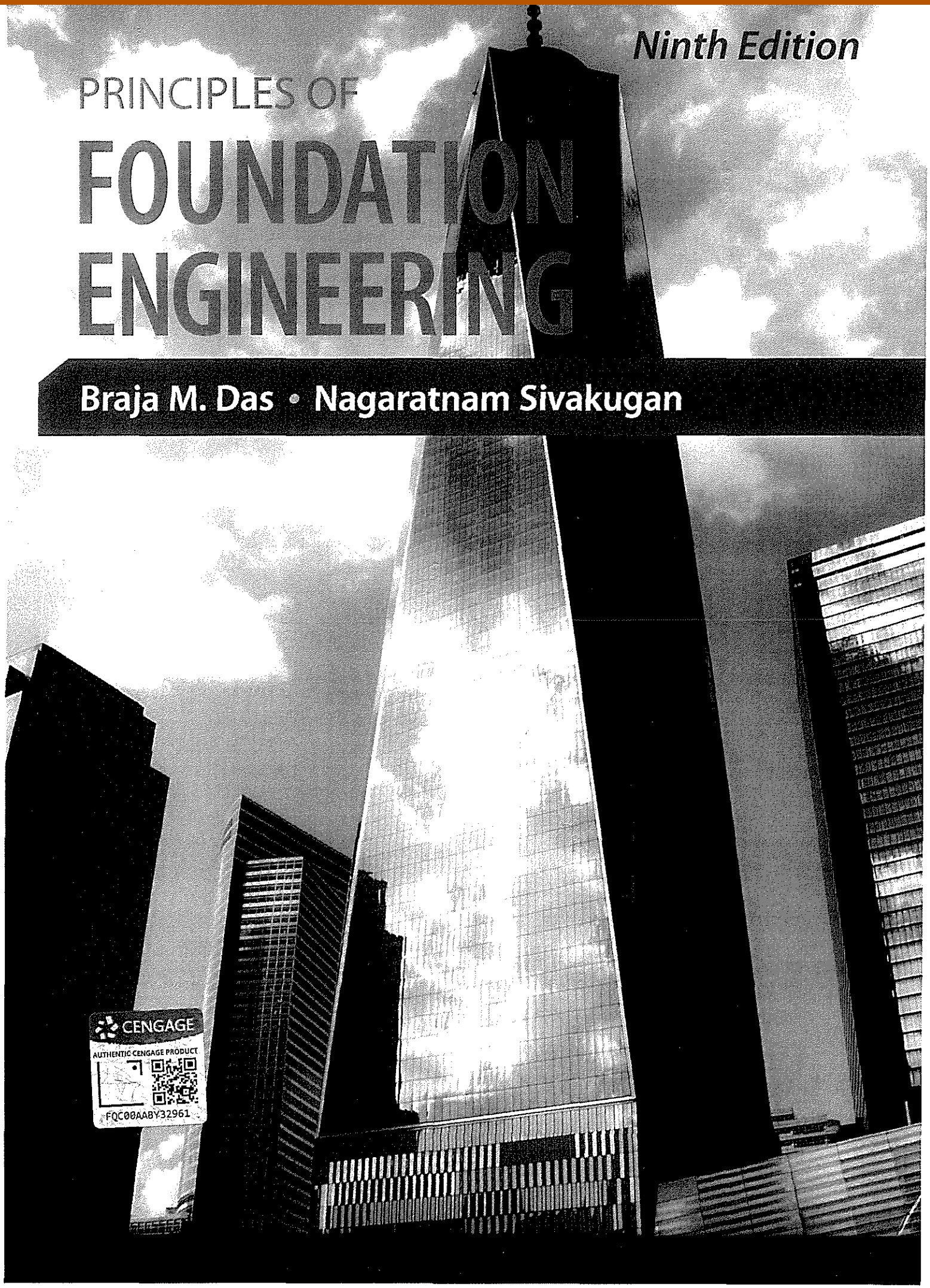
Ninth Edition

PRINCIPLES OF FOUNDATION ENGINEERING

Braja M. Das • Nagaratnam Sivakugan



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