Book Reviews

Computer methods and advances in geomechanics. G. Beer, J. R. Booker & J. P. Carter (eds). Balkema, Rotterdam, 1991. £122 (3 volumes, hardback). ISBN (set) 90-6191-189-3.

This three-volume publication is the summarized proceedings of an international conference held at Cairns, Australia, in May 1991. Volume 1 contains four keynote papers and 121 papers on the themes of: CAD, expert systems and software; geotechnical engineering and applications; experimental studies, testing and field instrumentation; joints, localization and structural materials; slopes, stability and distinct element methods; constitutive modelling; dynamics and cyclic loading. Volume 2 contains 136 papers on the themes of: earthquakes and geophysical applications; back analysis, comparison of field measurements and predictions; analytic, semi-analytic and boundary element methods; numerical methods; mining applications; tunnels and underground openings; environmental, resource and groundwater geomechanics: flow problems. Volume 3, which was not available for review until March 1992, presumably contains the discussion.

The large number of papers, themes, subjects and approaches in this conference make it a daunting task for the reviewer and it would be misleading to suggest that it has been possible to read more than a selection of the papers. It appears, rightly or wrongly, that the subject groupings reflect the submissions to a rather open conference, rather than a conscious effort to concentrate the subject matter into specific areas. As a result, some of the papers sit together uneasily and there is a variable standard of presentation as they have obviously been prepared by their authors in camera-ready form.

For those already deeply involved in geotechnical theory and computation, the conference provides much interest in their specialist field and an insight into alternative approaches and techniques. For such a reader the publication will be a valuable library resource. As it is not a text book, it is of less use to the beginner and its content will simply horrify a large number of engineering geologists and geotechnical engineers. I merely point out that the inexorable penetration of personal computers and computer methods into the general field of geotechnics will bring more and more people into contact with these methods and while the majority of us will use them as ‘black boxes’, someone somewhere has to know how they work. This conference was a large-scale gathering of those who do.

As a sample of some of the less usual papers on computer methods which the publication contains, I have selected a small number of the papers for brief comment.

Coulthard & Ciesielski describe a computer system that helps to choose which computer program to use in analysing particular problems.

Priest et al. describe a set of simulation and design programs used in the teaching of geotechnical engineering and give the student response to the exercise. These exercises replace conventional laboratory based work.

Moore et al. present one of the papers which starts to use fractal principles to describe the semi-ordered chaos of a soil mass. Most of us normally think of fractals in terms of beautiful (but useless) abstract art, or scenery in computer games.

Giani & Ferrero analyse the behaviour of sea and river walls under wave action. The particular walls considered date back to the eighteenth century.

The majority of papers, however, use the short paper format to describe a single advance in theory or application in a particular area and act as a pointer to who is active in that area.

E. N. Bromhead

The Frozen Earth. P. J. Williams & M. W. Smith. 1989 (paperback edn 1991). Cambridge University Press, 306 pp paperback, £19.50. ISBN 0-521-42423-2.

Building from first principles, this book develops into a thorough and complete appraisal of current process based geocryological knowledge.

From analysis of the fundamental properties involved in ground freezing to the development of continuous and discontinuous permafrost, the concepts of frost heave, soil moisture suction and excess soil ice are explored in detail. Links between climate, microclimate and the frozen ground regime are developed, together with an exhaustive account of the parameters affecting the ground thermal regime.

Excellent coverage is provided of the thermodynamics and hydrology of frozen soils, whilst the principles of soil mechanics involved during the freezing and thawing of natural ground are comprehensively reviewed and rigorously explained.
A somewhat brief chapter on thaw-induced slope instability is provided with the description of processes associated with solifluction, periglacial landsliding and thermokarst being oversimplified. Too little attention is given to the concept of the thaw consolidation ratio, and ground ice features such as patterned ground, pingos, palsas and the concept of differential ground heave, all of significance to soils engineers in cold climates, merit only limited exploration.

