Timber Engineering

Introduction

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

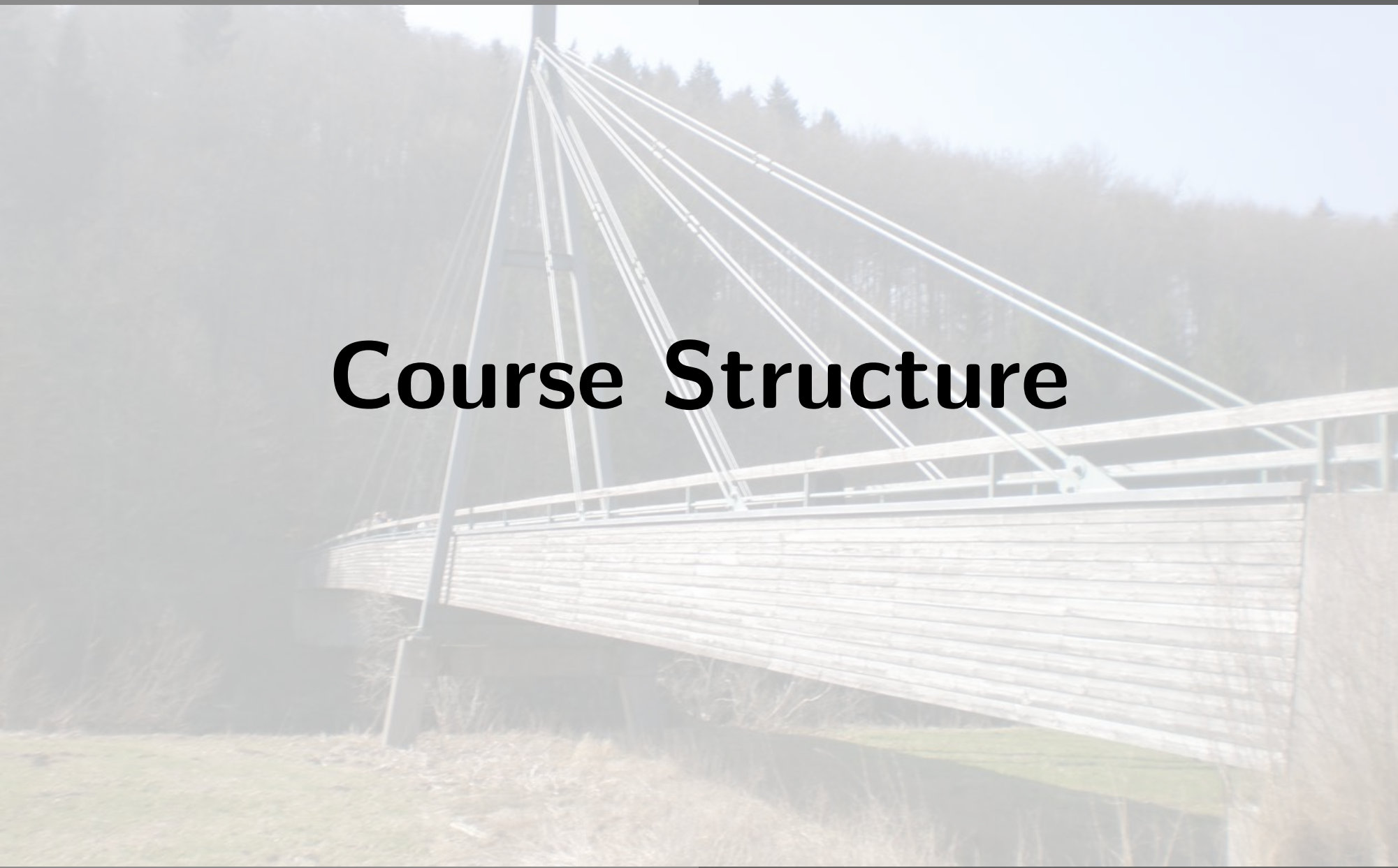
Ultimate limit states (ULS)

