Price Faculty of Engineering
Department of Biosystems Engineering

BIOE 4560, Structural Design in Wood

Winter 2025

Course Outline

Instructor
Dr. Farhoud Delijani, P.Eng.
(he/him/his)
E3–374 EITC
(204) 474–8613
Farhoud.Delijani@umanitoba.ca

Student Hours
- Open door policy
- Individual assistance is always available by appointment – stop by!

Teaching Assistant
- Eduardo Ferreira
  ferreire@myumanitoba.ca

Lecture Location
- EITC E2-165
  Tues 8:30 - 9:45 AM
  Thurs 8:30 - 9:45 AM

Lab/Tutorial Locations
- EITC E2-105
- Grain storage research lab, AgEng building
  Mondays 2:30-5:25 PM

Contact Hours
- 4 credit hours
- Lectures:
  37 hours
- Laboratories:
  24 hours

Prerequisites:
CIVL 3770 or BIOE 3590

Course Website:
http://umanitoba.ca/umlearn

Course Description

Design using wood as a structural material in light-frame buildings. Consideration of design constraints associated with sawn lumber as well as based composite materials. Emphasis on use of computer-based design aids.

Why is this course useful?

It has been commented on by many senior engineers that sometime within an engineer's career they will have to design something with wood. From a strictly pragmatic point of view, this course will provide the engineering student with at least the basics of wood design in preparation for this inevitable event. Although uncertain where credit should lie for the following statement —"If wood were discovered today, it would be considered a wonder material" — it essentially sums up an overall philosophy of the developers of this wood design course share.

Within any naturally occurring population there may exist variations on a central theme. Wood, a natural material, is no exception. Although the physical characteristics of a specific wood species may virtually be the same, anomalies exist. These anomalies, within any species group, will have an inherent impact on the material, shaping its structural performance and behaviour. It is the intent of the developers of this course, therefore, to assist students in developing a feel for the use of wood in structural design. Furthermore, the course will extend the understanding of the behaviour of discrete wood-member components to how this individual behaviour may affect a structural system.

As a noted researcher has put it, "Timber is as different from wood as concrete is different from cement" (Madsen, 1992). The developers of this wood-design course feel that it is of fundamental importance that participants gain an appreciation of how the natural structure of wood affects the behaviour of the engineering material we euphemistically call lumber.

Who should take this course?

This is a design/technical elective for students in the Biosystems and Civil Engineering program.

How this course fits into the curriculum

This course is intended for students in their senior year in Biosystems/Civil Engineering. This course will provide the student with the opportunity to gain an understanding of wood as an engineering material, the relationship between how a material reacts with its environment and how we as design engineers can integrate this knowledge into design. From a pragmatic point of view, we will also get an understanding of CSA O86 Engineering Design in Wood, the national standard for wood design in Canada.

Engineering-Related Objectives

By the end of the term, students will have the knowledge to design basic structures using dimensional lumber in compliance with the Canadian national code. It is also an objective of this course that students will gain a 'feel' for how wood behaves within a structure and the implications of design assumptions.

Topics covered

1. Introduction and Overview
2. Wood as an Engineering Material
3. Lumber Grading and Structural Wood Products
4. In Grade Testing and Limit States Design
5. Wood Frame Construction
6. Flexural Design Built Up Glulam and Notches

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 75%
- Engineering Design: 25%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and teamwork
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

Grading Scale

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Letter	Mark
A+	95-100
A	86-94.99
B+	80-85.99
B	73-79.99
C+	65-72.99
C	60-64.99
D	50-59.99
F	< 50

7. Design of Tension Members
8. Design of Compression Members
9. Combined Axial and Flexural Members
10. Connections
11. Shearwall and Diaphragms
12. Truss Design
13. Post Frame Buildings

Lab topics

1. Creep
2. Flexural member
3. 5ply beam
4. Plywood beam
5. Connections
6. Trusses
7. Site visits
8.

Textbook

Wood Design Manual – 2020, Canadian Wood Council (Available at https://webstore.cwc.ca/) (required and must be purchased immediately!).