The consequences of 'greenhouse' warming upon areas of continuous and discontinuous permafrost are discussed, but more could be made of this topic, given the potentially catastrophic effects global warming may have upon the permafrost environment. The concept of permafrost creep within frozen soils is also examined, but the importance of this phenomenon in the development of such features as valley-side bulging, cambering and strata disruption is not considered.

With its excellent coverage of the physical processes of ground freezing and thawing, this well written, authoritative book should become a standard text on this subject for all engineers and earth scientists working in permafrost environments. The concept of permafrost creep within frozen soils is also examined, but the importance of this phenomenon in the development of such features as valley-side bulging, cambering and strata disruption is not considered.

M. C. Gallop

Rock Mechanics: Theory and Applications with Case Histories. W. Wittke. Springer, Heidelberg, 1990. 1074 pp hardback; DM 248. ISBN 3-540-52719-2.

Several noteworthy books have been written on rock mechanics during the past 25 years, and various aspects of this branch of physical sciences have been discussed. The present new book on rock mechanics brings many new ideas, interpretations and treatments of the application of this science to engineering practice and represents a major advance.

The book contains 28 chapters and two appendices. The book is divided into five main parts: conceptual models; analytical procedures; application of analytical procedures; rock mechanics investigations; and design and construction of engineering structures in rock.

The first chapter introduces the reader to the significance of rock mechanics and comments on the book contents in relation to the general needs of rock engineering.

The first part on conceptual models begins with Chapter 2 which examines models of grain and rock mass fabrics with emphasis placed on rock structural features as impinge on engineering designs both within and on such rock masses. There are several photographs and line diagrams which illustrate clearly the points under discussion. The third chapter gives a comprehensive treatment of models concerned with the stress-strain behaviour of rock masses; mathematical representation of such modelling concepts is discussed thoroughly. The swelling phenomenon in rocks is addressed in Chapter 4. Seepage flow through rock masses is discussed in Chapter 5, with particular emphasis being placed on flow through fissures and rock joints; the treatment has a sound mathematical basis with several practical examples being illustrated.

Analytical procedures are discussed in Chapters 6 (rock mass stress and strain aspects), 7 (stresses and deformations in swelling behaviour), 8 (rock mass wedge stability), 9 (seepage flow with discrete model) and 10 (3-D seepage flow with homogeneous model). Several examples are used to illustrate the mathematical modelling concepts discussed.

Important applications of rock mechanics analytical procedures are dealt with in Chapters 11 (traffic tunnels), 12 (caverns), 13 (pressure tunnels), 14 (dams), and 15 (slopes). An outstanding feature of all these chapters is the excellence of the illustrations used to demonstrate the nature of the applications under discussion; the application of engineering principles to the solution of rock mechanics problems is well demonstrated by the examples used by the author.

Investigations in rock mechanics take up over 450 pages (almost half of the book) and are given detailed treatment in Chapters 16 (introduction), 17 (site investigation), 18 (laboratory tests), 19 (discontinuity shear tests), 20 (deformability of rock masses), 21 (in situ stresses), 22 (excavation of deformation investigations), 23 (groundwater and permeability) and 24 (examples of case histories).

The final part of the book gives further examples of design and construction of engineering structures in rock and in particular in Chapters 25 (general), 26 (Hasenberg Tunnel, Stuttgart), 27 (Wehr Powerhouse Cavern) and 28 (Estangento-Sallente Powerhouse Cavern). These case studies serve as excellent examples which illustrate design principles applied to engineering structures in rock.

Appendices A and B give mathematical details of vector and matrix algebra and probability theory and statistics.

The book contains a comprehensive supporting list of references, although the index appears rather short for a book of over 1000 pages.

The book will appeal strongly to engineering geologists, hydrogeologists and geotechnical engineers and will prove of special value as a reference book for designers concerned with all aspects of engineering structures in various rock conditions. It is also recommended as an essential text for all concerned with engineering geology courses at undergraduate and postgraduate levels.

B. N. Whittaker
The Theory of Strata Mechanics. Henryk Gil. Elsevier, Amsterdam, 1990 (Developments in Geotechnical Engineering 63). $100.00 hardback; 278pp. ISBN 0-444-98761-4.

