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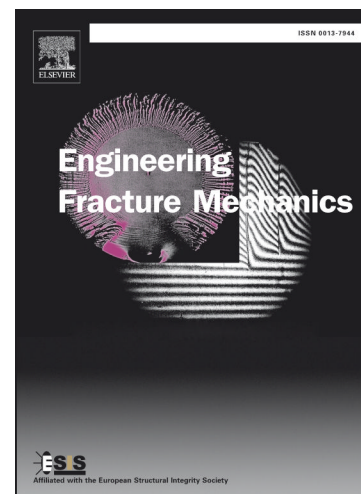
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A non-local approach for probabilistic assessment of LCF life based on optimized effective-damage-parameter

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Abstract

The present paper includes two parts of low cycle fatigue (LCF) life analysis using the weakest-link method and a novel non-local approach respectively, which are both conducted based on previously published fatigue test results of TA19 notched specimens. The weakest-link method is applied to the prediction of strain fatigue life by introducing the Smith-Watson-Topper (SWT) parameter. The accuracy of the weakest-link method is found to be highly dependent on the values of Weibull parameters. The life scatter factor and the percentage for the data out of $\pm 3\sigma$ scatter, which are introduced to evaluate the accuracy of deterministic and probabilistic life prediction respectively, have opposite tendency with the value of shape parameter for Weibull function. Accordingly, a non-local approach is proposed based on optimized effective-damage-parameter (OEDP). The optimization procedure for the effective damage parameter is established to ensure an optimum life scatter factor. Meanwhile, a probabilistic SWT model based on linear regression is developed to describe the dispersion of fatigue life. It is shown that a satisfactory accuracy of LCF life estimation can be achieved using the proposed method.

Keywords: stress concentration; size effect; low cycle fatigue; probabilistic fatigue life estimation; weakest-link method.

Nomenclature

Symbols

a_0	undetermined parameter in probabilistic life model	$N_{e,i}$	experimental fatigue life for the i^{th} data
b_0	undetermined parameter in probabilistic life model	ΔN	life scatter factor
b_N	Weibull shape parameter for fatigue	P_f	probability of component failure

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