Cracking in desiccating soils: experimental analysis and practical implications

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ABSTRACT

Soils undergoing desiccation may develop cracks due to the induced shrinkage. Those cracks reduce substantially the mechanical properties of soils (bearing capacity, strength, etc.) and increase permeability. Generally, cracks develop from the soil surface which defines the interface of the soil-atmosphere interaction problem. However, inner individual cracks generated by desiccation have been observed as well in laboratory experiments [1]. Therefore, knowledge of cracks becomes a fundamental issue in many practical works, as the assessment of the stability of slopes, the analysis of bearing capacity of foundations and pavements, or the confinement properties of liners in waste storage facilities. Despite its relevance, the study of cracking due to desiccation is a recent topic in Unsaturated Soil Mechanics.

The presentation includes the description of an experiment involving a tray of a clayey soil subjected to drying and wetting cycles in an environmental chamber, where air relative humidity is controlled. Cycles of relative humidity induce volume changes in the soil and eventually cracking. Soil becomes gradually not sensitive to these cycles reducing their impact on volume change. Drying generates shrinkage and cracks, but wetting may induce cracks as well, because the strength of the soil increases with suction and wetting reduces that suction. It is shown that in this type of experiments, flow of water vapour through the soil surface (i.e., evaporation) is the main driving process.

The presentation also includes a brief description of other experiments that show the role of the soil surface in this context. In particular, when the soil is exposed to environmental conditions, evaporation may be enhanced by other factors like radiation and wind velocity [2].

This work highlights the conditions leading to crack generation and suggests the main points that should be considered when analysing the stability or the serviceability of a practical geo-structure in a context of climate change conditions.

REFERENCES

[1] Lakshmikantha, M.R., Prat, P.C., Ledesma, A. “Boundary effects in the desiccation of soil layers with controlled environmental conditions”, *Geotechnical Testing Journal*, Vol. **41** (4), pp. 675–697, (2018).

[2] J.A. Cordero. Experimental analysis of soil cracking due to environmental conditions. PhD Thesis, UPC-BarcelonaTech, Spain, (2019).