Timber Engineering

Introduction

The lecture slides gathered in the present document are part of the course Timber Engineering at Aalto University in spring 2021. The current document is at draft stage, meaning that it is only distributed to students and researchers. It shall not be further redistributed nor posted on public web sites.

Timber Engineering?

What engineers are doing?

Plan, design, built, maintain, ...

- Structures
- Infrastructures

...in order to balance

- Associated Risk (simplified the associated failure probability)
- Investments into more safety

Requirements for the (structural) design

Eurocode 0 (EN 1990)

A structure shall be designed to have adequate:

- Structural resistance
- Serviceability
- Durability

Requirements for the (structural) design

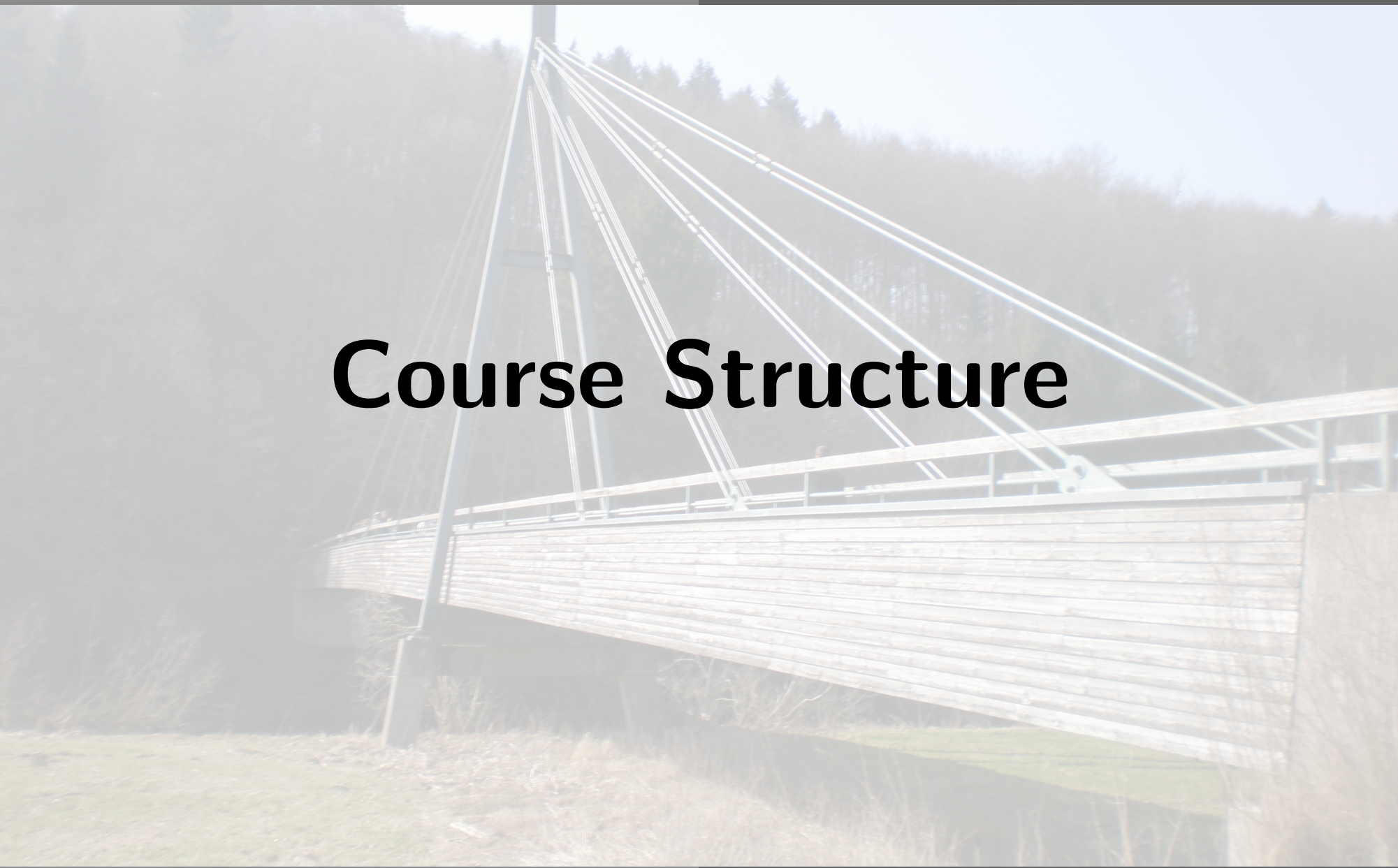
Ultimate limit states (ULS)

