

lower risk of slope failure during operation. The proposed mining method was applied to the Mae-Moh lignite mine of Thailand as a case study.

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Vacuum consolidation field test on a pseudo-fibrous peat

A vacuum consolidation field test was successfully implemented for a 10×10 m area of raised bog, in order to investigate the performance of the method in pseudo-fibrous peat deposits and also to evaluate the viability of this technique for the construction and improvement of roads over peat. The efficiency of two different spacing of prefabricated drain was investigated for the 4 m-deep peat deposit. The test was instrumented and monitored for a period of 11 months. Two different vacuum-generating systems were also tested during the project. The field data were back-analysed using a range of finite-element models incorporated in PLAXIS. Acceptable results were obtained for the ground vertical displacements. The design parameters were determined by means of oedometer tests, indicating that the geotechnical properties of the peat obtained in conventional tests can be used in the design of vacuum consolidation projects.

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C. Mariantonietta, Università degli Studi di Salerno, Italy *A methodological approach for the analysis of shallow landslides in non-collapsible soils*

Shallow landslides in non-collapsible, physically weathered fine-grained soils may cause huge consequences – in terms of environmental and economic damages – due to their simultaneous occurrence over large areas. Indeed, the prediction of the areas potentially affected by these phenomena is a relevant issue for land use planning and/or design purposes. A multidisciplinary and multi-scale methodology able to fulfill this goal is proposed, tested and validated over an area in southern Italy affected by widespread shallow landslides that can be classified as earth slides-earth flows. In particular, moving from small (1:100 000) to large scale (1:5000), the methodology is based on geological (heuristic) criteria and it allows both the automatic detection of the areas potentially affected by these phenomena and, for each scale, the proper identification of the main factors leading to the landslide occurrence. On the other hand, moving from detailed (1:1000) to large scale the analyses are based on geotechnical (deterministic) procedures – that is, physically based (TRIGRS and TRIGRS-unsaturated) and limit-equilibrium methods – and they can allow landslide susceptibility zoning in a quantitative way. Efficiency and reliability of the proposed methodology are confirmed by its application to a well known case study in New Zealand using the data available in the scientific literature.

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Experimental investigation of microstructural changes in deforming granular media using X-ray tomography

This thesis presents an experimental investigation into the

micromechanics of granular media. The novelty that this work brings is that during the campaign of triaxial compression tests (run on a series of three sands with different grain shapes, prepared dense and tested at different cell pressures) the specimens are imaged (in around 15 configurations) during loading using X-ray tomography. Specimens are relatively small (22 mm height, 11 mm diameter), allowing scanning at a sufficient resolution to identify all the grains ($>50\,000$). Grains are identified in these three-dimensional images using a standard watershed algorithm, and techniques are developed to characterise the granular structure, grain-to-grain contacts, and to measure the full kinematics of all grains between imaged states. These measurements allow the micromechanisms responsible for the observed macroscopic behaviour to be understood. Important mechanisms such as the increasing rotational frustration of angular grains in a shear band are identified; this is used to explain the higher value of residual stress for these materials. Signs of localised deformation are seen to occur well before the peak in many samples, and complex patterns of rotating grains are noticed around the peak of each sample's response.

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A pore-scale coupled hydromechanical model for biphasic granular media. Application to granular sediment hydrodynamics

The behaviour of multiphase materials covers a wide range of phenomena of interest to both scientists and engineers. The mechanical properties of these materials originate from all component phases, their distribution and interaction. A new coupled hydromechanical model is presented in this work. It associates the discrete-element method (DEM) for the solid phase, and a pore-scale finite-volume (PFV) formulation of an incompressible flow problem. The emphasis of this model is on the description of the interaction between phases at the microscale. It has affordable computational costs, allowing the simulation of thousands of particles in three dimensions. Pore bodies and their connections are defined locally through a regular triangulation of the packings. The correspondence of the DEM-PFV model with the classic Biot's theory of poroelasticity is discussed. The model is validated through comparison of the numerical results with Terzaghi's analytical solution for the consolidation problem. An approach to analyse the hydrodynamics of a sea bed sediment subjected to waves is finally presented. The reproduction of the phenomenon of sediment liquefaction is analysed.

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Modelling of geomaterial solid-fluid transitions. Application to landslides

In the field, under specific external conditions, soils can turn into fluid – for example, during mud-flow or debris-flow initiation. This work deals, in a general way, with solid-fluid transitions in geomaterials behaviour and aims to develop a new constitutive model describing both solid and fluid phases and the transition in between. In order to describe this complex behaviour with a single numerical tool, the FEMLIP numerical method (finite-element method with Lagrangian integration points) is chosen since it can handle both history dependent behaviour, essential for solid description, and unlimited fluid strains. The main originality of the proposed transition model lies in two developments: