

Trends and Prospects in Geotechnics

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The Special Issue, titled “Trends and Prospects in Geotechnics”, was launched with an invitation to authors from all over the world to address current and future challenges in geotechnics. As is well known, the world is constantly changing, and so are geotechnics. Advances in constitutive models, sustainable materials, biobased methods, nanotechnology, energy, artificial intelligence, and climate change, among other topics, are examples of the most recent advances, trends, and prospects in soil mechanics and geotechnical engineering. Twenty-six manuscripts were submitted to this Special Issue, and twelve were accepted for publication. Contributions were received from 13 countries (Australia, Brazil, China, Germany, Iraq, Japan, Malaysia, Pakistan, Poland, Portugal, South Korea, Sweden, and Thailand), representing 4 continents (America, Asia, Europe, and Oceania), which addressed some of these emerging topics, with a specific focus on the research, design, construction, and performance of geotechnical works.

In the first paper, Sukmak et al. [1] study the effects of several types of cohesive-frictional soil and geotextile reinforcement configurations on the bearing capacity via laboratory tests and numerical simulation. Several factors were studied, which included embedment depth of the top reinforcement layer, width of horizontal planar form of the reinforcement, spacing between geotextile reinforcement layers, and number of reinforcement layers. The outcome of this research provides a preliminary guideline in a design of reinforced soil foundation structures with different ground soils and other reinforced soil foundation structures with different geosynthetic types.

In the second paper, Yan et al. [2] present a novel study that integrates the spatial time domain reflectometry technique, high precision tensiometer, and consistent outflow logging to investigate the dynamic response of moisture distribution, soil suction, and seepage flux during a transient drainage process. After performing experimental validation tests, the authors concluded that the spatial time domain reflectometry technique offers the researcher a higher resolution of moisture distribution variation with time.

The third [3] and twelfth [4] papers deal with tailing dams. In the third paper, Do et al. [3] investigate the effects of the pond filling rates on excess pore water pressure and the stability of an upstream tailings dam by a numerical study. The approach presented in the paper can be a guide for dam owners to keep a sufficiently high pond filling rate, while still ensuring the desirable stability of an upstream tailings dam. On the other hand, in the twelfth paper, Consoli et al. [4] propose a new approach to deal with the stability problems of tailing dams. In this work, a new approach is proposed for tailings disposal: stacking compacted filtered ore tailings–Portland cement blends. The influence of compaction, as well as the amount of Portland cement, on strength and stiffness properties was evaluated. Although there are parameters that require further studies (moisture content, sustainable binders, and confining pressure), the authors concluded that the addition of a binder to the compacted filtered tailings reduces the volume of hydraulically carried out sediments, thus allowing smaller sedimentation structures downstream of the disposal structure.



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The fourth [5] and ninth [6] papers are focussed on the study of machine learning algorithms as a tool to accurately predict the geomechanical properties of rock or soils, thus minimizing the costs associated with the pre-design and design stages of geotechnical structures. In the fourth paper, Ahmad et al. [5] investigate supervised machine learning algorithms (support vector machine, random forest, AdaBoost, and k-nearest neighbour) to predict the rockfill material shear strength. The performance of the supervised machine learning models are assessed using statistical parameters. The SVM model results in the best and highest performance algorithm, which suggests that this algorithm is more robust in comparison with others in rockfill material shear strength prediction. On the other hand, in the ninth paper, Tinoco et al. [6] study the performance of four machine learning algorithms (artificial neural networks, support vector machines, random forest, and multiple regression) to predict the unconfined compressive strength and the tensile strength of soil–binder–water mixtures reinforced with short fibres. Exploring global sensitivity analysis ensured a deeper understanding around the proposed algorithms. The authors concluded that the proposed models were able to catch both mechanical properties behaviour with a promising performance (R^2 higher than 0.95), particularly those based on artificial neural networks.

The fifth [7] and tenth [8] papers study the effects of applying nanomaterials to chemically stabilised soils, i.e., innovative materials with a promising future. In the fifth paper, Takahashi et al. [7] studied the effects of using cellulose nanofibre (CNF) as an additive in Portland cement in the treatment for soft soil. Authors have concluded that CNF can mix the Portland cement evenly, hardly change the permeability, and reduce the variation in the strength, while at the same time, promoting an increase in the initial age and a reduction in the long-term strength development. In the tenth paper, Correia et al. [8] identify the key parameters in the chemical stabilization of soils with multiwall carbon nanotubes (MWCNT). The characteristics of the surfactant (with an impact on MWCNT dispersion) and time (the importance of MWCNT diminishes as the stabilized matrix becomes denser and stronger) seem to be fundamental parameters which affect the geomechanical behaviour of the stabilized soil enriched with MWCNTs. From the study, the authors concluded that MWCNTs applied in a proper concentration and enriched with a specific surfactant type may be a short-term valid alternative to the partial replacement of traditional additives.

The sixth [9] and eleventh [10] papers deal also with chemically stabilised soils, but now focusing on durability, quality control, and quality assurance issues. In the sixth paper, Ehwailat et al. [9] investigate the use of different materials (nano-magnesium oxide, ground granulated blast furnace slag, and rice husk ash) in soil stabilization to prevent ettringite formation (associated to volume increase), thus avoiding the deterioration of civil engineering structures. The results proved the potential of the nano-magnesium oxide-based binders (incorporating ground granulated blast-furnace slag and rice husk ash) as effective soil stabilizers, showing them to be valid alternatives to traditional binders. In the eleventh paper, Kitazume [10] studies the importance of quality control and quality assurance (QC/QA)-related activities along the workflow of soil stabilisation projects. Based on the Japanese experience/results with mechanical mixing technology by vertical shaft mixing tools with horizontal rotating circular mixing blade, the current and recent developments of QC/QA are presented, which demonstrates their importance to clients and engineers.

In the seventh paper, Mendonça et al. [11] present an interesting study where a more sustainable alternative (xanthan-like biopolymer) is proposed to replace the use of Portland cement in soil stabilisation problems. The authors showed that a treatment with xanthan-like biopolymers or with commercial xanthan gum can be used to replace the Portland cement over the short term (curing time less than 14 days), although a greater level of effectiveness is obtained with the use of the commercial xanthan gum, due to its higher level of purity. The soil treatment with xanthan-like biopolymer creates a network of fibres that link the soil particles, while the commercial xanthan gum fills the voids with a

homogeneous paste. Although the results are promising, future studies are still needed to ensure that this bio-material is fully safe.

In the eighth paper, Abdulhamid et al. [12] present a soil contaminated with crude oil in order to reduce the level of soil pollution and then reuse it as a construction material. The contaminated soil is chemically stabilised with two types of Portland cement. The geomechanical properties of the contaminated and stabilised soil have shown that the treatment with Portland cement is an effective remediation method for processing waste to produce a safe, dry material acceptable for onsite application. Moreover, the remediation of contaminated soil with crude oil can utilize Portland cement type II, resulting in a more significant improvement compared to ordinary Portland cement.

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