Geology 314: Engineering Geology

Syllabus and Schedule - Fall 2007
Dr. Robert Mitchell

Text

Geotechnical Engineering Principles and Practice, D. P. Coduto

Learning Objectives

I will introduce (1) the fundamentals of the engineering properties of Earth materials, (2) examine the role of geologists in engineering projects, and (3) develop the quantitative skills for solving basic engineering geology problems.

My combined engineering and science background enables me to discuss the engineering properties of Earth materials and communicate their importance in the geosciences. In the first half of the course I will introduce the stress-strain relationships of Earth materials in accordance with Hooke's law (linear-elastic relationship). This includes concepts such as compression, tension, shear, the elastic moduli (Young's, Poisson's ratio, Bulk, Shear), linear strength, triaxial strength, thermal expansion, density, porosity, water content, fluid pressure, hydraulic conductivity, cohesion, and effective stress (Mohr-Coulomb equation). These concepts are examined with regard to hard rock, including: rock mechanics (tunnel and mine design), seismic wave velocities, and rock slope stability.

In the second half of the course I discuss the engineering properties of unconsolidated materials and clay as applied to compaction, consolidation, subsidence, liquefaction, and soil slope stability. I also introduce common geotechnical methods such as the Unified Soil Classification System and American Standard Testing Methods (e.g., Atterberg limits and Proctor tests), and terminology such as factor of safety, stress bulbs, sensitivity, and quick clay, for example. While most of the topics consider one-dimensional stress and strain, I do discuss moments (torques) when lecturing on topples and soil slope failures and introduce Mohr's circles when discussing triaxial stress and strain.

Where appropriate, I relate the physical concepts to other geologic disciplines such as role of engineering properties of Earth materials in seismic events, structural geology, and ice mechanics. I also emphasize that the heterogeneity of Earth materials can dramatically influence a mechanical result and presents enormous challenges in engineering works. Most all of my lectures use equations to quantify and develop a topic.

Assessment

Assignments

The problem sets are very much like those encountered in physics, only they have geological meaning. The exercises enforce the theory and develop problem solving skills and critical thinking. There is an incentive to complete the problem sets because they will help you learn the concepts and are the basis for test questions, and represent 25% of the total grade. I do not require the memorization of equations, therefore, I provide an equation sheet that is updated throughout the quarter for exercises and exams. I do require you to recognize variables and manipulate equations, however.

Problem sets will be given out on a weekly basis and will be due at the beginning of class time. Problem sets turned after class on the due date will be deducted 5%, and 10% for each day they are late.

Field Trip

There will be a field trip (to be announced, but likely Nov 10 or 17). A small fee (< $5.00) will be required to participate.

Exams

I give two exams during the quarter and a comprehensive final exam. The exams represent 75% of the grade. I expect you to understand a concept both conceptually and quantitatively, therefore, my exams tend to be a mix of concept description and equation identification and manipulation. I provide an equation sheet with each exam, which is the same version of the one used for the problem sets, so your familiarity with the equation sheet becomes essential. I also provide a study guide prior to an exam summarizing the essential concepts I expect you to understand.

You will be required to take all exams at the scheduled times. Make-up exams will be given only in the case of official prearranged absences or emergencies. An excused absence form from the office of Student Affairs is required.

The grading break down will be as follows:
Homework...25 %
Exam 1.....25%
Exam 2.....25%
Final Exam...25% (The final is scheduled for Friday, Dec. 14 at 10:30 am)

A grading scale will be as follows (a curve is possible but not certain):
100-93 = A, 92-90 = A-, 89-88 = B+, 87-83 = B, 82-80 = B-, 79-78 = C+, 77-73 = C, 72-70 = C-, 69-68 = D+, 67-63 = D, 62-60 = D-, 60 or below = F

Academic honesty is an important part of every course at WWU. Please refer to Appendix D (p. 389-390) of the 2007-2008 Course Catalog for details.

Geol 314 - Engineering Geology Topics
The assigned readings are from your text (Coduto)
1. Introduction—definition of engineering geology (pp. 1-14).
2. Bulk properties of rock—porosity, bulk density, unit weight, moist density (pp. 97-103)
3. 1-D stress and strain—compression and tension (pp. 314-320)
4. Geostatic stress and Bulk Modulus (pp. 321-323)
5. Mining columns—factor of safety
6. Shear stress and strain
7. Translational slides—in terms of forces & factor of safety equation (pp. 518-523)
8. Translational slide—in terms of stresses & factor of safety equation
9. Translational slides—engineered slopes (bolts)
10. Translational slides—road cuts
11. Topples—moments
12. Exam 1
13. Soils introduction (pp. 33-43)
14. Site characterization (pp. 46-84)
15. Soil classification—coarse fraction & the Unified Classification System (pp. 136-155)
16. Engineering properties of clays (sensitivity—quick clays) (pp. 125-127 & 494-495)
17. Soil classification—fine fraction, plasticity & Atterberg Limits (pp. 128-131 & 143-146)
18. Induced Stress (pp. 323-336)
19. Effective Stress (pp. 336-345)
20. Consolidation—settlement and compression index (Cc) (Chapter 11)
21. Consolidation—rates (permeability) and Liquifaction (Chapter 12)
22. Compaction (Chapter 6)
23. Soil shear strength—triaxial test and Mohr's circles (Chapter 13)
24. Exam 2
25. Rotational slides—moments (Chapter 14)
26. Rotational slides—method of slices
27. Rotational Slides—vegetation and triggers
28. Rotational Slides--mitigation