GHENT UNIVERSITY

Course Specifications

From the academic year 2017-2018 up to and including the

Glass and Timber Structures (E044630)

Course size (nominal values; actual values may depend on programme)

Credits 3.0	Study time 90 h	Contact hrs	30.0 h

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	English	lecture	27.5 h

Lecturers in academic year 2018-2019

Belis, Jan	TW14	lecturer-in-charge
Jorissen, André	TW14	co-lecturer

Offered in the following programmes in 2018-2019	crdts	offering
Master of Science in Engineering: Architecture (main subject Architectural Design and Construction Techniques)	3	A
Master of Science in Engineering: Architecture (main subject Urban Design and Architecture)	3	A
Master of Science in Civil Engineering	3	A
Exchange Programme Architecture	3	A

Teaching languages

English

Keywords

Glass structures, glass technology, glass strength, buckling, bolted connections, adhesive connections, post-breakage behaviour, robustness, innovation, timber structures, wood technology, Eurocode 5

Position of the course

In the first part of the course, students get acquainted with glass used as a building material, and with its main structural and design-related basic principles. Strength and brittle behaviour of glass are studied, as they require an atypical engineering approach. The course focuses on elementary calculations of glass structures. Finally, a safe design philosophy is emphasised, including basic principles of the residual resistance and stiffness of partly or fully broken glass components.
The second part of the course deals with timber structures. After a thorough introduction to the principles of wood technology, the mechanical behaviour of timber and timber products is taught. This knowledge is further elaborated according to design methods of Eurocode 5 for simple load-bearing components in common structural typologies. Finally, students learn how to design common connections of timber components.

Contents

GLASS STRUCTURES

- **Introduction to glass in buildings**
  - Introduction
  - Glass and its General Characteristics
  - Flat Glass Production methods
  - Glass Products Processing
- **Glass tempering**
  - Strengthening methods for glass
  - Mechanical tempering models
  - Measuring residual stress in glass
  - Nickel-Sulfide inclusions
- **Interlayers and Laminated (Safety) Glass**
  - Introduction
  - Laminated (safety) glass definitions

- Applicable European Standards
- Interlayer products: Lamination Processes, Viscoelasticity, Quality Control

- **Fracture Strength**
  - Fracture mechanics
  - Glass testing
- **General Design Guidelines**
  - Overview
  - Actions on glass components: Introduction, Type of actions, Typical values
  - Current design methods
  - Post-breakage and robustness
- **Insulated glass**
  - Fundamentals
  - Supporting systems
  - Loads
  - Design: Design Example, IGU Examples
- **Curved glass**
  - Principles
  - Cold bending
  - Bending by lamination
  - Hot bending
  - Basis for calculation (curved versus flat glass)
  - Examples
- **Bolted connections**
  - Examples of bolted connections in glass structures
  - Structural design of bolted connections (state of the art)
  - Design concepts (in discussion)
- **Adhesive connections**
  - Introduction
  - Adhesives & substrates
  - Typology & cases
  - Analysis & design
- **Stability**
  - Introduction
  - Fundamental stability phenomena
  - Influencing parameters
  - Column buckling
  - Lateral torsional buckling
  - Plate and shear buckling

TIMBER STRUCTURES

- **Introduction**
  - General: examples with explanation; in this part also a large number of wood products and connection techniques is treated
  - Timber properties
    - Density
    - Effects of humidity
    - Effects of load duration
    - Electrical properties
    - Thermal properties
    - Chemical and biological properties
    - Durability
- **Strength and stiffness**
  - Design values: characteristic values, material factor, modification factor, volumetric effects, calculation examples
- **Connections**
  - Design
    - Force Analysis
    - Efficient ways to enable forces to pass through a connection
    - Connections with pin-shaped devices
      - Screws (pull-out, as reinforcement)
      - loaded in shear: European Yield Model (Johansen-Meyer theory) – Eurocode 5 background information.
- **Stability: timber components with rectangular cross-sections loaded in compression and/or bending**
  - Theory
  - Calculation examples
- **Exercises: calculation examples**

Initial competences

Mechanics of materials, Structural analysis I, Construction of buildings

Final competences

1 Design conceptually and structurally correct glass structures and timber structures.

2 Explain construction and structural concepts.
3 Perform strength and stability checks of elementary primary glass components and connections.
4 Dimension basic timber members and connections.
5 Recognise, denominate and explain frequent glass pathologies.
6 Apply basic principles for fire-safe timber structures.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture

Learning materials and price

syllabus with handouts, readers
price ca. 12 EUR

References

- Weller, Nicklisch, Thieme, Weimar. Glasbau-Praxis 2. Auflage, Berlin: Bauwerk Verlag GmbH, 2010.
- Haldimann, Luible, Overend. Structural Use of Glass. Structural Engineering Documents 10. Zürich: IABSE, 2008.
- Schittich, Staib, Balkow, Schuler, Sobek. Glass Construction Manual 2nd ed. Basel, Boston- Berlin: Birkhäuser, 2006.
- WTCB. TV Bijzondere Glaswerken, 2011.
- WTCB. Toepassing van de eurocodes op het ontwerp van buitenschrijnwerk. WTCBTijdschrift, nr. 11, Brussel: 2009.
- NBN S 23 002 Glaswerk, 2007.
- Herzog, Natterer, Schweitzer, Volz, Winter. Timber Construction Manual, Basel, Boston- Berlin: Birkhäuser, 2004.
- Blass H.J., e.a. Timber Engineering. Step 1: Basis of design, material properties, structural components and joints, Almere: Centrum Hout, 1995.
- Blass H.J., e.a., Timber Engineering. Step 2: Design – details and structural systems. Almere: Centrum Hout, 1995.
- Eurocode 5 - Design of timber structures. Part 1-1: : General - Common rules and rules for buildings.
- Eurocode 5 - Design of timber structures. Part 1-2: General - Structural fire design.
- Natterer, Sandoz, Rey. Construction en bois: Matériau, technologie et dimensionnement (TGC volume 13), Lausanne: Presses Polytechniques et Universitaires Romandes, 2005.

Course content-related study coaching

teaching staff is available before and after classes

Evaluation methods

end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period

Written examination, oral examination

Examination methods in case of periodic evaluation during the second examination period

Written examination, oral examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Oral exam (Glass structures), written exam (Timber structures)

Calculation of the examination mark

Exam Glass structures: 50%
Exam Timber structures: 50%