

# CEE 380 GEOTECHNICAL ENGINEERING

TTh 11:00-12:20 p.m.

1017 Civil Eng Building (Hydrosystems Lab)

Web Site: <https://canvas.illinois.edu/courses/56274>

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## Introduction

This course is concerned with engineering problems in which the material is soil or rock. Soil mechanics consists of the study of soil properties and soil behavior, whereas foundation engineering is the design of foundations on soils and rock. In this course, we will focus on understanding some of the basic principles of soil properties with some applications to earth structures. The principles given in this course are also applicable to rock mechanics.

I am interested in having you develop an appreciation of the significance of natural material (soil and rock) in civil engineering applications. This course will:

1. Introduce you to the discipline of geotechnical engineering and be your stepping stone into this area.
2. Help you recognize problems you will encounter in your engineering practice that are related to geotechnical engineering. At that point, if geotechnical engineering is not your specialty, STOP and seek assistance from a geotechnical engineer.
3. Help you answer some questions that might be asked on your Fundamentals of Engineering (FE) and Professional Engineer (PE) exams.

## Connections

In this course we will encounter and use new vocabulary. It is important that you strive to make connections among all aspects of the course – facts, principles, theories, explanations, etc. – in order to increase your knowledge and deepen your understanding of Geotechnical Engineering.

Often, these connections are easy to make, especially if you consciously look for them and seek help in making them. Mental connections are not always obvious and making them is greatly enhanced by one's eagerness, patience, determination, perseverance, and general emotional readiness to learn. The great joy of making discoveries comes from being focused and from willing to learn from mistakes without succumbing to frustration.

First and foremost, it is important that you try to make connections with other course material that you may have had or you are learning this semester. Many of the principles that are covered in this course are based on concepts and material you are already familiar with. In this course you will see new applications to these concepts. In addition, it is very important that you make connections with people and places. Personal connections with fellow students, teachers, experts, advisors, and others in our community will greatly enhance your academic progress and personal maturity.

## Required Text Book

An Introduction to Geotechnical Engineering (2<sup>nd</sup> edition), Robert D. Holtz, William D. Kovacs & Thomas C. Sheahan, Prentice-Hall, 2010. *(Please note we will not use the 1<sup>st</sup> edition.)*

## Supplementary Reading

1. Foundation Engineering, 2<sup>nd</sup> Edition, Peck, Hanson and Thornburn
2. Various course handouts

## Books on Reserve at Grainger

1. Peck, R. B., Hanson, W. E., Thornburn, T. H.; Foundation Engineering 2<sup>nd</sup> ed.
2. Taylor, D. W.; Fundamentals of Soil Mechanics
3. Terzaghi, Karl; Soil Mechanics in Engineering Practice 3<sup>rd</sup> ed.
4. Lambe, T. William; Soil Mechanics
5. Mitchell, James Kenneth; Fundamentals of Soil Behavior 2<sup>nd</sup> ed.
6. Craig, R.F.; Soil Mechanics
7. Braja Das; Advanced Soil Mechanics

## Course Format

Lectures and Attendance: The course is delivered in person and the slides are uploaded to Canvas by 11:00 am on Tuesdays and Thursdays. **You are expected to attend all lectures.** You are responsible for what is presented verbally as well as what is written on the slides. Each lecture includes questions graded for participation conducted through the “quizzes” feature on CANVAS. **Everyone is expected to bring their electronic devices to class.** Anyone who does not submit the lecture questions on time without a valid excuse (i.e. excused absence) will receive a zero for

that question. The lowest 4 grades will not be considered for the final grade calculation. **You will have one week after the score for the assignment has been posted on Canvas to request a re-grade. No regrade requests will be considered after the one-week period.** After each lecture you should review the slides and study appropriate readings and work examples in the textbook. The attendance of the lectures is worth 5% of your course grade. Submission of the quizzes outside of the lecture room and assistance in doing that is considered cheating and will result in F score.