- Safety of people
- Safety of the structures

Serviceability limit states (SLS)

- Functioning of the structure or structural members under normal use
- Comfort of people
- Appearance of the construction works*

*In the context of serviceability, the term "appearance" is concerned with such criteria as high deflection and extensive cracking, rather than aesthetics.



Course Structure

Expected learning outcomes

- Understanding of the structural behaviour of solid timber and engineered wood products
- Understanding the principles for the design of beam type elements (cross-sections subjected to stresses, stability of members, serviceability limits, fire exposure)
- Understanding the principles for the design of connections with metal type fasteners
- **Ability to design standard beam type elements and connections with metal type fasteners**

Content

Part I – Wood as a building material

Part II – Basis of the design

Part III – Ultimate limit state design of beam type elements

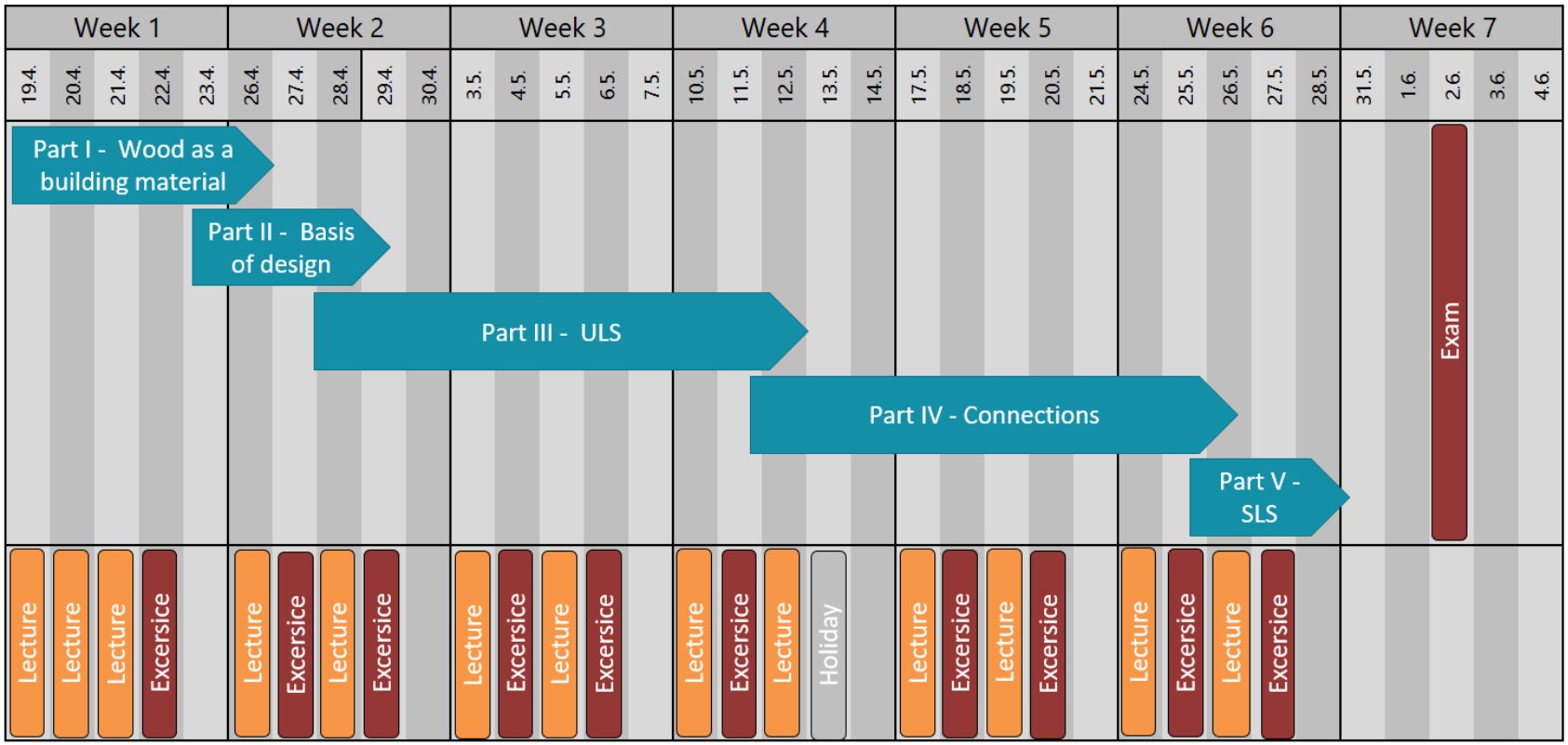
Cross-sections, Stability, Fire

Part IV – Connections with metal type fasteners

Laterally loaded fasteners, Axially loaded fasteners

Part V – Serviceability limit state design

Schedule


Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
19.4.
20.4.
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31.5.
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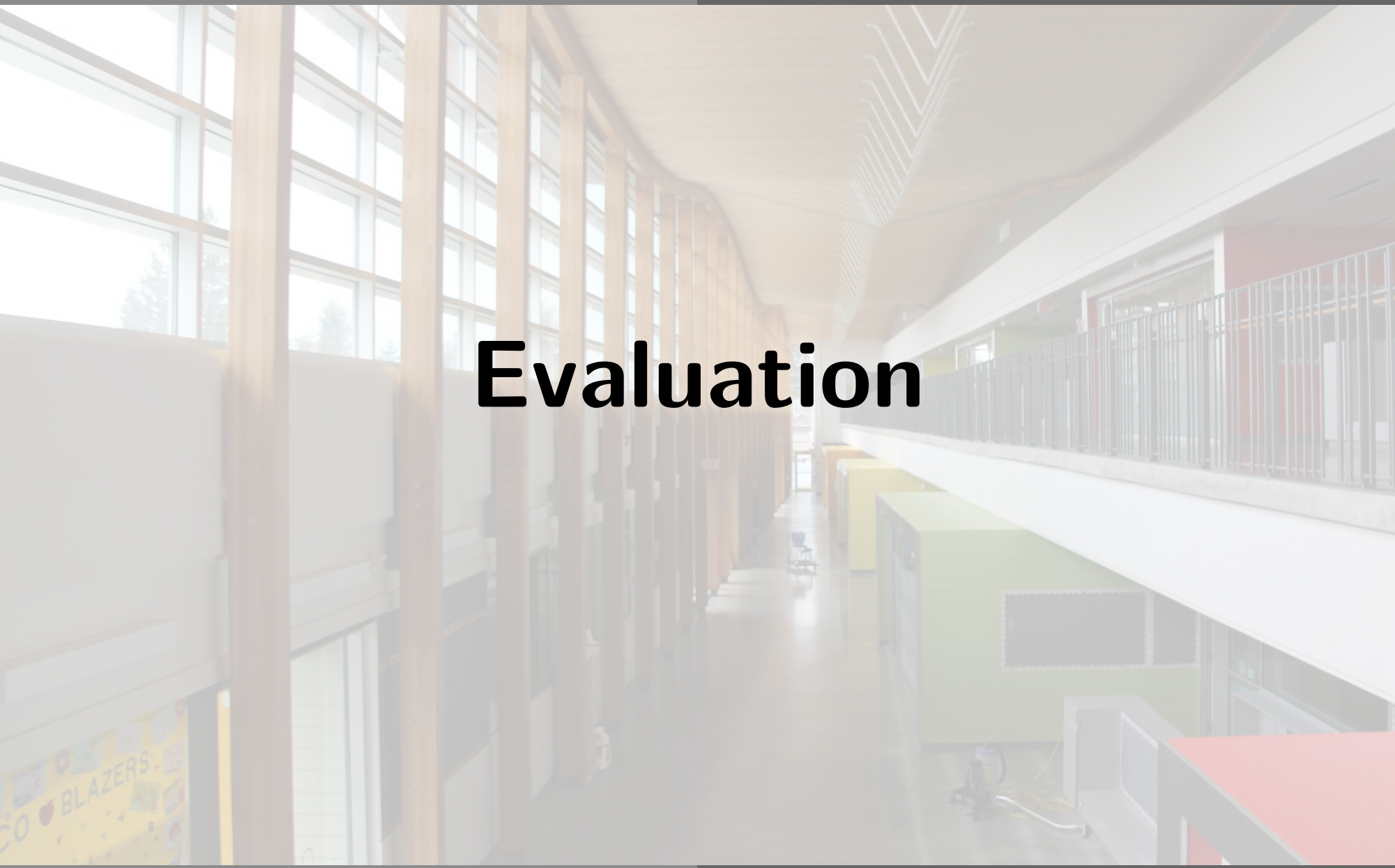
2.6.
3.6.
4.6.
Part I - Wood as a building material
Part II - Basis of design
Part III - ULS
Part IV - Connections
Part V - SLS
Exam
Lecture
Excersice
Holiday