- 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

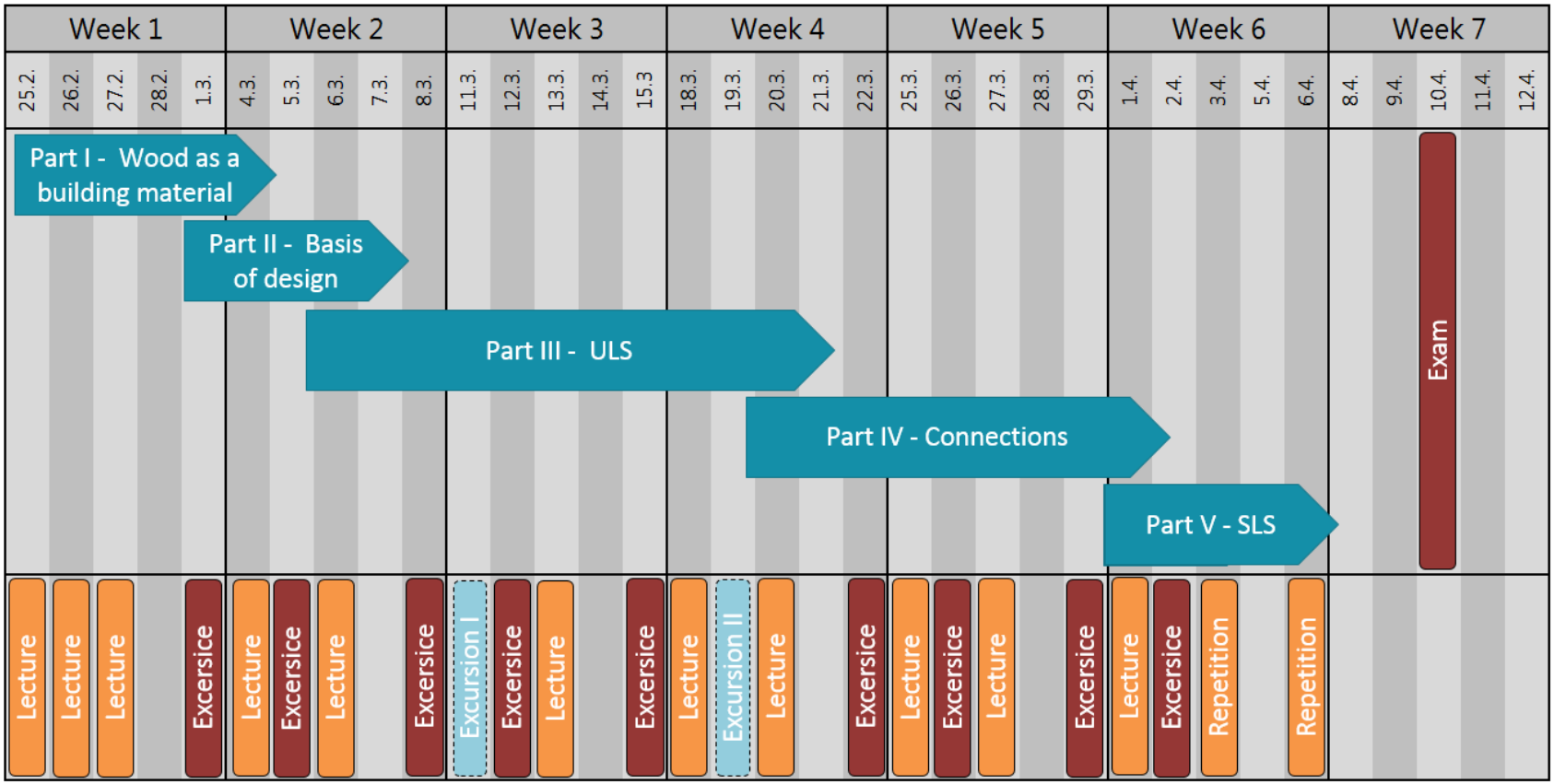
Part III – Ultimate limit state design of beam type elements