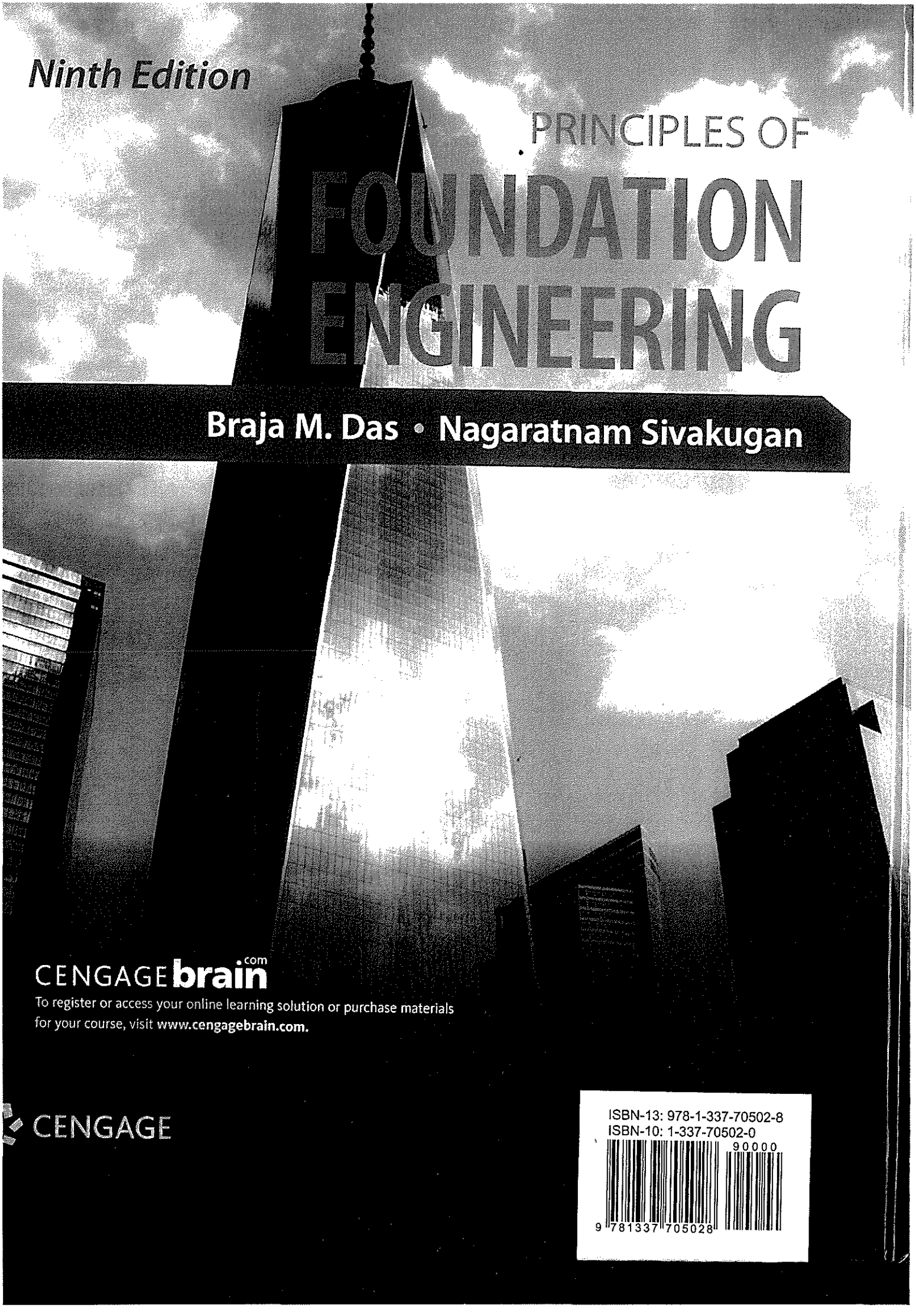
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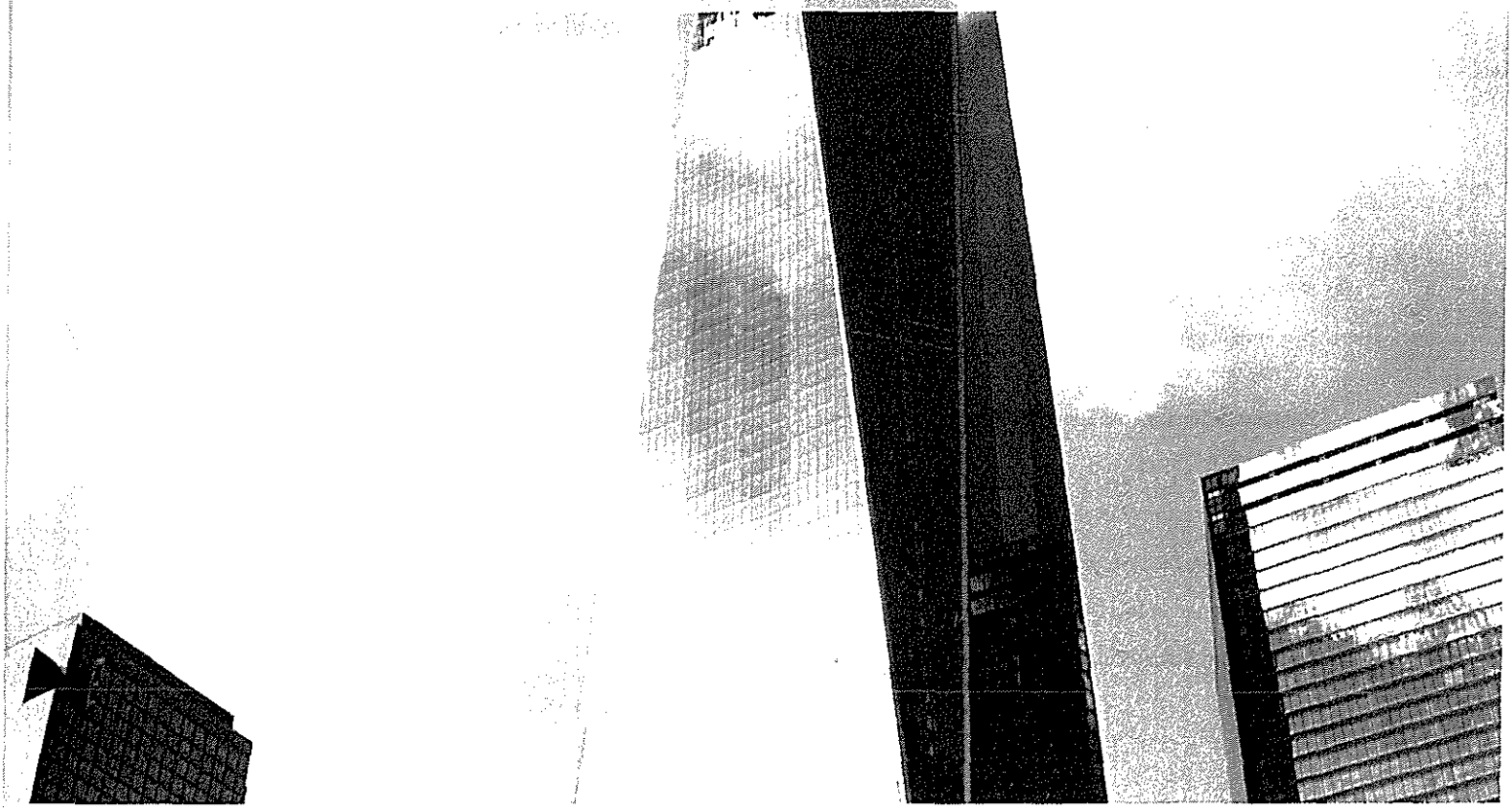

