

COURSE INFORMATION

Course Name: Geotechnical Engineering II

Course Code: CIVENG 3B03

Session Offered: Term 2 – Winter 2023

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: SeonHong Na, Ph.D., P.Eng.

Phone: ext. 21720

Email: nas1@mcmaster.ca

Office Hours/Contact: TBA

Class Schedule Day(s):	Time:	Location: Virtual
Lecture: Friday	12:30 PM – 02:20 PM	HH109
Tutorial 1: Thursday	10:30 AM – 12:20 PM	BSB 108
Tutorial 2: Monday	12:30 PM – 02:20 PM	ABB 271
Lab. 1: Thursday	02:30 PM – 05:20 PM	JHE 114
Lab. 2: Tuesday	02:30 PM – 05:20 PM	JHE 114

1. COURSE OBJECTIVES

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

Website

Avenue to Learn (<http://avenue.mcmaster.ca>). Students are required to check A2L regularly.

Textbook

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

Additional Readings: (on demand)

1. J. Knappett and R.F. Craig, 2012, Craig's Soil Mechanics (9th Edition), CRC Press
2. Canadian Geotechnical Society, 2006, Canadian Foundation Engineering Manual (CFEM). 4th Ed.

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)	
WEEK 5	Bearing capacity of soils for shallow foundations (Budhu Ch.12)	Assignment #2
WEEK 6	Settlement of shallow foundations (Budhu Ch.12)	Quiz #2
WEEK 7	Midterm Recess	
WEEK 8	Slope stability analysis - I (Budhu Ch.16)	Assignment #3
WEEK 9	Slope stability analysis - II (Budhu Ch.16)	Term Test
WEEK 10	Introduction to earth pressure – Rankin Theory, Coulomb theory, (Budhu Ch.15)	Group Assignment
WEEK 11	Retaining structures – design considerations and selection (CFEM ch.26 and lecture notes) (Budhu Ch.15)	
WEEK 12	Excavation Hazards and safety (OHSA. of Ontario and lecture notes), Introduction to Canadian Building Code and Foundation Manuals	Quiz #3
WEEK 13	Final review	
FINAL EXAMINATION	Scheduled during the regular University Final Examination period established by the Registrar's Office	

This schedule is provided as a guide and can be changed depending upon the pace of lectures.

4. ASSESSMENT OF LEARNING	WEIGHT %
Assignment (3 assignments)	15
Group Assignment (1 assignment)	10
Laboratory experiments and reports (4 labs)	20
Quiz (3 quizzes)	15
Term Test (1 test)	15
Final Exam	25

This is tentative and can be changed by the instructor.

- **Assignments**

Due dates will be indicated on each assignment. Assignments are to be submitted on time. Group assignment task will be critical thinking related to professional work and need teamwork submission. Assignments that are submitted late will be docked 10% per day. If a student submits MSAF and is accepted, the percentage will be added to the final exam. Only partial solutions (or answers) will be posted on Avenue. However, all assignments will be reviewed during tutorials.

- **Laboratory experiments**

This is mandatory to pass this course. Everyone 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 typically performed in groups of four in two lab sessions. 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. Note that the lab sessions can be replaced by other materials depending on the situation.

- **Term test**

The term test will be held during the lecture or tutorial session, and the date and guidelines will be announced via A2L. It is your responsibility to make yourself available for the term test. There will be no make-up test. If the term test is missed due to illness, please contact Academic Advisor (Darlene Hayward, JHE H301, Ext. 24646, dhayward@mcmaster.ca) for accommodation request. If such a request is approved, the weight of the missed term test will be added to the final exam.

- **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 must bring textbooks, notes, papers, drawing instruments, calculators, etc.

- **Quizzes**

Quizzes will be held during the lectures or tutorial sessions. Or Quizzes can be scheduled other time slots virtually. Conceptual and straightforward questions will be asked. If an MSAF is accepted for a Quiz, then the weight of the quiz will be added to the final exam.

5. LEARNING OUTCOMES

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

- understand basic soil mechanics principles including soil strength characteristics
- define principal stresses and stress path
- determine failure state associate with Mohr-Coulomb failure criteria
- interpret the results of conventional lab test and handle them to evaluate shear strength parameters
- investigate the bearing capacity and settlement of shallow foundations (immediate and primary consolidation)
- illustrate the design procedure of shallow foundations and retaining structures using the field test results
- perform stability analysis for embankments and natural slopes
- explain the concept of active and passive earth pressures to analyze and design earth retaining structures

CEAB (Canadian Engineering Accreditation Board) Attributes and Indicators

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

- Attribute 1. Knowledge base for engineering
 - Indicator 1.1: Competence in Mathematics
 - Indicator 1.4: Competence in Specialized Engineering Knowledge

- Attribute 3. Investigation
 - Indicator 3.1: Selects appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies
 - Indicator 3.2: Synthesizes the results of an investigation to reach valid conclusions

6. 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 and policies". It is your responsibility to understand McMaster University's Risk Management system, which is supported by a collection of Risk Management Manuals (RMMs) that contain programs and policies in support of the Risk Management System. The RMMs are available from https://hr.mcmaster.ca/employees/health_safety_well-being/our-safety/risk-management-manuals-rmms/.

It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for specific experiments (see course lab manuals) and the laboratory equipment https://www.eng.mcmaster.ca/sites/default/files/civil_lab_health_and_safety_manual.pdf

Additionally, McMaster University's workplace health and safety guidance related to COVID-19 must always be followed (available from <https://hr.mcmaster.ca/resources/covid19/workplace-health-and-safety-guidance-during-covid-19/>).

The safety requirements for JHE 114 are listed below. Students not abiding by these safety requirements will be given one warning. Second offences will result in the student being asked to vacate the laboratory and receiving a grade of zero for that particular lab.

- Glasses or safety glasses/goggles must be worn in the lab at all times.
- Contact lenses are not to be worn in the lab.
- No short (i.e., above the knee) pants or skirts are permitted in the lab – lab coats must be worn over top of your clothing in these instances.
- Closed-toe shoes must be worn at all times.
- No loose clothing is allowed.
- Long hair must be tied back.
- Disposable latex or nitrile gloves must be worn when working with hazardous chemicals.
- Heat resistant gloves must be worn when removing hot items from the drying oven (as indicated by the laboratory instructor).
- Dust masks must be worn (as indicated by the laboratory instructor).
- Hearing protection must be worn (as indicated by the laboratory instructor).

7. 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.

8. 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.

9. 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