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Mechanical, chemical, mineralogical, morphological and computational characterization of Ecuadorian Soil: A first nationwide data baseline

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We introduce a first attempt to generate a nationwide baseline about the mechanical, chemical, mineralogical and morphological characterization of Ecuadorian soil. With this aim, the analysis of unaltered soil samples corresponding to the capitals of twenty-three provinces and six other significant locations in Ecuador is performed as follows: First, the gradation and Atterberg limits of each sample allow us to obtain each sample's classification according to the Unified Soil Classification System (USCS), which, in turn, provides important information regarding the soil's mechanical behaviour. Second, unconsolidated undrained (UU) tri-axial tests are carried out in order to determine the strength related to each sample, i.e., internal friction angle and cohesion. Third, chemical and mineralogical features are obtained by means of a scanning electron microscope (SEM). Fourth, the morphology of the grains that furnish the fabric of each given soil sample is obtained by calculating parameters such as roundness, sphericity, grain volume, and grain surface area. This morphology (actual shape of each grain) is first obtained through 3D X-ray computed tomography (3DXRCT) of the samples, and then by turning the 3DXRCT voxel-based images into mathematical functions called level sets (LS) that enable us to perform calculations on the morphology of the grains. Thus, a virtual database can be created in order to generate more accurate computer models with enhanced predictive capabilities and an improved evaluation of microstructure directly from a real physical sample. These are the first few steps in order to develop more sophisticated computational models, which could eventually replace both: the need for extensive and costly laboratory tests to understand real natural phenomena, and the use of phenomenological models that fail to incorporate micro-mechanical and morphological effects that are key when it comes to the material's behavior. However, much remains to be done…

REFERENCES

[1] Jerves, A.X. Kawamoto, R.Y. Andrade, J.E.: A geometry-based algorithm for cloning real grains. Granular Matter. (2017). DOI: 10.1007/s10035-017-0716-7

[2] Jerves, A.X., Kawamoto, R.Y., Andrade, J.E.: Effects of grain morphology on critical state: a computational analysis. Acta Geotech. **11**, 493–503 (2015)
[3] Kawamoto, R., Andò, E., Viggiani, G., Andrade, J.E.: Level set discrete element method for three-dimensional computations with triaxial case study. J. Mech. Phys. Solids **91**, 1–13 (2016)
[4] Vlahinic, I., Ando, E., Viggiani, G., Andrade, J.E.: Towards a more accurate characterization of granular media: extracting quantitative descriptors from tomographic images. Granul. Matter (2013). DOI:10.1007/s10035-013-0460-6
[5] Jerves, A.X., Andrade, J.E.: A micro-mechanical study of peak strength and critical state. Int. J. Numer. Anal. Methods Geomech. **40**, 1184–1202 (2015)
[6] Kawamoto, R., Andò, E., Viggiani, G., Andrade, J.E.: All you need is shape: predicting shear banding in sand with LS-DEM. Journal of the Mechanics and Physics of Solids. (2017). ISSN 0022-5096.
[7] ASTM Standard D 2850. 2003. "Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils". ASTM International. West Conshohocken. PA. (2003). www.astm.org.
[8] ASTM D6913 / D6913M-17. "Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis". ASTM International. West Conshohocken. PA. (2017). www.astm.org
[9] ASTM D4318-17. "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils". ASTM International. West Conshohocken. PA. (2017). www.astm.org