## Structural Design in Wood ~ Course Outline BIOE4560
Department of Biosystems Engineering
University of Manitoba

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Course Description

Calendar Description
BIOE 4560 Structural Design in Wood. 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. Prerequisites: CIVL 3770 or BIOE 3590

Student's Learning Responsibilities:
Attendance and punctuality are expected, if you must be absent, please notify instructor beforehand through email. Also, while the importance of technology in our daily lives is recognized (laptops, smartphones) please use them with discretion. When we are engaged in class discussion and interaction, your full attention is requested. In accordance with university policy all email communication for this course shall be conducted using your University of Manitoba email address only. In accordance with university policy all email communication for this course shall be conducted using your University of Manitoba email address only. For full details of the Electronic Communication with Students please visit:
http://umanitoba.ca/admin/governance/media/Electronic_Communication_with_Students_Policy_-_2014_06_05.pdf
Please note that all communication between you as a student and your instructors must comply with the electronic communication with student policy:
(http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html).
Please ensure that you are also monitoring your UM Learn account for this course.

Why is this course useful?

It has been commented on by many a senior engineer 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 for the course.

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 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 developer 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 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 a 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. For Biosystems students this is one of the courses in the design elective package for Sustainable Buildings Specialization.

**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 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.

**Intended Learning Outcomes:**
By the end of the term BIOE 4560 students should be able to:
1. Demonstrate an understanding of the Canadian standard for wood design CSA O86 for the design of wood structures
2. Explain/demonstrate how a natural engineering material responds to load and how an understanding of the fundamental properties of wood informs design.
3. Prepare reports that demonstrate an understanding of wood behaviour from hands-on experience in the lab.
4. Complete a set of calculations to evaluate the suitability of a wood component and/or system with regards to loads, serviceability and constructability.
5. Read a set of construction plans, determine the load on a structural component and evaluate if the component is in compliance with the code.
### Expected Competency Level **

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<th>Learning Outcome</th>
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*Attributes:
A1 A knowledge base for engineering  
A2 Problem analysis  
A3 Investigation  
A4 Design  
A5 Use of engineering tools  
A6 Individual and team work  
A7 Communication skills  
A8 Professionalism  
A9 Impact of engineering on society/environment  
A10 Ethics and equity  
A11 Economics and project management  
A12 Life-long learning  

**Competency Levels:**
1 - Knowledge (Able to recall information)  
2 - Comprehension (Able to rephrase information)  
3 - Application (Able 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 whole)  
6 - Evaluation (Able to judge of the worth of something)  

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### Textbook, Reading, Materials

**Textbook** – The required textbook for the course is:


Handouts and notes will be provided in class and on UMLearn.

### Using Copyrighted Material

Please respect copyright. Copyrighted content will be used in this course and ensured that the content used is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by us, are made available for private study and research and must not be distributed in any format without permission.

### Recording Class Lectures

Dr. K. Dick, and the University of Manitoba hold copyright over the course materials, presentations and lectures that form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission from Dr. Kristopher Dick. Course materials (both paper and digital) are for the participant’s private study and research.
Course Content and Scope:
The following is a basic list of topics to be covered during this course. The order in which they have been presented does not, however, necessarily imply the order in which they will be encountered, as with any design course there are topics that overlap and are interrelated.

Lectures/Theory
1. Introduction
   - Course administration
   - Building design vs. Member selection
   - Design aides, codes, standards
2. Structural options in wood
   - Material properties of wood and relationship to design
   - Sawn lumber
   - Wood composites
3. Component design – flexural, compression, shear, tension
4. Roof support systems
5. Wall systems and Permanent Wood Foundations (PWF)
6. Design of connections - bolted, nailed, truss plates
7. Diaphragm and shearwall design
8. Post frame construction
9. Use of National Building Code and design plans

Laboratories:
1. Tests to illustrate typical load response of wood.
2. Selected building components will be designed by students, built, tested and analysed.
3. Selected individual structural components will be tested to failure and their performance analysed.
4. Site visit to structure under construction
5. Site visit to engineered wood fabrication plant.

Academic Dishonesty:
All applicable rules and regulations in this year’s University of Manitoba General Calendar including those on academic dishonesty, plagiarism, cheating and examination impersonation are to be read and followed. A reproduction of another student’s work is not acceptable.
**Evaluation:**
The basis for evaluation is established,

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<th>Component</th>
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<td>Assignments / Lab reports</td>
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<tr>
<td>Mid Term Test</td>
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<td>Final Exam</td>
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**Important Dates**

- **Mid Term Test**: March 20, 2017 (during lab time)
- **Voluntary Withdrawal Date**: March 31, 2017
- **Last Day of classes**: April 21, 2017

**General Course Policies:**

~ Late assignments not accepted, unless **prior approval** from instructor. Assignments submitted after due date without prior approval will be deducted 10% per day. Missed assignments will receive a zero grade.~

~ Attendance at labs is considered mandatory. If unable to attend consult the instructor **prior** to the lab.