

## **CIVE 5208 – Advanced Mechanics of Reinforced Concrete**

### **Course Outline**

(Winter 2023)

#### **1. Instructor**

Vahid Sadeghian, Ph.D., P.Eng.

Email: [Vahid.Sadeghian@Carleton.ca](mailto:Vahid.Sadeghian@Carleton.ca)

Office hours: TBA

#### **2. Lecture Schedule**

The course will be taught in-person on Tuesdays from 14:35 to 17:25 at 303 Southam Hall.

#### **3. Objectives**

The objective of this course is to adapt and apply principles of solid mechanics to the analysis of reinforced concrete, taking into account the nonlinear constitutive behaviour of the materials and other behaviour characteristics particular to reinforced concrete. Through this course students will:

- ✓ review various analytical approaches to modelling reinforced concrete.
- ✓ critically evaluate existing constitutive models and failure criteria.
- ✓ discuss methods of implementation and range of applicability.
- ✓ apply the reviewed methods to practical problems; performance assessment and forensic analyses.
- ✓ be introduced to some of the related state-of-the-art research studies.
- ✓ learn how to use a nonlinear finite element analysis software specifically developed for reinforced concrete.

#### **4. Course Topics (subjected to change)**

1. Introduction
2. Overview of Failure Criteria for Concrete
3. Analytical Models for Reinforced Concrete
4. Modified Compression Field Theory
5. Introduction to the VecTor2 Finite Element Analysis Program
6. Accounting for Prestrains (shrinkage, temperature, prestressing, etc.)

7. Disturbed Stress Field Model
8. Assessment and Forensic Analysis (time permitting)

## 5. Evaluation Method

Type	Percentage
Assignments	25%
Project	25%
Final Exam	50%

## 6. Prerequisites

1. CIVE 3206 (Design of Reinforced Concrete Components) or equivalent
2. CIVE 3202 (Mechanics of Solids II) or equivalent

## 7. Graduate Attributes

Engineering programs are accredited by the Canadian Engineering Accreditation Board (CEAB). As part of this process, we collect GA data to assess how effectively we are teaching or conveying the GAs with a goal to continually improve our programs. The GA data are aggregate data for a course and are NOT linked to student names or student numbers.

## 8. Final Examination

Final exams are for evaluation purpose and will not be returned to students. 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](#).

## 9. Academic Dates

Students should be aware of the academic dates posted on the Registrar's office web site <https://carleton.ca/registrar/registration/dates/academic-dates/>

## 10. 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.

## 11. Copyright

The materials created for this course and posted on the website 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).

## 12. 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. For final exams, the deadlines to request accommodations are published in the [University academic calendars](#) for both undergraduate and graduate students.

**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](#).

### 13. 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 department at [orCEEUGChair@cunet.carleton.ca](mailto:orCEEUGChair@cunet.carleton.ca).

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

1. **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/>

2. [Emergencies and Crisis](#) and [Emergency Numbers](#)
3. **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/>
4. **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/>
5. **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/>
6. **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/>
7. **Distress and Crisis Ontario, Available for chat 2 pm – 2 am EST.** <https://www.dcontario.org/>
8. 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/>.

#### 14. Special Information for Pandemic measures

1. It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are [a number of actions you can take](#) to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.
2. **Feeling sick?** Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come

to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's [symptom reporting protocols](#).

3. **Masks:** Carleton has paused the [COVID-19 Mask Policy](#), but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.
4. **Vaccines:** Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in [cuScreen](#) as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.
5. All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the [University's COVID-19 website](#) and review the [Frequently Asked Questions \(FAQs\)](#). Should you have additional questions after reviewing, please contact [covidinfo@carleton.ca](mailto:covidinfo@carleton.ca).