METHODS OF IMPROVING THE FATIGUE STRENGTH OF FILLET WELDED JOINTS

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Abstract

A survey of published work shows that the fatigue strength of fillet welded joints can be very slow in comparison with the normal static design stress. However, significant improvements in strength have been obtained both by local machining of the weld and by methods such as peening and spot heating, but the reasons for the increases have not been fully determined.

In the investigation described in this dissertation a study has been made of the effect of stress relieving, local machining, peening, spot heating and local compression treatment on the fatigue strength of various types of fillet welded joint. It has been shown that all these methods are effective in improving fatigue strength under certain circumstances.

Local machining has the effect of shifting the S-N curve to the right so that there is an increase in endurance at all applied stresses.

It has been proved that the increase in fatigue strength, resulting from peening, spot heating and local compression is due to the residual compressive stresses introduced at the notch either at the end of the weld or at the weld toe. These techniques have been shown to be more beneficial when the applied stresses are partially compressive rather that fully tensile. They have shown to be more beneficial under low applied stresses than under high stresses (i.e. at long endurances rather than at short lives).

Since it seemed likely that the fatigue behaviour of welded joints could be considered primarily as a crack propagation problem, an extensive fatigue test programme was carried out on the sheet specimens of various steels under both pulsating tension and alternating loading in order to define rates of crack propagation. It has been shown that the crack propagation rate can be expressed in terms of the fracture mechanics parameter, K, and that it is a function of material yield stress. It has also been shown that the fatigue behaviour of

welded specimens can be rationalised using these crack propagation results and that the effect of variations in residual stress and applied stress can be satisfactorily explained.