

NORTHEASTERN UNIVERSITY
Department of Civil and Environmental Engineering

Advanced Soil Mechanics
CIV G301

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Text: 1) “An Introduction to Geotechnical Engineering”
By: Robert D. Holtz and William D. Kovacs

2) Supplemental Class Notes

Topics

1. GEOLOGIC ORIGIN OF SOIL DEPOSITS
 - 1.1 Types of Rocks
 - 1.2 Soil Formation
 - 1.3 Soil Deposits
 - 1.4 Example Soil Profiles

2. INTRODUCTION TO GEOTECHNICAL ENGINEERING (**Chapter 1**)
 - 2.1 Historic Perspective
 - 2.2 Geotechnical Problems in Civil Engineering

3. SOIL CLASSIFICATION AND MINERAL COMPOSITION
 - 3.1 Index and Soil Classification (**Chapters 2&3**)
 - 3.1.1 Phase Relations
 - 3.1.2 Grain Size Distribution
 - 3.1.3 Atterberg Limits
 - 3.1.4 Unified Soil Classification System
 - 3.2 Soil Particle Shape and Mineral Composition (**Chapter 4**)
 - 3.2.1 Particle Shape
 - 3.2.2 Soil Minerals
 - 3.2.3 Soil Structure

4. STRESSES IN SOILS
 - 4.1 Effective Stress Concept (**Section 7.5**)
 - 4.2 Vertical Stress Calculations (**Section 7.5**)

- 4.3 Horizontal Stress Calculations (**Section 7.6**)
 - 4.4 Stress Distribution (**Section 8.12**)
 - 4.5 Stresses and Displacements
 - 4.6 Stresses at a Point-Mohr Circle (**Chapter 10**)
5. FLOW THROUGH POROUS MEDIA (1-DIMENSIONAL FLOW)
- 5.1 Bernoulli's Energy Equation (**Section 7.2**)
 - 5.2 Darcy's Law for 1-D Flow (**Section 7.3**)
 - 5.3 Effective Stresses Under 1-D Flow (**Section 7.8**)
 - 5.4 Special Seepage Condition-Piping (**Section 7.8**)
 - 5.5 Practical Considerations (**Section 7.8**)
6. TWO-DIMENSIONAL FLOW (**Section 7.9**)
- 6.1 Why Worry About Seepage?
 - 6.2 Seepage Analysis Approaches
 - 6.2.1 Field Monitoring
 - 6.2.2 Analytical Approach
 - 6.2.2.1 Flow Net
 - 6.2.2.2 Computer Applications
 - 6.3 Control of Seepage
 - 6.4 Coefficient of Permeability (**Section 7.4**)
 - 6.5 Filter Requirements and Example Applications (**Section 7.11**)
7. COMPRESSIBILITY AND SETTLEMENT (**Chapter 8**)
- 7.1 Compressibility of Clays and Settlement
 - 7.1.1 Field Conditions
 - 7.1.2 Laboratory Consolidation Tests
 - 7.1.3 Primary Consolidation Settlement
 - 7.1.3.1 Normally Consolidated
 - 7.1.3.2 Over Consolidated
 - 7.1.4 Field Consolidation Curve
 - 7.1.5 Typical Values of C_c and C_v
 - 7.2 Consolidation Settlement of Sands
8. TIME RATE OF CONSOLIDATION AND SETTLEMENT (**Chapter 9**)
- 8.1 Laboratory Condition
 - 8.2 Field Condition
 - 8.3 Terzaghi's Theory for 1-D Consolidation
 - 8.3.1 Uniform increase in Excess Pore Pressure
 - 8.3.2 Triangular Increase in Excess Pore Pressure
 - 8.3.3 Measurement of Coefficient of Consolidation
 - 8.4 Secondary Compression of Clays
 - 8.5 Precompression with Surcharge
 - 8.6 Sand Drains
 - 8.7 Consolidation of Layered Soil Profile
 - 8.8 Field Monitoring of Settlement and Pore Pressures

- 8.8.1 Settlement Measuring Instruments
- 8.8.2 Pore Pressure Transducers
- 8.8.3 Example of Field Measurement and Analysis of Settlements and Pore Pressures

9. **SHEAR STRENGTH OF SOILS (Chapter 11)**

- 9.1 Geotechnical Problems that Require Shear Strength
- 9.2 Shear Strength of Sands
 - 9.2.1 Laboratory Tests
 - 9.2.1.1 Direct Shear tests
 - 9.2.1.2 Triaxial Test
 - 9.2.2 Example Applications
 - 9.2.3 Factors Affecting Friction Angle of Sands
- 9.3 Shear Strength of Clays
 - 9.3.1 Typical Cases of Load Conditions
 - 9.3.2 Drained Loading “ Short-term Condition”
 - 9.3.3 Stress Path
 - 9.3.4 Example Applications of Drained Strength
 - 9.3.5 Undrained Loading “Fast Loading”
 - 9.3.6 Comparison of Consolidated Drained and Consolidated Undrained Strength for Normally Consolidated Clays
 - 9.3.7 Comparison of Consolidated Drained and Consolidated Undrained Strength for Over Consolidated Clays
 - 9.3.8 Laboratory Unconsolidated Undrained Tests
 - 9.3.9 Laboratory Unconfined Compression Tests
 - 9.3.10 Summary Notes on Shear Strength of Clays
 - 9.3.11 Measurement of Undrained Shear Strength of Clays
 - 9.3.12 Example Applications of Undrained Strength

10. **STABILITY OF SLOPES**

- 10.1 Stability Problems
- 10.2 Types of Slope Failures
- 10.3 Causes of Slope Failure
- 10.4 Methods of Stability Analysis
- 10.5 Slope Stability Charts
- 10.6 Example Applications

Grade for the Course:

- 1- Assignments 70%
- 2- Final Examination 30%

Assignment Set	Points				Total
	Problem 1	Problem 2	Problem 3	Problem 4	
1	3	1	3	5	12
2	5	2	4		11
3	6	8			14
4	8	8	4		20
5	15				15
6	3	1	3		7
7	7	7	7		21

Total	100
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