3D multiscale modelling of strain localization: using a micromechanically-based model

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ABSTRACT

Granular materials react with a complicated mechanical behavior when subjected to external loading paths. A powerful and straightforward way consists in developing micro-mechanical models embedding different scales in order to account for the different mechanisms involves. The three-dimensional micro-mechanical model (3D-H model [1, 2]), takes into account an intermediate scale (meso-scale) which makes it possible to describe a variety of constitutive features in a natural way. Then, the 3D-H model is implemented within an FEM code (ABAQUS). In this approach, the finite element method is used to solve a boundary value problem and the 3D-H model is employed as a micro constitutive relationship used at a representative volume element scale. This approach provides therefore a convenient way to link the macroscopic observations to intrinsic microscopic mechanisms. The plane-strain biaxial loading condition is selected to simulate the occurrence of strain localization. By defining properly the shear band area, microstructural mechanisms are investigated inside and outside the shear band. Moreover, a second-order work directional analysis is performed by applying strain probes at different stress-strain states along drained biaxial loading paths. The normalized second order work introduced as an indicator of unstable trend of the system is analyzed not only on the macroscale but also on the microscale, opening on emergent features.

REFERENCES

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