Book reviews

Localization and Bifurcation Theory for Soils and Rocks. *T. Adachi, F. Oka and A. Yashima (editors). Rotterdam: Balkema, 1998. 370 pp. ISBN 90 5809 004 3. £53*

This book contains 38 refereed papers, emanating from the fourth in a series of international workshops (Gifu, Japan, September–October 1997). It is divided into three sections—theoretical, experimental and numerical—with the numbers of papers per section (24:5:9) reflecting the bias towards theory: some of the papers in the theoretical section seem to be misplaced, however.

Many papers emphasize the problem of using standard continuum theory for modelling non-associated and strain-softening geomaterials. Specifically, while conventional (local) models are an acceptable representation of material response prior to localization, at the onset of localization (bifurcation) the constitutive equations become ill-posed, due to the vanishing determinant of the constitutive tensor. This leads to non-uniqueness, or, in a finite element context, to element-size dependency. For example, mesh refinement leads to a decrease in the width of the localized zone: more importantly, it can also lead to dramatic variations in global load–displacement response.

A common theme, therefore, is the development of non-standard continuum theories for combating numerical problems in strain localization, this mainly being done within the framework of elasto-, visco- or hypo-plasticity. In general, the well-posedness of the differential equations can be restored by adding additional degrees of freedom, or by adding higher-order gradient terms in space or time—for example: strain-gradient-dependent models, which use higher-order strain-gradient terms; integral continuum models, which consider the relationship between average stresses and strains; and Cosserat continuum models, which include rotational degrees of freedom. In these models, the width of the localization zone is determined by a material length scale. Also considered are: strain-rate-dependent models, which use higher-order terms in time; and strain-rate-independent models, which use different local models inside and outside the localization zone.

The experimental papers are more disparate—topics covered include: the cracking of clays due to compaction; centrifuge bearing capacity tests on clay; and earthquake simulations using a shaking table. However, other papers study the mechanics of localization (and instability) in sand through standard element tests (triaxial/biaxial), including the effects of pore pressure migration. These papers 'link-in' better with the theoretical papers and with several of the numerical papers which investigate failure in biaxial compression (again, including pore pressures). The numerical section also includes: the finite element analysis of delayed (excavation) failure in an overconsolidated clay; adaptive mesh computations of passive earth pressure failure; and analyses using discrete elements.

The impression given is that research in this area is still somewhat compartmentalized into its component disciplines. For example, while some papers report on the use of non-standard continua in finite elements, primarily for 'small' problems, others have retained the use of standard continua and defined shear band thickness more crudely through use of a specified element size. Furthermore, most current research is of a fundamental nature and there has been little attempt, so far, at modelling large-scale problems using the more advanced theoretical and numerical techniques.

This book has benefited from the focused nature of the workshop. Most papers complement each other, resulting in a comprehensive coverage of the subject. The papers are also longer, and therefore more detailed, than is usual in conference proceedings. While not easy to read, it contains much useful information, especially on more fundamental issues: this is a valuable book for the researcher.

M. A. Hicks

Physics and mechanics of soil liquefaction. *P. V. Lade and J. A. Yamamuro (eds). Rotterdam: A. A. Balkema, 1999. 361 pp. ISBN 9 05 809038 8. £83.50.*

This edited volume is the proceedings of the international workshop on the physics and mechanics of soil liquefaction held in Baltimore, Maryland, USA from 10 to 11 September 1998. It is indicated in the Preface that 'Each invited participant was expected to contribute a paper, which represents, in the opinion of the author, the current state-of-the-art in his/her focus area in experimental liquefaction research'.

Of the 30 papers included in the proceedings, 21 of them were contributed by authors based in the USA, five from Europe, of which two were UK based, three from Canada and surprisingly only one from Japan. The lack of Japanese contributions in the conference could be due to the fact that the conference was sponsored by the National Science Foundation of the USA. However, this definitely impairs the international aspect of the conference, as Japan is one of the leading nations in soil liquefaction research, especially on the experimental side. Nevertheless, the list of contributors reads like the *Who's Who* in active experimental soil liquefaction research in North America.

A good range of papers is found in the proceedings, including

(*a*) the mechanism of instability
(*b*) effect of soil gradation on liquefaction
(*c*) factors affecting liquefaction susceptibility
(*d*) soil fabric and its effect on liquefaction
(*e*) methods of characterizing liquefaction potential
(*f*) methods of characterizing post-liquefaction deformation
(*g*) centrifuge studies of liquefaction
(*h*) field studies of liquefaction.

For anyone who is interested in liquefaction problems, there are some articles in this volume that will appeal to him/her. There are some highly theoretical papers such as the discussions of stability conditions proposed by Drucker and by Hill. On the other hand, there are some papers which offer very practical accounts such as the 'undisturbed sampling of loose sand using *in-situ* ground freezing' as performed in the CANLEX project. Practical criteria for 'triggering and post-liquefaction strength issues in fine-grained soils' were given in the paper authored by researchers in the US Army Engineer Waterways Experiment Station.

A lot of experimental data were presented or summarized, which makes this volume a good resource for future research and practical reference. There are even results of experiments performed under a 'microgravity' environment on board the SpaceHab module of the Space Shuttle.

As there was no page limit (or it has not been strictly policed), some of the papers offered a more detailed account than normally presented in a typical conference. Discussions on topics such as 'the critical state line and its application to soil liquefaction' and 'comments on the determination of the undrained steady state strength of sandy soils' can be explained to a useful extent. No doubt, much of the research has been or will be published in greater detail in journals, such as *Géotechnique*. Nevertheless, having this diversity of information within one volume makes it a useful addition to the bookshelf of researchers and practitioners interested in liquefaction phenomena.

—A. Chan

Basin modelling: practice and progress. *S. J. Düppenbecker and J. E. Iliffe (eds). London: Geological Society, Special Publication No. 141, 1998, 256 pp. ISBN 1 86239 008 8. ISSN 0305 8719. £75.00.*

This volume is a compilation of papers presented at a conference on basin modelling. The information is mainly directed towards those involved in research and extraction in the petroleum industry. However, there is a substantial body of field information on the response of large depths of geological material that have been subjected to compaction and heating which provoke changes in the solid and fluid material properties. These data have proved to be a rich source for calibrating the models developed. As a consequence these data and this modelling work are of significant interest to a much wider range of workers, particularly in the geotechnical field. The high pressures and temperatures inherent in the geological compaction process show up the basic variability of the solid and fluid materials, and those conducting research into numerical modelling and experimental verification of constitutive relationships should be interested in the modelling of these conditions where every element is on the move.

The first three papers illustrate the point made above.

(*a*) Giles *et al.* Compaction—the great unknown in basin modelling. The authors highlight the interactive role that is played by physical, thermal and chemical processes. They conclude that current models are not good enough and therefore new models, based on a better understanding of the physical processes, will have to be developed.
(*b*) Okui *et al.* Simulation of oil expulsion by 1-D and 2-D basin modelling—saturation threshold and relative permeabilities of source rocks. A fascinating piece of work examining the relative importance of grain size and shape for the permeability of source rocks to multiphase flow.
(*c*) Waples *et al.* Some thoughts on porosity reduction—rock mechanics, overpressure and fluid flow. An examination of 'effective stress' in the light of rate-determining processes.

It is true to say that there is something to be gained by a geotechnical engineer from each of the 14 papers presented. All engineers and geologists will gain valuable insight into the behaviour of geological sediments by reading the papers in this volume, and as such it is well worth a place on their bookshelf.

—A. E. Skinner