CIVENG 3B03 Geotechnical Engineering II
Winter 2020

Session

**Term II:** Monday, January 06 – Tuesday, April 07

Instructor

**Dr. SeonHong Na**
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Contact: seonhong@mcmaster (ext. 21720)
Office hours: By appointment

Teaching Assistants

Kianoosh Koocheki: koochekk@mcmaster.ca
Ehsan Motevali Haghighi: motevale@mcmaster.ca

Class Schedule

**Lectures:** Thursday, 11:30-13:20 (BSB B135)
**Tutorials:** Tuesday, 08:30-10:20 (ABB 271)
             Tuesday, 14:30-16:20 (T13 125)
**Labs:**    Wednesday, 14:30-17:20 (JHE 114)
             Friday, 11:30-14:20 (JHE 114)

Prerequisite

CIVENG 3A03 Geotechnical Engineering I

Course Objectives

Geotechnical Engineering is the subdiscipline that deals with the physical and mechanical properties (or behavior) of geological materials, as well as with their interaction with engineered structures. A geotechnical engineer is normally involved in the analysis, design and construction of foundations for structures, earth and rock dams, embankments, tunnels and underground structures, highways, railways, airfields, bridge abutments and pier foundations etc. Geotechnical Engineers often also get involved in geoenvironmental problems dealing with underground contamination and transport, as well as decommissioning of sites and remediation.

The purpose of this course is to develop a good understanding of the mechanics of soil behavior under various natural and imposed loading conditions. With the knowledge of soil properties introduced in the prerequisite course (CIVENG 3A03), this course focuses on the strength of idealized soil elements from which the behavior of large soil masses may be
inferred. The basic concepts are then applied to the design and analysis of geotechnical structures (including shallow foundations and earth retaining structures) as well as the analysis of slope stability. To complement the theoretical studies, students will be given opportunity to carry out standard laboratory tests on various soils to explore soil strength in details.

**Teaching Method**

The topics in this course will be presented using a traditional lecture format. Students are expected to attend lectures to ensure that they appreciate what material is considered to be most important. Tutorials will be used to present examples and case histories, or review materials that the students should already be familiar with. Assignments are intended to help consolidate the understanding of material presented in lectures as well as extend concepts covered in lectures.

**Textbook**


**Additional Readings**


**CEAB (Canadian Engineering Accreditation Board) Attributes and Indicators**

Through this course you will develop the following attributes and indicators:

- **Attribute 1. Knowledge**
  - Indicator 1.4: Competence in specialized engineering knowledge
- **Attribute 2. Analysis**
  - Indicator 2.3: Ability to obtain substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions
- **Attribute 4. Design**
  - Indicator 4.1: Recognizes and follows an engineering design process
  - Indicator 4.2: Recognizes and follows engineering design principles

**Learning Outcomes**

When you have successfully completed this course, you will be able to:

- explain basic soil mechanics principles including phase relationships, soil classification and description, effective stress, pore pressure, and consolidation [CEAB Indicator 1.4]
- define principal stresses, stress invariants, and stress paths; draw Mohr’s circle to determine stress state in soils [CEAB Indicator 1.4]
• determine the stress state at failure state associated with Mohr-Coulomb failure criteria [CEAB Indicator 1.4]
• interpret the results of conventional lab tests and use them to evaluate shear strength parameters [CEAB Indicator 1.4]
• investigate the bearing capacity and settlement of shallow foundations (immediate and primary consolidation) [CEAB Indicators 2.3, 4.2]
• illustrate the design procedure of shallow foundations and retaining structures using the field test results [CEAB Indicators 4.1, 4.2]
• explain the concept of active and passive earth pressures to analyze and design earth retaining structures [CEAB Indicators 2.3, 4.2]
• perform stability analysis for embankments and natural slopes [CEAB Indicators 2.3, 4.2]

Assessment of Learning

1. Assignments: 10 %
2. Laboratories: 15 % (Group Submission)
3. Quizzes: 10 % (Will check attendance)
4. Mid-term Test: 20 % (Tentatively on Tuesday, February 25)
5. Final Exam: 45 %

* Assignments must be handed in on time.
* Laboratory experiments are mandatory to pass this course. Each individual is required to participate in a total of 4 lab experiments (direct shear test, unconfined compression test, vacuum triaxial test, and unconsolidated-undrained triaxial test) during the term. The experiments are normally performed in groups of four in two lab sessions. They will take place in JHE 114 (the soil mechanics lab. On the ground floor of the building). Students have one week to write lab reports, which must be submitted by 5:00 pm, the same day of the week following the completion of the experiments. Extensions on due dates for labs will be granted only under exceptional circumstances.
* Pop-up Quizzes will be held during the lectures or tutorial sessions.
* Mid-term test will be 2 hours during the time allocated for the tutorial. No books or other aids will be allowed, except for the Standard McMaster calculation. Examination paper will be provided.

