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Analysis of dynamical effects during compaction band formation

Francesco Cecinato

Assistant Professor in Geomechanics, University of Trento

Tuesday June 16, 2 - 4pm, Room LG05, Tyree Building

Compaction bands (CBs) are responsible for significant anisotropy alterations of permeability in geological materials, hence understanding their formation conditions appears of key importance to all applications involving fluid extraction/injection from/into the ground. While most of the available models to understand CB formation are focused on interpreting the onset of a single CB, little effort has been so far dedicated to understand the documented periodicity of CBs.

In this work, the role of dynamical effects in inducing the post onset evolution of CBs is analyzed by means of a dedicated model for porous media with compressible constituents, with reference to a horizontal layer of sandy, water-saturated material. Elastic waves are generated as a first CB occurs due to sudden, localized volumetric collapse. If the waves are reflected at the interface with a softer material or with a previously formed CB, they produce significant local effective stress concentrations, which can promote the formation of further CBs in a cascade fashion, according to a regular geometric pattern.

The spatial distribution of dynamically generated CBs, as well as the extent of the phenomenon, depend on the geometry of the domain and on the material's permeability. Sensitivity analysis is also performed to assess the key properties that promote dynamical CB insitu formation, identifying as the most influential conditions large stratum stiffness (increasing with depth) and the presence of softer layers. In contrast, the presence of less permeable and/or stiffer layers is not believed to play a major role in the proposed mechanism.

Short bio:

Dr Francesco Cecinato is Assistant Professor in Geomechanics at the University of Trento (Italy) since December 2012. Prior to his return to academia, Francesco spent four years working both as a consultant for a geotechnical engineering firm, and as a geomechanics specialist at the research centre of ENI E&P in Milan. His research interests span from constitutive and numerical modelling of geomaterials to geotechnics and experimental soil/rock mechanics. His fields of expertise include geothermal ground structures, landslide analysis, wave propagation in porous media, the mechanics of geologic and ceramic materials at high temperatures, chemo-mechanical modelling of bonded geomaterials and petroleum-related geomechanics with emphasis on unconventional reservoir problems.

