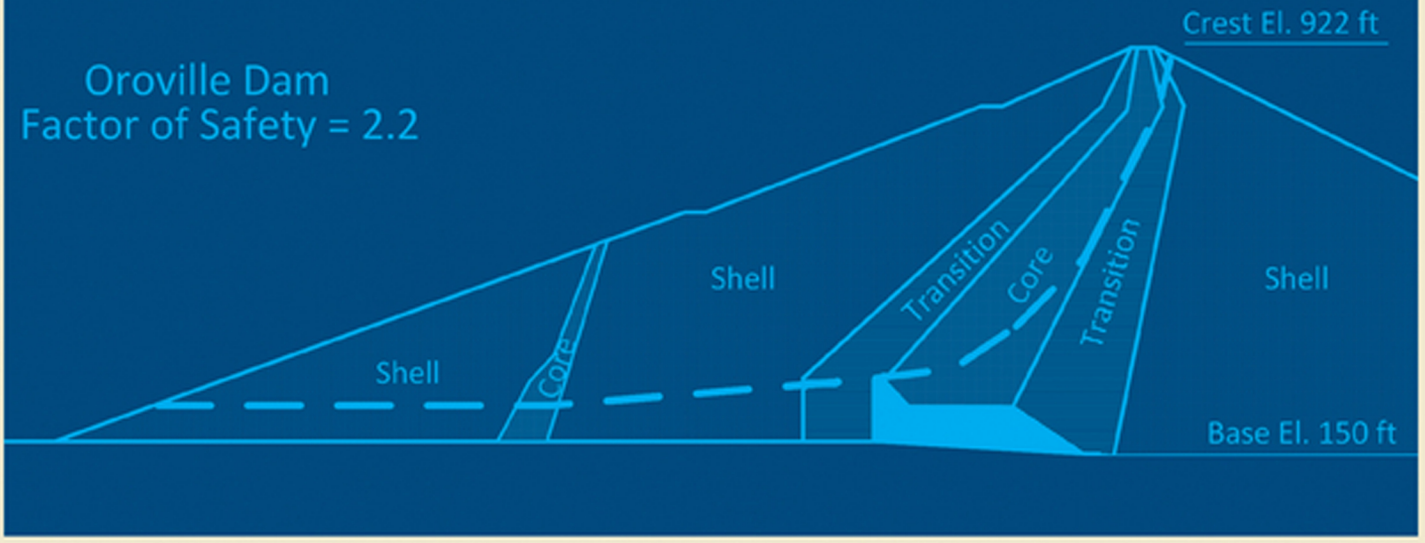
J. Michael Duncan
Stephen G. Wright
Thomas L. Brandon

SOIL STRENGTH and SLOPE STABILITY

SECOND EDITION



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FOREWORD

Slope stability is arguably the most complex and challenging of all the subdisciplines of geotechnical engineering, and is often the least understood. In the first edition of this book, the authors captured the essence of this subject in an authoritative, comprehensive, and informative manner. Since publication in 2005, the first edition has come into widespread use in the profession and has virtually become a classic in the slope stability literature. The authors have certainly done no less in this second edition. Eleven of the 16 chapters have been significantly expanded and/or supplemented with new material. Moreover, the new materials are highly focused on the latest knowledge, experience, and practices that have been developed since the first edition. These new insights will render this second edition a highly relevant and useful volume for practitioners, academics, and students for years to come.

While all the valuable new additions to the book are too voluminous to address in detail here, there are several items in the writer's opinion that are particularly relevant. In Chapter 2, case histories have been added of the New Orleans "I-Wall" failures during Hurricane Katrina, from which much valuable information was obtained. Chapter 3 includes a new discussion of the effective stress envelope for unsaturated soils. Chapter 5 on shear strength has been significantly expanded with new concepts on curvature of strength envelopes and recent correlations of shear strength with various field tests and index properties. In the nine years since publication of the first edition, our understanding of soil strength and its application to slope stability analysis has made significant strides, especially related to fully softened strengths of highly plastic clays. Chapter 5 also includes a detailed discussion of this topic including laboratory testing methods, representation of curved strength envelopes with piecewise linear and power-curve techniques, and application of fully softened strength in slope stability analyses. Chapter 6 includes a presentation on the finite element strength reduction method for calculating the factor of safety of slopes and an update on determination of pore pressures by finite element methods. Chapter 7 includes new finite element solutions to the verification problems and a new verification problem using a curved strength envelope. Chapter 8 on reinforced slopes has been updated to include current FHWA (2009) methods for MSE walls. Chapters 9 and 10 contain updated material on rapid drawdown and seismic slope stability analyses. While this is but a brief discussion of a few of the many new portions of the book, it illustrates the breadth of new valuable material in the second edition.