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Contents

Preface xv
About the Authors xxi

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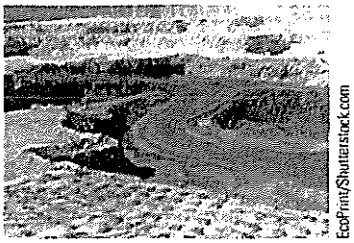
1 Introduction 1

1.1 Geotechnical Engineering 2
1.2 Foundation Engineering 2
1.3 Soil Exploration 2
1.4 Ground Improvement 3
1.5 Solution Methods 4
1.6 Numerical Modeling 4
1.7 Empiricism 5
1.8 Literature 5
REFERENCES 6

Part 1 Geotechnical Properties and Soil Exploration 7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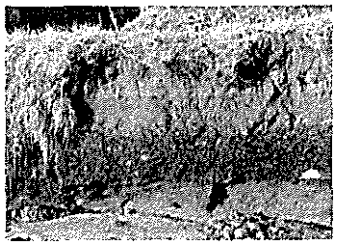
2 Geotechnical Properties of Soil 8

2.1 Introduction 9
2.2 Grain-Size Distribution 9
2.3 Size Limits for Soil 12
2.4 Weight–Volume Relationships 12
2.5 Relative Density 16
2.6 Atterberg Limits 18
2.7 Liquidity Index 19
2.8 Activity 19
2.9 Soil Classification Systems 20
2.10 Hydraulic Conductivity of Soil 27
2.11 Steady-State Seepage 32
2.12 Effective Stress 33
2.13 Consolidation 36
2.14 Calculation of Primary Consolidation Settlement 41
2.15 Time Rate of Consolidation 42
2.16 Range of Coefficient of Consolidation, c_v 48
2.17 Degree of Consolidation Under Ramp Loading 49
2.18 Shear Strength 51
2.19 Unconfined Compression Test 56
2.20 Comments on Friction Angle, ϕ' 57
2.21 Correlations for Undrained Shear Strength, c_u 60
2.22 Selection of Shear Strength Parameters 60
2.23 Sensitivity 61

2.24 Summary 62
PROBLEMS 62
REFERENCES 65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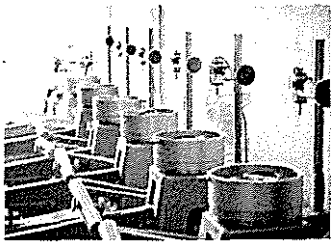
3 Natural Soil Deposits and Subsoil Exploration 67
3.1 Introduction 68

Natural Soil Deposits 68
3.2 Soil Origin 68
3.3 Residual Soil 69
3.4 Gravity-Transported Soil 70
3.5 Alluvial Deposits 71
3.6 Lacustrine Deposits 73
3.7 Glacial Deposits 74
3.8 Aeolian Soil Deposits 75
3.9 Organic Soil 76
3.10 Some Local Terms for Soil 76

