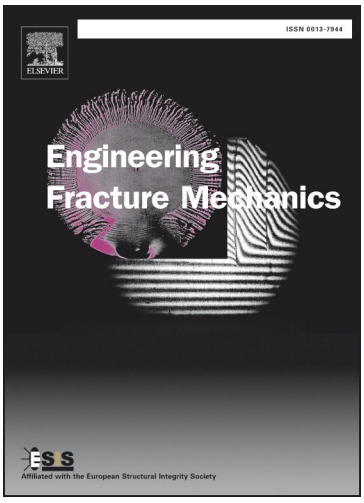

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Fracture Toughness Testing Using Non-Standard Bend Specimens - Part I: Constraint Effects and Development of Test Procedure

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Abstract

This work addresses the development of a fracture toughness test procedure using standard and non-standard SE(B) specimens, including non-standard 4-point bend configurations. In the present study, extensive plane-strain finite element analyses are conducted on non-standard bend geometries with varying specimen span over width ratio (S/W) and loaded under 3-point and 4-point bending. The potential influence of specimen geometry and loading on fracture behavior in terms of $J-Q$ descriptions to quantify constraint effects is characterized first. Next, a large new set of plastic η-factors applicable to these non-standard bend geometries which serve to estimate the experimentally measured toughness values in terms of load-displacement records, including the J-integral and the crack tip opening displacement (CTOD), is provided. To facilitate contact with other test protocols, a new set of rotational factors, r_p, to determine the CTOD based on the plastic hinge model is also described. The extensive numerical analyses conducted here provide a large set of fracture toughness test parameters, which not only validate the existing relationships available in current standards, but also provide support to standardization efforts for fracture toughness testing using non-standard bend geometries.

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