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MULTIAXIAL FATIGUE STRENGTH ASSESSMENT OF WELDED JOINTS USING THE PEAK STRESS METHOD – PART II: APPLICATION TO STRUCTURAL STEEL JOINTS

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Abstract

In Part I of the present manuscript, the Peak Stress Method (PSM) has been extended for the first time to assess the fatigue strength of welded joints in aluminium alloys subjected to in-phase as well as out-of-phase multiaxial loadings. A so-called equivalent peak stress has been defined on the basis of the averaged Strain Energy Density (SED) fatigue strength criterion. The equivalent peak stress can be used in principle to assess either weld toe and weld root fatigue failures in conjunction with an appropriate design curve for multiaxial fatigue loadings. In the present Part II of the paper, the Peak Stress Method is applied to assess the multiaxial fatigue strength of welded joints made of structural steels. The method has been validated against a bulk of experimental data taken from the available literature. The equivalent peak stress has shown to correlate with good approximation most of the analysed experimental data.

Keywords: Multiaxial fatigue, Welded joints, Peak Stress Method, Strain Energy Density, Coarse Mesh, Steel.

Nomenclature

a	reference dimension to select the minimum mesh density ratio *a*/*d* for PSM application
c_w	coefficient which takes into account the effect of the nominal load ratio R
d	average size of a finite element mesh
E	elastic modulus
f_{w1}, f_{w2}, f_{w3}	correction coefficients to evaluate of the equivalent peak stress
$K_{FE}^{*}, K_{FE}^{**}, K_{FE}^{***}$	non-dimensional K_1, K_2 and K_3 relevant to the peak stress method (constant parameters)
l	pre-crack length due to the lack of penetration
R_0	radius of the control volume for the averaged SED evaluation
R_σ, R_τ	nominal load ratio referred to normal and shear stresses, respectively
R_X, R_Y	nominal load ratio referred to the forces F_X and F_Y, respectively