The Southwest Mechanics Lecture Series

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THREE–DIMENSIONAL EFFECTS ON FATIGUE CRACK CLOSURE IN THE SMALL–SCALE YIELDING REGIME

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Location: **Room 110 Civil Engineering Building**

Abstract

Plasticity induced closure often influences strongly the behavior of fatigue cracks at engineering scales in metallic materials. Current predictive models generally adopt the effective stress–intensity factor ($\Delta K_{eff} = K_{\max} - K_{op}$) in a Paris law type relationship to quantify crack growth rates. This work describes a 3–D finite element study of mode I fatigue crack growth in the small–scale yielding (SSY) regime under a constant amplitude cyclic loading with zero *T*–stress and a ratio $K_{\min}/K_{\max} = 0$. Dimensional analysis suggests, and the computational results confirm, that the normalized remote opening load value, $K_{op}/K_{\max}$, at each location along the crack front remains unchanged when the peak load ($K_{\max}$), thickness (*B*) and material flow stress (σ_0) all vary to maintain a fixed value of $\bar{K} = K_{\max} / \sigma_0 \sqrt{B}$. Through parametric computations at various $\bar{K}$ levels, the results illustrate the effects of normalized peak loads on the through–thickness, opening–closing behavior and the effects of σ_0 / E, where *E* denotes material elastic modulus. This new scaling relationship and the computational results provide the needed framework to rationalize and extend existing simplified models of the crack closure process.