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An Inverse Approach for Determining Creep Properties from a Miniature Thin Plate Specimen under Bending

Authors : Yang Zheng, Wei Sun

Abstract : This paper describes a new approach which can be used to interpret the experimental creep deformation data obtained from miniaturized thin plate bending specimen test to the corresponding uniaxial data based on an inversed application of the reference stress method. The geometry of the thin plate is fully defined by the span of the support, l, the width, b, and the thickness, d. Firstly, analytical solutions for the steady-state, load-line creep deformation rate of the thin plates for a Norton's power law under plane stress ($b \rightarrow 0$) and plane strain ($b \rightarrow \infty$) conditions were obtained, from which it can be seen that the load-line deformation rate of the thin plate under plane-stress conditions is much higher than that under the plane-strain conditions. Since analytical solution is not available for the plates with random b-values, finite element (FE) analyses are used to obtain the solutions. Based on the FE results obtained for various b/l ratios and creep exponent, n, as well as the analytical solutions under plane stress and plane strain conditions, an approximate, numerical solutions for the deformation rate are obtained by curve fitting. Using these solutions, a reference stress method is utilised to establish the conversion relationships between the applied load and the equivalent uniaxial stress and between the creep deformations of thin plate and the equivalent uniaxial creep strains. Finally, the accuracy of the empirical solution was assessed by using a set of "theoretical" experimental data.

Keywords : bending, creep, thin plate, materials engineering
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