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PII: S0142-1123(17)30372-9
DOI: http://dx.doi.org/10.1016/j.ijfatigue.2017.09.007
Reference: JIJF 4460

To appear in: *International Journal of Fatigue*

Received Date: 14 June 2017
Revised Date: 7 September 2017
Accepted Date: 8 September 2017

Please cite this article as: Ostash, O.P., Chepil, R.V., Vira, V.V., On the assessment of fatigue life of notched structural components, *International Journal of Fatigue* (2017), doi: http://dx.doi.org/10.1016/j.ijfatigue.2017.09.007

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Abstract

The growth of a microstructurally short and a physically small cracks in the fatigue process zone of size d^* and the formation of initial macrocrack of length $a_i = d^*$ in compact tension notched specimens are investigated. The base notch fatigue curve for the assessment of the period of macrocrack initiation in a notched specimens of various shape is considered. The prediction results of the fatigue life N_f of notched specimens (a strip with a central hole or a slit, and a strip with a U-notch of various tip radius) at the stress ratio R = 0.1 and 0.5 are presented. Two procedures for the assessment of $N_f = N_i + N_p$, where N_i is the period to macrocrack initiation and N_p is the period of macrocrack propagation up to specimen failure, basing on the unified model of fatigue fracture, are proposed. It is shown that N_f values calculated using these procedures are in good agreement with experimental data. The accuracy of received specimens fatigue life is larger than predicted by the known methods.

Keywords: fatigue life; notched specimens; unified model; fatigue process zone; crack initiation and growth.

Nomenclature

a = crack length

a_c = critical macrocrack length

a_i, l_0, l_i = initial macrocrack length

d^* = fatigue process zone size

da/dN = fatigue crack growth rate

h = notch depth

K_t = theoretical stress concentration factor

K_f^{cal}, K_f^{exp} = calculational and experimental fatigue stress concentration factors

l = slit semi-length

N_i^{cal}, N_i^{exp} = calculational and experimental number of cycles to macrocrack initiation (of length $a_i = d^*$)

N_f^{cal}, N_f^{exp} = calculational and experimental specimen fatigue life

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