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Sustainable, High-Performance Building Solutions in Wood (HiBiWood)

2020-1-LV01-KA203-077513

COURSE CURRICULA

BSc/BA trans-disciplinary elective module

“Sustainable, high-performance building solutions in wood“

BSc/BA elective module prepared by FH Campus Wien, Austria

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INTRODUCTION

The EU Green Deal, the EU Taxonomy and the New European Bauhaus are initiatives of the EU Commission that aim at leading Europe into a climate-neutral future by 2050. The construction sector is currently responsible for an immense contribution to global warming, where about 8% of anthropogenic CO2 emissions worldwide come from the manufacturing process of cement[1]. To meet the EU climate targets for the reduction of greenhouse gas emissions, a rethink in the construction industry is unavoidable. One of the greatest opportunities for reducing emissions in the building industry lies in the increased use of regionally, renewable building materials. Timber has excellent constructive properties and is also ideal to bind CO2 in the long term due to its carbon storing effect. In addition, it offers high levels of prefabrication, which means that construction time spent on site can be remarkably reduced compared to conventional methods[2]. Timber is increasingly being used globally, but it requires specific expertise as well as a general rethinking of current planning and construction processes[3]. For fully exploiting its potentials, the current training of civil engineers and architects is still insufficient, especially in highly prefabricated construction, where extensive knowledge is already required during preliminary design due to fire protection, building physics and panelization of building components. The industry needs specially trained experts who understand the technical and economic interrelationships with other trades and building materials, which makes the embedding of timber specific design methods in the civil engineering and architecture curricula necessary[4]. Due to the complexity of the matter, the traditional academic transmission of knowledge is not sufficient. An integrated approach that brings together several disciplines and the acquisition of real-life skills are necessary.

The project HiBiWood aims to satisfy the future demands of European higher education in the field of design and construction of sustainable, high performance building solutions in timber. It explores the following questions: how to integrate the latest timber-specific knowledge in the classic university curricula and how to guide students during the learning process by applying innovative didactic approaches. The cross-border partnership of six institutions, including five European universities (FH Campus Wien in Austria, HAMK in Finland, RBC in Latvia, Cracow University of Technology in Poland, KVK in Lithuania, and Study and Consulting Center in Lithuania) ensures the international exchange of knowledge on sustainable building practices and increases the competences of all project participants (students, teachers, but also construction companies). The main target groups are European higher education institutions, especially teachers/trainers and BSc/BA students of architecture, civil engineering and building site management.

The identified challenges are addressed through a transdisciplinary elective module with nine ECTS, that will be embedded in the academic programmes of the partner universities.

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[1] European Commission, „A European Green Deal – Striving to be the first climate-neutral continent “, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en [10.08.2023]

[2] H. Kaufmann, R. Strauch, „Ressourcenschonung durch Synergie – Hochbauten in Holz-Hybridbauweise“, Best of DETAIL – Holz, Institut für internationale Architektur-Dokumentation GmbH & Co. KG, München, 2014

[3] F. Lattke, M. Stieglmeier, „Holzbaugerechter Planungsprozess“, in: Zuschnitt – Zeitschrift über Holz als Werkstoff und Werke in Holz, Nr. 70, proHolz, Wien, 2018

[4] J. Koppelhuber, K. Schafferer, „Ein Gesprch über den Holzbau und die Bedeutung der Ausbildung (…)“, in: Zuschnitt – Zeitschrift über Holz als Werkstoff und Werke in Holz, Nr. 78, proHolz, Wien, 2020

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PROJECT OBJECTIVES

The specific objectives of the project *"HiBiWood"* are:

- Education and training for all participants (students, educators, researchers, companies) in the field of multi-story timber construction.
- Development and implementation of a transdisciplinary elective module within the programs of the partner universities, aligning with the demands of the construction industry in terms of sustainable buildings.
- Integration of innovative student-centred project-based, research-based, blended-learning and cross-disciplinary learning approaches into Bachelors' degree study programs.
- Formulation of guidelines/principles to facilitate the practical execution of sustainable building projects.
- Enhancement of the competencies of students and teachers in problem-solving, teamwork, innovative thinking.
- Ensuring the strategic transdisciplinary, transnational cooperation among higher education institutions and business enterprises in the development of new learning methodology and the course.
- Raising awareness of different actors at local, national, EU and international level about the potentials of timber as building material and promotion of multi-storey timber constructions.

The transdisciplinary module is intended to close the knowledge gaps in university education on the construction of multi-storey timber buildings. The students will acquire deeper professional knowledge, skills and real-life competences that meet the demands of the employment market.

DESCRIPTION AND CONTENT OF THE MODULE

The 9 ECTS trans-disciplinary innovative module *"Sustainable, high-performance wooden building solutions in wood"* is addressed to BSc/BA students of the planning disciplines: architecture, civil engineering and building site management.

