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# SOIL MECHANICS IN ENGINEERING PRACTICE

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## PREFACE

Soil mechanics originated several decades ago under the pressure of necessity. As the practical problems involving soils broadened in scope, the inadequacy of the scientific tools available for coping with them became increasingly apparent. Efforts to remedy the situation started almost simultaneously in the United States and in Europe, and within a short period they produced an impressive array of useful information.

The initial successes in this field of applied science were so encouraging that a new branch of structural analysis appeared to be in the making. As a consequence, the extent and profundity of the theoretical investigations increased rapidly, and experimental methods were developed to a high degree of refinement. Without the results of these painstaking investigations a rational approach to the problems of earthwork engineering could not have been attempted.

Unfortunately, the research activities in soil mechanics had one undesirable psychological effect. They diverted the attention of many investigators and teachers from the manifold limitations imposed by nature on the application of mathematics to problems in earthwork engineering. As a consequence, more and more emphasis has been placed on refinements in sampling and testing and on those very few problems that can be solved with accuracy. Yet, accurate solutions can be obtained only if the soil strata are practically homogenous and continuous in horizontal directions. Furthermore, since the investigations leading to accurate solutions involve highly specialized methods of sampling and testing, they are justified only in exceptional cases. On the overwhelming majority of jobs no more than an approximate forecast is needed, and if such a forecast cannot be made by simple means it cannot be made at all. If it is not possible to make an approximate forecast, the behavior of the soil must be observed during construction, and the design may subsequently have to be modified in accordance with the findings. These facts cannot be ignored without defying the purpose of soil mechanics. They govern the treatment of the subject in this book.

Part A deals with the physical properties of soils and Part B with the theories of soil mechanics. These two parts are very short, but they contain all that engineering students and the average engineer need to know about soil mechanics proper at the present time. The heart of the book is Part C.

Part C deals with the art of getting satisfactory results in earthwork and foundation engineering at a reasonable cost, in spite of the complexity of the structure of natural soil strata and in spite of the inevitable gaps in our knowledge of the soil conditions. To achieve this goal the engineer must take advantage of all the methods and resources at his disposal—experience, theory, and soil testing included. Yet all these resources are of no avail unless they are used with careful discrimination, because almost every practical problem in this field contains at least some features without precedent.

Every discussion of practical problems in Part C starts with a critical survey of conventional methods and proceeds step by step to whatever improvements have been realized with the assistance of the results of research in soil mechanics. Therefore, the experienced engineer is advised to start reading the book at the beginning of this part. He should use Parts A and B only for reference, to get information about concepts with which he is not yet familiar. Otherwise he would be obliged to digest a considerable amount of material before he would be in a position to realize its function in his field of interest.

The details of the methods for coping with the practical problems covered by Part C may change as experience increases, and some of them may become obsolete in a few years because they are no more than temporary expedients. Yet the merits of the semiempirical approach advocated in Part C are believed to be independent of time. At the end of each article of Part C the reader will find a list of references. In their choice priority was given to those publications that are likely to foster the urge and capacity for careful and intelligent field observations. In connection with these references it should be emphasized that some of the discussions and closures may contain more important information than the articles themselves.

Since the field of soil engineering is too broad to be covered adequately in a single volume, various important topics such as highway, airport, and tunnel engineering had to be excluded. Brief references concerning these fields have been assembled in an appendix.

In its early stages, the manuscript was critically studied by Professor C. P. Siess, whose comments were especially helpful. The authors also appreciate the suggestions of the several practicing engineers who read various portions of the text. In particular, they are indebted to Mr. A. E. Cummings, Mr. O. K. Peck, and Mr. F. E. Schmidt for criticisms of Part C, to Dr. R. E. Grim for review of Article 4, and to Dr. Ruth D. Terzaghi for assistance in the preparation of Article 63.

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# CONTENTS

	Page
INTRODUCTION	xvii
PART A. PHYSICAL PROPERTIES OF SOILS	
CHAPTER I. INDEX PROPERTIES OF SOILS	
1. Practical importance of index properties	3
2. Principal types of soils	4
3. Size and shape of soil particles	9
4. Properties of very fine soil fractions	10
5. Mechanical analysis of soils	17
6. Soil classification based on grain-size characteristics	19
7. Soil aggregate	24
8. Consistency and sensitivity of clays	30
9. Minimum requirements for adequate soil description	36
CHAPTER II. HYDRAULIC AND MECHANICAL PROPERTIES OF SOILS	
10. Significance of hydraulic and mechanical properties of soils	40
11. Permeability of soils	40
12. Effective and neutral stresses and critical hydraulic gradient	51
13. Compressibility of confined layers of soil	56
14. Consolidation of clay layers	74
15. Shearing resistance of soils	78
16. Triaxial-compression tests	93
17. Shear characteristics of quicksand and soft clay	100
18. Stress and strain in soils	105
19. Effect of vibrations on soils	111
CHAPTER III. DRAINAGE OF SOILS	
20. Water table, soil moisture, and capillary phenomena	114
21. Processes of drainage	119
PART B. THEORETICAL SOIL MECHANICS	
CHAPTER IV. PLASTIC EQUILIBRIUM IN SOILS	
22. Fundamental assumptions	137
23. States of plastic equilibrium	138
24. Rankine's earth-pressure theory	144
25. Influence of wall friction on the shape of the surface of sliding	151
26. Coulomb's theory of active earth pressure against retaining walls	153
27. Point of application of earth pressure	158
28. Passive earth pressure against rough contact faces	160
29. Bearing capacity of shallow footings	167
30. Bearing capacity of piers and piles	175

	Page
31. Stability of slopes	181
32. Earth pressure against bracing in cuts	192
33. Arching in soils	199
<b>CHAPTER V. SETTLEMENT AND CONTACT PRESSURE</b>	
34. Introduction	201
35. Vertical pressure in soil beneath loaded areas	202
36. Settlement of foundations	208
37. Contact pressure and theories of subgrade reaction	212
<b>CHAPTER VI. HYDRAULICS OF SOILS</b>	
38. Scope of hydraulic problems	218
39. Seepage computations	219
40. Mechanics of piping	229
41. Theory of consolidation	233
42. Stability of earth dams	242
<b>PART C. PROBLEMS OF DESIGN AND CONSTRUCTION</b>	
<b>CHAPTER VII. SOIL EXPLORATION</b>	
✓ 43. Purpose and scope of soil exploration	255
× 44. Methods of soil exploration	258
× 45. Program for subsoil exploration	285
<b>CHAPTER VIII. EARTH PRESSURE AND STABILITY OF SLOPES</b>	
46. Retaining walls	312
47. Drainage prior to excavation	329
48. Lateral supports in open cuts	342
49. Stability of hillsides and slopes in open cuts	354
50. Compaction of soils	372
51. Design of fills, dikes, and earth dams	381
52. Stability of base of embankments	394
<b>CHAPTER IX. FOUNDATIONS</b>	
× 53. Foundations for structures	407
× 54. Footing foundations	413
× 55. Raft foundations	443
56. Pile foundations	456
57. Pier foundations	484
58. Dam foundations	494
59. Safeguards against piping	502
<b>CHAPTER X. SETTLEMENT DUE TO EXCEPTIONAL CAUSES</b>	
60. Settlement due to construction operations	515
61. Settlement due to lowering the water table	524
62. Settlement caused by vibrations	528
63. Settlement due to deterioration of foundation concrete	530
<b>APPENDIX. MISCELLANEOUS PROBLEMS OF DESIGN AND CONSTRUCTION</b>	<b>537</b>
<b>INDEX</b>	<b>543</b>