Editorial

Carlos Lam DPhil, CEng, MICE, MHKIE

Geotechnical Engineer, Geotechnical Engineering Office, Civil Engineering and Development Department, The Government of the Hong Kong Special Administrative Region, Hong Kong

Welcome to this special issue of *Geotechnical Engineering* on 'Engineering in Chalk', which is championed by Sarah Glover of Arup and myself. Chalk is an important geological and engineering material in many countries including the UK. Our understanding of this material has grown considerably since the International Chalk Symposium held at Brighton, UK, in 1989 (Burland *et al.* 1990). To bring together the knowledge and experience gained over the last three decades, the British Geotechnical Association, with the support of the Engineering Group of the Geological Society of London, hosted a major international conference on 'Engineering in Chalk' at Imperial College London in September 2018. To provide a platform for researchers and industry practitioners to publish their findings in fuller detail, this journal issued a call for papers on the same theme in June 2017 and attracted many high-quality submissions. This issue includes seven standard papers on this theme, as well as two Discussion contributions and two Corrigenda.

True to the theme, the seven standard papers all concern Chalk but of a wide variety of situations including deep foundations, excavation slurry, mechanical properties and cliff stability. As deep foundations remain a major interest among geotechnical practitioners and researchers, there are four papers concerning the design and performance of piles in Chalk. Of these, the two papers by Taylor *et al.* (2018) and Ganesharatnam *et al.* (2018) form a two-part series on the design and construction of bored piles supporting a new building at a site in east London. There are two London Underground (LU) tunnels running beneath this site, and the building that spans over the tunnels resulted in working piles loads of between 28 and 45 MN. The piles were founded in the grade A/B chalk stratum. The first paper by Taylor *et al.* (2018) describes the ground investigation techniques that were used to inform the development of the ground model and the specialist laboratory testing that was carried out to investigate the possible interaction of bentonite support fluid with the chalk found on site. The second paper by Ganesharatnam *et al.* (2018) goes on to discuss the preliminary pile load test and the design and construction of the working piles. The

authors also discuss the control on the properties of the bentonite support fluid during pile construction as well as the limitations on piles constructed in the LU exclusion zones. In my opinion, this case history will be a key reference for those involved in the design and construction of bored piles in Chalk in the future.

Also on the performance of piles in Chalk, Ball *et al.* (2018) present maintained load-test results for continuous flight auger piles founded in south-east England Chalk. The piles were designed using current industry practice. As the results demonstrated that all piles behaved satisfactorily at their working loads, the authors argue that the piles could be seen to be uneconomical. Through an examination of the available results, the authors propose that a higher limiting unit shaft resistance value (180 kN/m²) could be adopted for piles in Chalk, and that the limit should be no different from that for bored piles due to the modern methods of construction. The authors also advocate more industrial openness and less inertia in relation to the publication of test results in order to reduce the inefficiencies that exist in current design approaches.

At the time of this Editorial, many offshore wind farms are being designed and constructed in the North and Baltic Seas, where Chalk of varying degrees of strength, density and thickness can be found. Since there are significant uncertainties associated with the design of tubular steel driven piles in Chalk, Geduhn *et al.* (2018) present the results of laboratory and site-specific offshore pile load tests conducted for the Wiking offshore wind farm in the German Baltic Sea. From the laboratory test results, a relationship between the unit shaft resistance and the effective vertical overburden pressure was established, and this allows the pile length to be reduced from 70 m to about 40 m. From the dynamic and static pile load tests conducted on reduced-scale piles, a considerable set-up effect was observed about 10 weeks after the end of driving. With the improved design soil parameters justified by the pile load tests, the authors reported that the partial safety factors used in the pile design was reduced from 1.4 to 1.1 for

compression and 1.5 to 1.15 for tension, and this resulted in a considerable saving in steel usage. The experience gained from this study will be useful for other wind farm developments at sites where Chalk is present. Please note that a Corrigendum to Geduhn *et al.* (2018) has been issued to update the author list and provide additional references.