Cross-sections, Stability, Fire

Part IV – Connections with metal type fasteners

Part V – Serviceability limit state design

Schedule


Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
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Part I - Wood as a building material
Part II - Basis of design
Part III - ULS
Part IV - Connections
Part V - SLS
Exam
Lecture
Excersice
Excursion I
Excursion II
Repetition

Excursion I

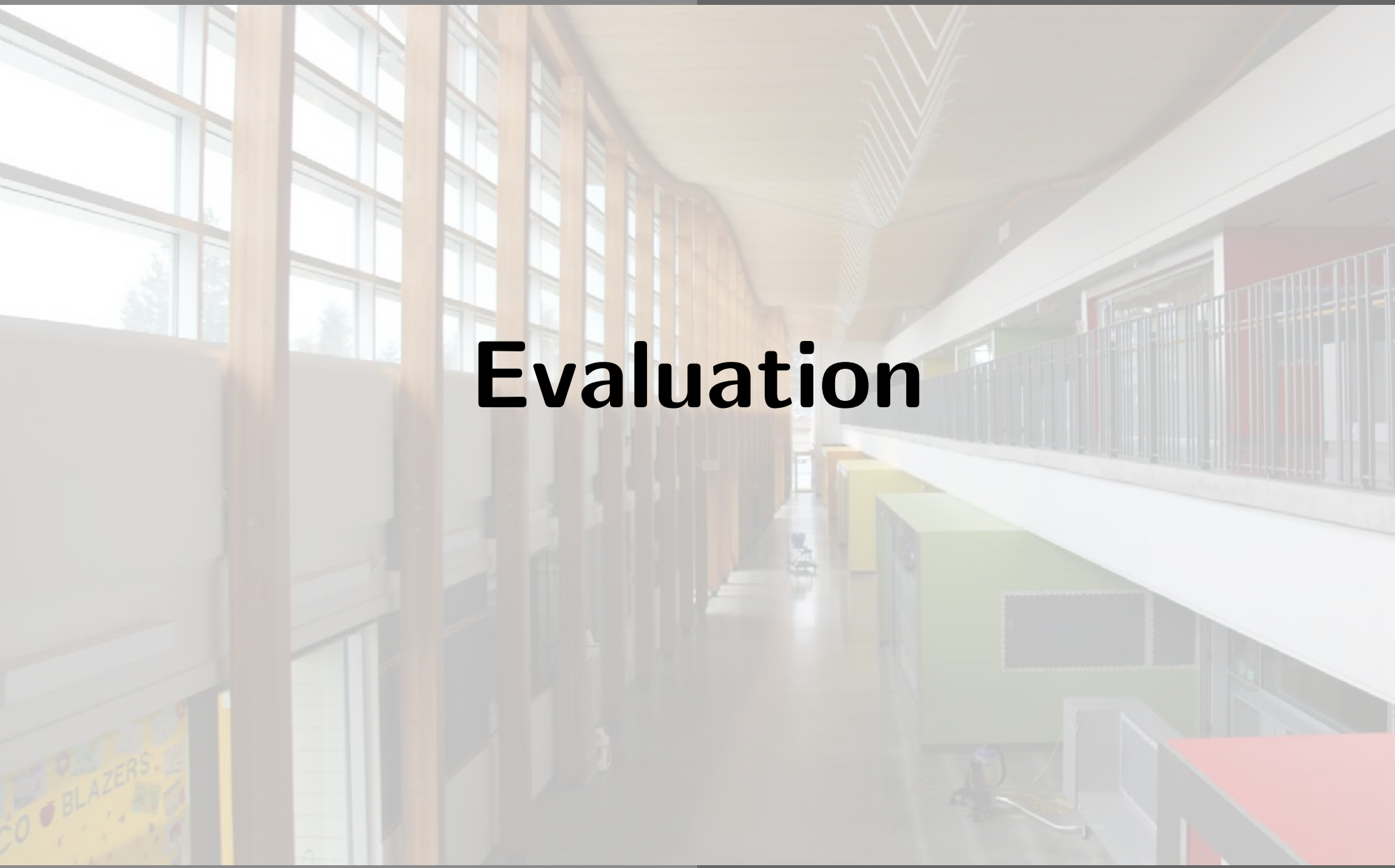
Eurofins – Tesing laboratory

- Date: 11.3.2019
- Structural testing facilities
- Inform me if you can not participate (email) until 4.3.2019

Excursion II

Construction site

- Date: 19.3.2019
- Lapinmki kindergarten
- Kangaspellontie 6, 00300 Helsinki
- Inform me if you need Safety equipment (helmet, shoes, attention vest) until 11.3.2019
- Inform me if you can not participate (email) until 11.3.2019



Evaluation

Overview

Assignments 25 %

Exam 75 %

Assignments

5 Assignments

Time:

- Uploaded on MyCourses: Friday (after the exercise)
- Deadline: Wednesday (before the lecture)

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: 10.4.2019 (Course exam)

(31.5.2019, Make-up exam)

1 A4 page with your own notes!

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

During the exam:

- Only registrants can enter examination hall
- Entry to the exam is not allowed after 30 minutes of the starting
- Leaving from the exam is only allowed after 35 minutes of the starting

When returning:

- Show your official ID (student card, Finnish or EU driving licence with photo ID, official ID certificate or passport)
- Please return all materials you have got (including questions as required)

Feedback

Feedback from **YOU** is appreciated!

(during the course)

Support

Contact

Gerhard Fink

gerhard.fink@aalto.fi

Room 268a

Steven Collins

Consultation-hours: Monday & Thursday 16:00-17:00

steven.collins@aalto.fi

Room 222

Support

8 contact hour lessons per week (lecture & exercise)

Be Active! & Ask questions!

Consultation-hour & email

Please ask precise questions!

MyCourses

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):

