RHEOLOGICAL-DYNAMICAL THEORY OF MULTIAXIAL FATIGUE

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Abstract: The paper deals with the rheological-dynamical analogy (RDA) in which the three-dimensional stress-strain relations are defined under cyclic variation of stress for Hencky's total strain theory. In many practical viscoelastoplastic problems, like as multiaxial fatigue under loading at constant stress amplitude and constant stress ratio, the load-carrying members are subjected to proportional loading. The classical Hencky's theory has the advantage of mathematical convenience but its disadvantage is that the deformations predicted for the volume element are independent of the loading path. The existing formulations of the constitutive models for metals are mainly based on the Prandtl-Reuss incremental theory of elastoplasticity, slip theory of plasticity or continuum damage mechanics. They have been shown capable of reproducing satisfactorily most experimental results available for metallic specimens. However, from the theoretical viewpoint little has been said about how these formulations relate to realistic predicting many different inelastic and time dependent problems of two- or three-dimensional solids, such as fatigue, discontinuous plastic deformation etc. In this paper, fundamentally new aspect of isochronous constitutive relations for Hencky's theory, which are dependent of the each loading path, is achieved by systematically introducing RDA concept into the continuum framework. Specific multiaxial fatigue formulation of triaxial state of stress is developed and discussed within the new theoretical tool.

Key words: RDA theory of fatigue; RDA isochronous constitutive relations; Relaxation of stresses; RDA fatigue strengths.

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