Bentonite support fluids have been commonly used for the construction of diaphragm walls and bored piles in the UK for many years, but there is little information about the on-site treatment of these fluids in the literature. Lam *et al.* (2018) presents a case history in Woolwich (east London) to highlight the necessity for proper handling of bentonite support fluids during excavations into Chalk, which can disintegrate to release significant amounts of fines into the fluids. The authors demonstrated that desanders, desilters and a centrifuge were necessary for fluid management during the excavations in order that the fluid could be maintained within specification over the course of the project. At the end of the project, the centrifuge was also used to separate the unwanted residual slurry into a paste and a centrate of near-clear water, thus eliminating the high costs of transport and disposal of the unwanted fluid. The experience gained in this project will be useful for foundation contractors who use bentonite support fluids for bored piling and diaphragm walling in Chalk.

The mechanical properties of crushed chalk are important for the design of many geotechnical structures including driven piles and earthworks. To improve our understanding of the stress- and time-dependent properties of destructured chalk, Bialowas *et al.* (2018) present the results of a series of drained triaxial tests with small-strain stiffness measurements by bender elements. Based on the bender element test results, the authors provided a full characterisation of the small-strain shear stiffness of reconstituted chalk with respect to the applied stress levels and volumetric state. The time-related small-strain stiffness and strength gains were also investigated by ageing the specimens under different isotropic stresses for a period of up to 72 d. The results revealed that there is an increase in the shear stiffness with time though the strength is not affected by ageing. A detailed explanation of these observed effects is given in the paper. The results of the experiments presented in this paper should be useful for the design of geotechnical structures in contact with remoulded or putty chalk, especially when an evaluation of their small-deformation behaviour is required.

Although the instability of Chalk cliffs has been the subject of many previous studies (e.g. Mortimore and Duperret (2004)), the effect of salt water on the weakening of Chalk mass is still not well understood. To fill this knowledge gap, Lawrence *et al.* (2018) carried out a field investigation combined with a comprehensive laboratory testing programme on core samples taken from two UK sites on the East Sussex coast, namely Brighton Marina and Peacehaven. Figure 1 shows a photograph of the sampling locations at Brighton Marina, where a sign warning

Figure 1. Locations of two drill holes and a warning sign at Brighton Marina, East Sussex, UK (Lawrence *et al.*, 2018)

the pedestrians of the potential hazardous falls of chalk can also be seen. From the results of uniaxial compressive strength (UCS) tests, the weakest Chalk was found to be near the cliff face and the strength nearly doubled over the length of the 9-m-deep boreholes. High chloride concentrations were also found to be associated with the lowest UCS values closest to the cliff face. These results clearly demonstrate the connection between salt concentrations in Chalk pore water and UCS reductions within coastal cliffs. The findings of this study should be useful for cliff recession management in the UK and beyond.

This issue also includes two Discussion contributions. The first Discussion (Elbaz *et al.*, 2018a) is based on a previous paper by Elbaz *et al.* (2018b), which deals with cutter-disc consumption during earth pressure balance (EPB) tunnelling in Guangzhou, China, where limestone and Karst caverns are present. A sinkhole incident, which can be attributed to the instability of the excavation face, was described in the original article. The discussor, J. N. Shirlaw, commented on various aspects of this case history and asked the original authors to suggest what measures, in retrospect, might have avoided the development of the sinkhole. The original authors' reply can be found after the discussor's comments. Readers who have an interest in EPB tunnelling are encouraged to read the original article (Elbaz *et al.*, 2018b) for a complete story of this interesting case history. Please note that a Corrigendum to Elbaz *et al.* (2018b) has been issued to correct some errors found in the original paper. The second Discussion contribution (Georgiannou *et al.*, 2018) is based on the previous paper by Georgiannou *et al.* (2017) that describes the geotechnical properties of a natural zeolite, which can be used as a compacted soil liner in geoenvironmental applications. The discussor,

F. A. Villalobos, commented on some of the laboratory test results presented in the original paper. The authors' reply can be found after the discussor's comments.

In closing, I would like to thank all of the authors who have contributed to this issue and the many reviewers who have volunteered their time to provide valuable feedback to the authors. I would also like to thank my colleagues on the Editorial Advisory Panel for *Geotechnical Engineering* and the staff at ICE Publishing for their help and support in preparing this issue. If you would like to raise any particular points regarding the papers published in this issue, please consider contributing to the journal in the form of a Discussion. Author instructions can be found at the end of each paper and on our website: <https://www.icevirtuallibrary.com/loi/jgeen>.

I hope you enjoy reading this issue of *Geotechnical Engineering*.

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