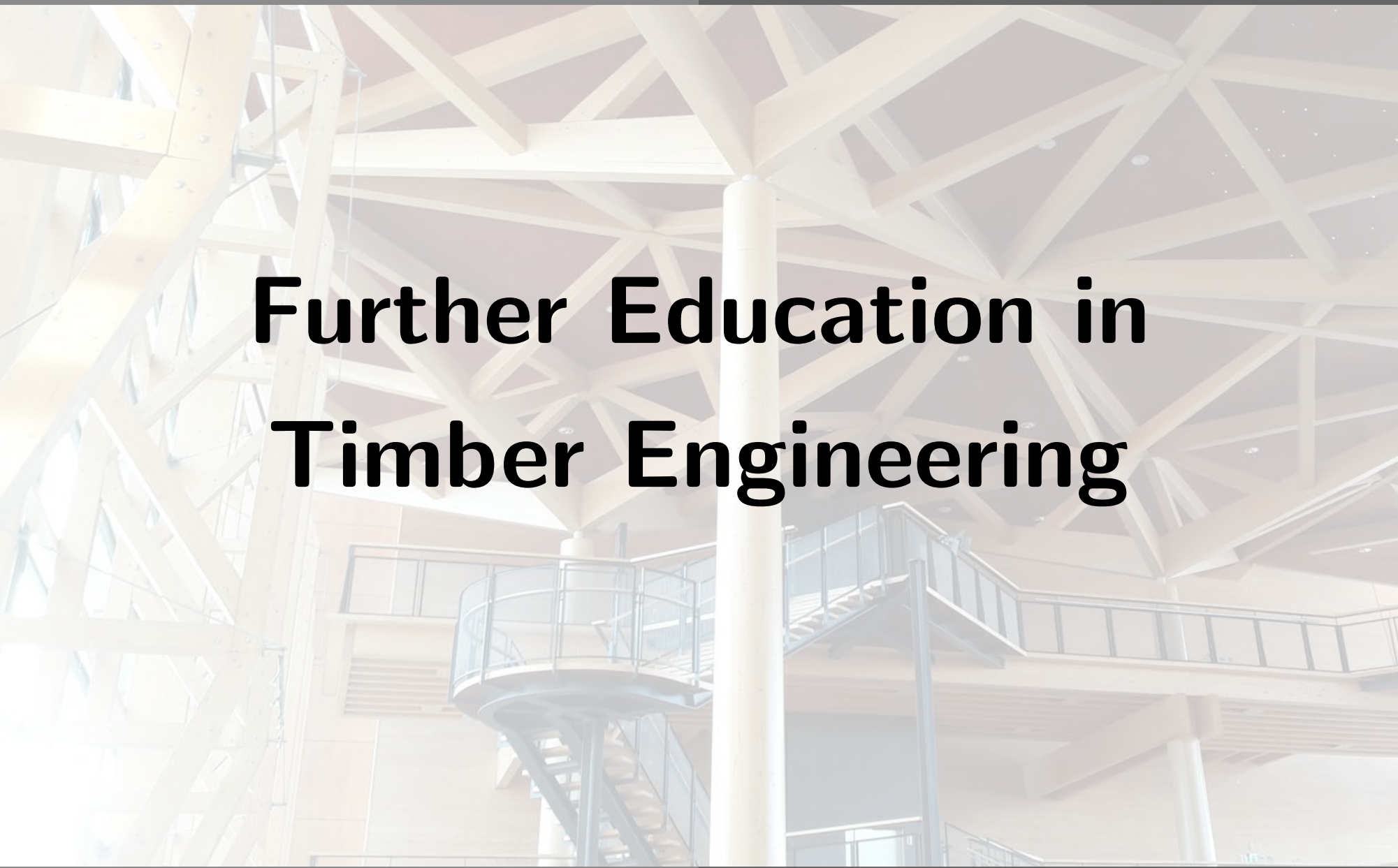
- Kollmann F.F.P., Cote Jr W.A. & et al. (1968). Principles of wood science and technology. I. Solid wood. George Allen & Unwin Ltd.
- Madsen B. & et al. (1992). Structural behavior of timber. Timber Engineering Ltd
- Madsen B. & et al. (2000). Behavior of timber connections. Timber Engineering Ltd
- 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 Rakennusinsinrien Liitto RIL ry. (2009). RIL 205-1-2009, Puurakenteiden suunnitteluohje – eurokoodi EN 1995-1-1
- Suomen Rakennusinsinrien Liitto RIL ry. (2017). RIL 205-1-2017, Puurakenteiden suunnitteluohje – eurokoodi EN 1995-1-1
- Suomen Liimapuuyhdistys ja Puuinfo Oy. (2014). Liimapuuksikirja, osa 1 `http://www.puuinfo.fi/suunnitteluohjeet/liimapuukasikirja`
- Suomen Liimapuuyhdistys ja Puuinfo Oy. (2015). Liimapuuksikirja, 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

Expected learning outcomes

- Understanding the structural behavior of beam type elements with varying cross-section or curved shape, notches and holes
- Understanding the structural behavior of reinforcements (e.g. screws, glues in rods)
- Understanding of the structural behavior of plate elements (cross laminated timber, timber concrete composites)
- **Ability to design timber structures for multistory buildings, halls and bridges**

Timber Structures – Content

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
- Puu-28.5010 Industrial Wood Construction

Structural Timber & Engineered Wood Products

Structural Solutions

Assessment of Timber Structures

Aspects of Structural Reliability