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-598, Advanced Topics in Civil Engineering-Experimental soil mechanics

Instructor information

Luis Zambrano-Cruzatty, Ph.D.	
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Office hours	TBD

Course description

Credits: 3. Laboratory and in-situ testing is a critical and necessary activity in geotechnical engineering. This course covers advanced topics about soil laboratory and in-situ tests used to evaluate soil behavior under various loading and environmental conditions. To begin, the course discusses the fundamentals of sampling, disturbance, and uncertainty in soil parameters. Following that, students will learn about the various laboratory tests through group practice sessions in which they will prepare, test, and report the results of various experiments to get consolidation and shear strength data. Similarly, advanced issues about in-situ testing are covered in this course. Finally, the course discusses how to callibrate constituive models using the results of the tests learned in this course.

Course information

Location	Boardman Hall 115
Day and time	Monday and Wednesday 5:00 to 6:30 PM

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, students will often be required to program or produce spreasheets, for which they can choose their preferred programming language or spreadsheet software.

Instructional Materials

There is not a unique literature reference for this course. Instead, I will distribute the needed manuscripts you will require through Brightspace. However, the following books are beneficial to understand the concepts behind the many laboratory tests procedures:

- Duncan, J. M., Wright, S. G., & Brandon, T. L. (2014). Soil strength and slope stability. John Wiley & Sons.
- 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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- Wood, D. M. (1990). Soil behaviour and critical state soil mechanics. Cambridge university press.
- Davis, R. O., & Selvadurai, A. P. (2005). Plasticity and geomechanics. Cambridge university press.

Course objectives

This course has the following objectives:

1. To learn about the different tests to obtain shear strength and consolidation parameters of soils.
2. To understand the effect of water drainage in soils to select the appropriate laboratory test and soil model.
3. To comprehend and learn the limitations and assumptions in the design and analysis of soil laboratory results.
4. To comprehend the process of soil characterization with emphasis on the selection and calibration of soil's constitutive models.

Learning outcomes

After completing this course the students should be able to:

1. Describe the sources of sampling disturbance and its effects on the quality and accuracy of laboratory results.
2. Describe the best practices for sample storage and preparation.
3. Describe the assumptions, boundary conditions, and stress and strain paths of laboratory tests.
4. Distinguish between drained and undrained analysis and total and effective parameters.
5. Produce technical specifications for a laboratory test, including drainage conditions, loading rates, loading magnitude, consolidation pressure, backpressure, and the like.
6. Perform advanced laboratory testing, including consolidation, direct shear, direct simple shear, triaxial, and vane shear tests.
7. Critically review laboratory reports and judge the quality and accuracy of reported results.
8. Analyse in-situ test results such as cone penetration testing, standard penetration test, and similar situations when intact sampling is not feasible.
9. Simulate laboratory tests using numerical models such as single element drivers or finite element analysis.
10. Design the laboratory program needed for the calibration of different constitutive models used in practice.

Course assesment

Laboratory practice	30%
Reports	20%
Project	30%
Final exam	20%

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Laboratory practice

There will be five laboratory sessions where you will perform the soil testing. You are expected to complete the test from the sample preparation until the test is completed. Some tests could demand around three hours or more of preparation, for which reason you will be expected to be present in the laboratory extra time. Similarly, you and your classmates will be required to inspect the state of your test in days and hours out of the planned class.

It is your responsibility to conduct the tests until completion, and your grade on this item will be assessed on your group performance. For instance, a group where all its members are present in the laboratory practice, and complete a laboratory test, as demonstrated by the submission of the lab report, will obtain the entire grade on that practice.

Reports

After completing a laboratory session, your group is required to submit a report of the test results. You have to assume that you are writing the report to a client, so you do not require to include theoretical aspects in the report. The report must include the methods for sample preparation, testing procedure and standard specification when available, explain any deviation from the standard if necessary, the analysis of the results, pictures of the sample before and after tests when appropriate, and attachments including spreadsheets with the data collected in the test.

Project

The project is a group project that entails creating instructions for conducting or operating laboratory equipment. The instructions must be succinct and comprehensive, as they will be used to set up and operate our current equipment by future users.

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 90
B	80-90
C	70-80
D	60-70
F	below 60

Late or incomplete assignments

Late submissions will not be considered for the entire grade. However, if you or anyone in your group anticipate that any 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.

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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 code 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.

Tentative schedule

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Table 1: Tentative schedule

Day	Date	Topic
M	29-Aug	Class begins: Syllabus, basic geotechnical review
W	31-Aug	Introduction: sampling, sampling storage
M	5-Sep	No class: Labor day
W	7-Sep	Advance laboratory testing: Consolidation test- Lecture
M	12-Sep	Consolidation test- laboratory
W	14-Sep	Direct shear test- Lecture
Th	15-Sep	Field site investigation (CIE-460)
M	19-Sep	Direct shear test- laboratory
W	21-Sep	CD triaxial test- lecture
M	26-Sep	CD triaxial test-laboratory
W	29-Sep	CU triaxial test-lecture
M	3-Oct	CU triaxial test-laboratory
W	5-Oct	UU triaxial test- lecture
M	10-Oct	No class: winter break
W	12-Oct	Strength index tests: Lecture
M	17-Oct	UU triaxial test- laboratory
W	19-Oct	Simple shear lecture
M	26-Oct	Simple shear: laboratory
W	28-Oct	Advanced in-situ testing: SPT
M	7-Nov	Advanced in-situ testing: CPT
W	9-Nov	Advanced in-situ testing: CPT-cont.
M	14-Nov	Advanced in-situ testing: F-CPT
W	16-Nov	Advanced in-situ testing: Pressuremeter test
M	21-Nov	Advanced in-situ testing: Marchetti penetrometer test
W	23-Nov	Thanksgiving day break- no class
M	28-Nov	Advanced in-situ testing: Vane shear test
W	30-Nov	Const. models and their calibration: Tresca, Mohr-Coulomb, von Mises, and Drucker-Prager
M	5-Dec	Const. models and their calibration: CamClay and NorSand
W	7-Dec	Discussion about class project
F	9-Dec	Classes end
M	12-Dec	Final exams begin. Final exam date TBD