

Editorial

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I am pleased to welcome you to the May 2016 issue of *Ground Improvement*, for which it has been my pleasure to write the editorial. *Ground Improvement* continues to develop and realise an ever-increasing range of applications in order to meet the demands for both development and re-development of sites for construction and associated infrastructure in a cost-effective and sustainable manner while remaining fit-for-purpose. The importance of ground improvement in providing resilience in earthquake prone areas in terms of soil liquefaction mitigation, or either reducing or mitigating risk in problematic soils generally cannot be underestimated. Research forms the basis for both development and advances in our understanding of ground improvement processes, whether at the laboratory or field scale, or by numerical modelling. To maximise research benefits it is important that there is an appropriate level of engagement between both academia and industry to ensure that required research objectives that are most relevant to the ground engineering practitioners and the specialist contractors who implement ground improvement (i.e. industry needs) and in turn for the benefit of society at large are recognised and addressed, while avoiding any unnecessary repetition.

The papers contained within this issue, comprising seven main papers and one discussion paper, reflect the true diversity of ground improvement, covering research at both laboratory and field scale, and also numerical analysis.

In the first paper by Vahidipour *et al.* (2016), laboratory-based modelling simulations in loose sand are employed to compare dynamic compaction (DC) adjacent to a slope (crest) with DC on level ground remote from any slope. It has been demonstrated that with an increase in applied energy or slope angle and reduction in distance from the crest of the slope, crater (imprint) depth increases. An effective distance parameter d (where d is the diameter of the DC weight), from the crest of the slope, where ground response is similar to that on level ground is established, with $1.2d$, derived for a 45 degree slope inclination, increasing to $2.8d$, for a 60 degree slope inclination. An empirical equation is also presented to estimate crater depth.

Continuing on the compaction theme, the second paper by Vega-Posada and Finno (2016) investigates through a comprehensive field-based research programme the benefits of measurement of enforced settlement/void closure as a more effective and repeatable form of verification of blast densification in sands, compared with the traditional approach of

reliance on the cone penetration test, standard penetration test and shear velocity test recognised as often giving misleading or contradictory results, despite visible post blast ground settlement. The maximum ground surface settlement measured in the field trials was in excess of 0.5 m, indicating achievement of relative density values in excess of 80% in some areas. The incremental surface settlements were observed to decrease after each consecutive blast indicating that beyond a certain amount of passes that the increase in soil density is minimal. It is worthy of note that a similar trend can be recognised with DC in sands where beyond an optimum energy input there are no significant gains to be made in terms of further enhancement of soil density.

The third paper by Gelder and Fowmes (2016) describes a study to develop a suitable site (field) scale applicable method of mixing polypropylene fibres into cohesive host soils, employing elevation of moisture content to facilitate mixing of the fibres and subsequent use of lime to then reduce the moisture content of the fibre-reinforced clay to workable levels. Addition(s) of fibres has been shown to increase both peak and post peak shear strength, and to improve the characteristics of the soils, increasing their ductility. Increases in the strength of fibre–lime composites were achieved in the study and were also found to peak at lime doses of 6%, although it is advocated by the authors that from an economic viability standpoint, lower lime doses, while having higher final moisture contents, would produce the required soil strength and compaction behaviour.

In the fourth paper Chen *et al.* (2016) examine the undrained deformation behaviour of sandy silt that is stabilised with environmentally friendly lignosulfonate (LS) under cyclic loading conditions by undertaking a series of laboratory cyclic triaxial tests conducted at various confining pressures and cyclic stress levels. Test results demonstrate that the rate of increase in axial strain is controlled by the addition of LS, which results in a smaller value of plastic axial strain (e_{ap}), and with rate of increase in e_{ap} increasing for both untreated and LS-treated soils, with increasing cyclic stress ratio (CSR). A critical value of CSR is shown to exist for a given LS content, below which the specimens could remain stable irrespective of the number of load cycles, with significant improvement in longevity, especially for treated specimens with LS = 2% by weight. Resilient modulus improvement was also found to increase significantly as a result of LS treatment when compared to untreated soil, with LS = 2% recognised as an optimal value.

The fifth paper by Kazi *et al.* (2016) describes laboratory-based modelling investigations of the load-settlement behaviour of a (model) strip footing with different embedment depths resting on a sand bed reinforced with a single layer of geotextile. The influence of the geotextile with and without wraparound ends at a depth of $0.3B$ from the base of the footing of width B , on load-bearing capacity forms a focus for the study, with the results of the study compared with numerical modelling using 2D finite element analysis. Significant improvement in load-bearing capacity and stiffness of the sand bed with increasing footing embedment together with provision of wraparound ends in the geotextile reinforcement is demonstrated. The results are presented graphically to provide general guidelines.

Description of field trials to investigate permeation grouting of sands using ultra-micro-fine cement as a countermeasure against soil liquefaction is provided by Hashimoto *et al.* (2016) in the sixth paper. Columns of improved soil of diameter 1.5–2 m and 2.5 m high were produced in a 3 m depth of relatively clean sand deposits, by introducing cement solutions with concentrations of $(w/c)_{cs} = 8$ and 12 through boreholes set up along the entire depths of the sand deposits. It was also found that for clean sands the filling ratio (α) can be assumed as almost unity. It is concluded that it is therefore adequate to presume that the radius of a column of improved soil can be estimated solely from the volume of cement solutions injected into sand deposits.

The consolidation process in soft clay, in the presence of vertical band drains, has been examined by Razouki (2016) in the seventh and final main paper, using an implicit finite-difference technique, assuming a constant coefficient of radial flow consolidation, with the investigation providing a useful insight into the effect of vertical drain spacing and frequency of cyclic loading on the consolidation process. The findings indicated that an increase in the frequency of haversine cyclic loading causes an increase in the number of cycles required to achieve the steady state. The effective stress at the impermeable boundary of a unit cell of a prefabricated vertical drain decreases with time but with some fluctuations without changing sign. These fluctuations become more pronounced for increasing values of cycle length, causing an increase in the maximum effective stress.

A useful discussion paper (Kelly and Litwinowicz, 2016) on a paper entitled 'Assessment of smear parameters for use in wick drain design' (Kelly, 2014) is also included at the end of this issue.

I hope you find the papers stimulating and informative and would actively encourage discussion on these to further

enhance our understanding and development of current and future ground improvement processes. Instructions for making a contribution to a discussion (or briefing) paper can be found at the end of each paper.

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