Editorial

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On behalf of the Editorial Board, we wish you a happy New Year. To start 2019, it is our pleasure to introduce the themed issue on advances in seismic design. For the majority of UK-based practising engineers, seismic design may seem like an esoteric concept that is better left to seismic specialists. However, as the eight papers written by authors from New Zealand, Hong Kong, USA, India, Australia, Portugal, Italy and the UK show, geotechnical seismic design is accessible and practical for the practising geotechnical engineer. Topics selected for this issue illustrate how seismic considerations can be incorporated in the design and analysis of structures and in code development.

Two papers discuss issues of seismic design of shallow foundations. Hokmabadi *et al.* (2019) present soil inertial factors for assessing bearing capacity under seismic loading. The additional loads caused by the moving mass of the structure during seismic excitation, termed inertial forces, reduce the bearing capacity of the shallow foundations. They recommend soil inertial factors as a function of the horizontal acceleration, the ϕ angle and slope angle to evaluate the seismic bearing capacity of shallow foundations for level and sloping ground. The second paper by Millen *et al.* (2019) shows how the non-linear response of shallow foundations may be incorporated in a displacement-based design procedure. The impetus for the paper was the lack of soil–foundation–structure interaction (SFSI) modifying factors and absence of methods for controlling peak deformations of buildings founded on soft soils. Millen *et al.* (2019) consider SFSI as an important step in performance-based design frameworks that enables practitioners to better estimate deformations of foundations and superstructures. A displacement-based design procedure that considers SFSI via foundation rotation and soil–foundation shear deformation is proposed and simple numerical studies were employed to further develop the method, which is subsequently validated using non-linear time history analysis.

Two papers tackle seismic design of retaining walls. Wood (2019) illustrates how the flexibility of a retaining wall influences the earthquake-induced soil pressures. In professional practice, a geotechnical engineer would either assume a rigid or a flexible wall when estimating seismic wall pressure. For these assumptions, methods of predicting earthquake pressures are well documented. Wood (2019) presents a methodology to estimate earthquake pressures for stiff walls with

intermediate flexibility. The author uses finite-element analyses of cantilever walls that deform by rotation about the base and flexure in the wall stem and also presents charts that can provide a useful preliminary design method for stiff walls. The next paper on retaining walls is by Pender (2019), which tackles the seismic design of gravity wall foundations. The author champions the idea that economical design of gravity retaining wall systems under seismic excitation can be achieved by allowing some movement of the wall. Pender (2019) investigated the seismic response of gravity wall systems founded on non-liquefiable soils using a pseudo-static approach. The author concludes ‘that the critical acceleration will usually be mobilised by moment failure of the foundation rather than sliding’ (Pender, 2019: p. 51) and calls for a review of design methods for gravity retaining wall systems subjected to earthquakes.

Sahoo and Ganesh (2019) present a study of the case for plate anchors embedded at shallow depths in sand subjected to seismic loading. The theoretical formulations developed are compared with results from Kumar (2001) for the variation of the dimensionless seismic factors as functions of horizontal accelerations. The developed formulations are also compared with experimental data from Ilamparuthi *et al.* (2002) and Liu *et al.* (2012) and the numerical analysis results of Merifield and Sloan (2006) to study the changes in the static uplift factor with changes in friction angle and embedment ratio. Reasonable agreement with the previously published studies is shown.

Biswas and Choudhury (2019) use wedge failure analysis to study the behaviour of rectangular caisson foundations in sand subjected to seismic loading. Formulations for the seismic passive earth pressure (and coefficient) are developed. In the subsequent parametric study, the effects of horizontal and vertical accelerations and mobilised soil–soil interface friction angle on the normalised depth and normalised seismic passive earth pressure are shown. The theoretical solutions are then compared with the centrifuge test results from Olson *et al.* (2017) with a reasonable match shown.

O’Riordan *et al.* (2019) illustrate the salient points of performing site response analyses for use in dynamic soil–structure interaction analyses (DSSI). DSSI analysis explicitly models both the superstructure and the soil, and subjects them to vertically propagating waves in the time domain. In this paper,

Figure 1. The study area for the seismic microzonation study reported in Sze *et al.* (2019) (reproduced from Sze *et al.* (2019))

the authors focus on the selection of input motions and the calibration of soil properties as done in their projects. O’Riordan *et al.* (2019) espouse careful selection of time histories for sites located near faults to account for velocity pulses, and also illustrate how we can use case histories of recorded ground motions to calibrate soil parameters for soft soil sites.

The last paper by Sze *et al.* (2019) shows how a low- to moderate-seismicity area such as Hong Kong can incorporate seismic hazards in developing the local code. This topic proves to be very popular as densely-populated cities with low- to moderate-seismicity such as New York, USA, and London, UK, may have a reasonably high earthquake risk as the buildings and infrastructure may not be designed for seismic loads. Sze *et al.* (2019) present the case study for Hong Kong where they performed a probabilistic seismic hazard assessment with recent seismicity data, site response analysis integrating topographic effect, assessed earthquake-induced landslide susceptibility of natural and man-made slopes. The study area for the seismic microzonation study is reproduced in Figure 1. This paper presents a useful methodology that may be applied in other parts of the world.

We hope that readers enjoy this special issue as it presents accessible concepts and useful solutions for the practising geotechnical engineer interested in seismic design.

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