CE 387M.1 - STABILITY OF EARTH SLOPES

Spring 2004

Time: MWF 9:00 AM - 10:00 AM
Location: ECJ 7.208
Instructor: Stephen G. Wright
Office Hours: ECJ 9.227C
            MW 1:30-3:30 PM; F 1:00-3:00 PM
Text: None
Prerequisite: At least one undergraduate course in geotechnical engineering or consent of instructor.
Co-requisite: CE 387L.1 (Shearing Properties of Soils) or consent of instructor.
Purpose:

CE 387M.1 is a basic graduate course covering principles of slope stability and the application of the principles to analysis and design of earth slopes. Many of the principles of slope stability and knowledge of soil shear strength that are covered in this course, also apply to problems of bearing capacity and earth pressures. Accordingly, the material covered in this course is planned and intended to provide you with a broad understanding of fundamentals pertaining not only to earth slopes, but also to a wide variety of other geotechnical engineering problems.

Teaching Technique:

Most of the course material is presented via lectures, reading assignments and homework problems. I will also use some of the concepts of “Cooperative Learning" to encourage more interaction among students and myself and foster teamwork and discovery.

No suitable text is available for this course. You will instead need to study the assigned reading from the literature and take good notes when I lecture on certain topics. I expect you to also learn through various group studies and problems that you are presented during the semester. Finally, as graduate students I expect you to read technical papers from the literature other than those that are specifically assigned.

Reading Assignments:

In addition to the reading that you should undertake on your own, some formal reading assignments will be made from technical papers in the published literature. A copy of each assigned paper will be made available as an Adobe PDF file in the Civil
Engineering Learning Resource Center (LRC). Unless otherwise stated, you should prepare a short, 1 or 2 page summary of each paper in your own words. Your summary should include the points that you consider most important and your best, critical evaluation of the paper. Reading assignments and summaries are due one week, i.e., the third class period, after they are assigned. You should be prepared to discuss assigned papers on the date that they are due. Late work will not be accepted.

**Homework Assignments:**

Homework problems will be assigned during the semester. For many of these assignments each student is required to submit his or her own, written solution. You will also be presented with several problems to “solve" as a group of 2 - 4 students. In some cases you will submit individual solutions to these problems, in other cases you will submit your work as a group. Work may be submitted either as formal written work or as oral presentations to the class, depending on the particular assignment. Because your work, whether done as an individual or a group, will be viewed and discussed by the class as a whole, it is essential that you complete your work on time.

Written assignments should be submitted as a short memorandum according to the format shown on the accompanying page of this syllabus.

**Examinations:**

There will be two examinations given during the semester and a final examination given in the scheduled final examination period. It has been my experience that I can determine better what students have learned and they feel less like they are "racing against the clock" by having examinations that are two-hours in length, rather than exams restricted to the normal 50-minute lecture period. Accordingly, I plan to schedule examinations that will extend outside the normally scheduled lecture period. Depending on students' schedules, the examinations may start one hour before or extend one hour after the normally scheduled meeting time, or examinations may be scheduled at another time of the day or on a day other than the normal class days, i.e. Tuesday or Thursday. No semester exams will be scheduled for a Saturday. I intend to avoid evening exams unless there is no other time of the day when students can meet for a two-hour examination.

A final exam will be given during the normally scheduled final exam period (2:00 - 5:00 PM, Thursday, May 13, 2004 according to the Spring 2004 Course Schedule) and will not be changed.

**Grading:**

Grading will be based on the examinations, class participation and your work on group and individual problem assignments. Failure to participate in class discussions and submit required work may result in at least a one letter grade reduction in your final course grade.

**Attendance:**

Graduate students are expected to attend class without special incentives or bonuses. Failure to attend will usually result in low exam grades and, thus, will influence at least indirectly your final grade. If you fail to attend class on a regular basis, it will
keep you from participating in class and can result in your grade being lowered by one or more letter grades due to your lack of participation.

Students with Disabilities:

The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD or the College of Engineering Director of Students with Disabilities at 471-4321.