Evaluation

Overview

Assignments 25 %

Exam 75 %

Assignments

5 Assignments

Time:

- Uploaded on MyCourses: Thursday (after the exercise)
- Deadline: Tuesday/Thursday (before the excercise)

Grading:

- Perfect, almost perfect (2 points)
- Few small mistakes (1 point)
- Otherwise (0 points)
- **Only assignments with correct static will be graded!**

Assignments

Quiz:

- Approx. 3 random question to check the static calculations
- Can be repeated multiple times
- Requirement to submit the assignment

Submission:

- Only possible after passing the quiz (to check the static calculations)
- Handwritten
- Reproducible: $A_{\text{n}} = b \cdot h = 80 \cdot 160 = 12800 \text{ mm}^2$
- Uploaded on MyCourses

Exam

Date: 2.6.2021 (Course exam)

(10.9.2021, Make-up exam)

1 A4 page with your own notes!

(recommendation)

Key points in the examination guidelines

When registering:

- Course exam (1st exam) can be registered together with course registrations
- Register for either course or make-up exams 7 days before.
- For exceptional cases please register exams two days before to the responsible teachers
- Registered exam cannot be cancelled when the registration period expires

Feedback

Feedback from **YOU** is appreciated!

(during and after the course)

Support

Contact session

8 contact hour lessons per week (lecture & exercise)

All contact sessions will be online (zoom)

Do not record the contact sessions!

Lecture notes on MyCourses

Before the lecture

Exercises & Assignments on MyCourses

After the exercise/assignment

Support

Contact sessions (lecture & exercise)

Be Active! & Ask questions!

Email

Please ask precise questions!

MyCourses

Contact

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Room 222

Literature

Recommendations for interested students

Slides (lecture notes)

Codes & standards (selection):

- EN 1990 (2002). Eurocode 0: Basis of structural design
- EN 1995-1-1 (2004). Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings
- EN 1194 (1999). Timber structures – Glued laminated timber – strength classes and determination of characteristic values
- EN 14080 (2013). Timber structures – Glued laminated timber and glued laminated solid timber – Requirements
- EN 1912 (2012). Structural timber – Strength classes – Assignment of visual grades and species
- EN 338 (2010). Structural timber – Strength classes
- EN 14375 (2004). Timber structures – Structural laminated veneer lumber –Requirements