The principal aim of this book is to develop a theoretical description of the movement of rock masses due to mining activity. This problem, as posed, is in terms of coal mining at depth in Eastern Europe and so the general geological situations described may not be familiar to British mining technologists, with massive roof blocks of sandstone and rheological properties of other rocks. The use of backfill materials, or stowing, is considered in many of the theoretical treatments, but this is now not routinely practised in Britain, due mainly to the difficulty of stowing material at a rate to match the extraction of coal. Partial stowing is employed especially at the side of a mine roadway which is to be re-used or which must be carefully protected, but this technique is not specifically described.

Surface ground movement due to mining or subsidence is treated very fully, using many differential equations. The general level of mathematics required to try to understand the theories proposed is far above that normally expected, with inverted Fourier transforms, tensors and integration by parts frequently mentioned. Chapter 3, on plane stress and strain distributions, has no fewer than 289 numbered equations, some of these occupying four or five lines. Practical verification of the method is confined to two pages at the end and most references are from Russian or Polish texts.

The volume may be very learned, but some more readily understood and explained version is required before the methods put forward can be generally adopted and much more practical verification of theory is necessary before full acceptance can be gained. Definitely a book for the mathematical specialist rather than the practical engineer.

N. Brook

6th International Congress of the International Association of Engineering Geology. D. G. Price (ed.). Balkema, Rotterdam, 1990. £203 (5 volumes, hardback). ISBN (set) 90-6191-130-3.

Divided into seven themes in four hardbound volumes with a fifth volume of symposia, the 6th International Congress celebrates the 25th anniversary of the IAEG by displaying the diversities of engineering geology as a science. It certainly succeeds in this stated aim as there are 3013 pages of conference papers and a further 337 pages of symposium papers (devoted to four topics that are considered by the organizers as being of particular importance). The tables of contents alone run to over 45 pages. Most of the papers are in English, with a few in French. Editing must have been a mammoth task; the production certainly does justice to the hard work that went into it.

The scope and detail of the papers is overwhelming in terms of being able to review them comprehensively. There is a wealth of information and since the papers are generally of a specialist nature they are unlikely to be of interest to all readers. It is interesting that there is an environmental slant to many of the papers, a fact that the editor attributes to the true nature of engineering geology rather than to current fashion.

Delving into the text at intervals reveals that the Congress truly was international and there is a good spread of ideas and techniques. In fact the spread is a little too good and it would be difficult to ‘scan’ through the proceedings on the off-chance of seeing something relevant to one’s particular area of interest. The five volumes are rather like a sample of all the current branches of engineering geology and I would expect that libraries and institutions would be the main purchasers.

Even with seven themes it has often proved difficult for the editor to ‘pigeon hole’ all the papers exactly. In fact, within each theme there is a bewildering diversity of topics and the following list is by no means comprehensive but should give you an idea of the contents.

Volume 1 encompasses engineering geology and site investigation and the papers include contributions on geographic information systems, piezocones, snow melt, the fractal geometry of clays and a classification of Dutch peats. Volume 2 covers remote sensing, geophysics and hydro-engineering geology with topics ranging from seismic tomography and sidescan sonar to leakage through dams, ground subsidence, contaminant transport and the state of Spanish springs. Volume 3, surface engineering geology, includes papers on landslides, frictional heating, foundation design, materials properties and vibration. The themes of Volume 4 are underground engineering geology, construction materials and the engineering geology of land and marine hydraulic structures. There are papers on tunnels, mines, subsidence, low-temperature storage, flood control, sea bed stability, coasts, concrete aggregates, rock durability and soil descriptions, to cite but a few.

The symposia volume also contains papers from a large number of authors and the distinction between these and the rest of the conference papers is not obvious. There are four symposia: computers, which includes maps, boreholes, logs, databases, numerical modelling and training; environmental protection,
pollution and waste disposal, which includes landfill, fibres, groundwater remediation and the risks of chemicals in the environment; coastal protection and sea-level rise, which includes rock armour, land reclamation and various case histories from around the world; and the oil industry, which includes papers on site investigation, geophysics, geomorphology and shallow gas.

