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Book reviews

James K. Mitchell, Kenichi Soga, Fundamentals of Soil Behavior, third ed., John Wiley & Sons Inc., Hoboken, NJ, 2005, 577 pp., US$ 130.00, ISBN 0-471-46302-7.

The 1st edition of *Fundamentals of Soil Behavior* published in 1976 focused on understanding soil behavior primarily for applications in geotechnical engineering. In the 1980s and early 1990s, environmental issues related to the use of soils as barrier materials for waste containment and in situ remediation of contaminated soils came to the forefront of a variety of disciplines and professions, including geotechnical engineering. As a result, a 2nd edition that expanded the coverage of the 1st edition to include the understanding of the composition, structure, and behavior of soils that is required to address these environmental issues was published in 1993. The format of the 3rd edition is, in the words of the authors, ". . . much the same as in the first two editions, [but] the contents have been reviewed and revised in detail, with deletion of some material no longer considered to be essential and introduction of substantially new material to incorporate more recent developments". Even though the 3rd edition has been significantly revised, updated, and expanded, the authors' stated purpose for the 3rd edition remains the same as for the previous two editions, viz., ". . . the development of an understanding of the factors determining and controlling the engineering properties and behavior of soils under different conditions, with an emphasis on *why* they are what they are".

Aside from the inclusion of a co-author (Soga), the new aspects of the 3rd edition of *Fundamentals of Soil Behavior* include: (1) a separate chapter on time effects pertaining to soil strength and deformation behavior; (2) additional soil property correlations; (3) sets of questions and problems at the end of each chapter. These question-and-problem sets, which were not included in either of the first two editions, make this 3rd edition of *Fundamentals of Soil Behavior* particularly attractive for use as a textbook.

The 12 chapters of the 3rd edition of *Fundamentals of Soil Behavior* are as follows:

- Introduction
- Soil formation
- Soil mineralogy
- Soil composition and engineering properties
- Soil fabric and its measurement
- Soil–water–chemical interactions
- Effective, intergranular, and total stress
- Soil deposits – their formation, structure, geotechnical properties, and stability
- Conduction phenomena
- Volume change behavior
- Strength and deformation behavior
- Time effects on strength and deformation

After the introductory chapter, where the authors lay the framework for the scope and organization of the book, the basics of soil formation, including consideration of rock and soil weathering, erosion and transportation of soil materials, depositional processes, and postdepositional changes in sediments, are covered in Chapter 2. Chapter 3 on 'Soil mineralogy' then provides a comprehensive, yet succinct overview of soil mineralogy which is outstanding. The reviewer credits his basic understanding of soil mineralogy, in general, and clay mineralogy, in particular, to this chapter in earlier editions of the book. The presentation then transitions nicely from the solid-phase material covered in Chapter 3 to the composition and engineering properties of soils in Chapter 4 and the importance of soil fabric on soil behavior in Chapter 5.

Chapter 6 on 'Soil–water–chemical interactions' then introduces and discusses the potential influence of the type and composition of the soil liquid phase on soil behavior, and includes excellent descriptions of the classic diffuse-double layer (Gouy–Chapman) theory for colloidal particles subjected to electrolyte solutions, the types and magnitudes of interactive forces between soil particles, the nature of cation exchange and ion exchange theories, and the influence of interactions between inorganic and organic chemicals and soils on soil behavior. Chapter 6 offers solid background for anyone who deals with the effects of hazardous chemicals on soils and soil behavior. Chapter 7 then provides a brief overview of the concept of effective, intergranular, and total stress that forms the foundation for geotechnical engineering. Chapter 8 on 'Soil deposits' focuses primarily on the interrelationship between soil structure and characteristics and engineering properties.