Literature

Recommendations for interested students

Further recommended literature (selection):

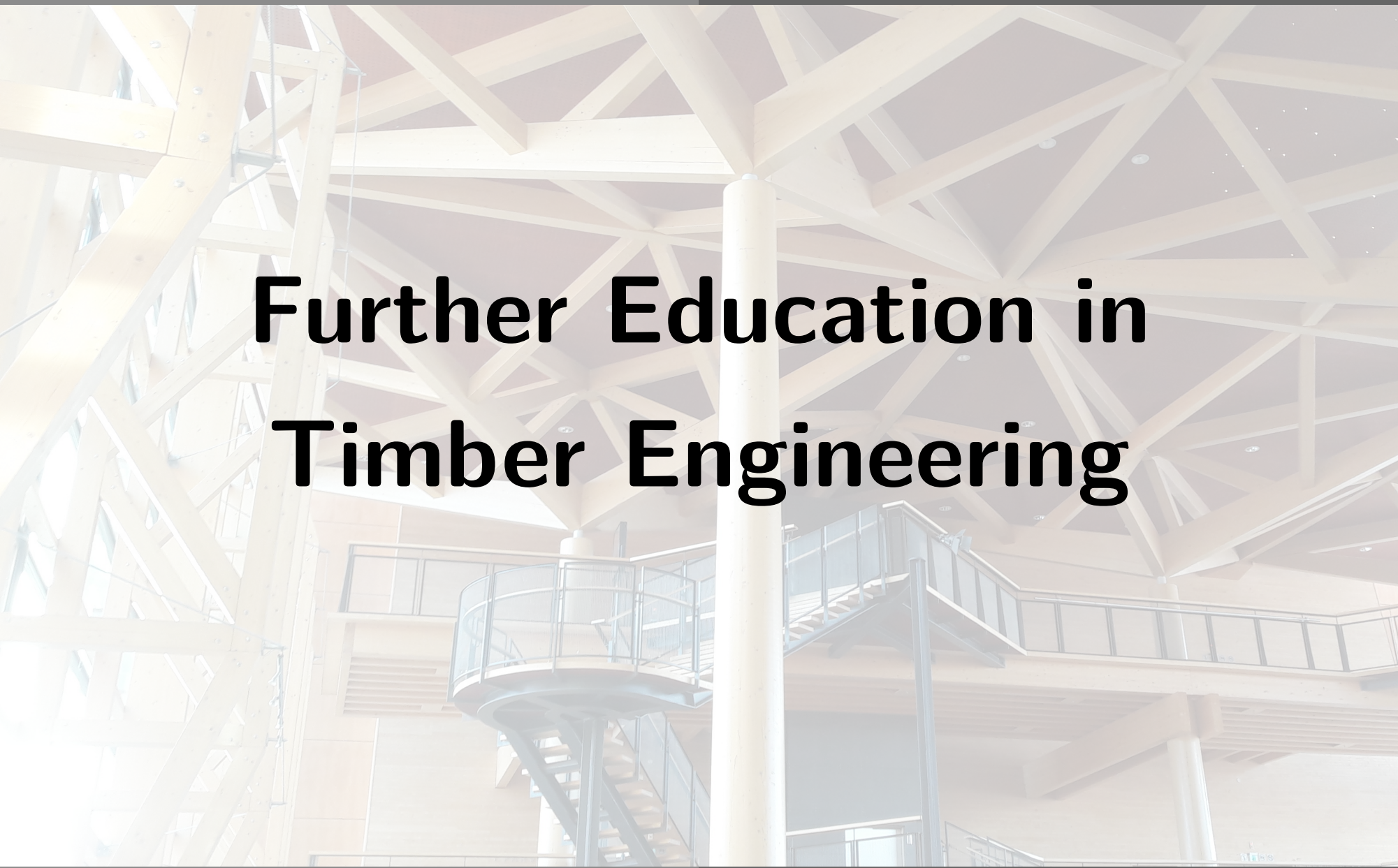
- Kollmann F.F.P., Cote Jr W.A. & et al. (1968). Principles of wood science and technology. I. Solid wood. George Allen & Unwin Ltd.
- Madsen B. & et al. (1992). Structural behavior of timber. Timber Engineering Ltd
- Madsen B. & et al. (2000). Behavior of timber connections. Timber Engineering Ltd
- Thelandersson S., Larsen H. & et al. (2003). Timber engineering. Wiley West Sussex, England
- Melchers R.E. (1999). Structural reliability analysis and prediction. John Wiley & Son Ltd
- JCSS (2001). Probabilistic Model Code Part I - Basis of Design. `http://www.jcss.byg.dtu.dk/Publications/Probabilistic_Model_Code`
- JCSS (2006). Probabilistic Model Code Part III - Resistance Models (3.05 Timber). `http://www.jcss.byg.dtu.dk/Publications/Probabilistic_Model_Code`
- Blass H.J. & et al. (1995). Timber Engineering, STEP, Volumes 1 & 2, Centrum Hout, Netherlands
- Ross, R.J. (2010). Wood handbook: wood as an engineering material. Centennial ed. General technical report FPL ; GTR-190. Madison, WI : U.S. Dept. of Agriculture, Forest Service, Forest Products Laboratory `https://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr190.pdf`
- Swedish Forest Industries Federation. (2016). Design of timber structures, volumes 1-3. `http://www.svenskttra.se/publikationer/publikationer/design-of-timber-structures/`