LEVEL OF STUDIES[5]

First cycle (BSc/BA) ☒	**Second cycle (MSc/MA) ☐**	**Third cycle (PhD) ☐**

[5] According to the Framework of Qualifications for the European Higher Education Area, Annex 8: http://www.aic.lv/ace/ace_disk/Bologna/Bergen_conf/Reports/EQFreport.pdf [15.02.2023]

Through lectures, technical literature, excursions to production halls and construction sites, analysis of case studies and elaboration of timber-specific topics the participants will acquire professional knowledge and competences about timber materials and systems. The students will apply the contents on a project, going through all real-life phases (from preliminary design to detailed planning and building site management).

The module is designed to provide a comprehensive coverage of the key aspects related to multi-story timber construction – architectural design, structural systems, timber technology, building physics, building site management. The approach taken is interdisciplinary and holistic, integrating these various aspects in all module phases, with varying levels of depth to address students with different levels of knowledge. Simultaneously, it complements conventional academic teaching by implementing innovative approaches, as integral planning, problem-based learning, problem solving, learning by doing and blended learning, described in detail in the chapter *"Learning and teaching strategies"*.

The module encompasses four theoretical courses, totalling 4 ECTs and three project-based exercises with 5 ECTs. These components collectively contribute to the achievement of the Learning Outcomes (LO1, LO2, and LO3) as detailed in the *"Learning Outcomes and Assessment"* section.

The structure of the module is flexible, allowing for completion within a single session (one semester) or divided across two or three semesters. This design accommodates universities in tailoring the module to specific study programs and students' existing knowledge.

The module's content is outlined as follows:

Nr	Module Component	Type	Learning outcomes	Number of hours	ECTs
1.	Architectural Design in Timber – Introduction	Lecture	LO1	15 +10h	1
2.	Advanced Architectural Design in Timber	Lecture	LO1 & LO2	15 +10h	1
3.	Design of a residential timber building	Exercise	LO1	50h	3,5
4.	Construction solutions for a timber building	Exercise	LO2	50h	
5.	Timber Engineering	Lecture	LO2	15 +10h	1
6.	Elaboration of building site management concept	Exercise	LO3	40h	1,5
4.	Building Site Management and Building Process with Timber	Lecture	LO3	15 +10h	1
			TOTAL:	**240**	**9**

CREDITS AND LEARNING HOURS

ECTS Value[6]	Academic learning hours[7]	Length (in Semesters)	Years in which to be offered
9	240	1, 2 or 3 (selectable)	2023/2024

DISTRIBUTION OF LEARNING HOURS

Lectures (25%)	Individual studies (17%)	Project-based learning (58%)	Total
60	40	140	240

LEARNING AND TEACHING STRATEGIES

At the core of the didactic concept of the module are the integral planning (interdisciplinary approach) and the PBL method (problem-based learning)[8] [9]. Students from different European countries and fields of study (architecture, civil engineering and building site management) plan a multi-storey building in timber in small groups, carrying out all real-life project phases (from preliminary design to detailed planning and building site management) and implementing sustainable principles. Early involvement of the different disciplines during the conceptualization phase prevents collisions and misunderstandings at the technical interfaces and significantly benefits the projects by allowing informed design decisions that facilitate the planning process in further phases. This approach results in fewer changes during the advanced phases of the planning process, leading to reduced time and costs, minimized errors, and higher quality and lifecycle optimization. Furthermore, better communication and transparency among the students increases shared knowledge, leading to a more collaborative and productive planning process. Skills related to communication and project management are developed, including the ability to plan collaboratively, make informed decisions, and integrate interdisciplinary knowledge.

Three workshops were held as part of the project (Vienna 2021, Cracow 2022, and Riga 2023), which served as test runs for the development of the module curriculum. Each workshop focused on different real-life project phase (architectural design, construction solutions and building site management), while dealing simultaneously and holistically with the complexity of planning a multi-story timber building.

The module provides a deeper and holistic knowledge about the key planning aspects of timber buildings (architectural design, structural systems, timber technology, building physics (sound, moisture, heat, fire protection), cost estimation, montage, and logistics), that are applied directly on the project. The development of the assignments mirrors the real-life phases of constructing a

[6] European Credit Transfer System, 1 ECTS = 25-30 academic learning hours. Please refer to ECTS Users' Guide: https://ec.europa.eu/education/ects/users-guide/docs/ects-users-guide_en.pdf

[7] 1 academic learning hour is equal to 45 minutes

[8] Kim, H., & Lee, J. (2014). An investigation into the effectiveness of problem-based learning in architectural design education. Journal of Architectural Education, 68(3), 233-244.

[9] Al-Hussaini, A., & Al-Jibouri, S. (2016). The implementation of problem-based learning in civil engineering education: A case study. Journal of Education and Practice, 7(13), 105-114.

building with emphasis on different disciplines: 1) architectural design and timber technology; 2) engineering and detailed constructive execution of the project; 3) building site management.