Tutorials

Attendance at tutorials is mandatory. Students will generally be assigned problems that, in some cases, are to be completed during the tutorial session. The teaching assistants and/or instructor will be available during the tutorial period to answer questions concerning assignments, labs, etc. Students are required to bring textbook, notes, papers, drawing instruments, calculates, etc.
Course Topics (Tentative)

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<thead>
<tr>
<th>Schedule</th>
<th>Topic</th>
<th>Textbook</th>
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<tr>
<td>Week 1</td>
<td>Introduction to soil mechanics and foundation engineering; Review of basic soil properties</td>
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<td>Week 2</td>
<td>Stresses in soil; Mohr-circle</td>
<td>Ch. 7, 8</td>
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<td>Week 3</td>
<td>Failure and shear strength of soil; Failure criterion; Laboratory tests to determine shear strength parameters</td>
<td>Ch. 10</td>
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<td>Week 4</td>
<td>Interpretation of shear strength of soils; Concept of stress path and stress invariants; Field tests and empirical relations for shear strengths</td>
<td>Ch. 8, 10</td>
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<td>Week 5</td>
<td>Bearing capacity of soils for shallow foundations I</td>
<td>Ch. 12</td>
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<td>Week 6</td>
<td>Bearing capacity of soils for shallow foundations II</td>
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<td>Week 7</td>
<td>Settlement of shallow foundations</td>
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<td>Week 8</td>
<td>Introduction to earth pressure – Rankine theory</td>
<td>Ch. 15</td>
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<td>Week 9</td>
<td>Earth pressure – Coulomb theory</td>
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<td>Week 10</td>
<td>Retaining structures – design considerations</td>
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<td>Week 11</td>
<td>Slope stability analysis I</td>
<td>Ch. 16</td>
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<td>Week 12</td>
<td>Slope stability analysis II</td>
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<td>Week 13</td>
<td>Final Review</td>
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University Statement of Changes of the Course

The instructor and McMaster University reserves the right to change or revise information contained in course outlines in extreme circumstances. If a modification becomes necessary, reasonable notice and communication with the students will be given with an explanation and the opportunity to comment on changes. It is the responsibility of students to check regularly their primary email account via their@mcmaster.ca alias and course website.

Health and Safety

The Faculty of Engineering is committed to McMaster’s University Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs”.

It is your responsibility to understand McMaster University workplace and environmental health and safety programs and policies. For information on these programs and policies please refer to McMaster University Environmental & Occupational Health Support Services at [http://www.workingatmcmaster.ca/eohss/](http://www.workingatmcmaster.ca/eohss/)

It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for some of the experiments and the laboratory equipment.
Laboratory Safety

The Faculty of Engineering is committed to McMaster University's Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs". It is your responsibility to understand McMaster University Workplace and Environmental Health and Safety programs and policies. For information on these programs and policies please refer to McMaster University Environmental and Health Support Services Occupational Safety Risk Management Manual at:
It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for some of the experiments and the laboratory equipment.

Communications

It is the student’s responsibility to:
- maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- use the University provided e-mail address or maintain a valid forwarding e-mail address.
- regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their "@mcmaster.ca" alias.
- accept that forwarded e-mails may be lost and that e-mail is considered received if sent via student's @mcmaster.ca alias.
- check the McMaster/Avenue email and course websites on a regular basis during the term.

Academic Integrity

You are required to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at: www.mcmaster.ca/academicintegrity.

The following illustrates only three forms of academic dishonesty:
- Plagiarism, e.g., the submission of work that is not one’s own or for which other credit has been obtained.
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations.
Protection of Privacy Act (FIPPA)

The Freedom of Information and Protection of Privacy Act (FIPPA) applies to universities. Instructors should take care to protect student names, student numbers, grades and all other personal information at all times. For example, the submission and return of assignments and the posting of grades must be done in a manner that ensures confidentiality - see http://www.mcmaster.ca/univsec/fippa/fippa.cfm

Academic Accommodations of Students with Disabilities Policy

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) https://sas.mcmaster.ca/ to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's https://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicAccommodation-StudentsWithDisabilities.pdf

Academic Accommodation for Religious, Indigenous or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Requests for Relief for Missed Academic Term Work – MSAF

The McMaster Student Absence Form is a self-reporting tool for Undergraduate Students to report absences that last up to 5 days and provides the ability to request accommodation for any missed academic work. Please note, this tool cannot be used during any final examination period. You may submit a maximum of 1 Academic Work Missed requests per term. It is YOUR responsibility to follow up with your Instructor immediately regarding the nature of the accommodation. If you are absent more than 5 days or exceed 1 request per term you MUST visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation. This form should be filled out immediately when you are about to return to class after your absence. http://www.mcmaster.ca/msaf/

In any cases, you can contact Academic Advisor (Darlene Hayward, JHE H301, Ext. 24646, dhayward@mcmaster.ca) and get useful information.
Anti-Discrimination

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.


Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.