**Course Info:**

Meeting Times and Location: 6:05 – 8:55 pm T Azrieli Pavilion 132

Reference Books:


Course Webpage: The course materials will be available on Brightspace [https://brightspace.carleton.ca/](https://brightspace.carleton.ca/). Please follow the course web page for announcements, posted lectures, etc.

**Class Description:**

Introduction to conservation engineering; history of conservation and restoration; types of historic buildings and structural components; mechanical properties of commonly used construction materials in historic buildings; mechanics of unreinforced masonry walls and arches; seismic damage in historic buildings, repair and strengthening strategies.

Prerequisites: CIVE2200, CIVE2700

**Tentative Lecture Schedule:**

W1: Introduction to Conservation Engineering – Modern Approach in SAHC - ISCARSAH

W2: Mechanical Properties of Masonry

W3: Thrust Line Analysis and Arch Mechanics

W4: Limit Equilibrium Analysis of Masonry Buttresses

W5: Kinematic Limit Analysis (upper-bound theorem): Arches

W6: Kinematic Limit Analysis (upper-bound theorem): Pier-Spandrel and Complex Masonry Systems

W7: Masonry Wall Behavior-Part1 (Vertical Loads, Point Loads, Horizontal Loads (In-Plane Capacity)

W8: Masonry Wall Behavior-Part2 (Out-of-Plane Capacity)

W9: Masonry Buildings: Basic Concepts, Rigid and Flexible Floor Diaphragm
**W10:** Damage and Collapse Mechanisms of Masonry Buildings  
**W11:** Repair and Strengthening Applications in Masonry Buildings  
**W12:** Repair and Strengthening Applications in Masonry Buildings  
Presentations will be given by the experts and professional in the field of conservation engineering. Case studies and real-life problems will be thoroughly discussed

**Course Objectives**

- To learn the essential structural elements (such as arches, vaults, and walls) used in historic buildings.
- To learn material properties of brick and stone masonry and related binding materials (e.g., lime- or cement-base mortar).
- To learn limit analysis, lower and upper bound theorems to analyze masonry arch and arch-pier systems.
- To learn kinematic limit analyses and assess collapse mechanism of masonry buildings.
- To learn how to compute in and out-of-plane load carrying capacity of unreinforced load-bearing masonry walls and their associated damage mechanisms.
- To learn rigid and flexible floor diaphragm.
- To learn recent approaches in repairing and strengthening for historic masonry buildings

**Marking Scheme:**

Assignments (50%): Total 5 assignments.  
Final Exam (50%)

**Notes:**

* The instructor may modify the outline during the term as the course progresses.  
* Academic integrity is essential to the pursuit of learning and scholarship in a university. As a result, the University treats cases of cheating and plagiarism very seriously. Carleton University's Policy on Academic Integrity ([http://www.carleton.ca/registrar/academic-integrity](http://www.carleton.ca/registrar/academic-integrity)) outlines the behaviors that constitute academic dishonesty and the processes for addressing academic offences. It is your responsibility to be familiar with these policies. Any students who do not act with academic integrity will face severe consequences including immediate referral to Associate Dean of Student Affairs.  
* **Copyright on Materials:** The materials created for this course are intended for personal use and cannot be reproduced, redistributed, or posted on any website.  
* Graduate Attributes: The Canadian Engineering Accreditation Board (CEAB) requires the faculty to collect data on graduate attributes and use that data to improve our program. The aggregate data is used for accreditation purposes and to guide program improvements only, and have no impact on individual student progression or evaluation. Data is collected in many courses across the faculty.  
* Academic Accommodation: Students with diverse learning styles and needs are welcome in this course. You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows. For more information, please consult: [http://students.carleton.ca/course-outline](http://students.carleton.ca/course-outline)
Pregnancy Obligation: Please contact the 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 consult: http://students.carleton.ca/course-outline.

Religious Obligation: Please contact the 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 consult: http://students.carleton.ca/course-outline.

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 for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).