The timber-specific knowledge needed for the elaboration of the assignment is acquired through a methodology mix:

- Self-study using the provided teaching materials and technical literature (available on the project´s E-learning platform).
- Face-to-face lectures from teachers and experts from the construction industry (available on the project´s E-learning platform).
- Best-Practice Examples (available on the project´s E-learning platform).
- Analysis of case studies: development of technical reports.
- Elaboration of timber-specific questions with focus on construction systems, building physics and site management (fact sheets: available on the project´s E-learning platform).
- Excursions to timber production halls and construction sites to gain practical/ real-life experience.
- Guidance through experts from the construction industry.

During the elaboration of the assignment the teachers give continuous supervision to the students, providing direct feedback and answering questions and thus guarantee the quality of the elaborated projects.

ACADEMIC PROGRAMMES AND UNIVERSITIES

The following chapter introduces the collaborating universities and their programs, where the module is to be implemented.

Originating Institution, Department	**Module Co-ordinator(s)**
Riga Building College	Linda Krage
Klaipedos Valstybine Kolegija	Dainora Jankauskiene
FH-Campus Wien	Martin Aichholzer, Elena Mitrenova
Cracow University of Technology	Łukasz Wesołowski
Häme Ammattikorkeakoulu Oy	Cristina Tirteu

PROGRAMME(S) IN WHICH TO BE OFFERED

Institution	**Programmes**
Riga Building College	Architectural Technology
Klaipedos Valstybine Kolegija	Civil Engineering
FH-Campus Wien	Architecture - Green Building
Cracow University of Technology	Architecture / Architecture and urbanism
Häme Ammattikorkeakoulu Oy	Construction Engineering / Site Management

LEARNING OUTCOMES AND ASSESSMENT

By completing the module, students will master the following learning outcomes (LO1, LO2, LO3), achieved through the four lectures and three project-based exercises described further on in the document.

Learning Outcomes of the module[10]	***Methods of study***	***Assessment Criteria***	***Assessment methods of student achievements***	***Achievement level indicators***
LO1. Design a multi-storey timber building with architecture quality; Apply different timber constructions (load bearing systems)	PBL Lectures Literature analysis Case studies Independent study	Demonstration of knowledge about timber construction systems and load bearing properties and critical application during the creative process/arch. decisions; highlighting the weaknesses and strengths of each system.	☒ Problem solving questions ☐ E-tests ☐ Regular tests ☒ Problem solving tasks ☒ Projects ☒ Peer evaluation ☐ Automated feedback ☒ Final evaluation ☐ Other:	***Threshold:*** Evidence of basic understanding of timber construction systems and poor application according to the design requirements. ***Typical:*** Evidence of good understanding of timber systems and application according to the design requirements. ***Excellent:*** Evidence of excellent understanding of timber constructions systems, their load bearing properties and influence on the design requirements; creative incorporation of this analysis into the design process.
LO2. Develop details of building elements (superstructure catalogue) considering physical-	PBL Lectures Literature analysis Case studies Independent study	Demonstration of knowledge about the physical-technical properties of timber and its	☒ Problem solving questions ☐ E-tests ☐ Regular tests ☒ Problem solving tasks ☒ Projects	***Threshold:*** Evidence of general understanding of the physical and structural properties of timber and poor application by the development of the superstructure catalogue

[10] Learning outcomes are specified in three categories – as **knowledge, skills and competence**. This signals that qualifications – in different combinations – capture a broad scope of learning outcomes, including theoretical knowledge, practical and technical skills, and social competences where the ability to work with others will be crucial. Please refer to Cedefop (2017). Defining, writing and applying learning outcomes: a European handbook. Luxembourg: Publications Office of the European Union. https://www.cedefop.europa.eu/files/4156_en.pdf.

technical properties of timber		critical application by the development of the superstructure catalogue	☒ Peer evaluation ☐ Automated feedback ☒ Final evaluation ☐ Other:	***Typical:*** Evidence of good understanding of the physical and structural properties of timber and application by the development of the superstructure catalogue
				Excellent: Evidence of excellent understanding of the physical and structural properties of timber; creation of successful sound/heat/fire/moisture protection concepts that are incorporated successfully in the superstructure catalogue
LO3. Develop building site management concept for a multi-storey building	PBL Lectures Literature analysis Independent study	Demonstration of ability to plan and organise the erection of timber projects: dimensions, cost estimation, transport, montage, logistics; effects of selected variants, advantages/ disadvantages; Critical application on a project	☒ Problem solving questions ☐ E-tests ☐ Regular tests ☒ Problem solving tasks ☒ Projects ☒ Peer evaluation ☐ Automated feedback ☒ Final evaluation ☐ Other:	***Threshold:*** Evidence of general understanding of planning and organising timber construction projects
				Typical: Evidence of good understanding of planning and organising timber construction projects
				Excellent: Evidence of excellent understanding of planning and organising timber construction projects; Successful development of a building site management concept

LECTURE TOPICS – CONTENT AND DESCRIPTION

The individual lectures of the module are organized into 4 courses, each with 15 SWS (academic attendance hours), corelating to 1 ECTs. In this way, the lectures can also be held separately as theoretical courses, independent from the practical project-based exercises.
The knowledge transfer of the lectures is supported by small tasks, which are described in more detail in the *Assignment Book* of the project and were tested as preparatory tasks during the three intensive courses C2, C4 and C6.