Subsurface Exploration 77
3.11 Purpose of Subsurface Exploration 77
3.12 Subsurface Exploration Program 77
3.13 Exploratory Borings in the Field 80
3.14 Procedures for Sampling Soil 83
3.15 Split-Spoon Sampling and Standard Penetration Test 83
3.16 Sampling with a Scraper Bucket 92
3.17 Sampling with a Thin-Walled Tube 93
3.18 Sampling with a Piston Sampler 93
3.19 Observation of Water Tables 95
3.20 Vane Shear Test 96
3.21 Cone Penetration Test 100
3.22 Pressuremeter Test (PMT) 108
3.23 Dilatometer Test 111
3.24 Iowa Borehole Shear Test 114
3.25 K_0 Stepped-Blade Test 116
3.26 Coring of Rocks 117
3.27 Preparation of Boring Logs 120
3.28 Geophysical Exploration 121
3.29 Subsoil Exploration Report 127
3.30 Summary 128
PROBLEMS 129
REFERENCES 131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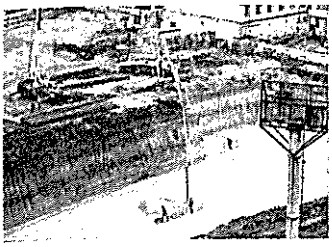
4 Instrumentation and Monitoring in Geotechnical Engineering 134
4.1 Introduction 135
4.2 Need for Instrumentation 135
4.3 Geotechnical Measurements 136
4.4 Geotechnical Instruments 137
4.5 Planning an Instrumentation Program 142
4.6 Typical Instrumentation Projects 143
4.7 Summary 143
REFERENCES 143

Part 2 Soil Improvement 145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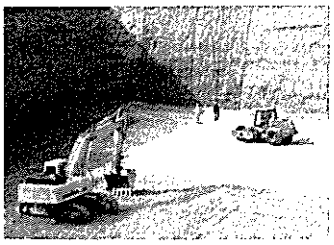
5 Soil Improvement and Ground Modification 146

5.1 Introduction 147
5.2 General Principles of Compaction 147
5.3 Empirical Relationships for Compaction 150
5.4 Field Compaction 154
5.5 Compaction Control for Clay Hydraulic Barriers 156
5.6 Vibroflotation 160
5.7 Blasting 164
5.8 Precompression 165
5.9 Sand Drains 170
5.10 Prefabricated Vertical Drains 179
5.11 Lime Stabilization 184
5.12 Cement Stabilization 187
5.13 Fly-Ash Stabilization 189
5.14 Stone Columns 189
5.15 Sand Compaction Piles 194
5.16 Dynamic Compaction 195
5.17 Jet Grouting 198
5.18 Deep Mixing 199
5.19 Summary 201
PROBLEMS 201
REFERENCES 202

Part 3 Foundation Analysis 205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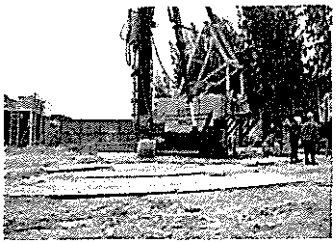
6 Shallow Foundations: Ultimate Bearing Capacity 206

6.1 Introduction 207
6.2 General Concept 208
6.3 Terzaghi's Bearing Capacity Theory 212
6.4 Factor of Safety 216
6.5 Modification of Bearing Capacity Equations for Water Table 217
6.6 The General Bearing Capacity Equation 218
6.7 Other Solutions for Bearing Capacity, Shape, and Depth Factors 225
6.8 Case Studies on Ultimate Bearing Capacity 227
6.9 Effect of Soil Compressibility 231
6.10 Eccentrically Loaded Foundations 235
6.11 Ultimate Bearing Capacity Under Eccentric Loading—One-Way Eccentricity 236
6.12 Bearing Capacity—Two-Way Eccentricity 242
6.13 A Simple Approach for Bearing Capacity with Two-Way Eccentricity 249
6.14 Bearing Capacity of a Continuous Foundation Subjected to Eccentrically Inclined Loading 251
6.15 Plane-Strain Correction of Friction Angle 254

6.16 Summary 254
PROBLEMS 254
REFERENCES 256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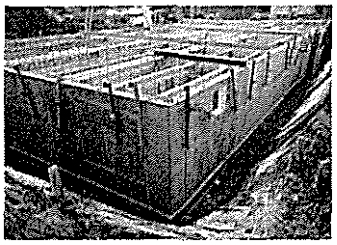
7 Ultimate Bearing Capacity of Shallow Foundations: Special Cases 258

7.1 Introduction 259
7.2 Foundation Supported by a Soil with a Rigid Base at Shallow Depth 259
7.3 Foundations on Layered Clay 266
7.4 Bearing Capacity of Layered Soil: Stronger Soil Underlain by Weaker Soil ($c' - \phi'$ soil) 268
7.5 Bearing Capacity of Layered Soil: Weaker Soil Underlain by Stronger Soil 275
7.6 Continuous Foundation on Weak Clay with a Granular Trench 278
7.7 Closely Spaced Foundations—Effect on Ultimate Bearing Capacity 280
7.8 Bearing Capacity of Foundations on Top of a Slope 282
7.9 Bearing Capacity of Foundations on a Slope 285
7.10 Seismic Bearing Capacity and Settlement in Granular Soil 286
7.11 Foundations on Rock 289
7.12 Ultimate Bearing Capacity of Wedge-Shaped Foundations 291
7.13 Uplift Capacity of Foundations 293
7.14 Summary 298
PROBLEMS 299
REFERENCES 300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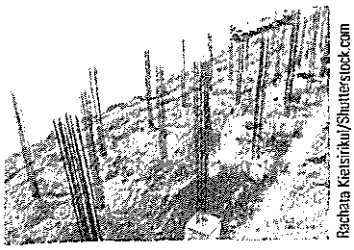
8 Vertical Stress Increase in Soil 302

