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

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ABSTRACT

ABSTRACT In this work, the creep and creep rupture behavior of both the spherical vessel and rotating disk, subjected to an internal pressure, are studied indetails based on the local continuum damage mechanicss approach using the element technique. A strained-controlled creep rupture creep damage law is derived from a more complex strained-dependent creep damage law. This law expresses creep damage solely in terms of creep strain, which indicates the creep strain is the only factor controlling the creep damage. Based on this one-dimensional creep damage law, a multi-dimensional creep damage law is postulatedusing respectively the maximum principal tensile strain criterion, the maximum principal tensile stress criterion, the maximum octahedral shear stress criterion and the mixed criterion. The solution procedure models the development of creep damage, due to the accumulation of creep strain, and involves the repetive solution for the associatedboundary-value problem, which consists of two successive time period of damage. While it is a typical boundary-vvalue problems for the first period, it becomesa moving boundary-value problems for the second period. During the first periodwhen the local value of creep damage throughout the vessel is less than a criticalvalue, the stresses redistribute and the damage developes monotonically. Duringthe second period, an initial rupture front propagates through the member and which leads eventually to a complete collapse. Finally, partial analytical solution for the spherical vessel is derived and used to verify the validity of the numericalresults obtained.

Keywords : Creep rupture ; Rupture Front

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