

COURSE INFORMATION

Course Name: Geotechnical Engineering II

Course Code: CIVENG 3B03

Session Offered: Winter 2021

Calendar Description: Shear strength characteristics and failure criteria for soils; direct shear, triaxial, plane strain and field tests; earth pressure theory; bearing capacity theory; slope stability and embankment analysis.

Instructor(s): Miah Alam, P.Eng.

Email: alamm43@mcmaster.ca

Office Hours/Contact (Virtual): Friday 2:30 PM to 4:30PM, (or by appointment)

Teaching Assistants:

Amir Arsalan Jameei (email: jameeia@mcmaster.ca)

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Class Schedule Day(s): **Lectures:** Wednesday, Time: 09:30 AM-11:20 AM Location: Virtual

Tutorials: Monday, Time: 10:30 AM-12:20 PM

Thursday, Time: 09:30 AM-11:20 AM

Labs: Monday, Time: 02:30 PM-05:20 PM

Tuesday, Time: 08:30 AM-11:20 AM

Prerequisite Course: CIVENG 3A03 Geotechnical Engineering I

1. COURSE OBJECTIVES

Soil and rock are still one of the most important construction materials used in natural state. All civil engineering works (buildings, bridges, roads, airfields, tunnels, landfills, reservoirs, pumping stations, etc.) are founded on or built in geo-materials (soil and/or rock). The stability and safety of engineering structures depend upon the characteristics and behaviour of various types of soil and rock. 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.

The purpose of this course is to develop a good understanding of the current theories of soil mechanics and geotechnical engineering. This course focuses on the shear strength characteristics of soil elements, plane strain, earth pressure theories, earth retaining system, slope stability in embankment and excavation safety. After successfully completion of the course, student can able to handle analysis parameters for the design of foundation for different type of structures, selection of earth retaining structure, slope stability related problem and excavation construction safety. To complement the theoretical studies, students will be given the opportunity to carry out standard laboratory tests on various soils to explore strength.

2. COURSE SPECIFIC POLICIES

Textbook

Budhu, M. 2010. Soil Mechanics and Foundations, 3rd edition, John Wiley & Sons.

Additional Readings: (on demand)

1. Canadian Geotechnical Society, 2006, Canadian Foundation Engineering Manual (CFEM). 4th edition ed. Vancouver
2. National Building Code of Canada (NBCC), 2015, Commentary K(Foundation). Ottawa, Ontario: National Research Council Canada.
3. Occupational Health and Safety Act. (OHS) of Ontario, Excavation Hazards, Part III, Excavations, O. Reg. 213/91.
4. Atkinson, J.H. 1993. An Introduction to The Mechanics of Soils and Foundations, McGRAW-HILL International (UK) Limited.

3. SCHEDULE

WEEK 1	Introduction to soil mechanics and foundation engineering; Review of basic soil properties.	
WEEK 2	Stresses in soil; Mohr-circle (Budhu Ch. 7,8)	Assignment #1
WEEK 3	Failure and shear strength of soil; Failure criterion; Laboratory tests for shear strength parameters (Budhu Ch.10)	Quiz #1
WEEK 4	Concept of stress path and invariants; Field tests and empirical relations for shear strengths (Budhu Ch. 8, 10)	Assignment #2
WEEK 5	Bearing capacity of soils for shallow foundations (Budhu Ch.12)	Quiz #2
WEEK 6	Midterm Recess / Midterm break/ Winter break	
WEEK 7	Settlement of shallow foundations (Budhu Ch.12)	
WEEK 8	Introduction to earth pressure – Rankin Theory, Coulomb theory, (Budhu Ch.15)	Assignment #3
WEEK 9	Excavation Hazards and safety (OHS) of Ontario and lecture notes)	Quiz # 3
WEEK 10	Apparent earth pressure theories of braced retaining structure, (CFEM ch.26 and lecture notes), Introduction to Canadian Building Code and Foundation Manuals,	
WEEK 11	Retaining structures – design considerations and selection (CFEM ch.26 and lecture notes) (Budhu Ch.15)	Group Assignment
WEEK 12	Slope stability analysis (Budhu Ch.16)	
WEEK 13	Final review	
FINAL EXAMINATION	Scheduled during the regular University Final Examination period established by the Registrar's Office	

