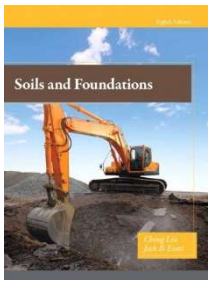
CE 4339 – Geostructural Design



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Lecture Time: TR 9:00 -10:20 AM

Office Hours: Students are always welcome. Contact us via Teams anytime.

Textbook: Soils and Foundations, 8th Edition, by Liu and Evett, Pearson

Introduction This course is concerned with Geostructural Design. The term "Geostructural Design" is used to describe the design of foundations for buildings and other structures, such as retaining walls. It also includes the design of natural slopes and pavement design. Geostructural Design must be based on, and make use of, the principles of Soil Mechanics and Geotechnical Engineering. However, it also requires knowledge of geology and involves numerous considerations that might be called "practical." We will spend a significant part of our time on the mechanistic types of problems. We will spend time to discuss practical types of problems because they are the main problems of interest in engineering practice.

Most of the students interested in Geostructural Design are also interested in structural design. Structural designers generally have well-developed codes which they are expected to follow. No comparable codes exist in Geostructural Design. In structures, the properties of materials are reasonably well defined because they are manufactured. In Geostructural Design, a major problem exists with trying to define the properties of the soil materials at a site. Structural members are relatively simple in shape. Strata of soil are often discontinuous, and the success of a "design" may hinge on whether a soil exploration program results in the discovery of critical strata. For the range of stresses usually used, structural materials are subject to small strains, and may often be taken as linearly elastic. Soils are often stressed to large strains and are almost always inelastic and have nonlinear stress-strain curves. Even if you choose not to engage in the practice of Geostructural Design, there is a high probability that you will work with geotechnical engineers or read their reports in your work. Therefore, an understanding of how they work and think can be very beneficial. This course is a mixture of theory and practice and is intended to help you make an easier transition from university classes to engineering practice.

Topics covered primarily include:

1. Calculating stability and design of retaining walls
2. Foundation design and bearing capacity for shallow and deep foundations
3. Consolidation and differential settlement of Foundations
4. Slope stability analysis of fills, embankments, cuts, dams
5. Pavement system design

Assuming that you already learned them in the Geotechnical Engineering course, we will also review the following items:

1. Geology
2. Index properties and soil classifications
3. Phase relations (air-water-solid)
4. Laboratory and field tests
5. Effective stress (buoyancy)
6. Shear strength

Schedule A tentative lecture schedule is attached, and the reading assignments are indicated. *I recommend that you read the appropriate sections for each topic before the lecture.* For each topic, I will provide a broad lecture on the subject

Grading Doing homework problems on time will count as 10% toward your grade. Quizzes will count as 55% of your grade. A comprehensive final examination will count as 35%.

Homework All homework problems are assigned for the semester below. Homework is assigned to help you learn the material, not to generate grades. It is acceptable to work with others when discussing methods of attack, but your written work should always be your own.

The homework problems will be collected but not graded. Unless otherwise noted, homework problems are due at 5:00 PM on Sunday the following week. Therefore, you will always have a weekend to work on your problems.

Experience clearly shows that a student's grade is strongly dependent on the effort that is put into working and understanding the homework. Although the homework does not directly count towards your grade, in practice it is the most important factor that will affect your grade.

Quizzes There will be a quiz almost every class. The problems will be similar to the homework problems or the examples in the textbook. Knowing that emergencies happen, I will drop the lowest two quiz grades.

Examination Final examination, which is comprehensive, will last 3 hours.

Neatness You will present homework problems completed in a neat and orderly fashion. On your quizzes and examination, your work must be easy to follow.

Attendance Because this is an online class, we will not see each other in the ways you may be accustomed to: during class time. Course content is delivered via the Internet. The lectures will be live, but they will be recorded for your future reference. You can access the recordings in the class OneDrive.

Preparation for Semester Ensure your UTEP e-mail account is working and that you have access to the Web and a stable web browser. You will need to have access to a computer/laptop, scanner, a webcam, and a microphone. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and Java. Check that your computer hardware and software are up-to-date and able to access all parts of the course. If you do not have a word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook and more) for free via UTEP's Microsoft Office Portal.