Reading Assignments: Each lecture will have associated readings from the textbook provided on the schedule. There are reading assignments associated with each set of readings to be completed through the “quizzes” feature on Canvas that are worth 10% of the overall grade. **Each reading assignment will allow for 2 attempts. Only the latest submission will be graded. Reading assignments will be due at 10:30 am on the respective lecture days.** The lowest grade will not be considered for the final grade calculation. **You will have one week after the score for the assignment has been posted on Canvas to request a re-grade. No regrade requests will be considered after the one-week period.**

Office Hours: Any question students may have about the course material are to be addressed to the lecturer via email or during the office hours. The TAs can also explain the solutions of quiz and homework problems during their office hours.

Homeworks: There will be 5 homeworks during the semester due (approximately) every other Thursday. In each homework, you will need to solve 3-6 geotechnical engineering problems that will prepare you for the midterms and final. Each homework has to be submitted to the designated section in Canvas before the class time on the due date. Your graded homeworks will be turned in within 1.5 weeks with the feedback on the problems solutions.

Case study of the week: Once per two weeks a student team will be assigned to present a current construction case study highlighting the geotechnical aspects of a project. The team will have to select the project from Engineering News Record (ENR), Civil Engineering, etc. or an ongoing construction project in the area. **The team will prepare a maximum of 10 slides summarizing the geotechnical aspects of the project and how they relate to material presented in class.** All slides shall be numbered. The presentation will be made at about 12:05pm on Thursdays, and will be allotted 10 minutes for presentation and 5 minutes for discussion. The presentation must at least include the following elements: **Introduction; Key Geotechnical Elements/Issues; Plan View & Cross-Section showing Soil Layers; Summary of Geotechnical Properties; and Summary of Challenges and Lessons Learned.**

In addition, a 4-page report summarizing the case study has to be submitted at the time of presentation. The report shall have no more than ½ page of references and shall not include figures and tables but will refer to those in the presentation. The figure and table references shall only be included in the presentation slides, while the references to the verbal and written content in the presentation and paper shall be placed in the paper. The report and presentation should be of the highest professional quality. **The report (pdf format) and presentation (power point) must be posted electronically on Canvas by 11:59 pm the day before the presentation is delivered (late submittal will receive a grade of zero).** In the midterms and the final, there will be questions based on the information covered in case study presentations.

Midterm Exams: There will be two 80-minute long midterm exams during the semester. The exams are open book and notes. The exams will happen during the class time and you are expected to turn in your solutions on the designated date by 12:20 PM.

Final Exam: There will be a 2.5-hour long final exam. The final exam is also open book and notes. You can visit <https://registrar.illinois.edu/final-exam-schedule> for the final exam schedule. In the exams you will be asked to apply material you have learned through class discussions and readings in both qualitative and quantitative questions, not just a mere repetition of the homework.

The completion of the homeworks and exams might require writing implements, a calculator, and drawing tools such as a bow compass, protractor, and graded straight edge. Many of these items can be purchased at local campus bookstores. The exam and homework solutions can be handwritten but scanned properly such that they are easy to be read and understood by the graders.

Extra Credit: Some of the homeworks and exams will contain extra credit questions. In addition, some extra credit can be earned by asking insightful questions related to the course material. This can be done by emailing the instructor or during the office hours and discussion sessions.

## Late Policy

Assignments, outside of the “Case study of the week”, can be submitted up to 2 days past the due date and time with a 25% deduction if submitted within 24 hours and a 50% deduction if submitted within 48 hours. Any other submissions past the designated period will not be graded.

