Contribution ID: **5** Type: **not specified**

Evolution of stresses and deformations in a road embankment in unsaturated, low-swelling soil subjected to hydro-mechanical pressures

We present simulation results of the evolution of stresses and strains in an unsaturated low-swell soil road embankment subjected to hydro-mechanical pressures using the finite element code CODE_BRIGHT. We assume that this bitumen-bearing backfill follows the Barcelona thermo-elasto-plastic model (BBM-TEP). This model describes the thermo-hydro-mechanical (THM) behavior of unsaturated fine soils based on variations in net stress and suction. Using this simulation, the analysis focuses on the collapse of road structures, generally due to the poor quality of the materials used, but also to natural phenomena such as capillary rise, and anthropogenic phenomena such as overloading. The paper shows that imbibition by upwelling induces an increase in the degree of saturation of over 50% in the lower part of the structure, and deformations of up to ten centimetres in amplitude when surcharges are added to the embankment surface. This paper also highlights the behavior of unsaturated soils, such as the decrease in void index with increasing effective stress or suction, and the increase in suction with increasing effective stress.

Keywords: low-swelling soil, road fill, hydro-mechanical pressures, stresses, deformations.

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