RESIDUAL STRESSES IN WELDED TUBULAR Y-JOINTS

J.A. Free

Abstract

Brittle fracture and fatigue cack propagation in welded structures are largely affected by residual stress and defect created by the welding process. This study is concerned with the prediction and determination of residual stresses in tubular Y-joints of off-shore structures. It investigates the relationships between the complex stress field in the weld region and the contiguous structure.

The project includes an experimental investigation comprising of three tubular joints, fabricated and welded within the laboratory. Experimental centre-hole drilling and block sectioning techniques are used to determine the through-thickness residual stresses due to welding. Stress transverse to the weld toe in the chord member is of particular interest.

A theoretical model, developed by extensively modifying a commercially available thermal-elastic-plastic finite elements package, provides good agreement with the experimental work. The computational model is capable of predicting three dimensional welding residual stresses through the thickness of a multipass weldment. A numerical finite element investigation provides residual stress data beyond the range of the experimental specimens.

A better understanding is presented of the mechanisms involved in the formation of residual stresses in complex multipass tubular joints. The as-fabricated stresses depend primarily on the local section stiffness. This has led to a simple model for predicting through-thickness residual stress distributions to the weld toe from the measured displacements.