## Academic Performance, Progress, Accomplishment and Grades

Your level of accomplishment will be recognized at the end of the semester by the letter grade you receive for the course. Individual accomplishment is measured against course standards and not against the performance of other students. The course standards of accomplishment are:

Points	Accomplishment Level	Letter Grade
90-100	Superior	A (including +/-)
80-89.99	Proficient	B (including +/-)
70-79.99	Acceptable	C (including +/-)
60-69.99	Mediocre	D (including +/-)
Below 60	Unacceptable	F

The following grade distribution will be made:

Homeworks	20%
Reading	10%
Attendance	5%
2 Midterms	15%/20%
Project of the week	5%
Final Exam	25%
Extra Credit (maximum)	5%

The exact letter grade (+/-) will be adjusted depending on class and individual performance. You are expected to attend all classes, submit all homeworks, and sit for all exams. **Please note the grades will not be provided via email.**

## Academic Conduct, Misconduct and Cheating

In this course you are encouraged to study and prepare for examinations with other students. However, when taking exams, and when writing your homework assignments, you have to work alone. The university regulations are very explicit about academic misconduct and cheating, and these regulations will be enforced. This course adopts a zero tolerance policy for cheating, any cheating case will be referenced to the front office and the students will receive an F in the class. During exams, we will apply a code of honor, under which you are to work alone and neither give nor receive help from any sources. Regarding the university code of academic integrity, please go to the following website: [http://admin.illinois.edu/policy/code/article1\\_part4\\_1-401.html](http://admin.illinois.edu/policy/code/article1_part4_1-401.html)

*Any material provided in CEE380, including but not limited to lecture slides and recordings, exams, assignments, and solutions may not be posted online, copied, or distributed in any form without the explicit written permission of Professor Makhnenko.*

## CEE Honor Code

To foster and promote integrity among students, the CEE Honor Code was developed. You (the student) commit to honor the code each time you sign an exam, and implicitly whenever you sign homework or other class assignments. The CEE Honor Code reads:

*I pledge to uphold the highest levels of professional and personal integrity in all of my actions, including 1) never assisting or receiving unfair assistance during exams, 2) never assisting or receiving assistance on class assignments beyond that specified by an instructor, and 3) always fully contributing to group activities that are part of a course activity.*

## Additional Activities

*Office hours:* You should take full advantage of the availabilities of the instructor and teaching assistants during office hours or by appointment. You can also correspond with us using e-mail.

I receive upwards of 50 emails per day. **Please make sure that in all email correspondence, the e-mail is sent from a UIUC e-mail address and the subject heading starts with "CEE380:" followed by the topic of the message.** This will ensure that it will receive prompt attention. E-mails sent from non-UIUC addresses (such as gmail and yahoo) or not containing "CEE380:" in the subject heading will be *discarded*. Even though your primary email account is a non-UIUC address, there is a way to set a "from" address to your UIUC email address. This is intended to verify your identity as a student at UIUC and in this class.

*Course Web Site:* The class web site will use the "Illinois Canvas" system. Class notes, homework, practice problems, and solution keys will be made available on the course web site. The submission of homeworks and project of the week files will also be done through Canvas. Students are responsible for announcements that will be periodically posted and are encouraged to make use of the discussion board on the site.

## **Accessibility**

To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require reasonable accommodations to participate in this class and related activities are contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to <https://www.disability.illinois.edu>.

## **COVID-19**

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community, including wearing a facial covering properly, disinfecting the immediate seating area, and using hand sanitizer. Students are also required to follow the campus COVID-19 testing protocol and vaccination. Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work. Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

## **Emergency Response Recommendations**

Emergency response recommendations can be found at the following website: <http://police.illinois.edu/emergency-preparedness/>. I encourage you to review this website that also includes campus building floor plans within the first 10 days of class.

## **Inclusivity**

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course instructor if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

## **Sexual Misconduct Reporting Obligation**

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: [wecare.illinois.edu/resources/students/#confidential](https://wecare.illinois.edu/resources/students/#confidential). Other information about resources and reporting is available here: [wecare.illinois.edu](https://wecare.illinois.edu).

## **Religious Observances**

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

## **Family Educational Rights and Privacy Act (FERPA)**

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

## **Impact on Society and Environment**

As civil engineers, through the projects we design and build, we have the potential to significantly impact our communities and the environment we live in. Always be mindful of the impact of your projects, and always try to ensure that they are positive.

