Book review

Fundamentals of soil behavior (3rd edn). J. K. Mitchell and K. Soga. Hoboken, NJ: John Wiley & Sons, 2005. 577 pp. ISBN 13: 978-0-471-46302-7. £80

This is the third edition of a classic textbook that has been of great benefit to a wide readership in both academia and industry. As its title implies, the style of each edition of this book has been to explain the behaviour of soils from a fundamental viewpoint. As discussed in the preface to the first edition, many geotechnical problems can be solved with knowledge of *how* a soil behaves, but for a more profound understanding we need to appreciate *why* they behave as they do. The philosophy has been to try to understand what causes observed soil behaviour by considering issues such as particle interaction and the effects of soil water on microscopic and chemical levels. In this new edition this approach is retained; new topics are introduced and others comprehensively updated and revised, resorting to the latest research and publications. This is a major achievement, given the vast and complex nature of some of the subject matter and the ever-increasing scope of literature available.

The order of presentation within the book has been changed to improve the flow of the subject matter, but most of the original content has been retained. Although the book has fewer chapters than the previous editions it has considerably more pages, reflecting the new and expanded material included. The early chapters (2 and 3) cover soil formation and mineralogy, with a section on determination of soil composition (e.g. using X-ray diffraction) logically included. This is very useful, given that several techniques are available. Chapter 4 discusses soil composition with relation to its engineering properties. In amongst the science and engineering are simple analogies with cooking (e.g. concerning particle sizes, and liquid and plastic states), which would be helpful for those recently introduced to the subject of soil mechanics. Fabric and its measurement are the subjects of Chapter 5. Many developments in the latter have been made since the previous edition, and these are described with illustrations, for example the use of X-ray computed tomography (CT scans).

Chapters 6 and 7 are devoted to soil–water chemical interactions and effective, intergranular and total stress. These chapters provide information at the molecular and microscopic level that is generally not covered in other texts on soil mechanics. Reference is made to the effects of partial saturation, introducing the significance of soil–water retention curves and their hysteresis. It is logical to have

included this component of soil–water–air interaction at the interparticle level, with the increasing developments in unsaturated soil mechanics. Having introduced soil properties and characteristics in terms of aspects such as mineralogy, interparticle forces and fabric in previous chapters, Chapter 8 goes back to geology, describing soil deposits, their formation, structure, geotechnical properties and stability. Most soil types encountered in practice are discussed, including a comprehensive section on residual soils, in relation to what has been discussed earlier, covering important phenomena such as liquefaction, sensitivity, and collapsing and swelling soils.

The next three chapters cover conduction phenomena (Chapter 9), volume change (Chapter 10) and strength and deformation behaviour (Chapter 11). These subjects are covered in much greater depth than in most standard textbooks. For example, Chapter 9 discusses processes involving diffusion, thermal and electrical conductivity as well as hydraulic conductivity. There is an extensive section on electro-osmosis and ground freezing and their application. Again, in all three chapters, recourse is made to earlier principles and phenomena that have been discussed, and insight is gained from new techniques such as the discrete element method and CT scans. The final chapter (Chapter 12) is a new addition, covering time effects on strength and deformation, a subject that has generated much interest in recent years, particularly its effect on geotechnical structures.

The book is very readable and self-contained. Comprehensive references, both classic and up to date, are given throughout the chapters for further study—a very helpful feature for students, researchers and those practising. Another new component that makes the book particularly attractive to those in teaching is the introduction of questions and problems at the end of each chapter; many of these are intended to be thought-provoking rather than having definite answers.

In summary, this book will remain a classic. There are few books on soil mechanics that have the depth and range of knowledge that are expressed in this textbook. With the ever-increasing challenges in geotechnical engineering, such as the safe and effective containment of contaminated or radioactive substances in the short and long term, there is a need to know fundamentally *why* soils behave as they do as well as *how* they behave. This book, in one volume, provides the opportunity to learn and understand more about linking the *how* with the *why*.

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