Nr	Theoretical Courses (Lectures)	Learning outcomes	Number of hours	Individual study	ECTs
1.	Architectural Design in Timber – Introduction	LO1	15h	10h	1
2.	Advanced Architectural Design in Timber	LO1 & LO2	15h	10h	1
3.	Timber Engineering	LO2	15h	10h	1
4.	Building Site Management and Building Process with Timber	LO3	15h	10h	1
		TOTAL:	**100**		**4**

Lectures	Duration
1. Architectural Design in Timber – Introduction	**15h / 1 ECTs**
Introduction – Global Environmental Issues. Why timber?	1h
Architecture – How to think/design in timber?	1,5h
History of (multi-storey) timber construction	1,5h
Forestry and Sustainable Aspects (Grey Energy, Efficiency, Economy, Economic Aspects, Regional Value Creation)	2h
Best practice: details, construction, architecture	1,5h
Building materials from tree to slab to "by-products"	1,5h
Static requirements – Introduction	2h
Introduction in Building physics – Heat / Sound / Moisture management	1h
Introduction in Building physics – Fire protection	1h
Building Construction: Plan generation and structural drawing	1h
Museum in Marszewo – first CLT public building in Poland - case study	1h
2. Advanced Architectural Design in Timber	**15h / 1 ECTs**
Production, interfaces, quality assurance, craft, prefabrication, details	1h

Tendering, structural systems, elements	1h
Timber technology, construction, connections, structural systems	1,5h
Timber technology, construction, connections, structural systems (company presentation)	1h
Timber BIM modelling. IFC and Operation and Maintenance	1,5h
CLT Production, Planning, Design	1,5h
Facade finishing types (construction/materials)	1h
Wooden facades, plaster systems	1h
Flat roof solutions (construction, materials)	1h
Interior finishing (walls, ceilings, floors)	1h
Balcony design and construction	1h
Openings (window and door fixing)	1h
Building installations - prefabrication wet rooms (onsite/partly prefab/prefab)	1,5h
3. Timber Engineering	**15h / 1 ECTs**
Architecture for timber engineers	1,5h
Introduction to engineered timber systems and components	1,5h
Structural systems / Building mechanics	2h
Introduction to Eurocodes / Eurocodes / EC5	2h
Advanced: Building physics - Heat / Sound / Moisture management	1,5h
Detailing for timber buildings	2h
Structural Systems – Elements	2h
Timber BIM modelling	1,5h
Design coordination (local regulations, fire protection)	1h
4. Building Site Management and Building Process with Timber	**15h / 1 ECTs**
Mapping the timber construction process	1,5h
Correlation of building construction parameters	1,5h
Structural systems and Building mechanic – installation chronology of load-bearing construction elements on the building site	1,5h
Moisture management on a building site	1,5h
Cost estimation for building life cycle assessment	1,5h
Cost estimation: Dimensions, transport, montage, and logistics	1,5h

BCF workflow and digital processes (coordination, construction, maintenance)	1,5h
Logistics – transportation, montage, timeline, coordination of companies*	1,5h
Best-practice examples of large-scale international projects in timber (company presentation)	1,5h
Sustainability concept – recyclability and dismantling strategies with timber*	1,5h
TOTAL	**60h / 4 ECTs**

1. Architectural Design in Timber – Introduction

Timber construction has gained significant attention as a sustainable and versatile building material. This course provides a comprehensive understanding of global environmental issues related to timber construction, explores the architectural aspects of designing with timber, examines the historical context of multi-storey timber construction, and delves into forestry and sustainable practices. Participants will learn about best practices, construction techniques, building materials, static requirements, building physics, and case studies of notable timber structures. The course aims to equip students with the knowledge and skills to effectively utilize timber in modern architectural design while considering environmental and sustainability factors.

1. LEARNING OUTCOMES (LO1)

By the end of the course, the students will be able to:

- Understand the global environmental issues associated with construction materials and why timber is a preferred choice in sustainable building practices.
- Acquire architectural thinking and design principles specifically tailored to timber construction projects.
- Explore the historical development and evolution of multi-storey timber construction methods.
- Comprehend the static and building physics requirements necessary for timber structures and their design implications.
- Trace the journey of timber from its raw form to the production of slabs and other by-products used in construction.
- Explore best practices for timber construction, including details, construction techniques, and architectural considerations.

