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 2023

Instructor information

Luis Zambrano-Cruzatty, Ph.D.	
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Course description

Credits: 3+1(CIE-366). Every single piece of infrastructure seats on soils. Understanding how it behaves under imposed loads is critical to prevent failure, anticipate risk, and/or mitigate hazards such as landslides or earthquakes. In CIE-365 we will learn the fundamental principles that control soil behavior. This is helpful to measure and calculate things like soil compaction, stresses, seepage, settlement, and shear strength of soils.

This course is pre-requisite for Geotechnical Engineering CIE-460 and is also requested worldwide in graduate programs of Geotechnical Engineering. This course will equip you with skills needed to interpret soil laboratory results and to understand soil properties and their expected values. These are skills highly valued in consultancy or construction firms regardless of the subdiscipline of Civil Engineering you ultimately focus on.

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 1. Time: 1:30 to 3:30 PM.
Graders	Kelsey Weir and Madison Ala
Office hours	Tuesday-Thursday 11 AM to 12 PM, other times by appointment.
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, quizzes, grades, and communications will be hosted there. In addition to Brightspace, I will use Jupyter Notebooks to solve problems using Python. Although you are not required to use Python or Jupyter Notebooks, you will gain a lot by doing it (you can add this skill in your CV!). In addition, you will be able to use the notebooks developed by me and save significant time solving your homework, exams, and quizzes.

Instructional Materials

The following is the **mandatory** course textbook:

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

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 groundwater 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 stress state and 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. Use soil phase relationships and understand soil index properties to characterize and classify soils.
2. Calculate total and effective stresses in soils considering water transport effects.
3. Calculate change of stresses due to some imposed loads and the settlement and rate of settlement due to consolidation of fine grained soils.
4. Evaluate stress states and calculate shear strength of soils using triaxial and direct shear tests.

Course assessment

Homework	20%
Quizzes	20%
Midterm	30%
Final exam	30%

Homework

You will submit homework using Brightspace. Homeworks are created as "quizzes", where you will input the answer to questions in input text boxes. In addition, to your answer, *upload a picture of your solution in pdf format only for partial credit. Please be aware that other file formats will not be considered for partial credit.* There will be three opportunities to submit your solutions, which will give you immediate feedback on how well you are doing.

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.

Late assignments are allowed if you check the option on the "quiz" to let me know you need extra time. If you choose that option, a new assignment will be sent to you that you will return directly to the TAs in hard copy format. Note that you will loose the opportunity to check your answers or receive immediate feedback in Brightspace, so I strongly encourage you to try to submit on time.

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I value professionalism, and I want you to start thinking with a professional mindset. Because of that, I pay attention to the use of units and significant digits when you report solutions. Full credit is assigned to homework with correct solutions but with a professional use of units and significant digits, this includes plots or any figure you submit as part of your homework.

Complete the Brightspace training session provided in this link for more information.

Quizzes

During the class I will administer quizzes using iClicker. Your quizzes are pass/fail graded, so no pressure there. As long as you participate in class and answer the quizzes you will get full credit.

Quizzes will be prompted during carefully chosen points in the class and will serve for me to see if the material has been understood. I will be valuable to you for the same reason. In addition, I'll let you ask questions that I will collect and answer immediately.

Midterm and Final exams

The midterm and final exams will be inspired on a case history problem, where you will need to apply what you learned in the semester. It will be take-home and you will have to answer very specific questions about the problem at hand.

While you solve your exam, you are welcome to reach out to me with pertinent and timely questions. However, expect delays on my answers.

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

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/

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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 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.

Tentative schedule

Day	Date	Topic	Lab
W	1/18/2023	Syllabus, Introduction, soil origins, site investigation	Soil
F	1/20/2023	No class, video lecture: Phase relationships	components
M	1/23/2023	Grain size distribution	Grain
W	1/25/2023	Atterberg limits and soil mineralogy	size
F	1/27/2023	Soil classification	distribution
M	1/30/2023	Compaction	Atterberg
W	2/1/2023	Water in soils: Frost action on soils	limits
F	2/3/2023	Water in soils: Capillarity and pore pressure	
M	2/6/2023	Water in soils: Total and effective stress	Visual
W	2/8/2023	Water in soils: Total and effective stress (cont.)	classif.
F	2/10/2023	Water in soils: Total head, pressure head, and hydraulic gradient	
M	2/13/2023	Water in soils: Darcy's law, 1D seepage	
W	2/15/2023	Water in soils: Permeability	Compaction
F	2/17/2023	Water in soils: Permeability	

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Day	Date	Topic	Lab
M	2/20/2023	No class: President's day	In-situ density
W	2/22/2023	Water in soils: 2D seepage, finite difference solution *	
F	2/24/2023	Water in soils: Flow nets, flow in a section, pore pressure	
M	2/27/2023	Water in soils: Flow nets, flow in a section, pore pressure **	Permeability
W	3/1/2023	Water in soils: Uplift pressure	
F	3/3/2023	Water in soils: Internal erosion	
M	3/6/2023	Externally generated stress: Elastic solution to point load	Site investigation
W	3/8/2023	Externally generated stress: Use of charts, num solutions, and superpossition	
F	3/10/2023	Consolidation: 1D compression of fine grained soils	
M	3/13/2023	No class: Spring break	
W	3/15/2023	No class: Spring break	
F	3/17/2023	No class: Spring break	
M	3/20/2023	Consolidation: Calculation of primary consolidation settlement	Bonus
W	3/22/2023	Consolidation: Rate of consolidation	
F	3/24/2023	Consolidation: Calculation of time-dependent consolidation	
M	3/27/2023	No class, video lecture: Consolidation: Applications	Consolid.
W	3/29/2023	No class, video lecture: Soil strength: 2D State of stress and principal stresses	
F	3/31/2023	Soil strength: 2D State of stress and principal stresses	
M	4/3/2023	Soil strength: Stresses at any orientation plane and Mohr's circle	Settlement estimates
W	4/5/2023	Soil strength: Invariant stresses	
F	4/7/2023	Soil strength: Solved samples of Mohr-circle problems using graphical solutions	
M	4/10/2023	Soil strength: Dilation of soils	Unconf. compression test
W	4/12/2023	Soil strength: Strength of coarse grained soils	
F	4/14/2023	Soil strength: Strength of fine grained soils	
M	4/17/2023	Soil strength: Mohr-Coulomb failure criteria	Direct shear
W	4/19/2023	Soil strength: Sample calculation of PSR, friction angles, cohesion, Su	
F	4/21/2023	Soil strength: Lateral earth pressure coefficients.	
M	4/24/2023	Soil strength: Sample calculation of active and passive earth pressure	Direct shear
W	4/26/2023	No class: Maine's day	
F	4/28/2023	Soil strength: Applications	
M	5/1/2023	Exams begin *	
W	5/3/2023	Final exam due date **	
F	5/5/2023	Semester ends	

M: Monday - E: Wednesday - F: Friday

No class: Video lecture

No class

Exam due

* Exam assignment date

** Exam due date