Numerical investigations on the effects of *T*-stress in creep crack

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Abstract

The influence of *T*-stress on creep crack tip stress field is studied based on finite element method in this paper. The modified boundary layer (MBL) formulation is introduced and used for the power-law creeping solids. The influences of *T*-stress on the creep zone and creeping fracture parameters are presented with MBL formulation and the *T*-stress affected creep crack tip field is also compared with the elastic field. Under the MBL formulation, the stress field for creep crack tip is investigated under different levels of *T*-stress. It can be found that lower negative *T*-stress violate the HRR singularity and elastic field greatly in creep crack tip field. The near crack tip stress field under large positive *T*-stress still obeys HRR singularity, while the far field is not the accurate elastic field any more. The creep zone size is also influenced by *T*-stress, and the small negative *T*-stress has the larger creep zone than that of larger *T*-stress at the same creep time. A novel parameter is proposed to characterize the creep zone considering the influence of *T*-stress on $C(t)$ or C^*-integral. For the same stress intensity factor with different *T*-stress levels, the constraint parameter *Q* under small scale creep is demonstrated to be described by a three order polynomial function of T/σ_0. The research shows that the constraint parameter *Q* of creep crack for specimens is also verified to rely on *T*-stress level.

Keywords: *T*-stress; Creep crack; Constraint effect; Creep zone size; Modified boundary layer formulation;