Wang, Y.-Y., Parks, D. M., Evaluation of the Elastic T-Stress in Surface-Cracked Plates Using the Line-Spring Method, International Journal of Fracture, Vol. 56, no. 1, 1992, pp. 25-40

Abstract

The elastic *T*-stress has been found to be an important parameter in characterizing the very near tip elastic-plastic stress state under 2-D plane strain conditions (Larsson and Carlsson [1]; Bilby et al. [2]; Betegón and Hancock [3]; etc.). Several computational methods have been developed to evaluate the *T*-stress (Larsson and Carlsson [1]; Kfouri [4]; Sham [5]). However, none of these methods can be readily adapted to calculate the elastic *T*-stress in a surface-cracked plate (SCP), which is essentially 3-D in nature. In this paper, the line-spring method, which has proven effective in computing the stress intensity factor of SCPs, is used to evaluate the elastic *T*-stress along the crack front. SCPs with same length and width, but different crack geometries, from low aspect ratio (a/c=0.24) to high aspect ratio (a/c=0.70), under both remote tension and bending, are studied using the line-spring method. Detailed, three-dimensional continuum finite element (FE) solutions of some 'extreme' cases, in terms of both aspect ratio and crack depth, under either remote tension or bending, are compared with the line-spring solutions. The line-spring solutions are in excellent agreement with the 3-D elastic FE solutions, but use 2 to 3 orders of magnitude less computational time and considerably less preparation and post-processing efforts. A concluding example demonstrates the utility of the *T*-stress in more accurately describing the crack front elastic-plastic field in a SCP at load levels up to moderate scale yielding.

Keywords

Fracture mechanics, Constraint, T-stress, Two-parameter characterization, Crack-tip fields