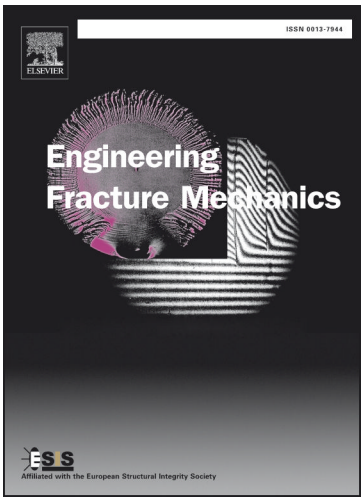

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3D numerical simulation of thermal fatigue damage in wedge specimen of AISI H13 tool steel

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Abstract: Thermal fatigue loading is a major failure mechanism in machinery operating at high temperatures. Exact numerical modeling of this phenomena helps in better understanding of crack propagation governing factors, which eventually helps in avoiding catastrophic failures. In this research numerical simulation model for crack propagation in a 3D wedge of AISI H13 tool steel has been developed. Thermal profiles incorporated in the model were taken from actual experimentation. Real time temperature dependent material data was incorporated into the model. Contour integral technique was used to simulate the behavior of material with increase in crack lengths. Total 11 models with different crack lengths were simulated to observe the behavior of crack length on J-integral, compressive and tensile stresses and Crack Mouth Opening Displacement (CMOD). 3D graphs of J-integral gives an insight of how thermal fatigue cracks behaves in bulk. The simulation results correlate well with experimental observations. Results show a significant drop in stresses and j-integral values after certain crack length, which eventually results in crack arrest.

Keywords: Thermal Fatigue; Finite element analysis; J-Integral; Residual Stress; Critical crack size;

Nomenclature:

Acronyms:

SIF	Stress Intensity Factor
CMOD	Crack Mouth Opening Displacement

Symbols:

$б_{tensile_{max}}$	Maximum Tensile Stress
a	crack length
D	Distance of maximum tensile stress point from centre in mm