2. CONTENT / INDIVIDUAL LECTURES

1.1. Introduction – Global Environmental Issues. Why timber?
1.2. Architecture – How to think/design in timber?
1.3. History of (multi-storey) timber construction

1.4. Forestry and Sustainable Aspects (Grey Energy, Efficiency, Economy, Economic Aspects, Regional Value Creation)
1.5. Best practice: details, construction, architecture
1.6. Building materials from tree to slab to "by-products"
1.7. Static requirements – Introduction
1.8. Introduction in Building physics – Heat / Sound / Moisture management
1.9. Introduction in Building physics – Fire protection
1.10. Building Construction: Plan generation and structural drawing
1.11. Museum in Marszewo – first CLT public building in Poland – Case study

3. ECTS	4. ACADEMIC HOURS
1 ECTs	15 SWS (+10h individual studies)

5. ASSESSMENT CRITERIA

Assessment Methods	Test, group discussion, presentations of best practices
Fail	The student fails to meet the minimum requirements.
Satisfactory	The student has basic understanding of the topics (40% in Test)
Good	The student has good understanding of the topics (60% in Test)
Very good	The student has good understanding of the topics (80% in Test)
Excellent	The student has advanced understanding of the topics (90%+ in Test)

6. SIGNIFICANCE FOR THE GOALS OF THE CURRICULUM

The course offers a general overview of the important aspects of timber constructions and thus serves as an introduction to the topic. It provides the basic knowledge needed to design a timber building.

7. DIDACTIC METHODS

The didactic methods implemented in the course are blended-learning and research-based learning – review of technical literature and video materials; analysis of best practices [Assignment Book]

8. TEACHING MATERIALS

Lectures, video materials, technical literature, case studies of timber buildings [O4 Best Practices], materials on the project´s E-learning platform

2. Advanced Architectural Design in Timber

This course deals with advanced topics related to timber construction, focusing on production processes, quality assurance, prefabrication techniques, and construction systems. Participants will explore timber technology, construction methods, connections, and structural systems. The course also covers timber BIM modelling, CLT (Cross-Laminated Timber) production and design, facade finishing types, wooden facades and plaster systems, flat roof solutions, interior finishing, balcony design, openings for windows and doors, and building installations with a focus on prefabricated wet rooms.

1. LEARNING OUTCOMES (LO1 & LO2)

By the end of the course, the students will be able to:

- Acquire comprehensive understanding of advanced timber construction techniques.
- Gain the knowledge necessary for developing details for timber buildings.
- Gain insights into timber technology, construction practices, connections, and structural systems

2. CONTENT / INDIVIDUAL LECTURES

2.1. Production, interfaces, quality assurance, craft, prefabrication, details
2.2. Tendering, structural systems, elements
2.3. Timber technology, construction, connections, structural systems.
2.4. Timber technology, construction, connections, structural systems (company presentation)
2.5. Timber BIM modelling. IFC and Operation and Maintenance
2.6. CLT Production, Planning, Design
2.7. Facade finishing types (construction/materials)
2.8. Wooden facades, plaster systems
2.9. Flat roof solutions (construction, materials)
2.10. Interior finishing (walls, ceilings, floors)
2.11. Balcony design and construction
2.12. Openings (window and door fixing)
2.13. Building installations - prefabrication wet rooms (onsite/partly prefab/prefab)

3. ECTS	4. ACADEMIC HOURS
1 ECTs	15 SWS (+10h individual studies)

5. ASSESSMENT CRITERIA

Assessment Methods	Test, group discussion, presentations of elaborated timber-specific topics
Fail	The student fails to meet the minimum requirements.
Satisfactory	The student has basic understanding of the topics (40% in Test)

Good	The student has good understanding of the topics (60% in Test)
Very good	The student has good understanding of the topics (80% in Test)
Excellent	The student has advanced understanding of the topics (90%+ in Test)

6. SIGNIFICANCE FOR THE GOALS OF THE CURRICULUM

The course offers advanced knowledge of the important aspects of timber buildings needed for the design process.

7. DIDACTIC METHODS

The didactic methods implemented in the course are blended-learning and research-based learning – review of technical literature and video materials, elaboration of timber-specific topics [Assignment Book]

8. TEACHING MATERIALS

Lectures, video materials, technical literature, case studies of timber buildings [O4 Best Practices], [Fact sheets], materials on the project´s E-learning platform

3. Timber Engineering

This course provides timber engineers and architects with a comprehensive understanding of engineered timber systems, structural mechanics, Eurocodes, building physics and their influence on the design process. Participants will gain knowledge and skills essential for effective collaboration between architects and engineers in timber construction projects. Through theoretical lectures, elaboration of timber-specific topics and case studies, participants will develop a strong foundation in timber engineering principles, enabling them to contribute to the successful design and execution of timber buildings.

