

Preface

In the last few decades, reliability-based design (RBD) approaches/codes and probabilistic analysis methods, such as probabilistic slope stability analysis with Monte Carlo simulation (MCS), have been developed for geotechnical structures to deal rationally with various uncertainties (e.g., inherent spatial variability of soils and uncertainties arising during geotechnical site characterization) in geotechnical engineering. Applications of the RBD approaches/codes and probabilistic analysis methods in turn call for the needs of probabilistic site characterization, which describes probabilistically soil properties and underground stratigraphy based on both prior knowledge (i.e., site information available prior to the project) and project-specific test results. How to combine systematically prior knowledge and project-specific test results in a probabilistic manner, however, is a challenging task. This problem is further complicated by the inherent spatial variability of soils, uncertainties arising during site characterization and the fact that geotechnical site characterization generally only provides a limited number of project-specific test data.

This book focuses on probabilistic characterization of uncertainties in geotechnical properties and their propagation in slope stability analysis using MCS. Several probabilistic approaches are developed and presented in this book for probabilistic site characterization and reliability analysis of slope stability. These approaches effectively tackle the following unresolved issues in geotechnical risk and reliability, which hamper the applications of probabilistic analysis and design approach in geotechnical practice:

1. How to determine project-specific statistics and probability distributions of geotechnical properties based on both prior knowledge and a limited number of project-specific test data obtained during geotechnical site characterization? (Chaps. 3–6)
2. How to express engineering judgments in a quantitative and transparent manner during geotechnical site characterization? (Chap. 4)

3. How to delineate underground stratigraphy (including number and boundaries of soil layers) probabilistically using a limited number of site observation data? (Chap. 6)
4. How to efficiently incorporate various geotechnical-related uncertainties (e.g., uncertainties in geotechnical properties) into slope stability analysis using MCS? (Chap. 7)
5. How to shed light on the relative contributions of various uncertainties to slope failure probability based on MCS? (Chap. 8)
6. How to make MCS-based probabilistic analysis approach of slope stability accessible to geotechnical practitioners who are usually unfamiliar with probability theory and statistics? (Chaps. 7 and 8)

As far as the authors are aware, this is the first book to revisit geotechnical site characterization from a probabilistic point of view and provide rational tools to probabilistically characterize geotechnical properties and underground stratigraphy using limited information obtained from a specific site. This book also develops efficient MCS approaches for slope stability analysis and implements these approaches in a commonly available spreadsheet environment by a package of worksheets and functions/add-in in Excel. These approaches and the software packages are readily available to geotechnical practitioners and alleviate them from reliability computational algorithms. The authors gratefully acknowledge the financial support by the National Science Fund for Distinguished Young Scholars (Project No. 51225903), the National Natural Science Foundation of China (Project Nos. 51329901, 51409196, 51579190, 51528901), the National Program on Key Research Project (2016YFC0800208), and the Natural Science Foundation of Hubei Province of China (Project No. 2014CFA001).

The authors would like to express my heartfelt gratitude toward many colleagues who give invaluable advice and insightful comments on this book. We would also thank Miss Shuo Zheng for her assistance in word processing of the manuscript and Mr. Fuping Zhang, Mr. Jian He, Mr. Xin Liu, and Ms. Mi Tian for their help on the proofread of the manuscript. Last but not least, the authors' deep gratitude goes to their families for their loving consideration and continuous support to encourage us to finish this book.

Wuhan, China
Hong Kong, China
Wuhan, China
March 2016

Zijun Cao
Yu Wang
Dianqing Li

Probabilistic Approaches for Geotechnical Site
Characterization and Slope Stability Analysis

Cao, Z.; Wang, Y.; Li, D.

2017, XVI, 190 p. 55 illus., 7 illus. in color., Hardcover

ISBN: 978-3-662-52912-6