Literature

Recommendations for interested students

Further recommended literature (selection, in Finnish):

- Suomen Rakennusinsinöörien Liitto RIL ry. (2009). RIL 205-1-2009, Puurakenteiden suunnitteluohje – eurokoodi EN 1995-1-1
- Suomen Rakennusinsinöörien Liitto RIL ry. (2017). RIL 205-1-2017, Puurakenteiden suunnitteluohje – eurokoodi EN 1995-1-1
- Suomen Liimapuuyhdistys ja Puuinfo Oy. (2014). Liimapuukäsikirja, osa 1 `http://www.puuinfo.fi/suunnitteluohjeet/liimapuukasikirja`
- Suomen Liimapuuyhdistys ja Puuinfo Oy. (2015). Liimapuukäsikirja, osat 2-3 `http://www.puuinfo.fi/suunnitteluohjeet/liimapuukasikirja`
- Puuinfo – Puurakenteiden suunnittelu, Lyhennetty suunnitteluohje



Further Education in Timber Engineering

Timber Engineering – CE:

- ✓ CIV-E4110 Timber Engineering
- ✗ CIV-E4120 Timber structures
- ✗ CIV-E4030 Engineering Design Exercises
- ✗ Special Assignment
- ✗ Master thesis: *possible topics*

Timber Structures

ULS of beam type elements

Varying cross-sections, curved beams, holes & notches

Reinforcements

Plane elements (CLT, TCC)

Performance

(Fire, Durability, NDT, Robustness)

Structural Solutions

(Residential buildings, Halls, Timber bridges)

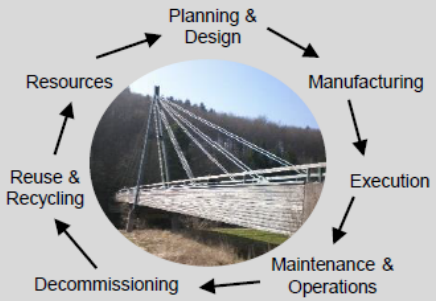
Selection of other courses

- CHEM E2105 Wood and Wood Products
- CHEM E2115 Wood Products: Application and performance.
- ARK-E4000 Wood in Architecture and Construction
- ARK-E4008 Industrial Wood Construction

Structural Timber & Engineered Wood Products

Structural Solutions

Assessment of Timber Structures



Aspects of Structural Reliability