1. LEARNING OUTCOMES (LO2)

By the end of the course, the students will be able to:

- Comprehend the structural systems and building mechanics relevant to timber construction, enabling the design of efficient timber structures.
- Develop an advanced understanding of building physics principles related to heat, sound, and moisture management in timber buildings.
- Deepen the knowledge about developing details for timber buildings.
- Utilize timber BIM modelling to enhance the design and coordination process, improving communication and collaboration between different trades

2. CONTENT / INDIVIDUAL LECTURES

3.1. Architecture for timber engineers
3.2. Introduction to engineered timber systems and components

3.3. Structural systems / Building mechanics 3.4. Introduction to Eurocodes / Eurocodes / EC5 3.5. Advanced: Building physics - Heat / Sound / Moisture management 3.6. Detailing for timber buildings 3.7. Structural Systems – Elements 3.8. Timber BIM modelling. 3.9. Design coordination (local regulations, fire protection)	
3. ECTS	**4. ACADEMIC HOURS**
1 ECTs	15 SWS (+10h individual studies)
5. ASSESSMENT CRITERIA	
Assessment Methods	Test, group discussion, presentations of elaborated timber-specific topics
Fail	The student fails to meet the minimum requirements.
Satisfactory	The student has basic understanding of the topics (40% in Test)
Good	The student has good understanding of the topics (60% in Test)
Very good	The student has good understanding of the topics (80% in Test)
Excellent	The student has advanced understanding of the topics (90%+ in Test)
6. SIGNIFICANCE FOR THE GOALS OF THE CURRICULUM	
The course offers comprehensive knowledge on timber engineering principles	
7. DIDACTIC METHODS	
The didactic methods implemented in the course are blended-learning and research-based learning – review of technical literature and video materials, elaboration of timber-specific topics [Assignment Book]	
8. TEACHING MATERIALS	
Lectures, video materials, technical literature, case studies of timber buildings [O4 Best Practices], [Fact sheets], materials on the project´s E-learning platform	

4. Building Site Management and Building Process with Timber

This course focuses on the management aspects of timber construction projects, covering the entire construction process from mapping and correlation of parameters to logistics, cost estimation, digital processes, and sustainability considerations. Participants will learn about the installation chronology of load-bearing construction elements on the building site, moisture management, cost estimation for building life cycle assessment, BCF (Building Information

Modeling, Construction, Facility Management) workflows, logistics, and best-practice examples of large-scale international timber projects. The course also emphasizes the importance of sustainability concepts, including recyclability and dismantling strategies with timber.

1. LEARNING OUTCOMES (LO3)

By the end of the course, the students will be able to:

- Map the timber construction process, understand its stages, and identify the key parameters that impact the project's success.
- Understand the installation chronology of load-bearing construction elements on the building site and ensure proper sequencing for a smooth construction workflow.
- Estimate costs for building life cycle assessment, considering dimensions, transport, montage, logistics, and the overall economic viability of timber construction projects.
- Understand sustainability concepts related to timber construction, including recyclability and dismantling strategies, and integrate them into project planning and execution.
- Understand the management of timber construction projects, while considering environmental, economic, and logistical factors.

2. CONTENT / INDIVIDUAL LECTURES

4.1. Mapping the timber construction process
4.2. Correlation of building construction parameters
4.3. Structural systems and Building mechanic – installation chronology of load-bearing construction elements on the building site
4.4. Moisture management on a building site
4.5. Cost estimation for building life cycle assessment
4.6. Cost estimation: Dimensions, transport, montage, and logistics
4.7. BCF workflow and digital processes (coordination, construction, maintenance)
4.8. Logistics – transportation, montage, timeline, coordination of companies*
4.9. Best-practice examples of large-scale international projects in timber (company presentation)
4.10. Sustainability concept – recyclability and dismantling strategies with timber*

3. ECTS	4. ACADEMIC HOURS
1 ECTs	15 SWS (+10h individual studies)

5. ASSESSMENT CRITERIA

Assessment Methods	Test, group discussion, presentations of elaborated timber-specific topics
Fail	The student fails to meet the minimum requirements.
Satisfactory	The student has basic understanding of the topics (40% in Test)

Good	The student has good understanding of the topics (60% in Test)
Very good	The student has good understanding of the topics (80% in Test)
Excellent	The student has advanced understanding of the topics (90%+ in Test)

6. SIGNIFICANCE FOR THE GOALS OF THE CURRICULUM

The course offers comprehensive knowledge on building site management and construction process of timber buildings

7. DIDACTIC METHODS

The didactic methods implemented in the course are blended-learning and research-based learning – review of technical literature and video materials

8. TEACHING MATERIALS

Lectures, video materials, technical literature, case studies of timber buildings [O4 Best Practices], [Fact sheets], materials on the project´s E-learning platform

TASKS FOR PROJECT-BASED LEARNING – CONTENT AND DESCRIPTION

In addition to the theoretical knowledge transfer through the described courses, the achievement of the Learning Outcomes LO1, LO2, LO3 is accomplished through hands-on, project-based assignments that mirror the actual phases of timber building projects.

