Department of
Civil and Environmental Engineering

THE UNIVERSITY OF MAINE

308 Boardman Hall
Orono, Maine 04469-5711
Tel: 207.581.1277
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CIE-365: Soil Mechanics-Spring 2022

Instructor information

Luis Zambrano-Cruzatty, Ph.D.	
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Course description

Credits: 3+1(CIE-366). Soil mechanics is a fundamental discipline from which geotechnical engineers have evolved a variety of methodologies for soil stabilization, foundations, dams and levee design, among many others. This is an introductory course in which we will discover and learn many methods and procedures for characterizing soil properties, the complexities and phenomena involved with water seepage through soils, and the physical and mechanical principles that can be used to represent soil behavior.

Course information

Location	Williams Hall 110
Day and time	Monday, Wednesday, and Friday. Time 10:00 AM to 10:50 AM.
Exam date	Monday, May 2. Time: 1:30 to 3:30 PM.
Graders	Parry Seddiqi and Benjamin Zeitlin
Office hours	Tuesday-Thursday 11 AM to 12 PM (Luis) Monday-Wednesday-Friday 11 AM to 12 PM (Parry) Tuesday 10-11 AM; Friday 9-10 AM and 4-5 PM (Benjamin)
Prerequisite	MEE-251 or concurrent

Course delivery method

This is an in-person, synchronous course.

Digital services, hardware, software

Brightspace will be used as a learning management system for the course. All class handouts, homework, quizes, grades, and communications will be hosted there. In addition to Brightspace, you will often be required to program or produce spreasheets, for which you can choose your preferred programming language or spreadsheet program.

Instructional Materials

I will distribute the necessary handouts both physically and electronically through Brightspace. The following is the course textbook which can be found in the Floger Library:

- Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (1981). An introduction to geotechnical engineering (Vol. 733). Englewood Cliffs: Prentice-Hall.

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Course objectives

This course has the following objectives:

1. Develop an understanding of soil phase relations, index properties, and their application to soil classification and compaction (ABET 1 and 2).
2. Develop an understanding of the importance of groundawater and seepage and its role in evaluating the effective stress in soils (ABET 1).
3. Develop an understanding of how to evaluate the stiffness/compressibility of soils and the role of seepage and permeability on time-dependent consolidation/settlement (ABET 1 and 2).
4. Develop an understanding of how to use Mohr's Circle and evaluate stresses in soil (ABET 1).
5. Develop an understanding of shear strength of soils and its role in the overall stability of earthen systems (ABET 1).

Learning outcomes

After completing this course you will be able to:

1. Identify the different phases in soil materials and their relationships.
2. Determine the index properties and the laboratory tests required to obtain them.
3. Describe the consistency of fine soils and the relative density of coarse soils.
4. Calculate the optimal water content for soil compaction in laboratory and field conditions.
5. Calculate the permeability of soils, seepage flow, forces, and potential for internal erosion.
6. Approximate in-situ pore pressure, total, and effective stress in a saturated soil mass.
7. Evaluate soil external loads' generated stresses and elastic settlements.
8. Calculate the time dependent total settlements in fine grained soils.
9. Characterize the state of stress, determine stress invariants, and rotate stresses.
10. Characterize the shear strength of soils using laboratory test results.
11. Select the appropriate method of analysis for drained and undrained shear strength.
12. Calculate the lateral earth pressure coefficients for at-rest, passive, and active conditions. [1]
13. Calculate the factor of safety against soil mass shear failure using simplified approaches. [1]

Course assesment

Homework	10%
quizes	60%
Final exam	30%

[1] Note that the outcomes listed above may or may not be covered. It will be determined by how far the course has progressed.

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Homework

Unless the activity specifically requests collaborative work, homework will be completed individually. As a result, the submitted work is required to be unique and conceptualized by the author. Nonetheless, collaboration among classmates is encouraged; for example, students meeting in groups to solve problems, comparing answers, and guiding others is allowed. Copying, stealing, or plagiarizing other people's work is not permitted.

You must submit your assignment in a memo format. Pretend you are submitting your work to a client summarizing your answers and attaching your actual work as an ademdum to the memo. Since you are writing to a client, be kind, concise, clear, and neat. **If you fail to submit the memo you will have a penalty of 25% of the total grade.**

An additional 25% of the total grade will be taken out for late assignments. However, if you anticipate that an assignment won't be finished on time, you must bring this issue with me before the submission due date. **Justifications out of the due date will not be considered. See the examples below.**

Example 1: A student submitted an assigment on time without memo and all the answers/solutions are correct. He will get 75% of grade (e.g., 7.5/10).

Example 2: A student submitted a late assigment with memo and all the answers/solutions are correct. He will get 75% of grade (e.g., 7.5/10).

Example 3: A student submitted a late assigment without memo and all the answers/solutions are correct. He will get 50% of grade (e.g., 5/10).

Quizzes

There will be a total of five Quizzes. They are made up of brief questions designed to assess learning and course objectives and are closed-notes. Only four of them will account for the final grade on this item. Therefore, the lowest grade will be dropped from the set. **You may need to draw Mohr circles or lines. Therefore, you will need a compass, a protractor, and rulers.**

DO NOT COME TO THE CLASSROOM if you are unwell with COVID-like symptoms and are afraid of missing a quiz date. Please send me an email to arrange a new date for the quiz.