The focus then shifts somewhat in Chapter 9 on 'Conduction phenomena' to a description of the physics of direct flows (i.e., water flow via Darcy's law, heat flow via Fourier's law, electrical flow via Ohm's law, and chemical flow via Fick's law) and coupled flow processes (e.g., electrokinetic phenomena) in soils. The coverage of the material in this chapter is

invaluable to anyone interested in these phenomena from the viewpoint of either containing hazardous chemicals with soil barriers or removing hazardous chemicals from contaminated soils. In the reviewer's viewpoint, the coverage of conduction phenomena in Chapter 9, which has been significantly updated and expanded relative to the 2nd edition, is worth the price of the book alone.

Finally, Chapters 10–12 shift back to topics that generally are more relevant to geotechnical engineering (e.g., general volume change behavior and consolidation, soil shear strength and stress–strain behavior). However, some of the topics covered in these three chapters, such as the influence of osmosis on soil volume change, fracturing in soils, and the effects of ground freezing are relevant to some applications involving hazardous chemicals (e.g., NAPL migration in fractures, environmental distress (e.g., freezing and thawing) of soils used to cover hazardous wastes).

The reviewer is readily familiar with both of the earlier editions, which are still currently on his bookshelf and have been referred to frequently throughout his career. In fact, most of the reviewer's fundamental understanding of the behavior of clays and the complexity of the interactions between chemicals and clay soils came from reading the material in the earlier editions of *Fundamentals of Soil Behavior*. Although the reviewer's formal background in geotechnical engineering undoubtedly enhanced his ability to grasp the material covered in these chapters, the text is written so clearly and the concepts explained so well that others with less formal background in soil behavior should be able to readily grasp the material without difficulty. In particular, the 3rd edition of *Fundamentals of Soil Behavior* will serve as a valuable resource for individuals in disciplinary fields that deal with environmental issues related to soils, but who have no formal knowledge of soil behavior (e.g., chemical engineers, environmental engineers). Overall, the wealth of new and updated information contained in the 3rd edition of *Fundamentals of Soil Behavior* makes inclusion of this 3rd edition a must for anyone who deals with the interactions between soils and hazardous chemicals.

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Paul E. Hardisty, Ece Ozdemiroglu (Eds.), The Economics of Groundwater Remediation and Protection, CRC Press, Boca Raton, FL, 2005, 362 pp., US$ 149.95, ISBN 1-56670-643-2.

This book is the first one I have seen in a series entitled "*Integrative Studies in Water Management and Land Development*." The series editor, Robert L. France, of Harvard University notes the complexity of ecological issues and environmental problems. The purpose, therefore, of this series is "... to produce a set of books that transcends disciplines of science and engineering alone."

Groundwater's importance is described best in the book's conclusion:

"All life on Earth depends on water. Groundwater is one of our most precious resources, and one of our most fragile. Of all the water on the planet, only 3% is fresh, and of that the majority is locked away as snow and ice at the poles. Less than a third of the fresh water on earth is actually available to support the ecosphere, and of this more than half is groundwater. Hundreds of millions of people all over the world, in developed and developing nations, depend directly on groundwater for their daily household needs. In some arid parts of the planet, groundwater is literally the sole source of water. Groundwater is also a critical part of the biosphere, feeding rivers, lakes, and wetland systems, sustaining life for untold species, and helping to maintain the earth's threatened biodiversity."

Unfortunately, industrialized nations have contaminated much land and the groundwater associated with it. The basic concept underlying this text is that economic analysis can be used to aid decision-making for environmental protection and restoration. To this end, the authors have thoroughly discussed both the concepts of groundwater flow and contaminant transport and the basics of economic decision-making techniques; cost/benefit analysis is emphasized.

The book ends with the above-noted concepts developed in the first 12 chapters used to present the following three detailed remediation cost studies:

1. remediation of a manufactured gas plant site in the United Kingdom;
2. MtBE-contaminated aquifer in the United States;
3. tritium-contaminated groundwater.

Following these examples, the authors present an example problem and solution.

This book is an innovative approach to the topic of contaminated land and groundwater. It will be of interest to environmental engineers, hydrologists, remediation engineers, environmental economists and policy and decision makers.

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