These exercises are extensively outlined in the project's Assignment Book and can be completed individually, similar to the theoretical courses. This approach allows universities and students to tailor the module curriculum based on their specific requirements and the students' prior knowledge.

Nr	Tasks	Learning outcomes	Number of hours	ECTs
1.	Design of a residential timber building	LO1	50h	3,5
2.	Construction solutions for a timber building	LO2	50h	
3.	Elaboration of building site management concept	LO3	40h	1,5
		TOTAL:	**140**	**5**

1. Design of a residential timber building

1. LEARNING OUTCOMES (LO1)

By the end of the course, the students will be able to:

- Understand timber constructions systems, their load bearing properties, and its effect on the design requirement.
- Acquire architectural thinking and design principles specifically tailored to timber construction projects.
- Comprehend the static and building physics requirements necessary for timber structures and their design implications.
- Creatively incorporate the acquired knowledge into the design process, resulting in the design of multi-storey timber buildings with high architectural quality

2. CONTENT

- Architectural design of 3 to 4 storeys residential building in timber
- Determination of the structural system and basic static calculations
- Considerations/concept regarding modularity, adaptability, conservation of resources in production, construction, operation, and dismantling
- Elaboration of all architectural plans
- Building a physical model
- Oral presentation of the project

The task is described in detail in the *Assignment Book* of the project

3. ASSESSMENT CRITERIA

Assessment Methods	Design project, oral presentation, physical model
Fail	The student fails to meet the minimum requirements.
Satisfactory	The student demonstrates poor understanding of timber construction systems and poor incorporation of the design requirements.
Good	The student demonstrates good understanding of timber construction systems and good incorporation of the design requirements.
Very good	The student demonstrates very good understanding of timber construction systems and very good incorporation of the design requirements.
Excellent	The student demonstrates excellent understanding of timber construction systems and excellent incorporation of the design requirements.

4. SIGNIFICANCE FOR THE GOALS OF THE CURRICULUM

	This course provides practical insights into creatively integrating the gained timber knowledge into the design process, thereby fostering the creation of multi-story timber buildings characterized by exceptional architectural quality.
5. DIDACTIC METHODS	
	The didactic methods implemented in the course are integral planning, project-based learning, learning by doing.
6. TEACHING MATERIALS	
	Lectures, video materials, technical literature, case studies of timber buildings [O4 Best Practices], materials on the project´s E-learning platform

2. Construction solutions for a timber building

1. LEARNING OUTCOMES (LO2)

By the end of the course, the students will be able to:

- Comprehend advanced static and building physics requirements necessary for timber projects.
- Create successful sound/heat/fire/moisture protection concepts.
- Develop details of building elements (superstructure catalogue) considering physical and structural properties of timber

2. CONTENT

- Comprehensive static analysis of the projects
- Modification of the architectural plans and building element dimensions
- Static calculations
- Superstructure catalogue with the connections (1:10 or 1:5): exterior wall-roof, exterior wall-ceiling, interior wall-ceiling, plinth (exterior wall), interior wall-roof, and cantilever components.
- Elaboration of a building physics concept: thermal insulation (u-value) and thermal envelope, seals and thermal breaks, impact, and airborne sound insulation (Rw, Lnw), and moisture protection.
- Considerations/concept regarding modularity, adaptability, conservation of resources in production, construction, operation, and dismantling
- Oral presentation of the project

The task is described in detail in the *Assignment Book* of the project

3. ASSESSMENT CRITERIA

Assessment Methods	Report with calculations and plans, oral presentation

Fail	The student fails to meet the minimum requirements.
Satisfactory	The student demonstrates poor understanding of the physical and structural properties of timber and poorly incorporates the knowledge in the developed details
Good	The student demonstrates good understanding of the physical and structural properties of timber and good incorporation of the knowledge in the developed details
Very good	The student demonstrates very good understanding of the physical and structural properties of timber and very good incorporation of the knowledge in the developed details.
Excellent	The student demonstrates excellent understanding of the physical and structural properties of timber and excellent incorporation of the knowledge in the developed details.

4. SIGNIFICANCE FOR THE GOALS OF THE CURRICULUM

This course provides advanced knowledge about structural and physical properties of timber as well as practical guidance for effectively integrating this knowledge into the development of connection details.

