral finite element models, are implemented to simulate the essential work of fracture test. The results for the essential and non-essential fracture indicate good agreement with EWF fitting. The linear extended finite element (XFEM) model yields more accurate results than the J-integral method. Crack opening displacement is measured by the EWF method, and is compared with the results of the studied models.

Keywords: Essential work of fracture, XFEM, J-Integral, Non-essential, fracture Toughness

List of nomenclatures

δ_o	0.2% offset displacement
p	Applied load
δ_{CTOD}	Crack tip opening displacement
J_C	Critical J-integral or release energy in Elastic Plastic Fracture Mechanics (EPFM)
δ	Displacement at failure
$d\delta$	Displacement increment