

FATIGUE EVALUATION OF WELDED STRUCTURES USING THE FINITE ELEMENT METHOD

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KEYWORDS

Fatigue evaluation, welded structures, structural hot spot stress method, nominal stress method, fatigue test, S-N curve

ABSTRACT

In this study, fatigue evaluation of cruciform and T connection joints are carried out using the finite element method and computed fatigue cycles are compared with the test results. Fatigue lives are calculated according to “structural hot spot stress” and “nominal stress” methods which are involved in the “IIW Recommendations for Fatigue Design of Welded Joints and Components” standard. IIW recommends general methods to evaluate welded structures that are subjected to fatigue loading. This guidance gives fatigue strength curves, which are assumed to represent a survival probability of at least 95% for various types of welded connections. Each S-N curve is identified by the characteristic of fatigue strength of the welded connection in MPa at 2 million cycles. In addition, IIW recommendations present different approaches for the fatigue assessment of welded joints and components, which are nominal stress, structural hot-spot stress, effective notch stress, fracture mechanics and component testing. In this study, nominal stress and structural hot spot stress approaches are considered. The survival probability of fatigue calculation is considered as 50% and FAT classes are modified with this probability level. Finite element analysis are performed with both solid and shell elements using different modelling configurations. In this work, the most frequently used shell and solid modelling techniques are considered. All finite element models are built and linear static analysis are performed using the commercial FE code ANSYS V16. To verify computations, fatigue bending tests are conducted for unique welded 5059 aluminum plates. Additionally, more complex structure is considered and fatigue test is performed for steel plates made of Weldox 690. The focus of this study is to investigation of the fatigue evaluation methods using finite element analysis for different element types and modelling techniques

and the verification of the fatigue calculations with experimental studies. Moreover, different evaluation methods are presented and future works are discussed for fatigue assessment of welded structures.