

22023-2024 Winter

# Advanced Foundation Engineering

Department of Civil and Environmental Engineering

CIVE 5501

## Teaching Team

### Instructor:

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## Course Description and requirements

### 1) Course schedule

\*Please refer to the [Public Class Schedule](#) for the most recent information

### 2) Course description

**Description:** Review of methods of estimating compression and shear strength of soils. Bearing capacity and performance of shallow and deep foundations, pile groups, and use of in-situ testing for design purposes.

**Objectives:** To develop understanding of the concepts, theories, and procedures of design for different types of foundations under static loadings.

### 2) Accreditation Units

Math	Natural Science	Complementary Studies	Engineering Science	Engineering Design
-	-	-	25%	75%

### 8) Text book(s)/References

- Coduto, D., *Foundation Design: Principles and Practices*, Prentice-Hall.
- Bowles, J., *Foundation Analysis and Design*, Fifth edition.
- Das, B.M., *Principles of Foundation Engineering*, Seventh edition.
- Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition, BiTech Publishers, 2007

### 9) Topics and tentative plan

#### Subsoil Exploration:

- Subsoil exploration program
- Exploratory borings in the field
- Procedures for sampling soil, and observation of water tables
- In-situ estimating compression and shear strength of soils

- Geophysical exploration
- Interpretation of soil parameters for foundation design

#### **Shallow Foundations:**

- Introduction
- Ultimate Bearing Capacity of Shallow Foundations
  - Bearing capacity of non-uniform materials
  - Bearing capacity from correlation with SPT and CPT values
- Settlement of Shallow Foundations
  - 1D settlement theory
  - 3D settlement and elastic displacement theory
  - Evaluation of soil parameters
- Mat Foundations
  - Common types of mat foundations
  - Bearing capacity of mat foundations
  - Settlement of mat foundations

#### **Deep Foundations:**

- Introduction
  - Load transfer mechanism in piles
  - Effect of method of installation on pile performance
  - Group effect in piles
  - Load test on piles
  - Pile types and pile materials, Piling Equipment and Installation
- Analysis and Design of Pile Foundations for Vertical Loads
  - Bearing capacity of single piles and pile groups
  - Settlement of single piles and pile groups
  - Design procedure for piles
  - Pullout capacity of piles
- Analysis and Design of Pile Foundations for Lateral Loads
  - Ultimate lateral resistance of single piles and pile groups
  - Lateral deflection of single piles and pile groups
  - Design procedure for piles
  - Vertical piles subjected to eccentric and inclined loads
  - Limit state Analysis for pile foundation design

### **10) Evaluation and marking scheme**

#### **a) Final Examination**

- i) **Final exams are for evaluation purpose and will not be returned to students.**
- ii) Exam Conditions: Closed book
- iii) Final Exam Weight: 60%

ii) Deferred Final Examinations: Students who are unable to write the final examination because of a serious illness/emergency or other circumstance beyond their control may apply for accommodation by contacting the Registrar's office. Consult the [Section 4.3 of the University Calendar](#).

- b) **Project (20%):** A design project will be assigned or critical review of some technical papers will be required.
- c) **Assignments (20%):** problems will be assigned and the solutions will be submitted towards the end of the term.
- d) **Self-Declaration form and deferred term work**

Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases. This must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult [Section 4.4 of the University Calendar](#).

## 11) Academic dates

Students should be aware of the academic dates (eg. last day for academic withdrawal) posted on the Registrar's office web site <https://carleton.ca/registrar/registration/dates/academic-dates/>

## Academic Integrity and Plagiarism

- a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: <https://carleton.ca/engineering-design/current-students/fed-academic-integrity> Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.
- b) One of the main objectives of the Academic Integrity Policy is to ensure that **the work you submit is your own**. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.” This includes reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:

- any submission prepared in whole or in part, by someone else;
- using another’s data or research findings without appropriate acknowledgement;

- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
- failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks.

## Copyright

The materials (including the course outline and any slides, posted notes, videos, labs, project, assignments, quizzes, exams and solutions) created for this course and posted on this web site are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).