8.1 Introduction 303
8.2 Stress Due to a Concentrated Load 303
8.3 Stress Due to a Circularly Loaded Area 304
8.4 Stress Due to a Line Load 305
8.5 Stress Below a Vertical Strip Load of Finite Width and Infinite Length 306
8.6 Stress Below a Horizontal Strip Load of Finite Width and Infinite Length 310
8.7 Stress Below a Rectangular Area 312
8.8 Stress Isobars 317
8.9 Average Vertical Stress Increase Due to a Rectangularly Loaded Area 318
8.10 Average Vertical Stress Increase Below the Center of a Circularly Loaded Area 323
8.11 Stress Increase Under an Embankment 325
8.12 Westergaard's Solution for Vertical Stress Due to a Point Load 328
8.13 Stress Distribution for Westergaard Material 330

8.14 Summary 333
PROBLEMS 333
REFERENCES 335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9 Settlement of Shallow Foundations 336
9.1 Introduction 337
9.2 Elastic Settlement of Shallow Foundation on Saturated Clay ($\mu_s = 0.5$) 337

Elastic Settlement in Granular Soil 339
9.3 Settlement Based on the Theory of Elasticity 339
9.4 Improved Equation for Elastic Settlement 350
9.5 Settlement of Sandy Soil: Use of Strain Influence Factor 354
9.6 Settlement of Foundation on Sand Based on Standard Penetration Resistance 361
9.7 Settlement Considering Soil Stiffness Variation with Stress Level 366
9.8 Settlement Based on Pressuremeter Test (PMT) 370
9.9 Settlement Estimation Using the $L_1 - L_2$ Method 375
9.10 Effect of the Rise of Water Table on Elastic Settlement 378

Consolidation Settlement 380
9.11 Primary Consolidation Settlement Relationships 380
9.12 Three-Dimensional Effect on Primary Consolidation Settlement 382
9.13 Settlement Due to Secondary Consolidation 386
9.14 Field Load Test 388
9.15 Presumptive Bearing Capacity 389
9.16 Tolerable Settlement of Buildings 390
9.17 Summary 392
PROBLEMS 392
REFERENCES 394

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10 Mat Foundations 396
10.1 Introduction 397
10.2 Combined Footings 397
10.3 Common Types of Mat Foundations 401
10.4 Bearing Capacity of Mat Foundations 403
10.5 Differential Settlement of Mats 406
10.6 Field Settlement Observations for Mat Foundations 407
10.7 Compensated Foundation 407
10.8 Structural Design of Mat Foundations 411
10.9 Summary 424
PROBLEMS 425
REFERENCES 425

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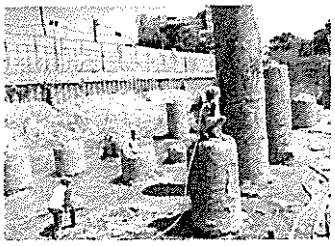
11 Load and Resistance Factor Design (LRFD) 427
11.1 Introduction 428
11.2 Design Philosophy 429

11.3 Allowable Stress Design (ASD) 431
11.4 Limit State Design (LSD) and Partial Safety Factors 432
11.5 Load and Resistance Factor Design (LRFD) 433
11.6 Summary 436
PROBLEMS 436
REFERENCES 437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12 Pile Foundations 438

12.1 Introduction 439
12.2 Pile Materials 440
12.3 Continuous Flight Auger (CFA) Piles 450
12.4 Point Bearing and Friction Piles 451
12.5 Installation of Piles 452
12.6 Pile Driving 453
12.7 Load Transfer Mechanism 458
12.8 Equations for Estimating Pile Capacity 461
12.9 Meyerhof's Method for Estimating Q_p 463
12.10 Vesic's Method for Estimating Q_p 466
12.11 Coyle and Castello's Method for Estimating Q_p in Sand 469
12.12 Correlations for Calculating Q_p with SPT and CPT Results in Granular Soil 473
12.13 Frictional Resistance (Q_s) in Sand 474
12.14 Frictional (Skin) Resistance in Clay 480
12.15 Ultimate Capacity of Continuous Flight Auger Pile 485
12.16 Point Bearing Capacity of Piles Resting on Rock 487
12.17 Pile Load Tests 493
12.18 Elastic Settlement of Piles 497
12.19 Laterally Loaded Piles 502
12.20 Pile-Driving Formulas 514
12.21 Pile Capacity for Vibration-Driven Piles 520
12.22 Wave Equation Analysis 521
12.23 Negative Skin Friction 524

