Finite Element Analysis for the Creep and Rupture of Spherical Vessel and Rotating Disk with Thermal Gradient

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ABSTRACT

When a struture member is subjected to stress at elevated temperature, a deformation process called creep occurs.Creep strain accumulates with time continuously and when the total strain comes to a critical value, creep rupture then occurs. Therefore, it is important that engineer must take into consideration the consequence creep may cause in designing a structure member under creep conditions. In this work, the creep and rupture behavior of both internally pressurized sphere and rotating disk are studied in details based on the local continuum damage mechanics in conjunction with the finite element solution technique. Temperature gradients are assumed to exit in sphere and disk and the numerical results thus obtained are compared to that are based on a uniform temperature distribution. A strain-controlled creep damage law is derived from a more complex strain-dependent creep law. This law expresses creep damage only in terms of creep strain, which indicates that the creep strain is the only function controlling the creep damaged. Based on this one-dimensional creep damage law, a multi- dimensional creep damage law is postulated using the maximum principal strain criterion, the maximum stress criterion and the maximum octahedral shear stress criterion. The finite element technique is used as the numerical tool to obtain the approximate solution. The solution procedure models the develpment of creep damage, due to the accumulation of creep strain, and involves the repetition solution for the associated boundary-value problem.

Keywords : Creep ; Thermal Gradient ; Creep Rupture

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