## Learning and Working Environment

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at [equity@carleton.ca](mailto:equity@carleton.ca)

We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

## Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

**Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at **613-520-6608** or [pmc@carleton.ca](mailto:pmc@carleton.ca).

You should request your academic accommodations in the [Ventus Student Portal](#), for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm. Please consult the [PMC website](#) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

**Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to

students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF\)](#).

**Pregnancy Obligation:** Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF\)](#).

**Religious Obligation:** Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF\)](#).

**Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit the [Sexual Violence Prevention & Survivor Support](#).

## Engineering Academic Advising

The [Engineering Academic Support Service](#) assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation.

Academic Advisors Contact can be found here: <https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/>.

## Student Mental Health and Wellness

As a university student you may experience a range of mental health challenges that can significantly impact your academic success and overall well-being. Carleton's [Wellness Services Navigator](#) is designed to help students connect with mental health and wellness resources.

If you need to talk to someone from the department for more information and support with connecting to resources, you can contact the following faculty members, depending on your program. Or contact the department at [orCEEUGChair@cunet.carleton.ca](mailto:orCEEUGChair@cunet.carleton.ca).

**ACSE:** Prof. [Scott Bucking](#)

Email: [scott.bucking@carleton.ca](mailto:scott.bucking@carleton.ca), Office: 5209 Canal Building

**CIVE:** Prof. [Heng Khoo](#)

Email: [heng.khoo@carleton.ca](mailto:heng.khoo@carleton.ca), Office: 3364 Mackenzie

**ENVE:** Prof. [Shoeleh Shams](#)

Email: [shoeleh.shams@Carleton.ca](mailto:shoeleh.shams@Carleton.ca), Office: 4242 Mackenzie

Here is a list of on-campus and off-campus recourses:

1. **Carleton's Wellness Desk:** Located at 204A MacOdrum Library, is a space for students to learn about resources, connect with our Wellness Coordinator, and decompress during stressful times of the year. You can pop into the Wellness Desk any time during its hours of operation – no appointments necessary! <https://wellness.carleton.ca/mental-health/wellness-desk/>
2. **Carleton's Health and Counselling Services:** To book an appointment contact the main clinic by calling (613) 520-6674. If urgent, let the Patient Care Coordinator know or go in person to the main clinic (2500 Carleton Technology and Training Centre Building) and indicate that they are in crisis and need to speak to someone right away. For more information, please see <https://carleton.ca/health/>
3. [Emergencies and Crisis](#) and [Emergency Numbers](#)
4. **Good2Talk (1-866-925-5454):** Good2Talk is a free, confidential helpline providing professional counselling and information and referrals for mental health, addictions and well-being to post-secondary students in Ontario, 24/7/36 <https://good2talk.ca/>
5. **Empower Me:** Undergraduate students have access to free counselling services in the community through Empower Me, either in person, by telephone, video-counselling or e-counselling. **This free service is accessible 24/7, 365 days per year.** Call **1-844-741-6389 (toll free)** to make an appointment with a counsellor in the community. More information is available <https://students.carleton.ca/services/empower-me-counselling-services/>
6. **The Walk-In Counselling Clinic (off-campus community resource):** The walk-in Counselling Clinic have offices in various locations across Ottawa and the greater Champlain region that are open 7 days a week. Individuals will be assisted, with no appointment, on a first-come, first-serve basis during the Walk-in Counselling Clinic hours. The Walk-in Counselling Clinic **offers services in many languages** and is free and confidential. More information can be found at: <https://walkincounselling.com/>
7. **Distress Centre of Ottawa and Region:** Available 10am-11pm, 7 days/week, 365 days/year. **Distress Line:** 613-238-3311, **Crisis Line:** 613-722-6914 or 1-866-996-0991, **Text:** 343-306-5550. <https://www.dcottawa.on.ca/>
8. **Distress and Crisis Ontario**, Available for chat 2 pm – 2 am EST. <https://www.dcontario.org/>
9. **BounceBack Ontario (Toll-Free: 1-866-345-0224)** is a free skill-building program managed by the Canadian Mental Health Association (CMHA). It is designed to help adults and youth 15+ manage low mood, mild to moderate depression and anxiety, stress or worry. Delivered over the phone with a coach and through online videos, you will get access to tools that will support you on your path to mental wellness. <https://bouncebackontario.ca/>.