A micromechanical-based model for the ductile cohesive-volumetric damage

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For numerical purposes, the cohesive-volumetric finite element method has gained much popularity in crack and damage simulations. A micromechanical-based damage model is here proposed for such ductile "cohesive-volumetric" media. The proposed model defines theoretical and practical criteria for the calibration of cohesive zone models (CZMs) in these simulations.

The studied medium is made of a hardening matrix (Hencky plasticity) containing penny-shaped cohesive inclusions (traction-separation laws). The spatial distribution of the cohesive inclusions can fit a prescribed finite element discretization. The overall elasto-plastic and damageable behavior is derived using a non-linear homogenization technique (variational approach of P. P. Castañeda, [1]). The proposed model: i/ can be applied whatever the shape of the cohesive law contrary to what is proposed in the literature, and ii/ has the capacity to exhibit the influence of the triaxiality loading rate on the overall ductile damage properties.

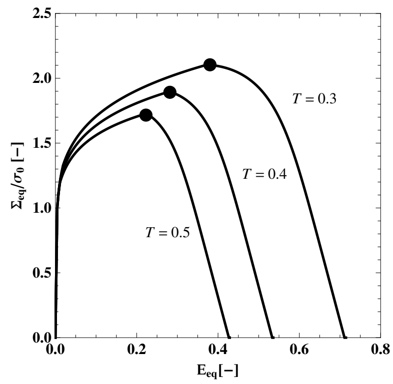

Figure 1. Effect of the triaxiality loading rate, T, on the overall behavior: normalized overall stress vs overall strain

For the case of a perfect-plastic bulk medium, a closed-form expression of the macroscopic potential is obtained. And whatever the volumetric plastic behavior, direct relationships between the local cohesive parameters and the overall material properties are developed. These relationships depend on: 1/ the mesh size and morphology, 2/ the applied triaxiality loading rate and 3/ the macroscopic material properties (maximal stress, failure energy, etc). More particularly, it is shown that *the cohesive parameters are triaxiality-dependent*. This dependency is consistent with previous results available in the literature and based on numerical or experimental studies (e.g. [2]).

REFERENCES

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