Effect of the Stress Distribution in Simple Welded Specimens and Complex Components on the Crack Propagation Life

C. Fischer, W. Fricke

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Effect of the Stress Distribution in Simple Welded Specimens and Complex Components on the Crack Propagation Life

C. Fischer[1], W. Fricke[1*]

[1]) Institute of Ship Structural Design and Analysis, Hamburg University of TechnologyHamburg, Germany

*) Corresponding author
Institute of Ship Structural Design and Analysis, Hamburg University of Technology, Am Schwarzenberg-Campus 4, 21073 Hamburg, Germany
w.fricke@tuhh.de

Abstract

While a long stable crack propagation phase was observed during experiments of complex welded components, very conservative estimations of the fatigue life were achieved in the past. The difference was explained by the stress gradient occurring over the plate thickness. This paper deals with numerical crack propagation simulations which were performed for geometrically different variants. The variants differ in global geometry, boundary conditions and weld shape. The analyses aim to investigate how the crack propagation is altered if the structural configuration gets more complex. In conclusion, the stress gradient over the plate thickness, the effective plate thickness due to vertical web plates and high notch effects slow down the crack propagation rate if the same stress value being effective for fatigue appears at the weld toe. Thereby, the load-carrying grade of the weld, the weld flank angle and the geometrical configuration also have an impact on both the notch effect and the local stress concentration.

Key words: Crack propagation simulation, Fatigue life, Notch effect, Stress gradient

Symbols and Abbreviations:

a	crack depth
a_i	initial crack depth
a_f	final crack depth
c	half crack width
c_i	initial half crack width
c_f	final half crack width
C	material parameter in Paris equation
F	force
F_s	factor for effective plate thickness
F_t	factor for stress gradient effect
F_w	factor for load-carrying grade of weld
h	depth
K_I	stress intensity factor for mode I
K_w	weld shape factor
L	length
m	exponent in Paris equation
M	bending moment