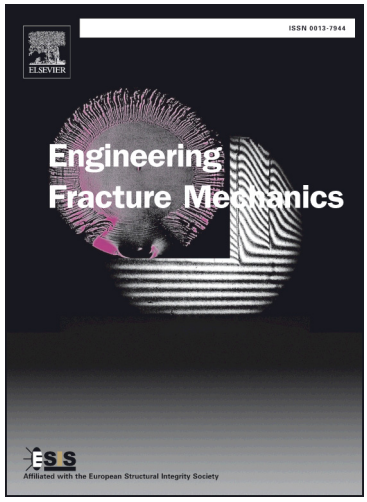

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PII: S0013-7944(16)30459-3
DOI: http://dx.doi.org/10.1016/j.engfracmech.2017.03.030
Reference: EFM 5455

To appear in: *Engineering Fracture Mechanics*

Received Date: 7 October 2016
Revised Date: 20 March 2017
Accepted Date: 21 March 2017

Please cite this article as: Saxena, A., Bassi, F., Nibur, K., Newman, J.C. Jr, On Single-Edge-Crack Tension Specimens for Tension-Compression Fatigue Crack Growth Testing, *Engineering Fracture Mechanics* (2017), doi: http://dx.doi.org/10.1016/j.engfracmech.2017.03.030

On Single-Edge-Crack Tension Specimens for Tension-Compression Fatigue Crack Growth Testing

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Abstract

Single-edge-crack (SEC) specimens with rigid threaded ends are well suited for fatigue crack growth testing in extreme environments and for conducting tests at negative load ratios. Stress intensity parameter, *K*, and crack mouth opening displacement, CMOD, solutions as a function of crack size for this geometry are derived using 3-D finite element analyses using multiple codes. Both *K* and CMOD values obtained are shown to be comparable between the various finite element codes used. The solutions are sensitive to the height (*2H*) to width (*W*) ratio of the specimen, as well as to the aggregate bending stiffness of the members of the loading train. A procedure utilizing the computational results for various *2H/W* values and a set of specially designed fatigue crack growth experiments is described to develop custom solutions for estimating K and CMOD values that account for both, the *2H/W* ratio and the bending stiffness of the loading train.

Key words SEC(T), K-calibration, CMOD, 3D Finite element, Fatigue Crack Growth

1. Introduction

Single-edge-crack (SEC) specimens are commonly used to generate fatigue-crack growth and fracture properties of metallic materials. The overall shape of the SEC specimen, as compared to compact, C(T), specimens, is much better suited for crack growth testing in extreme environments where the specimen is contained in an autoclave or an environmental chamber. Further, the possibility of gripping the specimen rigidly on the ends makes SEC specimen attractive for tension-compression load testing for which C(T) specimens are not suitable.

Expressions for estimating stress-intensity factor, *K*, and crack-mouth-opening displacement, CMOD, for SEC specimens have been available in the literature [1] for some time. However, in the case of rigidly gripped single-edge-notch tension, SEC(T), specimen, the K and CMOD values at various crack sizes are also a function of the specimen gage length and the stiffness characteristics of the loading train. No widely accepted *K* and CMOD solutions are available for these conditions which must be customized for the situation at hand.

In this paper, FEM analysis is used to determine the stress intensity parameter, *K*, and the crack mouth opening displacement (CMOD) relationships as a function of crack size for SEC(T) specimens that are rigidly gripped on the ends. The dependence of K-solutions on the gage length of the specimen is extensively explored in these calculations. However, there are no analytical or computational techniques capable of accounting for the stiffness of the loading train on the *K*-solutions for rigidly gripped SEC(T) specimens. Loading trains can be quite long, and therefore