Other reference materials (not required)

- National Building Code of Canada (latest edition), National Research Council of Canada, Ottawa
- Engineering Design in Wood (Limit States Design), CAN-CSA O86-19 Canadian Standards Association (already included in Wood Design Manual)
- Wood Reference Handbook, Canadian Wood Council
- Wood Building Technology (latest edition) Canadian Wood Council
- Reliability-Based Design of Wood Structures. 1989, Foschi, Folz, Yao. Structural Research Series, Report No.34. Dept. of Civil Engineering, Univ. British Columbia

Learning Outcomes

By the end of this course, you will be able to:

No.	Learning Outcome	Transferable Skill
1	Demonstrate an understanding of the Canadian standard for wood design CSA O86 for the design of wood structures	Design
2	Explain/demonstrate how a natural engineering material responds to load and how an understanding of the fundamental properties of wood informs design.	Design
3	Prepare reports that demonstrate an understanding of wood behavior from hands-on experience in the lab. Work in a team setting to complete an open-ended engineering design project.	Teamwork, Professionalism, design, written communication
4	Complete a set of calculations to evaluate the suitability of a wood component and/or system with regards to loads, serviceability, and constructability.	Design
5	Read a set of construction plans, determine the load on a structural component and evaluate if the component can carry the applied load and is in compliance with the code.	Design

Important Dates

- **Louis Riel Day**
  Feb. 17
  No classes or examinations
- **Winter term break**
  Feb. 18 - 21
- **Voluntary Withdrawal (VW)**
  Mar. 19
- **Good Friday**
  Apr. 18
  No classes or examinations
- **Last Day of Classes**
  Apr. 9
- **Examination and test dates**
  Apr. 11 - Apr. 25

CEAB Graduate Attributes Assessed

This course will assess the following CEAB graduate attribute indicators shown below:

Indicator (Level)	Indicator Description	Assessment Point
KB.4 (D)	Recalls and defines, and/or comprehends and applies, first principles and concepts in specialized engineering science	Term assignments and the mid-term exam
PA.3 (D)	Analyzes and solves complex engineering problems	Term assignments and the mid-term exam
IN.1 (D)	Gathers information (literature review, measurements, experiments, laboratory exercises) and analyzes data	Group and individual lab reports
DE.3 (D)	Develops/implements possible solutions to an open-ended design problem, leading to an appropriate recommendation	Final exam
ET.1A (I)	Uses analytical tools to complete engineering activities	Term assignments and the mid-term exam
IT.2 (D)	Contributes equitably to completion of group work	Group lab reports
CS.1 (I)	Understands, interprets and/or applies principles for effective engineering communication (oral, written and graphical)	Group and individual lab reports

Evaluation

Component	Value (%)	Assessor	Method of Feedback*	Learning Outcomes Evaluated	I/T**
Assignments	10	TA	S	1, 2, 4, 5, 6	I
Lab Reports	10	TA	S	1, 2, 3	I/T
Mid-term exam	30	Instructor	F, S	1, 4, 5	I
Final Examination	50	Instructor	F, S	1, 4, 5	I

* Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)
** I/T: **I** – Individual effort, **T** – Team effort

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Requirements/Regulations

- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication, or data storage devices) are allowed in examinations unless approved by the course instructor.
- All email communication must conform to the Communicating with Students university policy.

Communicating with Students

- Attending lectures and laboratories is essential for the successful completion of this course.
- Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. Students don't need to

Traditional Territories Acknowledgement

The University of Manitoba campuses are located on the original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

share personal information about their situation beyond declaring the nature of the extenuating circumstance on the self-declaration form.

Self-Declaration Form for Brief or Temporary Absence

- This form cannot be used for planned absences like vacations. It is also not to be used for longer-term absences, or ongoing circumstances (e.g., Authorized Withdrawals, Leaves of Absence, or other accommodations), which will still require additional documentation.

Self-Declaration Policy for Brief or Temporary Absences

- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance, and withdrawal.

General Academic Regulations

Engineering Academic Regulations

- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Resources

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

Copyright Notice

Copyright Office