The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5 – 9 June 2022, Oslo, Norway

Plastic-damage model for cyclic loading: phenomenological rule of mixtures approach

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Key Words: *fracture mechanics, plasticity, damage, cyclic loading, rule of mixtures.*

Through the undergone research a novel plastic-damage model approach is presented for the study of materials that exhibit combined energy dissipation mechanisms. This model is based on a phenomenological pseudo-composite theory in which each constitutive behaviour, damage and plasticity, act as a virtual material component of the whole physical entity.

The model is based on the Rule of Mixtures and on the serial/parallel Rule of Mixtures [1, 2], which were initially developed as homogenization techniques for accurately and efficiently analyzing composite and laminated materials with non-linear and anisotropic behaviours at each material component. Taking advantage of this feature, a simple and efficient plastic-damage model has been derived by combining a certain rule of mixtures with two pseudo-material components: plasticity and damage. Isotropic plasticity and isotropic damage models have been used on this work and equivalent hardening curves for each non-linear process have been formulated. The differences in the evolution of the dissipation process associated to each constitutive law have been considered resulting in a model that consistently dissipates the available total fracture energy.
The *pseudo-composite* behaviour is built weighting the presence of each non-linear process along the material life. This is done through volumetric participation functions calibrated to reproduce the cyclic response of the studied material. The capabilities of the proposed model are demonstrated with several numerical examples in which cyclic loading of frictional materials are performed.

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