

CEE 380 GEOTECHNICAL ENGINEERING

TTh 12:30-1:50 p.m.

3310 Newmark Civil Engineering Laboratory (NCEL)

Web Site: <http://compass2g.illinois.edu>

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Office hours: TTh 2:00-3:00 pm or by appointment

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Office hours	Mon. 12:00-2:00pm, Wed. 10am-12pm (NCEL 2310)

Introduction

This course is concerned with engineering problems in which the material is soil or rock (soil/rock mechanics, geotechnical engineering). Technically speaking, 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 Professional Engineer (PE) exam.

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 (2nd edition), Robert D. Holtz, William D. Kovacs & Thomas C. Sheahan, Prentice-Hall, 2010. (*Please note we will not use the 1st edition.*)

The errata for the first printing can be found on the Illinois Compass course website.

Supplementary Reading

1. Foundation Engineering, 2nd 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 2nd ed.
2. Taylor, D. W.; Fundamentals of Soil Mechanics
3. Terzaghi, Karl; Soil Mechanics in Engineering Practice 3rd ed.
4. Lambe, T. William; Soil Mechanics
5. Mitchell, James Kenneth; Fundamentals of Soil Behavior 2nd ed.
6. R.F. Craig , Soil Mechanics
7. Holtz & Kovacs , An Introduction to Geotechnical engineering
8. Braja Das , Advanced Soil Mechanics

Course Format

Lectures: Lectures begin promptly at 12:30 pm and end at 1:50 pm. You are expected to attend all lectures. Take thorough notes during the lecture, because you are responsible for what is presented verbally as well as what is written on the slides and whiteboard. After each lecture you should review your notes and study appropriate readings and work examples in the textbook.

Office Hours: In addition to answering any question students may have about the course material, the TAs will also solve extended length problems during their office hours.

Case study of the week: About once a week 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*, *Tunnels and Tunneling*, 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 1:35pm 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 is to be submitted at the time of presentation. The report shall have no more than $\frac{1}{2}$ page of references and shall not include figures and tables but will refer to those in the presentation. Figures and tables shall only be present 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. Please refer to *GroupProjectExample.pdf* on the Illinois Compass course website for the report format. The team may consult with the instructor prior to making a presentation. The report and presentation should be of the highest professional quality. *A group usually consists of 6-7 students, which given the grade weighing for the project (10% of final grade) should represent the equivalent of the work of one student for the entire semester.* **The report (pdf format) and presentation (power point) must be posted electronically on Compass2g by 10:00 pm the day before the presentation is delivered (late submittal will receive a grade of zero).**

Quizzes: At the start of every lecture, there will be a quiz. **The quizzes are open book with a duration of 5-15 min.** They will consist of multiple choice questions regarding topics from recent lectures and assigned reading material. The lowest 4 quizzes scores will not be considered. Please read the assigned reading materials and ask questions if you don't understand concepts to prepare for the quizzes. This is to accommodate up to 4 missed quizzes for any number of reasons including DRES accommodation. There will be no makeup of these quizzes. Solution will be promptly posted at the end of a given class session. **You will have one week after the score for the quiz has been posted on Compass2g to request a re-grade.**

Midterm Exams: There will be two 80-minute long midterm exams during the semester. The exams are open book and closed note.

Final Exam: There will be a 3-hour long final exam. The final exam is also open book and closed note. You can visit <https://registrar.illinois.edu/final-exam-schedule> for the final exam schedule.

In the exams you will be asked both qualitative and quantitative questions. The exams are not a mere repetition of the homework. You will be asked to apply material you have learned through class discussions, reading the textbook and the case history of the week.

You should come fully prepared for each exam and quiz. The completion of the exams and quizzes will 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.

Students may not pick up the assignments of their friends, as this violates University regulations on privacy.

Academic Performance, Progress, Accomplishment and Grades

My expectations include individual accomplishment on the part of every student, so that all of you not only fulfill your capabilities, but also expand your capacity and enrich your professional life. The knowledge you acquire, the skills you cultivate, and the attitude you develop are of great importance to me.