The current trend in conference proceedings is to make them fairly specialized and to market them as if they were a text book on the subject. This conference does not fall into this category. Neither can it be considered as a general review of engineering geology because of the specific nature of most of the technical contributions. In a curious way the range of technical information it contains could be the proceedings' weakness. Even the individual volumes contain such a wide variety of subject matter that all of it is unlikely to be of interest to the same person. I know it is easier said than done, but I would have thought that publishing the proceedings in a larger number of smaller volumes, concentrating on specific topics, would be more attractive to personal buyers who could be more selective. At over £200 I cannot see many individuals buying the complete publication.

K. D. Privett

Ground anchors and anchored structures. Petros P. Xanthakos. Wiley, New York, 1991. £62.80 hardback; 686 pp. ISBN 0-4715-2520-0.

This lengthy publication addresses a complete and comprehensive range of subjects relating to anchors and structural uses. The text falls essentially into two parts: the first half discussing anchor technology, the second going on to consider the use of anchors: the design principles of anchored structures, design examples and the performance of monitored anchored structures.

From initial chapters reviewing anchor systems, drilling, installation and grouting it is evident that, as in several similar engineering publications, the author relies to a very great extent on collection and summary of previously published data researched by himself or by others. Referenced data is extensive and drawn from world-wide sources, although direct reproduction from Rock Anchors State-of-Art (by Littlejohn & Bruce 1977), from DD81-Recommendation for Ground Anchorages (BSI 1982) and from VSL Losinger System is prevalent in many of these chapters.

The drilling systems that are summarized, although covering a broad range, are not fully updated (references date only from 1968 to 1974), and such essential modern overburden drilling modes as high-power rotary percussive systems and eccentric bit down-the-hole-hammer methods are not adequately emphasized. Similarly illustrations of drilling rigs portray machines antiquated by European standards.

A short chapter on special anchor systems covers a general range available pre-1980. More recently developed anchor systems used in the UK, such as shear tube anchor, single bore multiple anchor and jet grouted anchor are not mentioned, neither is reference made to continental systems involving ground strengthening by pregrouting, nor to the expander body anchor concept.

Chapters four to six on load transfer, anchor capacities, overall stability, corrosion risk and corrosion protection systems are well presented and in detail. The general design guide and corrosion protection recommendations are consistent with those of DD81 and in some areas (creep behaviour) a varied and useful background is provided. Records of incidents of tendon corrosion are well documented and are generally reproduced from FIP publications.

Chapter seven on anchor testing suggests a fresh approach for the UK engineer in that it provides a sound summary of anchor acceptance criteria as defined in other national Codes of Practice. Those criteria used in Germany and France are of particular interest.

Use and application of ground anchors is well covered in Chapter eight, whilst the following chapter, reviewing design principles of anchored structures provides probably as extensive a summary of such considerations as has been collected in a single document. Some of the design approaches may not be universally accepted, nor are they all adequately detailed to allow full application of the described principles; however, this chapter does provide numerous guidelines and where detail is lacking, information sources are extremely well documented. The final chapter summarizes a broad cross section of design examples and behaviour of anchored structures.

The text, although outdated in certain areas, is well written and presented, and illustrations are numerous and clear. It is unfortunate that the book frequently reproduces text and illustrations from the outdated BS document DD81 and not from the current Code of Practice BS 8081 (1988). (The latter document applies a small number of very important modifications to grouting and corrosion protection considerations from those set out in DD81.) Dr Xanthakos' book does, however, within its covers, provide an engineer with a broad acquaintance with the development of worldwide anchor practice and design principles. Perhaps its most effective contribution will be as an extensive conspectus of ground anchor reference papers dating from 1955 to approximately 1980 and as such it could provide a godsend for specialist researchers required to carry out a preliminary survey of technical papers!

A. D. Barley