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EDITORIAL

Guest Editorial to the Special Issue: Novel Technologies for Grouting, Jet Grouting and Soil Deep Mixing

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Ground improvement is among the most active fields of geotechnical engineering, continuously producing a variety of innovative solutions born to tackle new challenges and make traditional solutions more cost effective and environmentally sustainable. The race often takes place in an agitated manner, starting from empirical approaches without leaving time for the correct understanding of the phenomena through an in-depth scientific assessment and its translation into methods and models that provide reliability and soundness to technical solutions. The idea for this Special Issue is driven by the technological changes that have recently taken place in some relevant sectors of ground improvement, mostly due to the introduction of new products (binders, additives…) or to the digitalization of processes. The paper collection includes contributions from Italy, Germany, USA, Iran, India, Austria, Canada, China, Egypt and Brazil. The logical presentation of the subject has been approached by classifying the various contributions based on the two main issues posed by ground improvement, the effectiveness of treatments and the performance of ground-improved structures. Accordingly, the issue is organized by subdividing papers into two sections, the first one dealing with new technologies (8), the second one focusing on applications (5).

We, as guest editors, wish to thank the editorial board of Geotechnical and Geological Engineering for giving this opportunity and for the expert assistance provided throughout the publication process. Simultaneously we hope that readers will find this special issue on *Novel Technologies for Grouting, Jet Grouting and Soil Deep Mixing* useful and stimulating.

1 Technology

Barbosa et al. (2022) present an innovative technique of executing soil nails called sectorized post grouting (SPG). The method was qualitatively evaluated to determine the roughness of its surface before being applied to seven actual soil nailing projects so that it could be objectively evaluated. The authors found out that the new technique produced soil nails with superior pullout strength when compared to soil nails installed using gravity grouting and one-stage pressurized grouting. Besides, the method achieved comparable improvements in pullout resistance compared to nails installed via tube-à-manchette (TAM)

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grouting, although having a higher economic efficiency than TAM grouting.

Bocci et al. (2022) provided an experimental investigation of geopolymer materials as a cement mixture substitute for low-pressure injection for the improvement of coarse-grained soils. Material properties and mechanical tests were analyzed and carried out with different mixes. Due to its good strength/stiffness and injectability properties, the geopolymer material under study, accelerator, and filler, in the chosen mix design is a candidate to take the place of cement-based grouts and other chemical-based alternatives for the improvement of mechanical properties and to decrease the permeability of coarse-grained soils.

El Mohtar et al. (2022) present three experiments using digital imagery combined to give a better "inner look" at grout stability and permeation. Instead of just measuring the clear water bleed at the top, image analysis on bleed testing is utilized to show the internal stability of grouts by analyzing the w/c ratio along the height of the grout column. Second, relative to the anticipated theoretical front, a 2-D grout permeation test is used to demonstrate the differences in grout-front propagation over time for stable versus unstable grouts. Finally, to give a true "inside-look" of what deep-bed filtration looks like, stable and unstable grouts are infiltrated through translucent soil columns.

Getchell et al. (2022) present the outcomes of an experimental program on loose Ottawa sand modified with small amounts of Laponite (a synthetic nanoclay with (2:1) layer structure) using two specimen preparation methods. Advanced geotechnical tests were performed. At small to medium strains, the two methods' differing fabrics result in different behaviors. Every specimen reaches the same critical state as the clean sand regardless of specimen preparation method.

Njock et al. (2022) present an Improved Random Forest (IRF) model to assess ground displacement brought on by jet grouting. The new hybrid PSO-SA (Particle Swarm Optimization- Simulated Annealing) method is integrated into the suggested IRF model's random forest. The findings demonstrate that PSO-SA outperforms its competitors in terms of searching and convergence (PSO and SA). When used to forecast ground displacement, the IRF model performs better than the benchmark models.

Pratter et al. (2022) present tests on two different polymers employed in order to partially saturate the ground. The geotechnical testing program on the composite material of polymers and gravel is expanded by special experiments, such as rheometer tests, for chemical grouts in order to investigate the mechanical and hydraulic properties of the ground improvement. Strength testing on the composite material bring this to light. Last but not least, the numerical analysis of a track ballast stabilization using PFC-FLAC3D coupling shows the polymers' potential for use in real-world applications and their ability to manage challenging ground conditions.

Mojtahedi et al. (2022) show a thorough analysis using artificial neural networks (ANNs) of the costs associated with Deep Soil Mixing applications. Despite these significant possible sources of inaccuracy, the model's ability to accurately predict the improved UCS is demonstrated by its R^2 value of 0.83. A non-homogeneous combination of cement and soil throughout the operation, a change in the curing conditions between laboratory and field operations (such as temperature and humidity), or machine operation are some examples of the discrepancies between laboratory and field conditions that lead to errors, considering that it is impossible to replicate all the in-situ conditions of intact soil in laboratory compacted soil specimens.

Ali (2022) starts from the case study of a failure in Alexandria (Egypt) caused by an excess store load and compares Steel Slag Coarse Aggregate and Traditional Crushed Stone Aggregate in replacement mixtures with different mixture ratios and thicknesses. This study adopted a top replacement mixture layer with different mixture ratios and thicknesses to optimize these parameters based on experiments. The results of treatment are compared in terms of deformation and strength.

2 Applications

Prakash and Krishnamoorthy (2022) examine the effectiveness of stone and lime columns on the embankment stability, in terms of both safety and serviceability. The paper investigates the effectiveness of stone and lime column composite system with a numerical study.

Fan et al. (2022) adopt empirical prediction formulas, numerical simulation and tracer test to study the dynamic development characteristics of abscission layer, storage space of grouting, diffusion law of grout and its influence on groundwater. The results indicate the presence of a separation space in the top of water-conducting fracture zone, which develops and closes with the mining of working face.

Wang et al. (2022) perform orthogonal experiments and multi-objective optimization of mortar performance carried out with BP neural network and genetic algorithms to investigate the influence of various factors on mortar performance for the synchronous grouting of shields in anhydrous sandy cobble stratum, The results show the main factors affecting consistency, bleeding rate, density and compressive strength of the mortar.

Liu et al. (2022) presented two indirect testing methods, such as the Brazilian tensile strength test and the unconfined penetration test to give an experimental inquiry on its tensile strength on the cement-treated Champlain Sea clay.

Wannenmacher et al. (2022) presented drilling and grouting works at the Semmering Base Tunnel (Austria). For pre-excavation grouting, particular drilling and grouting techniques and materials have been developed and successfully applied in the building process. A Standpipe-Packer that replaces a traditional steel standpipe is one of the improvements, as is a drilling system that is precisely cased with grouting inserts to avoid borehole degradation and enable defined grouting. Additionally, this grouting-pipe method substitutes conventional tube-à-manchettes and uses preventers to regulate flushing while drilling. Finally, hybrid grout (a blend of cement and polyurethane) was used to stabilize the grout.

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