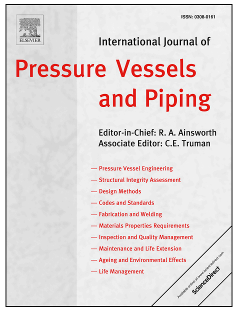
Accepted Manuscript



Reference stress solutions for plates with embedded off-set elliptical cracks under combined biaxial forces and cross-thickness bending

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PII: S0308-0161(18)30078-4

DOI: 10.1016/j.ijpvp.2018.05.011

Reference: IPVP 3714

To appear in: *International Journal of Pressure Vessels and Piping*

Received Date: 2 March 2018

Revised Date: 22 May 2018

Accepted Date: 30 May 2018

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Abstract: The reference stress solutions for plates with embedded off-set elliptical cracks under combined biaxial forces and cross-thickness bending are derived based on the Mises yield criterion and net-section collapse principle. The newly developed reference stress solutions are compared with the reference stresses of plates with embedded rectangular cracks evaluated using the available limit load solutions. The developed reference stress solutions have been used to predict *J* via the reference stress *J* scheme. Elastic-plastic 3-D finite element (FE) analyses are used to calculate *J* values along the crack front and the results are compared with the reference stress predictions. The results show that the estimated *J* values based on the reference stress method with the reference stress solutions developed in this paper are very close to the FE *J* values, but the predictions may be non-conservative. However, the non-conservatism could be removed by simply applying a constant factor less than 1 to the reference stress solutions when they are used in the reference stress *J* scheme.

Keywords: Plate; Biaxial loading; Off-set elliptical cracks; *J*-integral; Reference stress method

1. Introduction

The J-integral based failure assessment diagram (FAD) approach is adopted by many structural integrity assessment standards/procedures, such as R6 [1], BS7910 [2] and API579-1/ASME FFS-1 [3]. In the *J*-based FAD method, the elastic-plastic fracture parameter, *J*, is estimated via the reference stress *J* prediction scheme [4] from known elastic *J*, or, equivalently, the stress intensity factor (SIF) except for the stress-strain relationship of the material. Therefore, a compendium for SIF solutions is contained in most of the structural integrity assessment procedures/standards, such as [1-3]. For geometries and loading types which are not covered by the procedure compendium, the handbook solutions, such as [5], or results from finite element (FE) numerical calculations, such as [6], may also be used. In using the *J*-based FAD method, another important parameter, L_r, must be defined. In a structural integrity assessment of components containing defects, L_r may be evaluated using the limit load of the defective component as a ratio between the applied primary load and the corresponding limit load.