CARLETON UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
CIVE 5614 - DESIGN FOR FIRE RESISTANCE
COURSE OUTLINE – 2023 Fall

COURSE OBJECTIVES & LEARNING OUTCOME: Building codes set fire-resistance requirements for building assemblies to curtail both the spread of fire within buildings and the collapse of structural elements exposed to fire. Although the traditional method for assessing the fire resistance of building assemblies is by means of standard fire tests, recent years have witnessed the increasing use of mathematical modelling techniques.
This course is intended to provide the engineer with the basic knowledge required to design buildings for fire resistance. The student will be able to develop an understanding of the fire severity concept, to estimate time-temperature relationships for flashover fires, to perform the design of steel, concrete and wood building assemblies to resist fire exposure. As part of the structural fire design, material properties at elevated temperatures will also be discussed.
PREREQUISITE & RECOMMENDED KNOWLEDGE: Bachelor degree in Civil or Mechanical Engineering with knowledge of Steel, Concrete, and wood design.

INSTRUCTOR: Professor Ehab Zalok, Ph.D., P.Eng.
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Office Hours: by appointment

COURSE TOPICS & TENTATIVE PLAN:

Fire Safety in Buildings - Fire and Heat
Overview; Fire Safety Objectives; Process of Fire Development; Conceptual Framework for Fire Safety; Fire Resistance; Controlling Fire Spread; Building Construction for Fire Safety; Fuels; Combustion; Fire Initiation; Burning Objects; t-squared Fires; Pre-flashover Design Fires; Heat Transfer
Room Fires
Overview; Pre-flashover fires; Flashover; Post-flashover Fires; Design Fires; Other Factors
Fire Severity
Overview; Fire Severity and Fire Resistance; Fire Severity; Standard Fire; Equivalent Fire Severity
Fire Resistance
Overview; Fire Resistance; Assessing Fire Resistance; Fire-resistance Tests; Approved Fire-resistance Ratings; Fire Resistance by Calculation; Fire Resistance of Assemblies
Design of Structures Exposed to Fire
Overview; Structural Design at Normal Temperatures; Structural Design in Fire Conditions; Material Properties in Fire; Design of Individual Members Exposed to Fire; Design of Structural Assemblies Exposed to Fire
Steel Structures
Overview; Behaviour of Steel Structures in Fire; Fire-resistance Ratings; Steel Temperatures; Protection Systems; Mechanical Properties of Steel at Elevated Temperature; Design of Steel Members Exposed to Fire; Design of Steel Buildings Exposed to Fire
Concrete Structures
Overview; Behaviour of Concrete Structures in Fire; Fire-resistance Ratings; Concrete and Reinforcing Temperatures; Mechanical Properties of Concrete at Elevated Temperatures; Design of Concrete Members Exposed to Fire; Composite Steel-Concrete Construction Exposed to Fire
Timber Structures
Overview; Description of Timber Construction; Fire-resistance Ratings; Wood Temperatures; Mechanical Properties of Wood; Design Concepts for Heavy Timber Exposed to Fire; Design of Heavy Timber Members Exposed to Fire; Behaviour of Timber Connections in Fire

COURSE DELIVERY, EVALUATION & MARKING SCHEME:

In-class course where the instructor and students share information, ideas, and learning experiences.

- Lectures: Three hours a week
- Grading & Details:
  - Midterm (40%) closed book: Date/Time: Monday October 30th, during the class time
  - Final Examination (60%) closed book: Date/Time: Monday December 4th, during the class time
  - Students who score less than 33% during the term (term work) will be assigned the grade F, and,
  - A minimum percentage of 33% in the final exam is required to pass the course, and,
  - A minimum of 50% of term work plus final exam is required to pass the course.
  - The final examination is for evaluation purposes only, and the paper will not be returned or made available to students after it is marked.

COURSE WEBSITE AND COMMUNICATION

Course information will be available through Brightspace. Students are responsible for ensuring that they are correctly registered and that they are receiving messages properly through their official university email address.

RECOMMENDED REFERENCES:

- Buchanan, A.H., "Structural Design for Fire Safety" ISBN-10: 0470972890 | ISBN-13: 978-0470972892
- T.T. Lie, (Editor), Structural Fire Protection, American Society of Civil Engineers, Manuals and Reports on Engineering Practice No. 78, 1992.
- The SFPE Handbook of Fire Protection Engineering, 5th Edition, National Fire Protection Association, Quincy, MA, 2016. ISBN: 978-1-4939-2564-3

NOTE TO JOB SEEKERS AND GRADUATE STUDENTS

I can serve as a reference for you in your job search. The requirement for getting a reference letter is to achieve an 'A+' in the course. Letters of reference will be sent directly to employers or undersigned seal to you.

COURSE POLICIES

Email Policy: Emails must come from official Carleton University email addresses or through Brightspace. Problem analysis questions: Direct those to the Teaching Assistants (if applicable).

Appeals
All appeals for marks assigned in this course must be made within 7 days of the posting date.

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).

Extensions and Rewrites: In the interest of fairness for all students, requests for rewrites will only be granted for situations that are truly out of a student's control.

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 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 Accommodation: 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 .
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).

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You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www2.carleton.ca/equity/

Modified: September 11, 2023