CIV E 690 Advanced Foundation Engineering

Winter 2025 - January 06 to April 09

Class time: Tuesday, Thursday 8:00-9:20 Location: GSB 2-11

Instructor:

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Donadeo Innovation Centre For Engineering 6-261
Office Hours: By appointment or walk-in

Course Description:

*4 (fi) (either term, 3-1S-1) Theories of lateral pressures. Limit equilibrium methods, elasticity methods, semi-empirical methods. Soil anchors. Design of retaining walls and strutted excavations. Bearing capacity of shallow and deep foundations. Allowable settlement of structures. Analysis of settlement of shallow and deep foundations. Behavior of pile groups. Design problems in foundation engineering

Prerequisites: Civil Engineering, Geological Engineering, or other Engineering disciplines as approved by instructor

Course synchronous and asynchronous content delivery schedule:

Land Acknowledgment:

The University of Alberta acknowledges that we are located on Treaty 6 territory, and respects the histories, languages, and cultures of First Nations, Métis, Inuit, and all First Peoples of Canada, whose presence continues to enrich our vibrant community.

Lab Sections:

Section	Day	Time	Location
LAB H01	2025-02-12	14:00 - 16:50	NREF L1-120

Seminar Sections:

Section	Day	Time	Location
SEM J01	Wednesday weekly	12:00 - 13:00	See announcements

Course Objectives & General Content:

Upon completion of the course, students shall be familiar with the fundamental principles and practice of classic geotechnical engineering. Students shall be able to design shallow foundations and deep foundations following the concept of limit state design in Canada. Students shall know about lateral pressure theories and design retaining structures and anchoring systems. Students shall be familiar with geosynthetics and be able to conduct preliminary design of earth structures modified by geosynthetics. Students will be familiar with the design manual in Canada and possess a strong technical writing skill.

Learning Outcomes:

By the end of this course, students should be able to:

1. Shallow foundation design, effects of cold regions and climate change, ground improvement method
2. Pile foundation design for axial performance, laterally loaded piles, frost action
3. Rankine's earth pressure theory, Coulomb's earth pressure theory, cantilever wall, apparent earth pressure and excavation support, ground anchor shoring systems
4. Principle and design of mechanically stabilized earth wall, reinforced soil slope, geosynthetics for drainage and filtration

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Five mini-project reports, one lab report	Synchronous	Various	30%
Midterm Exam	Synchronous	in class	30%
Final Exam	Synchronous		40%

The deferred exam for this course will be held on May 10, 2025 or May 17, 2025.

The Faculty recommended grade point average for a 600 level course is 3.3.Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Calculator Policy

Only approved non-programmable calculators are permitted in examinations. Any calculator taken into an examination must have a sticker identifying it as an acceptable non-programmable calculator (gold sticker). Students can purchase calculators at the University Bookstore with the stickers already affixed. Calculators purchased elsewhere can be brought to the Student Services where the appropriate sticker will be affixed to the calculator.

Expectations for AI use

In this course, our primary focus is to cultivate an equitable, inclusive, and accessible learning community that emphasizes individual critical thinking and problem-solving skills. To ensure a fair and consistent learning experience for all students, the use of advanced AI tools such as ChatGPT or Dall-E 2 is strictly prohibited for all academic (written/coding/creative/etc.) work, assignments, and assessments in this course. Each student is expected to complete all tasks without substantive assistance from others, including AI tools.

Any use of AI tool in your academic work may result in academic penalties and be considered an act of cheating and a violation as outlined in the relevant sections of University of Alberta (November 2022) Code of Student Behaviour .

Text and References (Mandatory):

Handout notes

Text and References (Recommended):

The Engineering of Foundations, Salgado, R., 2008, McGraw-Hill
Foundation Analysis and Design, Bowles, J., 5th Edition, 1995, McGraw-Hill
Canadian Foundation Engineering Manual, 5th Edition, 2023 (digitally available via UofA library)

Website:

Canvas

Previous Examples of Evaluative Materials:

Sample exams will be available.

Lab Information:

Lab Topic	Date
Lab 1: Model foundation tests	2025-02-12

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

CIVE 690 Course agenda (subject to adjustment)

1. Introduction (3 lectures)

- Genesis of soils
- Principle of limit state and working stress design
- Geotechnical site investigation reporting
- Review of CPT and SPT practice

2. Shallow Foundations (5 lectures)

- Bearing capacities
- Bearing capacities from in-situ tests
- Foundation settlement
- Settlement from in-situ tests
- Frost heave and frost depth
- Ground improvement methods

3. Deep Foundations (8 lectures)

- Pile types and classification
- Pile capacities from analytical methods
- Pile capacities from in-situ tests
- Negative skin friction
- Piles in rock
- Frost action on piles
- Pile group capacity
- Settlement of single pile and pile group
- Introduction to pile dynamic analyses
- Laterally loaded piles – principles and OpenSees computer simulations
- Integrity of concrete piles
- Case study: design and verification of H-piles

Midterm: In-class, 80 min

4. Earth pressure and retaining structures (6 lectures)

- Classification of retaining structures
- Rankine's earth pressure
- Coulomb's earth pressure
- Design of cantilever retaining wall
- Apparent earth pressure and excavation support
- Design of ground anchors

5. Geosynthetics (3 lectures)

- Classification and functions of geosynthetics
- Properties of geosynthetics materials
- Testing of geosynthetics
- Principle and design of mechanically stabilization earth wall
- Reinforced soil slope and embankment
- Case study: RSS failure
- Embankment on soft ground
- Drainage and filtration

As an *optional* activity of experiential learning component, a 3-hour field demonstration of geotechnical site investigation practice such as CPT, SPT or pressuremeter may be offered to students, pending on negotiation with contractors.