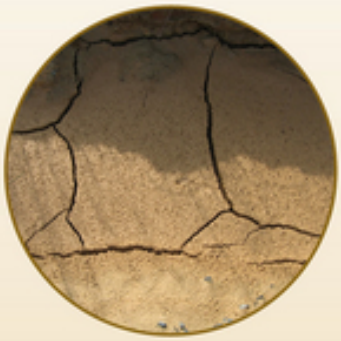
Metric version

Soil Mechanics Fundamentals


Muni Budhu

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SOIL MECHANICS FUNDAMENTALS

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MUNIRAM (Muni) BUDHU is Professor of Civil Engineering and Engineering Mechanics at the University of Arizona, Tucson. He received his BSc (First Class Honors) in Civil Engineering from the University of the West Indies and his PhD in Soil Mechanics from Cambridge University, England. Prior to joining the University of Arizona, Dr. Budhu served on the faculty at the University of Guyana, Guyana; McMaster University, Canada; and the State University of New York at Buffalo. He spent sabbaticals as Visiting Professor at St. Catherine's College, Oxford University; Eidgenössische Technische Hochschule Zürich (Swiss Federal Institute of Technology, Zurich); and the University of Western Australia. He authored and co-authored many technical papers on various civil engineering and engineering mechanics topics including soil mechanics, foundation engineering, numerical modeling, hydraulic engineering, and engineering education. Dr. Budhu has developed interactive animations for learning various topics in soil mechanics and foundation engineering, fluid mechanics, statics, and interactive virtual labs. He is the co-founder of YourLabs, developer of a knowledge evaluation system (www.yourlabs.com). Dr. Budhu has authored two other textbooks, *Soil Mechanics and Foundations* and *Foundations and Earth Retaining Structures*. Both books are available from John Wiley & Sons (www.wiley.com).

Other Books by this Author

	***Soil Mechanics and Foundations, 3rd Edition*** **by Muni Budhu** ISBN: 978-0471-43117-6 An in-depth look at soil mechanics, including content for both an introductory soil mechanics and a foundations course. For students and other readers who wish to study the detailed mechanics connected with the fundamental concepts and principles. This textbbook includes critical state soils mechanics to provide a link between soil settlement and soil shear strength.
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Website:
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Preface

Goal and Motivation

My intent in writing this textbook is to present accessible, clear, concise, and contemporary course content for a first course in soil mechanics to meet the needs of undergraduates not only in civil engineering but also in construction, mining, geological engineering, and related disciplines.

However, this textbook is not meant to be an engineering design manual nor a cookbook. It is structured to provide the user with a learning outcome that is a solid foundation on key soil mechanics principles for application in a later foundation engineering course and in engineering practice.

By studying with this textbook, students will acquire a contemporary understanding of the physical and mechanical properties of soils. They will be engaged in the presentation of these properties, in discussions and guidance on the fundamentals of soil mechanics. They will attain the problem-solving skills and background knowledge that will prepare them to think critically, make good decisions, and engage in lifelong learning.

Prerequisites

Students using this textbook are expected to have some background knowledge in Geology, Engineering Mechanics (Statics), and Mechanics of Materials.

Units

The primary unit of measure used in this textbook is the SI (International System) system of units. An imperial (US) units version version of this textbook is also available.

Hallmark Features

Contemporary methods: The text presents, discusses, and demonstrates contemporary ideas and methods of interpreting the physical and mechanical properties of soils that students will encounter as practicing engineers. In order to strike a balance between theory and practical applications for an introductory course in soil mechanics, the mechanics is kept to a minimum so that students can appreciate the background, assumptions, and limitations of the theories in use in the field.

1. The *implications of the key ideas* are discussed to provide students with an understanding of the context for the applications of these ideas.
2. *A modern explanation of soil behavior* is presented particularly in soil settlement and soil strength. These are foremost topics in the practice of geotechnical engineering. One-dimensional consolidation is presented in the context of soil settlement rather than as a separate topic (Chapter 7). The shear strength of soils is presented using contemporary thinking and approach. In particular, three popular failure criteria—Coulomb, Mohr-Coulomb, and Tresca—are discussed with regard to their applications and limitations. Students will be able to understand how to use these criteria to properly interpret soil test results and understand the differences between drained and undrained shear strength.

Pedagogy and design directed by modern learning theory: The content and presentation of the chapters are

informed by modern theories of how students learn, especially with regard to metacognition.

1. *Learning outcomes* listed at the beginning of each chapter inform students what knowledge and skills they are expected to gain from the chapter. These form the bases for the problems at the end of each chapter. By measuring students' performance on the problems, an instructor can evaluate whether the learning outcomes have been satisfied.
2. *Definitions of key terms* at the beginning of each chapter define key terms and variables that will be used in the chapter.
3. *Key points* summaries throughout each chapter emphasize for students the most important points in the material they have just read.
4. *Practical examples* at the end of some chapters give students an opportunity to see how the prior and current principles are integrated to solve “real world type” problems. The students will learn how to find solutions for a “system” rather than a solution for a “component” of the system.

Consistent problem-solving strategy: Students generally have difficulty in translating a word problem into the steps and equations they need to use to solve it. They typically can't read a problem and understand what they need to do to solve it. This text provides and models consistent strategies to help students approach, analyze, and solve any problem. Example problems are solved by first developing a strategy and then stepping through the solution, identifying equations, and checking whether the results are reasonable as appropriate.

Three categories—***conceptual understanding, problem solving, and critical thinking and decision making***—of problems are delineated at the end of the chapter to assess students' knowledge mastery. These are not strict categories. In fact, the skills required in each category are intermixed. Problems within the ***conceptual understanding*** category are intended to assess understanding of key concepts and may contain problems to engage lateral thinking. It is expected that the instructor may add additional problems as needed. Problems within the ***problem-solving*** category are intended to assess problem-solving skills and procedural fluency in the applications of the concepts and principles in the chapter. Problems within the ***critical thinking and decision-making*** category are intended to assess the student's analytical skills, lateral thinking, and ability to make good decisions. These problems have practical biases and require understanding of the fundamentals. Engineers are required to make decisions, often with limited data. Practical experience is a key contributor to good decisions. Because students will invariably not have the practical experience, they will have to use the fundamentals of soil mechanics, typical ranges of values for soils, and their cognitive skills to address problems within the ***critical thinking and decision-making*** category. The instructors can include additional materials to help the students develop critical thinking and decision-making skills.

Knowledge mastery assessment software. This textbook is integrated with YourLabs™ Knowledge Evaluation System (KES) (www.yourlabs.com). This system automatically grades students' solutions to the end of chapter problems. It allows students to answer the problems anywhere on any mobile device (smartphone, iPad, etc.) or any desktop computing device (PC, MAC, etc.). After answering each question in an assignment set