Final exam

The final exam will be closed-notes and comprehensive of the material covered in the class. **You may need to draw Mohr circles or lines. Therefore, you will need a compass, a protractor, and rulers.**

Grading

The following grading scheme will apply in this course.

A	above 93
A-	90-93^{-}
B+	87-90^{-}
B	83-87^{-}
B-	80-83^{-}
C+	77-80^{-}
C	73-77^{-}
C-	70-73^{-}
D	60-70^{-}
F	below 60

$^{-}$ indicates number is not included

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Academic honesty

Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct cod/e is dismissal from the University.

Please see the University of Maine System's Academic Integrity Policy listed in the Board Policy Manual as Policy 314: https://www.maine.edu/board-of-trustees/policy-manual/section-314/

Students Accessibility Services

If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581.2319, as early as possible in the term. **Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with me Luis Zambrano-Cruzatty privately as soon as possible.**

Sexual violence policy

The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination involving members of the campus, your teacher is required to report this information to Title IX Student Services or the Office of Equal Opportunity. If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources: For confidential resources on campus: Counseling Center: 207-581-1392 or Cutler Health Center: at 207-581-4000. For confidential resources off campus: Rape Response Services: 1-800-871-7741 or Partners for Peace: 1-800-863-9909. Other resources: The resources listed below can offer support but may have to report the incident to others who can help: For support services on campus: Title IX Student Services: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the Title IX Student Services website for a complete list of services.

Course schedule disclaimer

In the event of an extended disruption of normal classroom activities (due to COVID-19 or other long-term disruptions), the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

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Tentative schedule

Day	Date	Topic	Lab.
W	1/19/2022	Class introduction, syllabus, policies	Soil
F	1/21/2022	Invited speaker: Topic TBD	components
M	1/24/2022	Introduction: The geological cycle, soil origin	Grain size
W	1/26/2022	Introduction: Site investigation	dist.
F	1/28/2022	Index properties: Phase relationships	
M	1/31/2022	Index properties: Grain size distribution, Atterberg limits	Atterberg
W	2/2/2022	Index properties: Soil classification	limits
F	2/4/2022	Compaction	
M	2/7/2022	Quiz 1: Introduction, index properties, compaction, in-situ testing	Visual
W	2/9/2022	Water in soils: Groundawater table, pore pressure, total and effective stresses	classification
F	2/11/2022	Water in soils: Darcy's law	
M	2/14/2022	Water in soils: Permeability and hydraulic conductivity	Compaction
W	2/16/2022	Water in soils: One-dimensional seepage	
F	2/18/2022	Water in soils: 2D-3D seepage, flow nets, pore pressure, uplift force, seepage force	
M	2/21/2022	President's day: no class	In-situ
W	2/23/2022	Water in soils: piping	density
F	2/24/2022	Quiz 2: Water in soils	
M	2/28/2022	Induced stress: Approximations, Bousinesq's elastic solution	Permeability
W	3/2/2022	Induced stress: Bousinesq's elastic solution, superposition	
F	3/4/2022	Induced stress: Stress tensor, elastic deformations	
M	3/7/2022	Consolidation: Oedometer test, primary and secondary consolidation	Site
W	3/9/2022	Consolidation: Preconsolidation pressure, OCR	investigation
F	3/11/2022	Consolidation: Primary consolidation parameters	
M	3/14/2022	Spring break: no class	
W	3/16/2022	Spring break: no class	
F	3/18/2022	Spring break: no class	
M	3/21/2022	Consolidation: rate of consolidation	Bonus
W	3/23/2022	Consolidation: preloading, radial consolidation	
F	3/25/2022	Quiz 3: Induced stress and consolidaiton	
M	3/28/2022	State of stress: 2D stresses and Mohr's circle	Consolidation
W	3/30/2022	State of stress: principal stresses, stress invariants, rotations	
F	4/1/2022	State of stress:: Usage of Mohr's circle	
M	4/4/2022	State of stress: stress paths, simple shear, triaxial compression	Settlement
W	4/6/2022	Quiz 4: State of stress	estimates
F	4/8/2022	Shear strength: Mohr-Coulomb failure criteria	
M	4/11/2022	Shear strength: drained and undrained behavior	Unconfined
W	4/13/2022	Shear strength: Shear strength of clays	compression
F	4/15/2022	Shear strength: Shear strength of sands	test
M	4/18/2022	Quiz 5: Shear strength	Direct
W	4/20/2022	Lateral earth pressure: at-rest, passive, and active conditions [2]	shear
F	4/22/2022	Intro to slope stability [2]	
M	4/25/2022	Intro to bearing capacity [2]	Direct
W	4/27/2022	Maine's day: no class	shear
F	4/29/2022	Classes end: Q&A session	
M	5/2/2022	Final exam (1:30 PM- 3:30 PM) Williams Hall 110	

M: Monday - W: Wednesday - F: Friday

[2]This items may or may not be covered. It will be determined by how far the course has progressed.