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Editorial

Editorial of Special Issue "Natural and Artificial Unsaturated Soil Slopes"

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Natural and artificial slopes are frequently constituted, at least in part, by soils in unsaturated conditions. Their degree of saturation strongly influences the hydraulic and mechanical properties and, therefore, pore water pressures and stability. This Special Issue collects six papers focused on unsaturated soil behavior in engineering applications involving natural or artificial slopes. All the papers hold a significant laboratory/site experimental characterization and/or numerical analysis content for the interpretation of the considered phenomena.

Ponzoni et al. [1] report water retention data for a sandy silt and a silty sand coming from two different climatic European environments. The soils were tested in the laboratory by using two commercial devices, and the results were modeled with van Genuchten's law. The authors determined a correlation of the fitted parameters with the amount of fines and discussed the advantages and limitations of the proposed approach on the basis of drying–wetting test results. The study demonstrated the feasibility of the approach, aiming for a rather inexpensive characterization of retention properties for the assessment of climate impact on slope stability, and providing a careful evaluation and an elaboration of data.

Bovolenta et al. [2] discuss the reliability of soil moisture capacitive sensors, the operations related to their calibration and the installation phases for several European monitoring networks designed to assess the susceptibility to rainfall-induced debris and earth slides. The aim of such networks is to establish a cause–effect relationship between rainfall and landslides by measuring near-surface water content variations over time. After appropriate calibration, the systems are revealed to be able to provide consistent soil moisture data. The sensors are rather cheap, easily relocatable and replaceable, which makes a remotely managed network relatively inexpensive and rapid to install.

Castelli et al. [3] report experimental data derived from laboratory and site tests, carried out with the aim of evaluating soil parameters for debris-flow run-out simulations. The experimental activities included triaxial tests in unsaturated conditions and geophysical investigations. Starting from a study of the geological framework and the historical background, this research focuses on the causes that triggered a recent debris-flow event in Sicily, Italy. The authors discuss possible strategies to determine the hydro-mechanical parameters that can be used for a numerical analysis of such phenomena and the role of matric suction, which reflects soil infiltration, in the investigation of rainfall-induced landslides.

Sitarenios and Casini [4] present a three-dimensional, limit equilibrium, slope stability solution for translational planar failure modes. The solution uses Bishop's average skeleton stress combined with the extended Mohr–Coulomb failure criterion. The performance of the proposed theoretical solution is evaluated by comparing its predictions with the results of a full-scale slope failure experiment carried out in Switzerland. The 3D solution can satisfactorily capture the experimentally observed behavior. Furthermore, its simplicity and very limited calculation costs allow for an easy evaluation of different scenarios with respect to slope geometries and soil parameters, which can be very useful in a landslide back-analysis.

Ventini et al. [5] discuss the assessment of the hydraulic and mechanical behavior of river embankments, by considering transient seepage under unsaturated soil conditions. This is a more accurate approach than assuming, as frequently occurs in routine engineering practice, steady-state seepage and either fully saturated or "dry" conditions. A comprehensive procedure for the definition of the key aspects of the problem is presented. The soil characterization in unsaturated conditions of a compacted mixture of sand and fines, typical of flood embankments of the main tributaries of the Po River in Italy, is reported. The laboratory results are used for parameter estimation, aiming to model the embankment performance under transient conditions and following a set of possible hydrometric peaks. The importance of carrying out such an analysis is highlighted in a comparison with steady-state seepage analyses performed at the maximum hydrometric height recorded, which frequently provide excessively conservative stability assessments. Safety factor variations over time are obtained by limit equilibrium analyses as the effect of river level fluctuations, providing useful information for further detailed experimental and numerical investigations on the river embankment response.

Sepe et al. [6] analyze the capillary barrier formation at the interface between shallow soil layers characterized by textural discontinuities. The investigation is focused on the effects of rainfall events in pyroclastic deposits of the Vesuvian Area, in Campania region, Italy, undergoing shallow instability phenomena caused by progressive soil saturation. Based on a detailed field survey, the failure surface location was identified at the interface between grey pumice and black scoriae layers, likely due to their contrasting hydraulic properties. One-dimensional infiltration into the stratified soil is numerically simulated, considering rainfall events of increasing intensity and duration. The changes in the degree of saturation and suction over time are used for the evaluation of stability condition variations. By analyzing the time history of the infiltration process, the authors highlight the capillary barrier water break-through as a consequence of the progressive suction equalization between the two layers, as well as the gravity-driven downward water flux over time. The simulated failure conditions due to a medium intensity, long duration rainfall event are consistent with the field observations.

Conflicts of Interest: The authors declare no conflict of interest.

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