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TITLE

FATIGUE CRACK GROWTH OF NAVAL PLATFORM MATERIALS UNDER SPECTRUM LOADING

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Fatigue Crack Growth of Naval Platform Materials Under Spectrum Loading

by

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ABSTRACT

As part of the Defence Research Establishment Atlantic's continuing research efforts to quantify fatigue crack growth mechanisms in Canadian naval platform steels and weldments, the challenges associated with the prediction of fatigue crack growth under variable amplitude cyclic loading have been addressed, both experimentally and numerically. A number of unwelded A517 Grade F steel standard middle tension specimens have been fabricated and subjected to variable amplitude cyclic loading in accordance with the ASTM Standard E647. Realistic stress-time histories (incorporating pseudo-random stress ranges), which reflect representative long range statistical distributions of stresses in naval platform materials have been defined and employed in the experimental program. During the application of these cyclic stress-time histories to the precracked samples, their influence on crack extension has been continuously monitored. The results of these experiments have been compared with predictions based on current empirical fracture mechanics crack growth methodologies. The LIFE3D three dimensional finite element based fatigue analysis software package, which simulates the propagation of both surface and through-thickness cracks in solid bodies has been modified to incorporate variable amplitude loading conditions. In addition, crack retardation and crack closure models have been included in the software. The package has been employed to numerically simulate the crack growth of the A517 center cracked specimens, employing pseudo-random, hi-lo, lo-hi and root-mean-square representations of the afore-mentioned stress-time histories for comparison with the experimental crack growth results. The results of these studies to date will be presented, focusing on deficiencies in current available crack growth predictive methodologies, as applied to realistic loading conditions on naval platforms.