In keeping with the first edition, the authors have maintained a format beginning with elemental principles that university students can quickly comprehend and moving in a smooth and logical manner to the highly advanced material for even the most experienced user. It is the writer's opinion that the pristine covers of the new second edition publication will soon become ragged and worn in tribute to the widespread relevance and usefulness of this book.

Dr. Garry H. Gregory, Ph.D., P. E., D.GE
Board of Governors of the Geo-Institute
Chair of the Embankments, Dams, and Slopes
Committee of the Geo-Institute

PREFACE

In the nine years since the appearance of the first edition of *Soil Strength and Slope Stability* there have been significant developments in measurement of soil strength in the laboratory and the field, advances in methods of stability analysis, and development of new techniques for slope stabilization. In situ testing, particularly cone penetration testing, has improved the efficiency of soil exploration and evaluation of soil strength through the use of correlations. Chapter 5, on shear strength of soil and municipal solid waste, is greatly expanded in this edition, providing discussions of the behavior of rockfill, gravel, sand, silt, and clay, as well as compilations of data and typical values of their strengths. This edition also draws together more lessons that have been learned from recent slope failures, such as the failures of I-walls in New Orleans during Hurricane Katrina, and delayed failures that resulted from gradual softening of clays over long periods of time. The purpose of this book is to describe the current state of knowledge on soil strength and slope stability in a form that makes it easily accessible to geotechnical graduate students and professionals.

Development of this book would not have been possible without the assistance of many colleagues, whose contributions to our understanding we gratefully acknowledge. Foremost among these is Professor Harry Seed, who taught all of us and was the inspiration for our lifelong interest in soil strength and slope stability. We are also grateful for the opportunity to work with Nilmar Janbu, who during his sabbatical at Berkeley in 1969 taught us many valuable lessons regarding analysis of slope stability and the shear strength of soils. Our university colleagues Jim Mitchell, Roy Olson, Clarence Chan, Ken Lee, Peter Dunlop, Guy LeFebvre, Fred Kulhawy, Suphon Chirapuntu, Tarciso Celestino, Dean Marachi, Ed Becker, Kai Wong, Norman Jones, Poul Lade, Pat Lucia, Tim D'Orazio, Jey Jeyapalan, Sam Bryant, Ed Kavazanjian, Erik Loehr, Loraine Fleming, Bak Kong Low, Bob Gilbert, Garry Gregory, Vern Schaefer, Tim Stark, Binod Tiwari, Mohamad Kayyal, Marius DeWet, Clark Morrison, Ellen Rathje, George Filz, Mike Pockoski, Jaco Esterhuizen, Matthew Sleep, and Daniel VandenBerge have also contributed greatly to our understanding of soil strength and stability. Our experiences working with professional colleagues Al Buchignani, Laurits Bjerrum, Jim Sherard, Tom Leps, Norbert Morgenstern, George Sowers, Robert Schuster, Ed Luttrell, Larry Franks, Steve Collins, Dave Hammer, Larry Cooley, John Wolosick, Noah Vroman, Luis Alfaro, Max DePuy and his group at the Panama Canal Authority, and Fernando Bolinaga have helped us to see the useful relationships among teaching, research, and professional practice. Special thanks go to Alex Reeb, Chris Meehan, Bernardo Castellanos, Daniel VandenBerge, and Beena Ajmera for their invaluable assistance with figures, references, proofing, and indexing. Finally, we express our deepest appreciation and love to our wives—Ann, Ouida, and Aida—for their support, understanding, and constant encouragement throughout our careers and during the countless hours we have spent working on this book.

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