

SOIL
TESTING
for Engineers

T. WILLIAM LAMBE

The Massachusetts Institute of Technology

NEW YORK · JOHN WILEY & SONS, INC.
LONDON · CHAPMAN & HALL, LIMITED

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FIFTH PRINTING, FEBRUARY, 1958

PRINTED IN THE UNITED STATES OF AMERICA

Preface

The branch of engineering known as soil mechanics is still relatively young. Since its initiation, the number of colleges and universities giving formal courses in soils has steadily increased until today nearly every engineering school offers at least one course in soil mechanics. In the past, many instructors taught from their personal notes for lack of adequate textbooks. In recent years, however, several good books on the theory and practice of soil mechanics have appeared. The primary purpose of this book is to fulfill the need for a textbook for the teaching of soil testing. I think that it will also be of value as a reference book for practicing engineers and for personnel in soil laboratories.

There are many conditions, such as soil disturbance during sampling and unknown boundary conditions in nature, that require the engineer to use intelligence and experience in applying the results of laboratory tests to an actual soil problem. In many particular problems the results of laboratory tests can do no better than serve as a guide to the designer. For such problems field tests are often required. Even though this book is devoted entirely to laboratory testing, I hope that it will aid the student in attaining the proper perspective on the role of laboratory testing in soil mechanics.

In addition to an introductory chapter on general laboratory procedures, this book devotes a chapter to each of the tests presented. Only the common laboratory soil tests are included; several tests which are of a semi-empirical nature and the results of which cannot be well interpreted have been excluded. Also specialized research tests have not been included herein. Consideration was given to the inclusion of some clay technology and the related laboratory tests, such as the determination of clay minerals, nature and amount of exchangeable ions, electrical charges on particles, and degree of acidity (pH). Although rapid progress is being made in the development of clay technology, I feel that not enough is known concerning the influence of these clay properties on the engineering behavior of soil to justify their inclusion in this book.

Each chapter, after the first one, consists of sections entitled: Introduction, Apparatus and Supplies, Recommended Procedure, Discussion of Procedure, Calculations, Results, and Numerical Example. In the Introduction the property which is sought is defined and discussed, and practical applications of it are given. Under Apparatus and Supplies a list of the necessary equipment is given, along with photographs,* sketches, and any description thought desirable to illustrate important features. The reader should note that the detailed test procedures presented in this textbook are entitled Recommended Procedures. The exact procedure and type of apparatus which should be employed in any particular test depend on the soil in question and the use to be made of the results. An attempt has been made to give the principles of the laboratory

* Volume VI of *International Soil Mechanics Conference Proceedings*, Rotterdam, June, 1948, contains photographs and descriptions of the testing apparatus used by most of the major soil laboratories in the world. Unless otherwise noted, all photographs in this book were taken in the soil mechanics laboratory at the Massachusetts Institute of Technology.

tests in such a way that an instructor or a trained technician can see where he may alter the procedure to fit his particular needs. This book would perform a disservice to the profession if it posed as a manual and implied that a reader can always blindly follow detailed test procedures to obtain results which have much value. The results of soil tests should be interpreted by someone who understands the basic fundamentals.

As an illustration of the detailed computations, a numerical example is included at the end of each test. These examples employ recommended data-calculation sheets which minimize computation time and mistakes. A laboratory will find it advisable to stock a supply of data-calculation forms.

In an attempt to make this book reasonably self-sufficient, brief derivations of the formulas used in the test computations are included in the Appendix. Also in the Appendix are presented explanations and discussions of calibration procedures and special techniques, and other useful information.

I am indebted to the people who permitted me to use their work in this book. A concerted effort has been made to give proper credit to them for their contribution at the place where it was used. I would like to express my appreciation to my colleagues in soil mechanics at the Massachusetts Institute of Technology, Harl P. Aldrich, Paul B. Lawrence, C. C. Lu, W. R. Sutherland, and especially Professor D. W. Taylor, for reviewing the manuscript and making helpful suggestions. Miss Winifred Cadbury deserves credit for her aid in making this book more readable. Miss Dale Davisson and Miss Elizabeth Lilly typed and reviewed the manuscript. To Dr. Victor F. B. de Mello, a former member of the soil mechanics staff at the Massachusetts Institute of Technology, especial thanks are due for his sharp but constructive criticism based on a careful study of the manuscript.

T. WILLIAM LAMBE

Massachusetts Institute of Technology
June, 1951

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