## **Sustainability**

Here at Illinois, we are concerned about being sustainable. Please, be aware that everything you do has an environmental impact. Be conservative printing course materials and recycle used papers. Recycle cardboard, plastic, glass, aluminum, and compost – there are facilities for that available on campus and in Urbana-Champaign area. Save energy and water: turn off the lights if you do not need them and avoid having water running down the sink for no reason. Walk and bike instead of driving – it is more healthy and environmentally friendly.

### Course schedule

Date	Lecture No.	Lecture Topic	Reading Assignment	HW due	Case study
			Holtz, Kovacs & Sheahan (2 <sup>nd</sup> ed.)		
T, 1/21	01	Course logistics, Geotech applications	Chapter 1		
Th, 1/23	02	Geology & Weight-volume relationships	Sect. 2.1-2.4 / 3.1-3.4/5.5.1	RA 1	
T, 1/28	03	Grain size distribution	Sect. 2.5-2.6 / 4.5/ 7.10.1-7.10.2	RA 2	
Th, 1/30	04	Structure, consistency, and sensitivity	Sect 4.1-4.9 / 12.12	RA 3	
T, 2/4	05	Atterberg limits, Plasticity chart, Soil classification systems	Sect. 2.7-2.10 / 6.4	RA 4	
Th, 2/6	06	Soil compaction	Chapter 5	<b>HW1</b>	
T, 2/11	07	Seepage through soils (Darcy's law, Hydraulic conductivity, 1-D Flow)	Sect. 7.1-7.4/ 7.8	RA 5	
Th, 2/13	08	Seepage through soils (Pressure, elevation and total head)	Sect. 7.5 / 6.1-6.3		<b>T1</b>
T, 2/18	09	Effective stress and pore water pressure	Sect. 6.2 / 6.9-6.11 / 7.6	RA 6	
Th, 2/20	10	Effective stress and pore water pressure (cont'd)	Sect. 6.2 / 6.9-6.11 / 7.6	<b>HW2</b>	<b>T2</b>
T, 2/25	11	Review of the 1/3 of the course			
Th, 2/27	12	Exam #1			
T, 3/4	13	Volume change of soils, Consolidation	Sect. 8.1-8.6 / 8.10	RA 8	
Th, 3/6	14	Consolidation, Settlement computation	Sect. 8.7-8.15	RA 9	<b>T3</b>
T, 3/11	15	Time rate of settlements	Sect. 9.1-9.7 / 10.5-10.6	RA 10	
Th, 3/13	16	Time rate of settlements (cont'd)	Sect. 9.1-9.7 / 10.5-10.6	<b>HW3</b>	<b>T4</b>
3/15-3/23		Spring Break			
T, 3/25	17	Secondary compr., Ground improvement	Sect. 9.8 / 10.5-10.6		
Th, 3/27	18	Soil stresses under load	Sect. 10.1-10.3 / 11.1-11.2 / 13.2	RA 12	<b>T5</b>
T, 4/1	19	Soil stresses under load (cont)	Sect. 10.1-10.3 / 11.1-11.2 / 13.2		
Th, 4/3	20	Geotechnical field methods		<b>HW4</b>	<b>T6</b>
T, 4/8	21	Review of the 2/3 of the course			
Th, 4/10	22	Exam #2			
T, 4/15	23	Soil behavior during shear	Sect. 11.3-11.5 / 12.1-12.14 / 12.17 / 13.1-13.3 / 13.13		
Th, 4/17	24	Soil behavior during shear/Lab testing	Sect. 11.3-11.5 / 12.1-12.14 / 12.17 / 13.1-13.3 / 13.13	RA 13	
T, 4/22	25	Soil behavior during shear (cont.)	Sect. 11.3-11.5 / 12.1-12.14 / 12.17 / 13.1-13.3 / 13.13	RA 14	
Th, 4/24	26	Shear strength of geomaterials			<b>T7</b>
T, 4/29	27	Active-passive pressures		<b>HW5</b>	
Th, 5/1	28	Geotech aspects of FE exam			
T, 5/6	29	Course review			
Th, 5/15		Final Exam, 7PM			