4. ASSESSMENT OF LEARNING

WEIGHT %

Assignments (3 assignments)	15 %
Laboratory experiments and reports (4 labs) (Group submission)	20 %

Quizzes (3 quizzes) (Will check attendance)	15 %
Group assignment (1 assignment) (Group submission)	15%
Final Exam (Open Book)	35 %

- **Assignments**

Due dates will be indicated on each assignment. Assignments are to be submitted on time. Group assignment task will be a critical thinking related to professional work and need to be teamwork submission. Assignments that are submitted late will be docked 10% per day.

- **Laboratory experiments**

Laboratory experiments are mandatory to pass to 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 (Check your lab schedule posted on Avenue). The experiments are normally performed in groups of four in two lab sessions. The labs will take place in virtual. 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.

- **Quizzes**

Quizzes will be held during the lectures or tutorial sessions.

- **Tutorials**

Attendance at tutorials is mandatory. Students will generally be assigned problems that, in some cases, are to be completed during the tutorial session. All the assignments and the term test will be reviewed during tutorials. The teaching assistants and/or instructor will be available during the tutorial period to answer questions regarding assignments, labs, etc. Students are required to bring textbook, notes, papers, drawing instruments, calculators, etc.

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 materials are 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.

Website: Students are required to check Avenue regularly. Avenue to Learn (<http://avenue.mcmaster.ca>).

5. LEARNING OUTCOMES

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

- understand basic soil mechanics principles including soil strength characteristics, [CEAB attribute 1.4]
- define principal stresses and stress path [CEAB attribute 1.4]
- determine failure state associate with Mohr-Coulomb failure criteria [CEAB attribute 1.4]
- interpret the results of conventional lab test and handle them to evaluate shear strength parameters [CEAB attribute 1.4]
- investigate the bearing capacity of the of shallow foundations [CEAB attributes 2.3, 4.2]
- explain the concept of active and passive earth pressure [CEAB attribute 1.4]
- select the appropriate earth retaining system [CEAB attributes 2.3, 4.2]
- apply knowledge of code, manuals and regulations [CEAB attribute 5.2]
- recognize excavation hazards and safety [CEAB attribute 8.1]

- perform stability analysis for embankments and natural slopes [CEAB attributes 2.3, 4.2]

CEAB (Canadian Engineering Accreditation Board) Attributes and Indicators

Through this course you will develop the following attributes:

- CEAB attribute 1.4: “Competence in specialized engineering knowledge”
- CEAB attribute 2.3: “Ability to obtain substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions”
- CEAB attribute 4.1: “Recognizes and follows an engineering design process”
- CEAB attribute 4.2: “Recognizes and follows engineering design principles”
- CEAB attribute 5.2: “Ability to create, adapt, modify and extend tools and techniques to solve problems”
- CEAB attribute 8.1: “Demonstrates an understanding of the roles of the engineer in society, especially in protection of public and public interest”

6. 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 the student’s @mcmaster.ca alias.
- Check the McMaster/Avenue email and course websites on a regular basis during the term.

7. POLICIES

ACADEMIC INTEGRITY

You are expected 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. **It is your responsibility to understand what constitutes academic dishonesty.**

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. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>.

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.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the “Code”). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students’ access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact [Student Accessibility Services](#) (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

[McMaster Student Absence Form \(MSAF\)](#): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”.

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.

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 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.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

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>.

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.

https://www.mcmaster.ca/policy/General/HR/Discrimination_and_Harassment.pdf

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.

8. MCMASTER GRADING SCALE

Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49