5. DIDACTIC METHODS

The didactic methods implemented in the course are integral planning, project-based learning, learning by doing

6. TEACHING MATERIALS

Lectures, video materials, technical literature, case studies of timber buildings [O4 Best Practices], materials on the project´s E-learning platform

3. Elaboration of building site management concept

1. LEARNING OUTCOMES (LO3)

By the end of the course, the students will be able to:

- Create successful preliminary building site management concepts for the projects, considering costs, logistics, moisture protection on the building site, transportation and dimensions of building elements, prefabrication, digital processes, life cycle assessment, and management of all involved trades.
- Build a section model in 1:20 scale, representing all storeys of the building, from the foundation to the roof, including the individual layers of the building elements.

2. CONTENT

Comprehensive analysis/report with the aspects:

- Construction: level of prefabrication, modularity, selected products, applied digital processes.
- Logistics: dimensions of building components, transportation, assembling, timeline and coordination of trades, moisture protection and management of the building site.
- Assembly sequence from the foundation to the roof in chronological order.
- Rough cost estimation.
- Sustainability concept: temporary approach and combinability, dismantling concept, life cycle considerations.
- Reflection on the entire design process

Oral presentation of the project

Section model (1:20)

The task is described in detail in the *Assignment Book* of the project

3. ASSESSMENT CRITERIA

Assessment Methods	Report, oral presentation, section model (1:20)
Fail	The student fails to meet the minimum requirements.
Satisfactory	The student demonstrates poor understanding of timber construction process and develops poor building site management concept
Good	The student demonstrates good understanding of timber construction process and develops good building site management concept
Very good	The student demonstrates very good understanding of timber construction process and develops very good building site management concept
Excellent	The student demonstrates excellent understanding of timber construction process and develops excellent building site management concept

4. SIGNIFICANCE FOR THE GOALS OF THE CURRICULUM

The course offers comprehensive and practical guidance for developing building site management concept of timber buildings.

5. DIDACTIC METHODS

The didactic methods implemented in the course are integral planning, project-based learning, learning by doing

6. TEACHING MATERIALS
Lectures, video materials, technical literature, case studies of timber buildings [O4 Best Practices], materials on the project´s E-learning platform

ASSESSMENT OF THE PROJECT-BASED TASKS:

Assessment components (in chronological order of submission/examination date)				
Type of assessment	Weighting, %	Duration *(if exam)*	Word count *(if essay or similar):*	Component pass required
Design of residential timber building	35%			Yes ☒ No ☐
Construction solutions for a timber building	35%			Yes ☒ No ☐
Building site management concept	30%			Yes ☒ No ☐
Total:	100%			

LEARNING MATERIALS

Core materials:

- Kapfinger, Otto; Kaufmann, Hermann. Wood Works, Springer Verlag, Wien-New York, 2011
- Kaufmann, Hermann; Krötsch, Stefan; Winter, Stefan: Manual of Multistorey Timber Construction. Detail Business Information: München, 2017

Supplementary materials:

- Pech, Anton: Holz im Hochbau. Theorie und Praxis, Birkhäuser: Basel, 2016
- Jeska, Simone; Pascha, Khaled Saleh: Neue Holzbautechnologien, Birkhäuser Verlag GmbH, Basel, 2015
- Lennartz, M. W., & Jacob-Freitag, S.: New Architecture in Wood. Birkhäuser: Basel, 2016
- Götz; Hoor; Möhler; Natterer: Holzbau Atlas, Institut für internationale Architektur-Dokumentation GmbH, München, 1980
- Swedish Wood: Design of timber structures. Volume 1: Structural aspects of timber construction, Stockholm, ed. 3, 2022
- Swedish Wood: Design of timber structures. Volume 2: Rules and formulas according to Eurocode 5, Stockholm, ed. 3, 2022
- Swedish Wood: Design of timber structures. Volume 3: Examples, Stockholm, ed. 3, 2022

- Laura Tupenaite, Ineta Geipele, et al. Sustainable Public Buildings Designed and Constructed in Wood. RTU Press, Riga 2020.
- Swedish Wood: The CLT Handbook. CLT structures – facts and planning, Stockholm, 2019
- Hans Joachim Blaß, Carmen Sandhaas: Timber Engineering. Principles for Design, KIT Scientific Publishing, Karlsruhe, 2017

Online resources:

- https://www.thinkwood.com/mass-timber [23.03.2022]
- www.proholz.at [06.06.2003]
- www.dataholz.eu [06.06.2003]
- https://efectis.com/en/external-thermal-insulation-composite-systems-etics/
- www.steico.com

REQUIRED IT RESOURCES

No.	Software, manufacturer
1.	CAD software: Revit/ArchiCad/AutoCad
2.	3D design software: Rhinoceros 3D/SketchUp/ Cinema 4D/ 3D Max
3.	Graphics and image editing: InDesign, Illustrator, Photoshop
4.	Statics & Building physics calculations: Physibel

COURSE MATERIALS

E-learning platform: https://learn.hamk.fi/course/view.php?id=10006
Fact Sheets – Booklet
Assignment Book
Best-Practice Examples (Case studies)