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Editorial

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Editorial

Paul J. Vardanega BE, MEngSc, PhD, GMICE, MASCE, MIEAust, FHEA

Associate Professor in Civil Engineering, Department of Civil Engineering, University of Bristol, Bristol, UK (Orcid:0000-0001-7177-7851) (corresponding author: p.j.vardanega@bristol.ac.uk)

Way Way Moinet MEng, ACGI, MSc, DIC, PhD, CEng, MICE
Registered Ground Engineering Specialist, Principal Engineer, Geotechnical Consulting Group, London, UK (Orcid:0000-0001-7559-055X)

Riccardo Castellanza PhD

Associate Professor in Geotechnical Engineering, University of Milano Bicocca, Department of Earth and Environmental Science, Milan, Italy

The fourth issue of *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* for 2021 is a themed issue on the topic ‘deep and underground construction’. As cities continue to expand, the necessity to increase the utilisation of underground space will continue. Research to better improve the design and construction of tunnels, deep shafts and retaining structures and their interaction with other constructions forms a key research area for geotechnical engineers. In his Rankine Lecture paper, Mair (2008) highlighted the importance of research not only on the effects of tunnelling on structures but also on buried services. Recent papers on ‘deep and underground construction’ topics published in *Geotechnical Engineering* include those by Bazier *et al.* (2021), DeJong *et al.* (2019), Do *et al.* (2018), Elbaz *et al.* (2018), Faustin *et al.* (2018), Khorasani *et al.* (2018), Oreste *et al.* (2020), Packer *et al.* (2018) and Pedro *et al.* (2019).

We wish to thank all readers, contributors and reviewers for their continued support of the journal and hope that they enjoy reading the ten papers (Ball *et al.*, 2021; Ieronymaki *et al.*, 2021; Liang *et al.*, 2021; Liu *et al.*, 2021; Nguyen *et al.*, 2021; Smith *et al.*, 2021; Tan *et al.*, 2021; Wong, 2021; Yan *et al.*, 2021; Zhang *et al.*, 2021) included in this themed issue.

The first paper (Wong, 2021) is the British Tunnelling Society Harding Prize award-winning paper from 2019; it presents an assessment approach to study the effect of tunnelling on the deformation of framed structures. The paper shows that framed structures do not reliably follow greenfield movements.

The next two papers relate to the performance of tunnel constructions and make use of analytical and numerical methods. The second paper in the themed issue (Liang *et al.*, 2021) details an analytical study of a shield tunnel with comparisons to a Shanghai case history with associated three-dimensional (3D) numerical simulations. The effect of surcharge was studied parametrically on the longitudinal response of the tunnel (Liang *et al.*, 2021). The third paper (Nguyen *et al.*, 2021) studies the influence of tunnel shape on the forces in the tunnel lining by comparing a hyperstatic reaction method (HRM) to Plaxis^{2D} analysis (with both methods showing good agreement). The study concluded in part that circular tunnels offered the best stability with respect to the tunnel lining (Nguyen *et al.*, 2021).

In the next paper, Zhang *et al.* (2021) discuss the challenges with earth pressure balance tunnelling in difficult ground where weathered granite gives rise to a mixed face of granite boulders and weaker and more permeable completely weathered granite composed of incompact clay minerals. The mixed tunnelling face which grazed the rock–soil interface saw water ingress and even quicksand at the tunnel face, clogging of the cutter head and heavy disc cutter wear. Next, Yan *et al.* (2021) present a paper on the automated monitoring of a segmental precast-concrete-lined inclined shaft at five chosen sections. The in situ monitoring system recorded soil and pore water pressure on the segments and the rebar stress at two of the five sections; all data was transmitted to the information centre using optical fibre, allowing the ultimate limit state and therefore the structural health of the shaft to be assessed (Yan *et al.*, 2021).

Tan *et al.* (2021) used numerical analysis and field testing to demonstrate the stability of the proposed construction process for a super-large-span (up to about 30 m) tunnel at the confluence of two tunnels of approximately 12 and 15 m span in sandstone which forms part of the Shenzhen expressway in China (see Figure 1). The super-large-span tunnel was achieved by constructing a pilot tunnel which was then expanded back towards the bifurcation point of the two individual tunnels.



Figure 1. Maximum section of the Liantang tunnel in China (taken from Tan *et al.* (2021))



Figure 2. South end of excavation at its greatest extent for the ICD Brookfield Place development in Dubai (taken from Smith *et al.* (2021))

Ball *et al.* (2021) faced a complex interaction involving a new building overlying existing tunnels in London. The design questions studied in this paper include: (i) is it possible to construct the new building above the existing tunnels; and (ii) is this relevant to the risk of overloading and damaging the tunnel lining? Ball *et al.* (2021) detailed the process from geological investigation to 3D finite-element method (FEM) analysis and field monitoring. The authors showed the capability of the 3D FEM to show that analysed ‘stress changes over the long term on the tunnel linings were of the order of 5 kPa maximum ... and [this] was not considered to be material to the tunnel’ (Ball *et al.*, 2021: p. 427).

Liu *et al.* (2021) developed a method for estimating the building damage due to construction of an adjacent deep excavation in fine-grained soil. The most critical aspects of the case study include: (i) a sensible target such as the ancient building known as Red House, (ii) a very large and deep excavation adjacent to the target and (iii) a soft soil, the clay, exerting time-dependent processes. Instead of directly considering a complex 3D numerical model, the authors propose a criterion that forms part of preliminary analysis before finite-element modelling. They provide a ‘simple’ approach available for the validation of complex numerical models as well as for preliminary damage assessments (Liu *et al.*, 2021).

In the paper by Ieronymaki *et al.* (2021) a practical approach for prediction of ground movements induced by deep excavation is presented. It is important to note the study motivation: ‘to determine whether the complex 3D characteristics of the problem could be captured and accurately simulated by

equivalent 2D models, using soil properties estimated from limited field data, which is typically the case in engineering practice’ (Ieronymaki *et al.*, 2021: p. 446). A comparison of model prediction to monitored data of retaining wall deflection is presented.

In the final paper in this themed issue, Smith *et al.* (2021) report a case history related to deep excavation – that is, planning the construction of a deep (7-level) basement on the site of a previous excavation (i.e., a 5-level basement backfilled in 2009) (see Figure 2). The previously constructed basement provided considerable constraints to the new basement construction. Along with the in situ geological conditions this increased the project complexity. The decision making process described in this paper was of primary importance compared to the numerical analysis itself: described by the authors as being ‘of secondary importance in the design process’ (Smith *et al.*, 2021: p. 472). This paper shows the importance of informed engineering judgement in geotechnical design.

We hope that all readers enjoy this themed issue. We would also like to continue to encourage discussion articles on any of the papers in this themed issue or other papers published in the journal.

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