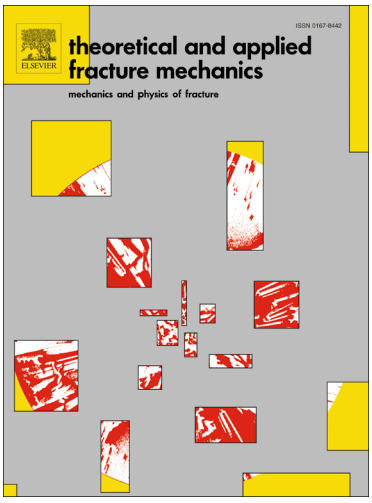

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Theoretical and numerical analysis of creep crack initiation combined with primary and secondary stresses

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Abstract

In this work, the creep crack initiation time (CCI) considering the residual stress effects were investigated by numerical simulation and theoretical approaches based on the ductility exhaustion model. The redistribution of stress under the combined loading condition (i.e. the tensile residual stress generated by the pre-compressed loads and primary loads) was taken into account. The elastic follow-up factor, *Z,* as well as the reference stress method, was considered as part of the theoretical method. The suitability of the theoretical method to the conditions that included combined primary and secondary stresses was then investigated. Reasonable and conservative predictions of CCI time could be obtained from the theoretical solutions when the elastic follow-up factor, *Z*, was taken into account within the K--Riedel-Rice (K-RR) controlled model (initiation initially under the elastic K field and then under transient creep stress conditions, the Riedel-Rice (RR)) and the Hutchinson-Rice-Rosengren--Riedel-Rice (HRR-RR) controlled model (initiation initially under the elastic-plastic Hutchinson-Rice-Rosengren (HRR) field and then under RR controlled stress field) compared with finite element (FE) solutions. K-RR was more suitable when the primary stress intensity factor K_I^P was below 15 MPam$^{1/2}$, and HRR-RR was more accurate when K_I^P was beyond 15 MPam$^{1/2}$. However, RRss (initiation under the steady state creep)