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Predicting the multiaxial fatigue limit and the multiaxial high-cycle fatigue life based on the unified equivalent shear stress from axial strength characteristics with various waveforms

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Abstract

A new method for predicting high-cycle fatigue life under constant multiaxial amplitude loading is proposed using a unified equivalent shear stress amplitude proposed by the author. This criterion is an extension of the multiaxial fatigue limit criterion proposed previously by the author. This criterion uses the axial loading S-N curve and the true fracture strength as commonly available material characteristic values. The fatigue test data from the literature such as the bending and torsion combined loadings, the biaxial loadings and the biaxial loadings with sinusoidal, triangular and trapezoidal waveforms, were used to verify the criterion. The fatigue lives estimation error and fatigue limit estimation error of the proposed criterion were better than that of the other criteria used for comparison.

Key Words: Multiaxial fatigue; fatigue life prediction; High-cycle fatigue; Fatigue design; waveform

Nomenclature

$\sqrt{J_{2,amp}}$ equivalent shear stress amplitude

$\sqrt{J_{2,amp,eq}}$ unified equivalent shear stress amplitude

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