If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP Help Desk as they are trained specifically in assisting with technological needs of students. Please do not contact me for this type of assistance. The Help Desk is much better equipped than I am to assist you!

Netiquett Sometimes communication online can be challenging. It is possible to miscommunicate what we mean or to misunderstand what our classmates mean given the lack of body language and immediate feedback. Therefore, please keep these netiquette (network etiquette) guidelines in mind.

- Always consider audience. This is a college-level course; therefore, all communication should reflect polite consideration of other's ideas.
- Respect and courtesy must always be provided to classmates and to the instructor . No harassment or inappropriate postings will be tolerated.
- When reacting to someone else's message, address the ideas, not the person. Post only what anyone would comfortably state in a face-to-face situation.

- Whatever is posted on online spaces is intended for classmates and professor only. Please do not copy documents and paste them to a publicly accessible website, blog, or other space.

Accommodations Policy UTEP is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the UTEP Center for Accommodations and Support Services (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at cass@utep.edu, or apply for accommodations online via the CASS portal.

Scholastic Integrity Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit HOOP: Student Conduct and Discipline.

Final Comment Good luck to all of you in this course. Please do not hesitate to ask questions in class, or, if necessary, to see me outside of class. Any specific comments that students may have on how the course may be improved are particularly welcome.

Lecture Topics

Lecture Topic 1. Soil Exploration (HW: 3-1 through 3-5)

- 3-1 Introduction
- 3-2 Reconnaissance
- 3-3 Steps of Soil Exploration
  - Boring
  - Sampling
  - Testing
- 3-4 Groundwater Table
- 3-5 Standard Penetration Test (ASTM D 1586)
- 3-6 Cone Penetration Test (ASTM D3441 AND D 5778)
- 3-7 Vane Test
- 3-11 Record of Soil Exploration

Lecture Topic 2. Consolidation of Soil and Settlement of Structures (HW: 7-2, 7-4, 7-5, 7-7, 7-11)

- 7-1 Introduction (different types of settlement)
- 7-3 Consolidation Test
- 7-4 Normally Consolidated Clay and Over Consolidated Clay
- 7-6 Settlement of Loads on Clay Due to Primary Consolidation
- 7-7 Time Rate of Settlement Due to Primary Consolidation
- 7-8 Settlement of Loads on Clay Due to Secondary Compression
- 7-9 Settlement of Loads on Sand

Lecture Topic 3. Shallow Foundations (HW: 9-2, 9-4, 9-6, 9-8, 9-10, 9-12)

- 9-1 Introduction
- 9-2 Loads on Foundations
  - Dead Load
  - Live Load
  - Wind Load
  - Snow Load
  - Earth Pressure
  - Water Pressure
  - Earthquake Forces
- 9-4 Bearing Capacity Analysis
  - Effect of Water Table on Bearing Capacity
  - Inclined Load
  - Eccentric Load
  - Footings on Slopes
- 9-5 Size of Footings

Lecture Topic 4. Deep Foundations (HW: 10-1, 10-4, 10-6, 10-8, 10-14, 10-16)

- 10-1 Introduction
- 10-3 Types of Piles
- 10-5 Pile Capacity
- 10-8 Negative Skin Friction (Down Drag)
- 10-9 Pile Groups and Spacing of Piles
- 10-10 Efficiency of Pile Groups
- 10-12 Settlement of Pile Foundations
  - Settlement of End-Bearing Piles on Bedrock
  - Settlement of Piles in Sand
  - Settlement of Piles in Clay
- 10-14 Introduction to Drilled Shaft Foundations

10-15 Bearing Capacity of Drilled Shafts
Drilled Shafts in Cohesive Soils
Drilled Shafts in Cohesionless Soils
10-16 Settlement of Drilled Shafts

Lecture Topic 5. Lateral Earth Pressure (HW: 11-1, 11-4, 11-5, 11-8)

11-1 Introduction
11-2 Earth Pressure at Rest
11-3 Rankine Earth Pressures
11-5 Effects of a Surcharge Load Upon Active Thrust

Lecture Topic 6. Retaining Structures (HW: 12-1, 12-4, 12-5)

12-1 Introduction
12-2 Retaining Walls
12-3 Design Considerations for Retaining Walls
12-4 Stability Analysis
12-7 Reinforced Earth Walls
12-9 Anchored Bulkheads

