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* Co-published with Prentice-Hall Inc. in North America.

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Queen's University, Kingston, Ontario

Boston
ALLEN & UNWIN, INC.
London Sydney

Allen & Unwin Inc.,
9 Winchester Terrace, Winchester, Mass. 01890, USA

George Allen & Unwin (Publishers) Ltd,
40 Museum Street, London WC1A 1LU, UK

George Allen & Unwin (Publishers) Ltd,
Park Lane, Hemel Hempstead, Herts HP2 4TE, UK

George Allen & Unwin Australia Pty Ltd,
8 Napier Street, North Sydney, NSW 2060, Australia

First published in 1983

Library of Congress Cataloging in Publication Data

Mitchell, Robert J.
Earth structures engineering.
Includes bibliographical references and index.
1. Earthwork. 2. Soil mechanics. I. Title.
TA715.M53 1983 624.1'891 83-2621
ISBN-13: 978-0-04-624004-2 e-ISBN-13: 978-94-011-6001-8
DOI: 10.1007/978-94-011-6001-8

British Library Cataloguing in Publication Data

Mitchell, Robert J.
Earth structures engineering.
1. Earthwork
I. Title
624.1'6 TA715

Set in 10 on 11 point Times Roman by Bedford Typesetters Ltd,
and printed in Great Britain
by Mackays of Chatham

Preface

Earth structures engineering involves the analysis, design and construction of structures, such as slopes and dams, that are composed mainly of earth materials, and this is a growth area in geotechnical engineering practice. This growth is due largely to increased involvement in designing various types of earth structures for the resources industries (slopes, impoundment structures, offshore islands, mine backfills), to the development of increasingly large hydroelectric projects, to the need for more freshwater storage and diversion schemes, and to the need for transportation, communications and other facilities in areas where the natural earth materials are occasionally subject to mass instabilities.

Although geotechnical engineering transects traditional disciplinary boundaries of civil, geological and mining engineering, the majority of geotechnical engineers are graduates from civil engineering schools. Here the geotechnical instruction has been concentrated on soil mechanics and foundation engineering because foundation engineering has traditionally been the major component of geotechnical practice. Geotechnical specialists, however, generally have acquired considerable formal or informal training beyond their first engineering degree, and an advanced degree with considerable cross-discipline course content is still considered an advantage for a young engineer entering a career in geotechnical engineering. Practical job experience is, of course, a necessary part of professional development but is readily interpreted and assimilated only if the required background training has been obtained. In recent years many engineering schools have, for a variety of reasons (including improved computational abilities and the changing role of professional engineers with the availability of more technologists) found room in their programs for more technical options (hence greater specialization) at the undergraduate level. In the geotechnical area, options in various aspects of earth structures engineering are an obvious choice and such course offerings can be found in many university calendars. Although texts, detailed design manuals, research papers and state-of-the-art reports have been published in most areas of geotechnical engineering, earth structures engineering is one area where there does not appear to be a publication of sufficient scope to serve as a basis for instruction. It is the purpose of this text to present the basic concepts, principles and procedures used in earth structures engineering at a senior undergraduate to graduate university level, and it is assumed that the reader has a basic knowledge of earth materials (basic geology) and earth mechanics (basic soil and rock mechanics).

Chapters 1 and 2 are to some extent a review of concepts, material properties and analyses detailed in basic geotechnical courses, but are also

designed to indicate some differences between the practices of foundation design and earth structures design and to extend some of the concepts and methodology particularly relevant to earth structures engineering. For example: the structural integrity and performance of a large earth dam will depend on the correct evaluation of the properties and variability of natural materials over an extensive area and suitable earth materials must be located to construct a safe yet economical structure – this additional emphasis on geological engineering is reflected in the brief reviews of terrain analysis and site investigation techniques presented in Chapters 1 and 2; earth structures are designed on limiting equilibrium (rather than limiting settlements) and ground water is a major design consideration (rather than a nuisance factor), yet design safety factors are, for reasons of economic viability, relatively low (1.5 rather than 3.0) and failures are relatively catastrophic – this additional emphasis on a more detailed interpretation of the shear behavior of earth materials is reflected in the brief reviews of strength and groundwater flow in Chapter 2. Chapters 1, 2 and 3 combine to provide basic design and analysis information for engineers concerned with the geotechnical aspects of transportation facilities and route selection.

Slope stability problems affect all types of land developments, from single dwelling residential buildings on ravine lots to major projects such as canals and reservoirs – Chapter 4 details the basic analyses and design considerations applicable to slope stability problems. Earth dams are continually being constructed and maintained for hydroelectric power production, water storage, recreation and waste management – Chapter 5 outlines the basic design concepts, principles and requirements for earth dams, discusses detailed design and construction considerations for typical situations and summarizes the state-of-the-art in dam design. Case study and research references are provided for more advanced study. Ground subsidence and mine backfill are discussed in Chapter 6. Example problems and tutorial problems are presented in Chapters 4, 5 and 6.

Although the book is specifically intended as a teaching text in civil and geological programs, practising geotechnical engineers should find it useful as a library reference. Mining engineers will also find analyses and design information and examples pertinent to mine operations throughout the book. After 15 years of research, consulting and teaching contact with engineers and students in civil, geological and mining engineering, the author has selected and presented material to form a teaching and reference text for today's geotechnical option students, tomorrow's earth structures engineers.

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Kingston, Ontario
JUNE 1982

Acknowledgements

It is not possible to acknowledge all of the many associates, friends and former teachers who have contributed to the development of this text, but special thanks are extended to my family for their support and encouragement. Credits are also due to Mrs Hazel Walker for typing the draft manuscripts and to Mr Jim Roettger for assisting in the preparation of figures.

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Contents

5 Earth dams

6 Ground subsidence and mine backfill

List of tables