A Residual Strength Approach for the Fatigue Analysis of Welded Components

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ABSTRACT

At present welded components subjected to fatigue loadings are designed and assessed using curves of stress-range against number of cycles as well as Palmgren-Miner's summation. These techniques concentrate on the endurance of the component and do not take into account the variation of the strength of the component during the fatigue life. Thus present design techniques assume that the strength of the component remains equal to the static strength throughout the fatigue life, and the variation in strength is independent of fatigue loading until the component fails at the end of the fatigue life. Present assessment techniques give the life of a component that has been expended as a portion of the total life and do not give any idea of the strength or crack length of the component.

A fundamental procedure of design and assessment has been developed in this thesis which takes into account the variation of the residual strength during the fatigue life of the component. A simple and easy method using linear curves has been determined to find the reduction in strength from fracture mechanics. Hence a hand method of assessment and design has been developed which can easily be used by practising engineers. Using the new technique the residual strength, the crack length and the remaining life of a component can be found. Furthermore, the procedure can be used to design components based on the residual strength variation and hence is more accurate and versatile compared to present methods where design is based on endurance.