Although grades are not the ultimate measure of your knowledge, abilities, or potential, they are useful guides to you and to others. 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 necessarily 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:

Quizzes	30%
<i>Case study of the week</i>	10%
2 Midterm Exams	20% each
Final Exam	20%

The exact letter grade (+/-) will be adjusted depending on class and individual performance. You are expected to attend all classes, submit all quizzes, and sit for all exams. **Please note the grades will not be provided via email. If you absences more than 10 times, you will automatically fail the course.** You are expected to arrive to class on time before the class starts.

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 are 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 (s) 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. ***Just Don't Do it***

Regarding the university code of academic integrity, please go to the following website:

http://admin.illinois.edu/policy/code/article1_part4_1-401.html

You are expected to listen attentively during class and participate in the discussions when requested. You may use your electronic device (e.g. laptop, iPad) only to take notes, view the class material or when required for quizzes and questions. Any other use of electronic devices such as cell phones, texting devices, headphones, web browsing, Facebook, Twitter, or recording devices is not permitted. Unauthorized conversations with your classmate during class are not permitted either. These activities are disruptive to the flow of the lectures and to your colleagues. Not following these procedures can result in loss of 5% of final grade and/or referral to the CEE associate head's office. These procedures are intended to promote a positive learning environment for all.

Any material provided in CEE380, including but not limited to 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 with input from several CEE undergraduate organizations, the CEE Graduate Student Advisory Committee, and the CEE Graduate Affairs Committee. You (the student) commit to honor the code each time you sign an exam, and implicitly whenever you sign homework or other class assignments. 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 is placed in the correct incoming email box and 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. Please contact your TA if you have any question about this. 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 Compass 2g" system. Class notes, homework, exams, and solution keys will be made available on the course web site. Students are responsible for announcements that will be periodically posted, and are encouraged to make use of the discussion board on the site, as well as other features outlined in the "Introduction to Illinois Compass" handout.

Helpful Study Hints

Review the sample examples prior to lecture. Take good notes during the lecture. Read and study the appropriate pages in the textbook. Do the sample exercises in the book, and learn keywords and concepts. Ask questions!

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 asked to see me as soon as possible.

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 CEE UIUC, 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 of 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.

Safety and Security in the Classroom

These recommendations are provided by the Office of Campus Emergency Planning. There are three basic methods to respond in emergencies that may affect persons on campus, and more specifically, individual buildings: **RUN** (get out), **HIDE** (find a safe place to stay inside), or **FIGHT** (with anything available to increase our odds for survival). (<http://police.illinois.edu/emergency/response/>)

ONLY FOLLOW THESE ACTIONS IF SAFE TO DO SO. When in doubt, follow your instincts - you are your best advocate!

RUN (get out) — Action taken to leave an area for personal safety.

- Take the time to learn the different ways to leave your building **BEFORE** there is an emergency.
- Evacuations are mandatory for fire alarms and when directed by authorities! No exceptions!
- Evacuate immediately. Pull manual fire alarm to prompt a response for others to evacuate.
- Take critical personal items only (keys, purse, and outerwear) and close doors behind you.
- Assist those who need help, but carefully consider whether you may put yourself at risk.
- Look for **EXIT** signs indicating potential egress/escape routes.
- If you are not able to evacuate, go to an Area of Rescue Assistance, as indicated on the front page of this plan.
- Evacuate to Evacuation Assembly Area, as indicated on front page of this plan.
- Remain at Evacuation Assembly Area until additional instructions are given.
- Alert authorities to those who may need assistance.
- Do not re-enter building until informed by emergency response personnel that it is safe to return.
- Active Threat - If it is safe to do so, run out of the building. Get as far away as possible. Do not go to the Evacuation Assembly Area.

HIDE (find a safe place to stay inside) — Action taken to seek immediate shelter indoors when emergency conditions do not warrant or allow evacuation.