Group Piles 528

12.24 Group Efficiency 528
12.25 Ultimate Capacity of Group Piles in Saturated Clay 531
12.26 Elastic Settlement of Group Piles 534
12.27 Consolidation Settlement of Group Piles 536
12.28 Piles in Rock 538
12.29 Summary 539
PROBLEMS 539
REFERENCES 543

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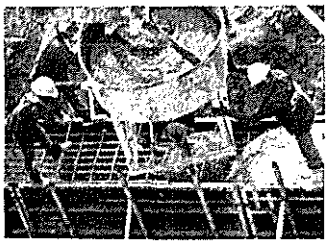
13 Drilled-Shaft Foundations 546

13.1 Introduction 547
13.2 Types of Drilled Shafts 547
13.3 Construction Procedures 548
13.4 Other Design Considerations 554

13.5 Load Transfer Mechanism 555
13.6 Estimation of Load-Bearing Capacity 556
13.7 Load-Bearing Capacity in Granular Soil 558
13.8 Load-Bearing Capacity in Granular Soil Based on Settlement 561
13.9 Load-Bearing Capacity in Clay 568
13.10 Load-Bearing Capacity in Clay Based on Settlement 570
13.11 Settlement of Drilled Shafts at Working Load 575
13.12 Lateral Load-Carrying Capacity—Characteristic Load and Moment Method 576
13.13 Drilled Shafts Extending into Rock 583
13.14 Summary 588
PROBLEMS 589
REFERENCES 590

1Roman Makedonsky/Shutterstock.com

14 Piled Rafts: An Overview 592
14.1 Introduction 593
14.2 Load-Settlement Plots of Unpiled and Piled Rafts Under Different Design Conditions 594
14.3 Poulos–Davis–Randolph Simplified Design Method 595
14.4 Case Study: Burj Khalifa Tower in Dubai 600
14.5 Summary 602
PROBLEMS 602
REFERENCES 602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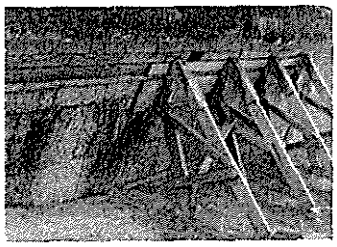
15 Foundations on Difficult Soil 603
15.1 Introduction 604

Collapsible Soil 604
15.2 Definition and Types of Collapsible Soil 604
15.3 Physical Parameters for Identification 606
15.4 Procedure for Calculating Collapse Settlement 608
15.5 Foundations in Soil Not Susceptible to Wetting 609
15.6 Foundations in Soil Susceptible to Wetting 611

Expansive Soil 612
15.7 General Nature of Expansive Soil 612
15.8 Unrestrained Swell Test 615
15.9 Swelling Pressure Test 617
15.10 Classification of Expansive Soil on the Basis of Index Tests 621
15.11 Foundation Considerations for Expansive Soil 624
15.12 Construction on Expansive Soil 626

Sanitary Landfills 630
15.13 General Nature of Sanitary Landfills 630
15.14 Settlement of Sanitary Landfills 631
15.15 Summary 633
PROBLEMS 633
REFERENCES 634

Part 4 Lateral Earth Pressure and Earth Retaining Structures 637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16 Lateral Earth Pressure 638

16.1 Introduction 639
16.2 Lateral Earth Pressure at Rest 640

Active Pressure 644

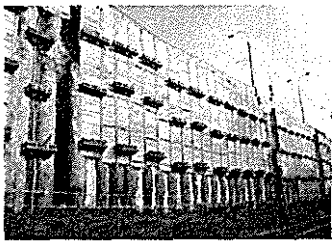
16.3 Rankine Active Earth Pressure 644
16.4 A Generalized Case for Rankine Active Pressure—Granular Backfill 649
16.5 Generalized Case for Rankine Seismic Active Earth Pressure—Granular Backfill 653
16.6 Rankine Active Pressure with Vertical Wall Backface and Inclined $c' - \phi'$ Soil Backfill 655
16.7 Coulomb's Active Earth Pressure 658
16.8 Lateral Earth Pressure Due to Surcharge 665
16.9 Active Earth Pressure for Earthquake Conditions—Granular Backfill 668
16.10 Active Earth Pressure for Earthquake Condition (Vertical Backface of Wall and $c' - \phi'$ Backfill) 672

Passive Pressure 676

16.11 Rankine Passive Earth Pressure 676
16.12 Rankine Passive Earth Pressure—Vertical Backface and Inclined Backfill 679
16.13 Coulomb's Passive Earth Pressure 681
16.14 Comments on the Failure Surface Assumption for Coulomb's Pressure Calculations 683
16.15 Caquot and Kerisel Solution for Passive Earth Pressure (Granular Backfill) 684
16.16 Solution for Passive Earth Pressure by the Lower Bound Theorem of Plasticity (Granular Backfill) 686
16.17 Passive Force on Walls with Earthquake Forces 688
16.18 Summary 691

