CREEP OF STRUCTURES

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Abstract

The constitutive relations used for predicting creep strain rates were reviewed. The approach of Taira el al holds promise as a means of accurately describing material strain rate behaviour at high temperatures. There is, however, no strain rate expression in common usage which is capable of predicting accurately changes in strain rate due to load changes.

In the absence of such an expression two structures, a beam in pure bending and a circular plate loaded at a central boss, were analysed including transient effects using time hardening and strain hardening strain rate expressions. Based on the results of these analyses and various other evidences the concept of a unique stress within the structure to which the overall deformation behaviour of the structure to which the overall deformation behaviour of the structure is linked was postulated. The value suggested for this reference stress was the stress at the common point of intersection of the stationary state stress distributions for various values of the stress index in the strain rate expression. The way in which the deformation of a structure may be linked to the strain associated with the reference stress for variable or steady loading was demonstrated. The concept of this reference stress is developed further and it was shown that a simple relation exists between the values of the reference stress, the yield stress of the material, the total load on the structure and the collapse load of the structure. In addition, the use of the reference stress in analysis was suggested as a means of standardising the form of non-dimensional results. Various results in the literature were explained using the reference stress.

Steady and variable loading tests were conducted on tensile specimens, beams in pure bending and circular plates with loaded central bosses. The specimens were made of 99% pure half hard aluminium which creeps at room temperature. Transient analysis gave good predictions for both structures. The reference stress concept gave good results for the beam

where transient effects were small. Anisotropy in the plate tests was explained and included in the predictions. More test results are required for the multiaxial variable load problem before firm conclusions may be given.