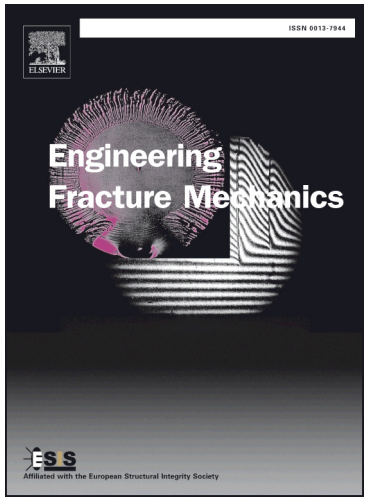

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Abstract

A methodology is developed using strain-based fracture mechanics (SBFM) and an effective strain-life (ESL) model for the fatigue analysis of as-received and high frequency mechanical impact (HFMI) treated structural steel welds. The methodology includes a crack closure model and accounts for the residual stress state at the weld toe. Several required input parameters for mild structural (CSA 350W) steel were obtained using relatively simple and inexpensive small-scale fatigue tests of smooth specimens, conventional monotonic and cyclic materials tests, laboratory measurements, and residual stress measurements. The ESL modelling component of the methodology is validated using direct crack growth measurements. The SBFM model is evaluated using the results of fatigue tests on weld specimens and is found to be capable of accurately or conservatively predicting the fatigue performance of the as-received and impact treated welds under one constant and two variable amplitude loading histories.

Keywords:

Fatigue life prediction, Strain-based fracture mechanics, Welded joints, Structural Steel, High frequency mechanical impact treatment