

Fatigue Crack Behaviour in a Residual Stress Field at Fillet Welds in Ship Structures

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Abstract : Fillet welds are used in joining longitudinal stiffeners in ship structures. Welding residual stresses in fillet welds are generally distributed in a non-uniform manner, as shown in previous research the residual stress redistribution occurs under the cyclic loading that is experienced by such joints during service, and the combination of the initial residual stress, local constraints, and loading can alter the stress field in ways that are extremely difficult to predict. As the residual stress influences the crack propagation originating from the toe of the fillet welds, full understanding of the residual stress field and how it evolves is very important for structural integrity calculations. Knowledge of the residual stress redistribution in the presence of a flaw is therefore required for better fatigue life prediction. Moreover, defect assessment procedures such as BS7910 offer very limited guidance for flaw acceptance and the associated residual stress redistribution in the assessment of fillet welds. Therefore the objective of this work is to study a surface-breaking flaw at the weld toe region in a fillet weld under cyclic load, in conjunction with residual stress measurement at pre-defined crack depths. This work will provide details of residual stress redistribution under cyclic load in the presence of a crack. The outcome of this project will inform integrity assessment with respect to the treatment of residual stress in fillet welds. Knowledge of the residual stress evolution for this weld geometry will be greatly beneficial for flaw tolerance assessments (BS 7910, API 591).

Keywords : fillet weld, fatigue, residual stress, structure integrity

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