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.

Dropping the Course:

Dropping this course will not be permitted after the twelfth class day (Wednesday, February 4, 2004) except in unusual circumstances. Poor performance and low grades are not considered a valid reason for dropping this course.

Outline and Schedule:

A tentative outline of topics to be covered in this course is attached. In the past the outline has been followed in the order shown; however, the topics covered and sequence of coverage may vary. As an example, the first “problem” you will be presented will actually involve earthquakes (Topic V-B on outline). An approximate number of periods to be spent on each topic is shown below.

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Topics Covered

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I. Introduction

II. Limit Equilibrium Procedures
   A. Mechanics
      1. infinite slope procedures
      2. log spiral procedures
      3. the "φ = 0" method
      4. Ordinary Method of Slices
      5. Bishop's simplified procedure
      6. Force equilibrium procedures
         a. Lowe
         b. Corps of Engineers
      7. Morgenstern and Price/Chen and Morgenstern
      8. Spencer's procedure
         a. circular slip surfaces
         b. adaptation to noncircular slip surfaces
      9. other procedures
         a. friction circle/Bell's procedure
         b. Janbu's procedure
   B. Accuracy of Procedures
   C. Selection of Analysis procedures
   D. Location of critical slip surfaces
   E. Three-dimensional analyses
   F. Computer programs

III. Stability of Embankments and Earth Fills
   A. "Slope" failures
      1. short-term stability
         a. undrained analyses
         b. effects of tension-special considerations in "active" zones
      2. long-term stability
         a. drained analyses
         b. steady-state seepage conditions
         c. effects of partial submergence
         d. negative pore water pressures
   B. "Foundation" failures
      1. embankment strength considerations
         a. effects of tension
         b. bearing capacity approaches
2. foundation strength considerations
   a. effects of creep, sample size and disturbance
   b. anisotropy
   c. partial drainage - stage construction
   d. special problems in "passive" zones
3. wedge methods of analysis

IV. Stability of Excavated and Natural Slopes
A. Short-term failures
B. Long-term failures
   1. pore pressure considerations
   2. progressive failure-residual shear strengths
   3. observational and empirical methods

V. Special Stability Conditions
A. Rapid drawdown
   1. effective stress analysis procedures
      a. instantaneous drawdown flow solutions
      b. Morgenstern's procedure
      c. transient flow solutions
   2. multi-stage (consolidated-undrained, R) analysis procedures
      a. Corps of Engineers procedure
      b. Lowe and Karafiath's procedure
B. Earthquakes
   1. pseudo-static procedures
   2. Newmark-type displacement analyses - yield accelerations.
   3. "Screening analyses.
   4. post-earthquake stability
B. Reinforced slopes - geosynthetics, tie-back anchors, soil nails

VI. Remedial Measures
A. Regrading
   1. slope flattening
   2. benching
B. Drainage
C. Buttressing
D. Restraint structures
   1. wells
   2. piles and piers
   3. special restraining structures
All homework assignments should be submitted in the form of a short Memorandum, generally of one or two (maximum) pages of text with accompanying figures, tables, drawings, etc. The memorandum should be typewritten; hand-written submittals will not be accepted. Your memorandum should contain at least the following information:

1. Your name (names if being submitted by a group).
2. Date.
3. Person to whom it is being submitted (me - the instructor).
4. A brief statement of the purpose of the memorandum (what was requested, who authorized it and what you did).
5. Reference to any drawings, figures, charts etc. - identify important information that they contain.
6. Description of what information was obtained and used to solve the problem (e.g. slope geometry, soil properties, seepage conditions, loading conditions - earthquake, rapid drawdown, surcharge).
7. Important results - typically a factor of safety and associated slip (failure) surface will be reported; a critical slip surface (plane, circle, etc.) will typically need to be shown in a figure. Important results must be clearly identified.
8. Appropriate conclusions and recommendations.

Also include any list of symbols, figures or tables that you think are appropriate, but do not obscure the important results with excessive computer output or calculation worksheets.