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Stress intensity factors under combined bending and torsion moments

Abstract

This paper discusses stress intensity factor (SIF) calculations for surface cracks in round bars subjected to combined torsion and bending loadings. Different crack aspect ratios, a/b, ranging from 0.0 to 1.2 and relative crack depths, a/D, ranging from 0.1 to 0.6 were considered. Since the loading was non-symmetrical for torsion loadings, a whole finite element model was constructed. Then, the individual and combined bending and torsion loadings were remotely applied to the model. The equivalent SIF method, F*EQ, was then used explicitly to combine the individual SIFs from the bending and torsion loadings. A comparison was then carried out with the combined SIF, F*FE, obtained using the finite element analysis (FEA) under similar loadings. It was found that the equivalent SIF method successfully predicted the combined SIF for Mode I. However, discrepancies between the results determined from the different approaches occurred when FIII was involved. It was also noted that the predicted F*FE using FEA was higher than the F*EQ predicted through the equivalent SIF method due to the difference in crack face interactions.

Keywords — Combined loadings, Finite element analysis (FEA), round solid bars, Stress Intensity Factor (SIF), surface cracks