

**NORTHEASTERN UNIVERSITY**  
**Department of Civil and Environmental Engineering**

**Foundation Engineering**  
**CIV G302**

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**Instructor:** Professor M .K. Yegian  
401 Snell Engineering  
Tel: (781)-910-6680 (cell)  
e-mail: [myegian@neu.edu](mailto:myegian@neu.edu)

**Text:** 1) “Principles of Foundation Engineering” Sixth Edition  
By: Braja M. Das  
  
2) Supplemental Class Notes

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**Topics**

Topic 10 STABILITY OF SLOPES  
(Carry over from the course Advanced Soil Mechanics, Fall 2006)

1. SUBSURFACE EXPLORATION

- 1.1 Purpose of Subsurface Exploration
- 1.2 Subsurface Exploration Program
- 1.3 Geologic and Man-Made Soil Deposits
- 1.4 Exploratory Techniques
- 1.5 Guidelines for Boring Layout
- 1.6 Guidelines for Boring Depths
- 1.7 Test Pits and Trenches
- 1.8 Preparation of Boring (Borehole) Logs

2. SHALLOW FOUNDATIONS: Ultimate Bearing Capacity

- 2.1 Types of Shallow Foundations
- 2.2 General Concept
- 2.3 Terzaghi’s Bearing Capacity Theory
- 2.4 The General Bearing Capacity Equation
- 2.5 Effect of Water Table
- 2.6 Effect of Soil Compressibility (Failure Type)
- 2.7 Factor of Safety Against Bearing Capacity Failure
- 2.8 Foundations with One-Way Eccentricity

- 2.9 Foundations with two-Way Eccentricity
- 2.10 Summary of Bearing Capacity Procedures
  - 2.10.1 Terzaghi's Approach
    - 2.10.1.1 Cohesionless Soils (Sands)
    - 2.10.1.2 Cohesive Soils (Clays, Long-Term Analysis)
    - 2.10.1.3 Cohesive Soils (Clays, Short-Term Analysis)
  - 2.10.2 General Bearing Capacity Equations (Meyerhof's Approach)
    - 2.10.2.1 Cohesionless Soils (Sands)
    - 2.10.2.2 Cohesive Soils (Clays, Long-Term Analysis)
    - 2.10.2.3 Cohesive Soils (Clays, Short-Term Analysis)
- 2.11 Presumptive Bearing Pressures
- 2.12 Bearing Capacity of Shallow Foundations: Special Cases
  - 2.12.1 Foundation on Soil over a Rigid Base
  - 2.12.2 Foundation on Layered Soils
  - 2.12.3 Closely Spaced Foundations
  - 2.12.4 Foundation on Top of a Slope
  - 2.12.5 Foundation on a Slope

### 3. SETTLEMENT OF SHALLOW FOUNDATIONS

- 3.1 Stresses below a Rectangular Foundation
- 3.2 Elastic Settlement Based on Theory of Elasticity
- 3.3 Schmertmann's Method for Settlement on Sand
- 3.4 Settlement on Sand Based on SPT (Meyerhof's Method)
- 3.5 Estimation of  $E_s$  and  $\mu_s$  for Elastic Settlement Calculations
- 3.6 Accuracy of Elastic Settlement Prediction
- 3.7 Consolidation Settlement
- 3.8 Field Load Test
- 3.9 Subgrade Reaction Method
- 3.10 Tolerable Settlement of Buildings

### 4. BEARING CAPACITY OF MAT FOUNDATION

- 4.1 Typical Combined Footings and Mat Foundations
- 4.2 Bearing Capacity of Mat Foundations
- 4.3 Compensated (Floating) Foundation

### 5. DEEP FOUNDATIONS

- 5.1 Typical Piles, Drilled Piers, and Caisson Foundations
- 5.2 Foundation Structural Capacity
- 5.3 Sources of Pile Capacity
- 5.4 Estimating Pile Axial Capacity

- 5.4.1 General Approach
- 5.4.2 Meyerhof's Method for  $Q_p$
- 5.4.3 Frictional Resistance  $Q_s$
- 5.4.4 Point Bearing on Rock
- 5.4.5 Settlement of Single Pile
  
- 5.5 Estimating Pile Lateral Capacity
  - 5.5.1 Elastic Solution
  - 5.5.2 Ultimate Pile Lateral Capacity ( Broms' Method)
  
- 5.6 Pile Load Test
- 5.7 Pile Driving Formulas
- 5.8 Negative Skin Friction (Pile Downdrag)
- 5.9 Pile Group Efficiency
- 5.10 Ultimate Capacity of Group pile in Saturated Clays
- 5.11 Consolidation Settlement of Group Piles
- 5.12 Drilled Shaft
  - 5.12.1 Drilled Shaft Type and Construction
  - 5.12.2 Load Bearing Capacity

## 6. Soil-Pile Interaction Analysis

- 6.1 Analysis of a Group of pile Subjected to Axial and Lateral Loading
- 6.2 Application of GROUP 7

### Grade for the Course

- 1- Assignments 100%
- 2- No Final Examination

<b>Perfect Score</b>
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Assigmnent Set	Points				Total	Weight	Score
	Problem 1	Problem 2	Problem 3	Problem 4			
1	3	3	4		10	0.15	1.5
2	5	5			10	0.1	1
3	2	1	4	3	10	0.15	1.5
4	5	5			10	0.2	2
5	2	6	2		10	0.2	2
6	10				10	0.2	2

Total Score	10
Grade %	100

## **References**

- 1- Das, B. M. (2007) “Principles of Foundation Engineering” Sixth Edition, Thomson.
- 2- Day, R. W. (2006) “ Foundation Engineering Handbook” McGraw-Hill
- 3- McCarthy, D. F. (2007) “Essentials of Soil Mechanics and Foundations” Seventh Edition, Prentice Hall.