Editorial

Colin Smith MA, PhD

Senior Lecturer, Geotechnical Engineering Group, Department of Civil and Structural Engineering, University of Sheffield, Sheffield, UK

Engineers are frequently called upon to determine the ultimate strength of a body or structure. While there are many hand calculation techniques for this purpose, mostly developed in the last century, the range of applicability of such techniques tends to be extremely limited. Also, although generally applicable numerical techniques are readily available, these tend to be complex, and normally involve approaching the collapse state in an incremental rather than direct manner.

This two-part themed issue focuses on methods that have been designed to avoid the need for an incremental, step-by-step analysis, using what are now commonly referred to as 'direct methods'. Such methods have recently been attracting increasing interest from researchers and practicing engineers who are seeking to take advantage of new mathematical formulations and numerical analysis techniques. Several have found their way into regular engineering practice, with commercial software offerings available to users for a number of specific applications. These facilitate fast, typically interactive, analysis. It is hoped that the range of tools available to practicing engineers will increase in coming years, and that this two-part themed issue offers an insight into the range and increasing speed and capability of such methods.

This first part presents three papers, describing applications in the fields of structural cyclic loading, masonry and geotechnics.

The first paper, by Panagiotou and Spiliopoulos (2015), is concerned with shakedown analysis of structural elements. Cyclic loading is a key issue for in many structural and geotechnical applications. The authors show how the recently developed 'RSDM-S' direct method, which utilises Fourier series, can be used to provide rapid, stable and efficient solutions to shakedown problems for beams and plates under various loading conditions.

The second and third papers, by Milani (2015) and Gueguin *et al.* (2015), explore the benefits of using homogenisation

techniques in conjunction with direct methods. Such techniques can be used to analyse systems with regular jointing patterns (e.g. occurring in fractured rock or masonry), or regular reinforcement elements, avoiding the need to explicitly model repeating elements. This can further add to the computational efficiency benefits associated with direct methods. Milani (2015) provides a detailed review of four homogenisation models that are used to model the in-plane response of masonry, highlighting their benefits over other approaches and investigating their applicability for a range of masonry forms. Gueguin *et al.* (2015) illustrate practical application of homogenisation to the stability of an embankment on reinforced soil, highlighting the influence of tensile failure in the soil and exploring the relative merits of differing reinforcement layouts.

We hope that these papers stimulate interest both in further research and in uptake in practice, and look ahead to part two of this themed issue, where direct methods will be applied to problems in fields ranging from fire engineering to concrete slab design.

REFERENCES

- Gueguin M, Hassen G and de Buhan P (2015) Numerical stability analysis of an embankment on reinforced soils. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **168(3)**: 122–130, <http://dx.doi.org/10.1680/eacm.14.00024>.
- Milani G (2015) Four approaches to determine masonry strength domain. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **168(3)**: 99–121, <http://dx.doi.org/10.1680/eacm.14.00025>.
- Panagiotou KD and Spiliopoulos KV (2015) Shakedown analysis of civil engineering structural elements. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **168(3)**: 90–98, <http://dx.doi.org/10.1680/eacm.14.00029>.