A numerical analysis of CTOD in constant amplitude fatigue crack growth

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A numerical analysis of CTOD in constant amplitude fatigue crack growth

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Abstract: The crack tip opening displacement, CTOD, is a classical parameter of fracture mechanics. The applicability of this parameter in the context of crack closure and fatigue crack growth is studied. An elastic-plastic finite-element model was developed to quantify the CTOD in a M(T) specimen for two aluminum alloys (AA6016-T4 and the AA6082-T6). An elastic regime was found for relatively low loads, and its upper bound was used to quantify the fatigue threshold. The plastic CTOD was found to be a measure of crack tip plastic deformation and an intimate relation was found with other non-linear crack tip parameters. Analysis without contact of crack flanks showed the validity of crack closure concept. No influence of stress state on plastic CTOD was found in the absence of crack closure, which indicates that the effect of this parameter is linked to crack closure effects. Finally, a relation was found between da/dN and plastic CTOD for the AA6082-T6 aluminum alloy, independent of stress ratio, showing that the plastic CTOD is an interesting alternative to ΔK in the analysis of fatigue crack propagation.

Keywords: crack tip opening displacement (CTOD); crack closure; fatigue threshold; aluminium alloy

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