Lecture Topic 7. Stability Analysis of Slopes (HW: 13-2, 13-4, 13-6, 13-8)

13-1 Introduction
13-2 Analysis of a Mass Resting on an Inclined Layer of Impermeable Soil
13-3 Slopes in Homogeneous Cohesionless Soils ($c = 0$, $\phi > 0$)
13-4 Slopes in Homogeneous Soils Possessing Cohesion ($c > 0$, $\phi = 0$, and $c > 0$, $\phi > 0$)
13-5 Method of Slices

Lecture Topic 8. Pavement Design (Homework problems and Lecture notes will be provided)

Introduction
Pavement Types
Flexible Pavements
Rigid Pavements
Pavement System Design: Principles for Flexible Pavements
Traditional AASHTO Flexible-Pavement Design Procedure
Traditional AASHTO Rigid-Pavement Design Procedure

Review Topics

Review Topic a. Engineering Properties of Soils (HW: 2-2,2-4,2-6,2-9,2-11,2-13,2-17,2-19,2-21)

2-1 Soil Types
2-2 Grain-Size Analysis
2-3 Soil Consistency-Atterberg Limits
2-4 Soil Classification Systems
    AASHTO Classification System (AASHTO M-145)
    Unified Soil Classification System (ASTM D 2487)
2-5 Components of Soils
2-6 Weight/Mass and Volume Relationships

Review Topic b. Subsurface Stresses in Soils (HW: 6-1, 6-3, 6-5, 6-7, 6-9, 6-11)

6-1 Introduction
6-2 Subsurface Stresses Caused by Overlying Soil Masses
6-3 Subsurface Stresses Caused by Surface Loadings
6-4 Vertical Pressure below a Concentrated Load
    Boussinesq Equation
6-5 Vertical Pressure below a Loaded Surface Area (Uniform Load)
    Approximate Method
    Method Based on Elastic Theory

Review Topic c. Shear Strength of Soil (HW: 8-2, 8-4, 8-5, 8-8, 8-10)

8-1 Introduction
8-2 Methods of Investigating Shear Strength
    Laboratory Methods for Investigating Shear Strength
    In Situ (Field) Methods for Investigating Shear Strength
8-3 Characteristics of the Failure Plane
8-4 Shear Strength of Cohesionless Soils
8-5 Shear Strength of Cohesive Soils

Review Topic d. Water in Soil (HW: 5-1, 5-3, 5-5, 5-7, 5-9, 5-11)

5-1 Introduction
5-2 Flow of Water in Soils
    Darcy's Law
    Laboratory Tests for Coefficient of Permeability
    Field Tests for Coefficient of Permeability
    Empirical Relationships for Coefficient of Permeability
    Permeability in Stratified Soils
5-3 Capillary Rise in Soils
5-4 Frost Action in Soils

Review Topic e. Soil Compaction and Stabilization (HW: 4-1, 4-3, 4-5, 4-7)

4-1 Definition and Purpose of Compaction
4-2 Laboratory Compaction Tests (ASTM D 698 and D 1557)
4-3 Factors Affecting Compaction of Soil
4-4 Field Compaction
4-5 In-Place Coil Unit Weight Test
4-6 Field Control of Compaction

Tentative Lecture Schedule

Week of	Tuesday	Thursday
8/25	Introduction	Review Topic a*
9/1	Lecture Topic 1	Review Topic b
9/8	Lecture Topic 2	Lecture Topic 2
9/15	Lecture Topic 2	Review Topic c
9/22	Review Topic c	Lecture Topic 3
9/29	Lecture Topic 3	Lecture Topic 4
10/6	Lecture Topic 4	Lecture Topic 4
10/13	Lecture Topic 5	Lecture Topic 5
10/20	Lecture Topic 6	Lecture Topic 6
10/27	Lecture Topic 6	Lecture Topic 7
11/3	Lecture Topic 7	Lecture Topic 7
11/10	Lecture Topic 8	Lecture Topic 8
11/17	Lecture Topic 8	Review Topic d
11/24	Review Topic d	Thanksgiving
12/1	Review Topic e	Review

* Review Topics are shaded in yellow. You have already studied them in Geotechnical Engineering.