XVII International Conference on Computational Plasticity, COMPLAS 2023
September 5-7, 2023, Barcelona, Spain

PHASE FIELD FOR COMPACTION BAND FORMATION: CAPTURE OF GRAIN CRUSHING AND PERMEABILITY EVOLUTION IN HETEROGENEOUS MEDIA

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ABSTRACT

Compaction bands form when the pore spaces between the solid grains of a rock mass collapse into a narrow zone. This deformation style has attracted much attention in the theoretical and numerical modeling community since the porosity reduction associated with pore collapse reduces the overall permeability of the rock, thus enhancing its potential to serve as a fluid flow barrier. Recent publications [1, 2] demonstrate the capability of the phase-field modeling approach for capturing the formation and propagation of compaction bands in porous rocks. In this talk, the phase-field approach is utilized to show how grain crushing and fluid flow impact the formation and propagation of compaction bands. In the context of the finite element method, a three-field variational formulation in terms of solid displacement, fluid pressure, and the phase-field variable is employed for this purpose. Using material parameters calibrated from real rocks, we show how the volume constraint imposed by fluid flow could impact the stress-strain responses of the rock as well as the ensuing geometric style of the compaction band.

REFERENCES

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[2] Wang, Y., Borja, R.I., Wu, W. Dynamic strain localization into a compaction band via a phase-field approach. *Journal of the Mechanics and Physics of Solids*, Vol. 173, 105228, 2023.