A Simple Method for Simulation of Crack Growth in Welded Structures

Hidekazu Murakawa

Osaka University, 11-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan.
Corresponding Author: Hidekazu Murakawa. Email: murakawa@jwri.osaka-u.ac.jp.

Abstract: It is known that fatigue life of welded structures, such as ships and bridges, is greatly influenced by welding residual stress. In case of real structures, the orientation of the stresses produced by dead load and that produced by applied load and that of welding residual stress are generally different from each other and they form a highly complex multiaxial stress states. On the other hand, the fatigue behavior has been mostly studied for uniaxial stress state without residual stress. The crack growth rate is related to the Range of stress intensity factor ΔK such as in the Paris' Low. To predict the fatigue behavior of real welded structures, the three dimensional stresses produced by dead load, applied load and welding must be rationally correlated with ΔK which is a scalar value. The author proposes a Characteristic tensor which characterizes the singular stress field at crack tip and its invariant parameters, such as principal values or the second order invariant of the tensor for example. They are used to compute ΔK in a consistent manner. Potential capability of the proposed Characteristic Tensor Method is demonstrated through examples. Further, the influence of welding residual stress on fatigue crack growth is discussed based on numerical computations.

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