PROBLEMS 691

REFERENCES 693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17 Retaining Walls 694

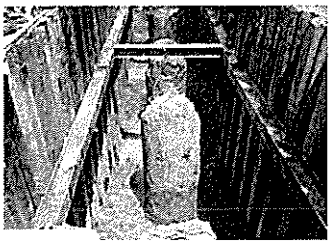
17.1 Introduction 695

Gravity and Cantilever Walls 697

17.2 Proportioning Retaining Walls 697
17.3 Application of Lateral Earth Pressure Theories to Design 698
17.4 Stability of Retaining Walls 699
17.5 Check for Overturning 701
17.6 Check for Sliding Along the Base 703
17.7 Check for Bearing Capacity Failure 706
17.8 Construction Joints and Drainage from Backfill 714

17.9 Comments on Design of Retaining Walls and a Case Study 717
17.10 Gravity Retaining-Wall Design for Earthq Conditions 720

Mechanically Stabilized Retaining Walls 722
17.11 Soil Reinforcement 723
17.12 Considerations in Soil Reinforcement 723
17.13 General Design Considerations 727
17.14 Retaining Walls with Metallic Strip Reinforcement 728
17.15 Step-by-Step-Design Procedure Using Metallic Strip Reinforcement 734
17.16 Retaining Walls with Geotextile Reinforcement 738
17.17 Retaining Walls with Geogrid Reinforcement—General 744
17.18 Design Procedure for Geogrid-Reinforced Retaining Wall 746
17.19 Summary 748
PROBLEMS 749
REFERENCES 750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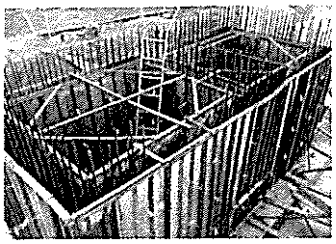
18 Sheet-Pile Walls 752
18.1 Introduction 753
18.2 Construction Methods 756
18.3 Cantilever Sheet-Pile Walls 757
18.4 Cantilever Sheet Piling Penetrating Sandy Soil 758
18.5 Special Cases for Cantilever Walls Penetrating a Sandy Soil 764
18.6 Cantilever Sheet Piling Penetrating Clay 767
18.7 Special Cases for Cantilever Walls Penetrating Clay 772
18.8 Cantilever Sheet Piles Penetrating Sandy Soil—A Simplified Approach 775
18.9 Anchored Sheet-Pile Walls 779
18.10 Free Earth Support Method for Penetration of Sandy Soil—A Simplified Approach 780
18.11 Free Earth Support Method for Penetration of Sandy Soil—Net Lateral Pressure Method 782
18.12 Design Charts for Free Earth Support Method (Penetration into Sandy Soil) 785
18.13 Moment Reduction for Anchored Sheet-Pile Walls Penetrating into Sand 789
18.14 Computational Pressure Diagram Method for Penetration into Sandy Soil 792
18.15 Field Observations for Anchor Sheet-Pile Walls 795
18.16 Free Earth Support Method for Penetration of Clay 797
18.17 Anchors 802
18.18 Holding Capacity of Deadman Anchors 804
18.19 Holding Capacity of Anchor Plates in Sand 804
18.20 Holding Capacity of Anchor Plates in Clay ($\phi = 0$ Condition) 811

18.21 Ultimate Resistance of Tiebacks 811
18.22 Summary 812
PROBLEMS 812
REFERENCES 813



19 Braced Cuts 814

19.1 Introduction 815
19.2 Braced-Cut Analysis Based on General Wedge Theory 817
19.3 Pressure Envelope for Braced-Cut Design 820
19.4 Pressure Envelope for Cuts in Layered Soil 822
19.5 Design of Various Components of a Braced Cut 823
19.6 Case Studies of Braced Cuts 831
19.7 Bottom Heave of a Cut in Clay 835
19.8 Stability of the Bottom of a Cut in Sand 839
19.9 Lateral Yielding of Sheet Piles and Ground Settlement 843
19.10 Summary 845
PROBLEMS 845
REFERENCES 846

Answers to Problems 847

Index 851

Preface

Soil mechanics and foundation engineering have developed rapidly during the last seventy years. Intensive research and observation in the field and the laboratory have refined and improved the science of foundation design. Originally published in the fall of 1983, *Principles of Foundation Engineering* is now in the ninth edition. It is intended primarily for use by undergraduate civil engineering students. The use of this text throughout the world has increased greatly over the years. It has also been translated into several languages. New and improved materials that have been published in various geotechnical engineering journals and conference proceedings, consistent with the level of understanding of the intended users, have been incorporated into each edition of the text.

NEW TO THIS EDITION

Based on the increased developments in the field of geotechnical engineering, the authors have added three new chapters to this edition. The ninth edition of *Principles of Foundation Engineering* contains a total of 19 chapters. Listed here is a summary of the major revisions from the eighth edition and new additions to this edition.

