SERIES IN GEOTECHNICAL ENGINEERING

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BOOKS IN SERIES:
Soil Testing for Engineers by T. William Lambe, 1951
Soil Mechanics by T. William Lambe and Robert V. Whitman, 1968
Soil Dynamics by Robert V. Whitman (*in progress*)
Fundamentals of Soil Behavior by James K. Mitchell, 1976
Elastic Solutions for Soil and Rock Mechanics by H. G. Poulos and E. H. Davis, 1974
Soil Mechanics, SI Version by T. William Lambe and Robert V. Whitman, 1978

The aim of this series is to present the modern concepts of soil engineering, which is the science and technology of soils and their application to problems in civil engineering. The word "soil" is interpreted broadly to include all earth materials whose properties and behavior influence civil engineering construction.

Soil engineering is founded upon many basic disciplines: mechanics and dynamics; physical geology and engineering geology; clay mineralogy and colloidal chemistry; and mechanics of granular systems and fluid mechanics. Principles from these basis disciplines are backed by experimental evidence from laboratory and field investigations and from observations on actual structures. Judgment derived from experience and engineering economics are central to soil engineering.

The books in this series are intended primarily for use in university courses, at both the undergraduate and graduate levels. The editors also expect that all of the books will serve as valuable reference material for practicing engineers.

T. William Lambe and Robert V. Whitman

PILE FOUNDATION ANALYSIS AND DESIGN

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PREFACE

This book deals with methods of analysis that may be useful in design of pile foundations. Many excellent textbooks are concerned with the more practical aspects of pile foundations, such as the factors influencing the selection of the type of pile, the techniques of installation, and practical details of construction and maintenance of piles. No attempt has been made to duplicate this type of information. The aims of the present book are to:

1. Present a consistent theoretical approach to the prediction of pile deformation and load capacity.
2. Present parametric solutions for a wide range of cases.
3. Demonstrate how such solutions can be used for design purposes.
4. Review the applicability of these approaches to practical problems.

In any theory, a certain amount of idealization is necessary to obtain a tractable mathematical solution; this is especially so when dealing with problems involving soil. In dealing with the deformations of pile foundations in this book, we have generally considered the soil as an elastic material, with allowances made for pile-soil slip and soil yield where appropriate. Although real soils possess few, if any, of the attractive attributes of an ideal homogeneous isotropic elastic material, they nevertheless can often be treated as elastic over a limited range of stress, provided that the "elastic" parameters are determined for this stress range. When used in this manner, with due discretion and a measure of engineering judgment, elastic-based theory has had considerable success in predicting the deformation of both shallow and deep foundations. Although other simple soil models have also been successfully used for various aspects of pile analysis (for example, the theory of subgrade reaction as applied to laterally loaded piles), elastic theory provides a unified basis for the analysis of all types of foundation; it also makes possible identification of the parameters that exercise a significant influence on pile performance. Since elastic theory allows consideration of stress transmission through a mass, it can be used to analyze the interaction between two or more piles and, therefore, to examine the behavior of groups of piles.

The material contained in this book is organized as follows:

1. The behavior of piles under vertical loads (Chapters 2 to 6).
2. The behavior of piles under lateral loading (Chapters 7 and 8) and under combined vertical and lateral loading (Chapter 9).
3. The behavior of piled rafts (Chapter 10).
4. Piles subjected to vertical or lateral soil movements (Chapters 11 to 13).
5. Miscellaneous topics such as pile buckling, dynamic loading, and pile load tests (Chapters 14 to 16).

Although the text deals with a relatively wide range of topics, it is by no means exhaustive. Furthermore, since geotechnical analysis is advancing at a very rapid rate, there may well be cases in which the analytical techniques we describe may have been superseded by more versatile methods capable of modeling real soil behavior more realistically. Nevertheless, we feel that the techniques and solutions presented in this book can be usefully applied to most practical problems and provide a basic series of results against which the results of more sophisticated analyses may be checked.

Some worked examples are given to illustrate the application of the solutions to practical problems. Because units are by no means standardized as yet, some of the examples are worked in SI units, some in British units, and a few in the Continental metric system.

We thank the many people who have contributed to this book and in particular Dr. N. S. Mattes, of the Electricity Commission of New South Wales, who obtained a considerable number of the elastic solutions presented, Dr. J. R. Booker and Dr. P. T. Brown of the University of Sydney, who provided a great deal of assistance with various aspects of the theoretical analyses, Mr. P. J. N. Pells who provided valuable information on the subject of piles

to rock, and Dr. T. J. Wiesner, who obtained some of the solutions presented in Chapter 10. The Civil Engineering Graduates Association of the University of Sydney gave financial support for the post-graduate course on pile foundations that formed the basis of this book. Grateful acknowledgement is given to Professor J. W. Roderick, former Head of the Department of Civil Engineering, who made the facilities of the Department available to us, to C. J. Peiti, B. Crook, J. Kilpatrick, S. Picken, J. Knight and B. Rocke who undertook the typing and assembly of the manuscript, and R. Brew and H. Papallo who prepared many of the diagrams.

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