- Severe Weather
 - Take the time now to learn the different ways to seek shelter within your building before there is an emergency.
 - If you are outside, proceed to the nearest protective building.
 - If sheltering-in-place due to severe weather, proceed to the identified Storm Refuge Area or to the lowest, most interior area of the building away from windows or hazardous equipment or materials.
- Active Threat
 - Lock or barricade your area.
 - Get to a place where the threat cannot see you.
 - Place cell phones on silent.
 - Do not make any noise.
 - Do not come out until you receive an Illini-Alert advising you it is safe.

FIGHT (with anything available to increase our odds for survival) — Action taken as a last resort to increase your odds for survival.

Active Threat

- If you cannot run away safely or cannot hide, be prepared to fight with anything available to increase your odds for survival.

Floor plans for major campus buildings showing the location of the exits, storm refuge areas and areas of rescue assistance (if they exist) are available at: <http://police.illinois.edu/emergencyplanning/floorplans/>

Course schedule

Date	Class No.	Topic No.	Lecture Topic	Reading Assignment	Proj. of the week
				Holtz, Kovacs & Sheahan (2 nd ed.)	
T, 1/16	01	01-02	Course logistics, Geotech applications	Chapter 1	
Th, 1/18	02	02	Geology & Weight-volume relationships	Sect. 2.1-2.4 / 3.1-3.4/5.5.1	
T, 1/23	03	03	Grain size distribution	Sect. 2.5-2.6 / 4.5/ 7.10.1-7.10.2	
Th, 1/25	04	04	Structure, consistency, and sensitivity	Sect 4.1-4.9 / 12.12	
T, 1/30	05	05	Atterberg limits, Plasticity chart, Soil classification systems	Sect. 2.7-2.10 / 6.4	
Th, 2/1	06	06	Soil compaction	Chapter 5	#1
T, 2/6	07	06	Soil compaction (cont'd)	Chapter 5	
Th, 2/8	08	07	Seepage through soils (Darcy's law, Hydraulic conductivity, 1-D Flow)	Sect. 7.1-7.4/ 7.8	#2
T, 2/13	09	08	Seepage through soils (Pressure, elevation and total head)	Sect. 7.5 / 6.1-6.3	
Th, 2/15	10	09	Effective stress and pore water pressure	Sect. 6.2 / 6.9-6.11 / 7.6	#3
T, 2/20	11	09	Effective stress and pore water pressure (cont'd)	Sect. 6.2 / 6.9-6.11 / 7.6	
Th, 2/22	12	10	Flow nets definition	Sect. 7.7-7.10	#4
T, 2/27	13	10	Flow nets definition (cont'd)	Sect. 7.7-7.10	
Th, 3/1			Exam #1		
T, 3/6	14	11	Volume change of soils, Consolidation	Sect. 8.1-8.6 / 8.10	
Th, 3/8	15	12	Consolidation, Settlement computation	Sect. 8.7-8.15	#5
T, 3/13	16	13	Time rate of settlements	Sect. 9.1-9.7 / 10.5-10.6	
Th, 3/15	17	13	Time rate of settlements (cont'd)	Sect. 9.1-9.7 / 10.5-10.6	
3/19-3/25			Spring Break		
T, 3/27	18	13	Secondary compression, Swelling	Sect. 9.8 / 10.5-10.6	
Th, 3/29	19	14	Ground improvement		#6
T, 4/3	20	15	Soil stresses under load	Sect. 10.1-10.3 / 11.1-11.2 / 13.2	
Th, 4/5			Exam #2		
T, 4/10	21	16	Soil behavior during shear	Sect. 11.3-11.5 / 12.1-12.4 / 12.9-12.10	
Th, 4/12	22	17	Soil shear strength	Sect. 12.5-12.14 / 12.17 / 13.1-13.5 / 13.13	#7
T, 4/17	23	17	Soil shear strength	Sect. 12.5-12.14 / 12.17 / 13.1-13.5 / 13.13	
Th, 4/19	24	17	Soil shear strength	Sect. 12.5-12.14 / 12.17 / 13.1-13.5 / 13.13	#8
T, 4/24	25	18	Active-passive pressures		
Th, 4/26	26	18-19	Active-passive pressures, Field methods		
T, 5/1	27	20	Class Evaluation & review		
T, 5/8			Final Exam 1:30 pm - 4:30 pm		