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An experimental investigation of the fatigue damage behaviour of adhesively bonded joints under the combined effect of variable amplitude stress and temperature variation

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Abstract

Under working conditions, adhesively bonded structures are exposed to variable cyclic loading and temperature variation. However, there is still limited number of works dealing with their relationship. The present study investigates the combined effect of variable amplitude stress and variation of temperature on the fatigue damage behaviour of adhesively bonded scarf joints. Initially, experiments at constant amplitude stress, which showed reduction of fatigue strength with increasing temperature, were carried out to establish base SN curves for calculations of cumulative damage. Then, tests under variable amplitude fatigue (VAF) were performed with constant temperature and with two, four and six temperature changes. Temperatures for VAF experiments were -10, 23 and 50°. VAF at constant temperature demonstrated: (i) damage retardation at -10 and 23°C and damage acceleration at 50°C and (ii) no clear effect on the fracture mode. Conversely, VAF with temperature variation showed: (i) high damage acceleration with an increase proportional to the number of temperature changes and (ii) a trend of more adhesive failure. For lifetime predictions made with a linear damage rule, good correlation was obtained at constant temperature. However, under variable temperature conditions caution must be taken since predictions overestimated fatigue lifetime.

Keywords

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