UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

PROJECT DESCRIPTION

Title:	Three-dimensional cracking in soils due to oscillations of environmental variables

Project description:

This project represents the development of a continuing line of research initiated in previous projects that has produced advances in a topic so far little studied: crack formation in soils due to changes in environmental conditions (such as drought), a recurrent phenomenon in Mediterranean-type climates with wide implications (e.g., change of soil's permeability or of its bearing capacity). Cracks can propagate from the upper surface in contact with the atmosphere towards the interior of the sample, but also in the opposite direction starting from the bottom surface and propagating towards the upper, external surface. These cracks do not necessarily cross the whole sample; rather, they may stop or even change direction in random interior points. The surface crack pattern is different in the upper and bottom surfaces, suggesting different types of cracking mechanisms on or near both surfaces which needs to be further investigated in more detail. Also, bending of the soil cells in the vertical plane is almost always present. This bending might be explained by differential drying between the sample's upper and bottom surfaces. The obvious conclusion is that cracking in soils is essentially a three-dimensional phenomenon and as such must be investigated both experimentally and from the theoretical and numerical viewpoints.
In this research project we propose to continue the experimental research focusing in two main subjects: a) study of the cracking process as a three-dimensional phenomenon, investigating key aspects such as the impact of crack opening in the volume of evaporated water, the cause of the different crack patterns seen on the top and bottom boundaries, or the three-dimensional crack pattern; and b) adding new features to an already existing environmental chamber to simulate, in the laboratory, cycles of temperature, air humidity or rain, to increase the precision and performance of the chamber because so far it has proven difficult to control some cyclic tests such as recurrent drought-rain episodes. On the theoretical/numerical side, research will focus on the simulation of the laboratory tests performed in the environmental chamber, which will allow a better understanding of the three-dimensional crack patterns in natural conditions and in turn to study real boundary value problems that may pose some risk conditions. Most of the effort will be devoted to developing a three-dimensional coupled finite element code that will be based on an already existing two-dimensional code.

UPC RESEARCHER CONTACT

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OTHER INFORMATION

Funding:	direct expenses: 110.000€, a techniciean of support and scholar FPI.
Duration:	2009 – 2012
Facilities:	Soil Mechanics Laboratory, Computer Facilities (both personal and intensive)