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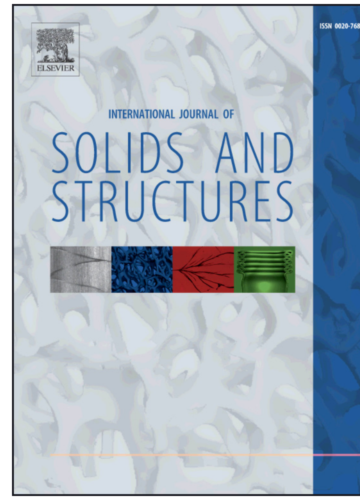

Numerical and theoretical analysis of compaction banding in highly porous cemented materials

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Abstract

In this paper, the mechanically induced compaction process in highly porous cemented materials is tackled and, in particular, the mechanical response of a cylindrical sample oedometrically loaded is numerically simulated. The results of the numerical campaign, performed by using a self-made finite element code, in which a non-local elasto-plastic strain softening constitutive relationship has been implemented, are discussed.

The influence on the numerical results of both the characteristic length size and the initial defect spatial distribution has been analysed.

If a local version of the constitutive model is employed, the localization takes place randomly: multiple compaction bands develop within the sample. The unique way of inducing a spatial propagation of the compaction band is to introduce a linear distribution of the initial defect. The numerical solution is mesh-dependent and for sufficiently large values of the number of elements, the numerical solution becomes unstable. This instability, commented and theoretically justified by employing a simple 1D rheological model, is interpreted as a consequence of the snap-back phenomenon, which is affected by both geometrical and mechanical parameters.

In contrast when the non-local version of the constitutive model is employed, the compaction band numerically observed propagates progressively within the sample until the material is completely damaged. Solely in case the defect is randomly distributed within the sample and its size is sufficiently large, compaction band propagation is inhibited and numerical stability is lost.

Keywords: compaction bands, characteristic length, elasto-plastic model, nonlocal approach

1. Introduction