A NOVEL THREE-INVARIANT ELASTO-PLASTIC-DAMAGED FORMULATION FOR METALLIC MATERIALS

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ABSTRACT- Aim of the present work is the evaluation of the ductile behavior of metallic materials undergoing multi-axial loading conditions.
Recent literature pointed out the necessity of evolving from the definition of the von Mises yield criterion as a representative plastic potential for metals to a more sophisticated formulation, that takes into consideration all the three stress tensor invariants, so capable to describe the material behavior in a generic loading path [1]. This need is confirmed by the experimental investigations performed by the authors on solid round steel bars, where the load is applied in form of uniaxial tension/compression and torsion combinations.
In the light of the above, a novel three-invariant elasto-plastic-damaged formulation is proposed in this work.
As regards plasticity, so to avoid the introduction of a large number of parameters in the material model, von Mises classical formulation is expanded into a new elasto-plastic one characterized by: a more sophisticated hardening law, function of the three plastic strain tensor invariants, and a plastic flow rule expressed in terms of the three stress tensor invariants to activate the proposed hardening [2].
As regards damage, the prediction of the final elongation/rotation to failure is another crucial point of the design of structures or components. In the framework of continuum damage mechanics, a criterion that considers the effect of the stress triaxiality and the Lode angle is here adopted [3].

REFERENCES

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