

## Preface

The 4th European Conference on Unsaturated Soils, E-UNSAT 2020–Unsaturated Horizons, was organised by Instituto Superior Técnico in Lisbon, in collaboration with Technische Universiteit Delft in Delft and Universitat Politècnica de Catalunya in Barcelona. The conference series is supported by the Technical Committee TC106 of the International Society of Soil Mechanics and Geotechnical Engineering on 'Unsaturated Soils', and E-UNSAT 2020 followed the previous successful ones in Durham (2008), Napoli (2012) and Paris (2016).

During the organisation of the conference, we had to face hard times due to the worldwide pandemic. Eventually, we had to renounce hosting the delegates in Lisbon, which we hope will be a sad exception in this conference series. However, this circumstance allowed the participation of many authors, nearly 50% of the total number, coming from outside Europe (Asia, North America, South America, Africa and Australia), and confirming the worldwide interest of Unsaturated Soils in the scientific community.

Following the example of the organisers of E-UNSAT 2016 in Paris, we decided to go for fully open-access online availability of the papers submitted to the conference. We strongly believe this will help in spreading knowledge and ideas beyond the event.

The proceedings collect the accepted 131 papers, whose authors come from 46 different countries. They do not include invited and keynote lectures. In announcing the conference, besides more traditional geotechnical engineering applications, we had sent a special invitation for contributions on environmental problems (engineered barriers to protect the environment, the reuse of waste materials, climate stresses, sustainable geotechnical design) and new technologies (energy geotechnics and bio-inspired technologies). The papers collected in these proceedings show that the environmental topic is now felt as a major concern, especially after the evidence of the delicate equilibrium between the environment and the human community we are facing in these times. Contributions to the two topics also came from some ongoing large European research project inside our community.

The 141 papers are divided into six broad sections:

- 1 - Field studies and engineering applications (34 papers)
- 2 - Theoretical and numerical models (30 papers)
- 3 - Experimental evidence and techniques (44 papers)
- 4 - Special session on energy geotechnics (15 papers)
- 5 - Special session on bio cementation (9 papers)
- 6 - Special session on the reuse of waste geomaterials (9 papers)

Three of them cover the development of theoretical, numerical and experimental approaches, unsaturated soils characterisation and applications to a variety of field problems. The last three are thematic, include rather new fields of study and suggest new horizons for our research in the engineering applications, showing the present intense effort of the community on protecting the environment and improving sustainability in a changing world. We hope the conference proceedings to be able to boost future applications as well, seeking for sustainability and novel applications. We believe that future conferences on Unsaturated Soils will focus even more on a new perspective on clean energy, low carbon footprint and forthcoming environmental issues, still supported by the hard theoretical and multiscale experimental works, which are part of our background and will prove fundamental to bring our results better to the practice.

All the papers underwent careful peer review before acceptance. We acknowledge the work done by the reviewers, for their fundamental contribution in assuring the scientific quality of the proceedings. Thanks are due to Jonathan Tenório de Lima, who helped Rafaela Cardoso in preparing the final layout of the papers.

Special thanks are due to our sponsors, GDS and VJ Tech, who remained on board in difficult industrial times, to FUNDEC and Abreu Agency for their help in the organisation of the online event. Acknowledgements are also due to Turismo de Lisboa, TAP and CGD for their understanding when we had to change the conference to an online format.

We thank the Chair, David Toll, and the Secretary of the TC106, Adrian Russell, for their support on decision making.

We all had to adapt to a format we were not expecting and to constraints we could not have imagined when we started organising the conference. Finally, we would like to warmly thank the resilience of the participants, which allowed us completing the organisation of the conference, even after being postponed and eventually changed to an online format. We hope these proceedings will reward the effort all authors have made in supporting the conference with their papers, and their patience in waiting for updated decisions during the previous months.

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