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Abstract

Detailed three-dimensional nonlinear finite element (FE) analyses and experimental moire studies are performed on a plate containing a moderately deep part-through surface crack to establish limits of HRR-dominance. The plate is subjected to predominantly far-field tensile loading. The material under investigation is ASTM A710 steel, which was constitutively modeled by large deformation J_2 flow theory of plasticity. The FE mesh was carefully constructed to resolve both crack front fields (such as *J*-integral and CTOD) and global fields (such as surface displacements, strains). By comparing the *J*-integral and CTOD results with an earlier HRR-dominance study using (small strain) deformation theory of plasticity, we found little effect of the different formulations on the crack front fields. The global deformation fields from the numerical simulation are in good agreement with our experimental results. The eventual loss of HRR-dominance is intimately related to the interaction of the global plastic flow fields with those of the crack front.

Keywords

Fracture mechanics, Surface cracks, Numerical analysis, Experimental test