CE 387R.4

Earth Retaining Structures

Class Lectures:
Days: Monday, Wednesday, Friday
Time: 9:00 a.m. - 9:50 a.m.
Building: Ernest Cockrell, Jr.
Room: ECJ 7.702

Instructor:
Dr. Jorge G. Zornberg
Office: ECJ 9.227A
Phone: (512) 232 - 3595
E-mail: zornberg@mail.utexas.edu
Office Hours: Mon, Wed 2:00 p.m. - 3:00 p.m.

Course Text:

The course text is available at Texas Union Copy Center, Room 2.214. Several additional books and manuals are also recommended. Relevant additional references include:


Course material:
Reading assignments and additional course material will be posted in Blackboard. The documents will be posted in electronic version (pdf format). The contents will be updated frequently, so you should check periodically for new material.

Course Prerequisites:
At least one undergraduate course in geotechnical engineering or consent of instructor.
Course Objectives:
The overall objective of this course is to provide students the fundamentals and tools needed for the design and analysis of earth retention systems. Specifically, this course covers the selection, design, and performance evaluation of earth retaining structures used for support of fills and excavations. The theory involving earth pressures and soil-reinforcement interaction are covered in detail. Class discussions also include case histories as well as demonstrating the selection, design and performance of various earth retaining structures. Upon completion of the course, the student should be able to:

- Quantify the lateral earth pressures associated with different earth systems.
- Evaluate the mechanical properties of geosynthetics used for soil reinforcement, including aspects related to time-dependent response.
- Identify the types, advantages, and disadvantages of the different earth retaining systems (e.g. gravity structures, geosynthetic-reinforced soil structures, earth anchored systems, soil nailing).
- Select the most technically appropriate and cost-effective type of retaining wall for the application from a thorough knowledge of available systems.
- Complete the design of retaining structures using appropriate design methods, factors of safety, earth pressure diagrams and field verification methods.
- Be knowledgeable of current US guidelines regarding the design of earth retaining structures.
- Master the design retaining structures considering both external and internal stability using hand calculations as well as state-of-the-practice numerical tools.

Schedule:
The class will meet for three lectures each week. A tentative schedule and outline of the lecture topics is attached. Because of various national and international committees, meetings and conference, I will have to travel on university-sanctioned business during this semester. I plan to cover these periods by scheduling activities (e.g. presentations, field trips) during the semester. Your help in scheduling these activities is sincerely appreciated.

Attendance:
Students are expected to attend all class periods. Since the course text will provide only supplementary information, the lectures are clearly the main source of information to be covered in the homework assignments and exams.

Examinations:
There will be a midterm exam, given during the regularly scheduled class time, and a comprehensive final examination, given at the scheduled final date. Make-up examinations will not be given. Students who miss a midterm exam will receive a grade of zero for that exam. Exceptions to this rule will be made only on a carefully considered basis, and only if the student contacts me before the exam. The examinations will be closed-book, closed-notes.

The final examination is Wednesday, December 14th from 7:00 pm to 10:00 pm
Homework Assignments:
Homework problems will be assigned on a regular basis. Extra copies of the assignments, as well as other class handouts, will be placed in the class box outside of ECJ 9.227. Completed assignments are due at the beginning of class on the date specified; late assignments will not be accepted for grading.

Homework is intended principally as a means of helping you to learn and understand the course material, rather than as a means of assigning points which directly determine your final grade. The assignments also are aimed at developing your engineering skills. As much as possible, your assignments will reflect real-world engineering practice where one must work with limited data, deal with uncertainty over site conditions, and compile engineering recommendations.

Each assignment must be submitted with a cover memorandum. A professional engineer's work entails much more than analysis. Hence, all assignments in this class must be submitted with a cover memorandum that briefly discusses your analysis. The cover memo should be typed, addressed to the instructor, and no more than one page long. The text of your memo should:

- Briefly state the purpose of your work (remind the reader of what was requested and what you did).
- Describe the data, material properties, and other information used to solve the problem, including any assumptions you may have used.
- Review important aspects of the problem and your solution.
- Refer to any attached drawings, plots, and other figures and identify the significant information they contain.
- Summarize important results, conclusions, and recommendations.

Attach your calculations, plots, and drawings behind the cover memo. Write your cover memo as if you were submitting your results to a professional client.

The term project involves preparation of a written report and its presentation in a seminar. The written report will be compiled throughout the term. The term project represents a significant portion of the grade, so you should dedicate adequate time during the semester rather than leaving the work towards the end of the term. Details regarding the scope and schedule of the different aspects of the final project will be provided separately.

Grading Policy:
Your final letter grade will be determined by your performance relative to others in the class. Divisions between grade levels, as well as a likely "class curve", are not pre-determined. Participation in class is explicitly considered in your final grade. In borderline cases your participation and attendance in class will also be considered. Your final score for this course will be computed using the following weights:

- Homeworks and term project: 25%;
- Class participation: 5%;
- Midterm examination: 30%;
- Final examination: 40%.
University Policies and Deadlines:

Dropping the Course:
- From the 1st through the 4th class day, graduate students can drop or add a course on Rose or TEX. Beginning with the 5th class day, graduate students must initiate any adds or drops in their department.
- Graduate students can drop a class until the last class day with permission from the departmental Graduate Advisor and the Dean.
- Graduate students with GRA/TA/Grader positions or with Fellowships may not drop below 9 hours in a long session.

Course Evaluation: A course/instructor evaluation will be conducted in class near the end of the semester. The standard form and procedure from The University of Texas Measurement and Evaluation Center (MEC) will be used.

Religious Observances: A student who is absent from a class or examination for the observance of a religious holyday may complete the work missed within a reasonable time after the absence, provided the student has notified the instructor in writing before the absence and not later than the 15th class day.

Students with Disabilities: The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Services for Students with Disabilities area of the Office of the Dean of Students at 471-6259 as soon as possible to request an official letter outlining authorized accommodations. For more information, contact that Office, or TYY at 471-4641, or the College of Engineering Director of Students with Disabilities at 471-4321.
Course Outline:

The tentative outline of lecture topics for the course is as follows:

- Introduction
- Types of earth retaining systems
  - Classification
  - Overview of fill wall systems
  - Overview of cut wall systems
- Earth pressure theory
  - Mohr’s circle
  - At rest, active, and passive earth pressures
  - Influence of movement on earth pressures
  - Earth pressure from surcharge loads and due to compaction
  - Earth pressures from seismic forces
- Design of externally stabilized walls
  - Design of CIP gravity and semi-gravity walls
  - Design of modular gravity walls
  - Design of sheet pile walls
  - Design of anchored walls
  - Other systems
- Reinforcing elements
  - Fundamentals of soil-reinforcement interaction
  - Functions and types of geosynthetics
  - Polymers
  - Mechanical properties of geosynthetic reinforcements
- Design of internally stabilized walls
  - Internal stability
  - Design of mechanically stabilized earth (MSE) walls
  - Design of segmental retaining walls
  - Design steps for reinforced steep slopes
  - Design of soil nail walls
- Additional aspects on earth retention systems
  - Construction aspects
  - Deformability analysis of earth retention systems
  - Performance monitoring of retaining structures
- Advances on soil reinforcement
  - Embankments over soft foundations
  - Reinforcements overlying voids: reinforced covers, reinforced pavements
  - New concepts in soil reinforcement

Case histories will be presented to illustrate the different concepts