- Numerous new photographs in full color have been included in various chapters as needed.
- The **Introduction** Chapter (Chapter 1) has been entirely revised and expanded with sections on geotechnical engineering, foundation engineering, soil exploration, ground improvement, solution methods, numerical modeling, empiricism, and literature.
- Chapter 2 on **Geotechnical Properties of Soil** includes new sections on the range of coefficient of consolidation and selection of shear strength parameters for design. All of the end-of-chapter problems are new.
- Chapter 3 on **Natural Soil Deposits and Subsoil Exploration** has an improved figure on soil behavior type chart based on cone penetration test. Approximately half of the end-of-chapter problems are new.
- Chapter 4 on **Instrumentation and Monitoring in Geotechnical Engineering** is a new chapter that describes the use of instruments in geotechnical projects, such as piezometer, earth pressure cell, load cell, inclinometer, settlement plate, strain gauge, and others.
- **Soil Improvement** (Chapter 5) has some details on typical compaction requirements as well as improved figures in the section of precompression. About half of the problems at the end of the chapter are new.
- Chapter 6 on **Shallow Foundations: Ultimate Bearing Capacity** has new sections on a simple approach for bearing capacity with two-way eccentricities, and plane strain correction of friction angle.
- Chapter 7 on **Ultimate Bearing Capacity on Shallow Foundation: Special Cases** has a section on ultimate bearing capacity of a wedge-shaped foundation. About half of the end-of-chapter problems are new.
- Chapter 8 on **Vertical Stress Increase in Soil** has a new section on stress below a horizontal strip load of finite width and infinite length. The majority of the end-of-chapter problems are new.

- In Chapter 9 on **Settlement of Shallow Foundations**, Section 9.3 on settlement based on the theory of elasticity has been thoroughly revised with the addition of the results of the studies of Poulos and Davis (1974) and Giroud (1968). In Section 9.6, which discusses the topic of settlement of foundation on sand based on standard penetration resistance, Terzaghi and Peck's method (1967) has been added. Elastic settlement considering soil stiffness variation with stress level is given in a new section (Section 9.7). Other additions include settlement estimation using the $L_1 - L_2$ method (Section 9.9) (Akbas and Kulhawy, 2009) and Shahriar et al.'s (2014) method to estimate elastic settlement in granular soil due to the rise of ground water table (Section 9.10). The section on tolerable settlement of buildings has been fully revised. More than half of the end-of-chapter problems are new.
- In Chapter 10 on **Mat Foundations**, the reinforcement design portion for the mats was removed to concentrate more on the geotechnical portion. All end-of-chapter problems are new.
- Chapter 11 on **Load and Resistance Factor Design (LRFD)** is a new chapter. It provides the design philosophies of the allowable stress design (ASD) and load and resistance factor design in a simple way.
- Chapter 12 on **Pile Foundations** has a new section defining point bearing and friction piles (Section 12.5). Section 12.5 on installation of piles has been thoroughly revised. Factor of safety for axially loaded piles suggested by USACE (1991) has been incorporated in Section 12.8 on equations for estimating pile capacity. The analysis by Poulos and Davis (1974) for estimation of elastic settlement of piles has been included in Section 9.17. About half of the end-of-chapter problems are new.
- In Chapter 13 on **Drilled Shaft Foundations**, several figures have been improved to aid in better interpolation for solving problems. More than half of the end-of-chapter problems are new.
- Chapter 14 on **Piled Rafts—An Overview** is a new chapter. It describes optimizations of the advantages of pile foundations and raft foundations for construction of very tall buildings.
- In Chapter 15 on **Foundations on Difficult Soil**, all but two of end-of-chapter problems are new.
- Chapter 16 on **Lateral Earth Pressure** has two new sections on (a) generalized case for Rankine seismic active pressure—granular backfill (Section 16.5), and (b) solution for passive earth pressure by lower bound theorem of plasticity (Section 16.15). The section on passive force on walls with earthquake forces (Section 16.7) has been expanded. All end-of-chapter problems are new.
- In Chapter 17 on **Retaining Walls**, a new section (Section 17.10) on gravity retaining wall design for earthquake conditions has been added. Discussion on the properties of geotextile has been expanded along with some new geotextile photographs. More than half of the end-of-chapter problems are new.
- Chapter 18 on **Sheet-Pile Walls** has three new sections added: (a) cantilever sheet piles penetrating sandy soil—a simplified approach (Section 18.8); (b) free earth support method for penetration of sandy soil—a simplified approach (Section 18.10); and (c) holding capacity of deadman anchors (Section 18.18). All end-of-chapter problems are new.
- In Chapter 19 on **Braced Cuts**, all end-of-chapter problems are new.
- Each chapter now includes a **Summary** section. New and revised example problems are presented in various chapters as needed.

INSTRUCTOR RESOURCES

A detailed **Instructor's Solutions Manual** containing solutions to all end-of-chapter problems, an **image bank** with figures and tables in the book, and **Lecture Note PowerPoint Slides** are available via a secure, password-protected Instructor Resource Center at https://login.cengage.com.

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