MODULE CURRICULUM

Originating Institution, Department	Module Co-ordinator(s)
VIA University College	Vijoleta Sulciene
Vilnius Gediminas Technical University	Laura Tupenaite, Tomas Gecys
Universitat Politècnica de Catalunya	Laia Haurie
Riga Technical University	Ineta Geipele
Technische Universitaet Wien	Kamyar Tavoussi

TITLE OF THE MODULE

Title of the module
"Design and Construction of Hybrid Engineered Timber Buildings"

PROGRAMME(S) IN WHICH TO BE OFFERED

The module is dedicated to architectural design, architectural technology, construction technology, civil engineering, real estate management and related BSc/BA specializations.

LEVEL OF STUDIES[1]

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

CREDITS AND LEARNING HOURS

ECTS Value[2]	Indicative academic learning hours[3]	Length (in Semesters)	Year in which to be offered
9 ECTS	225	1 or 3 semester(s)	2nd or 3rd

DISTRIBUTION OF LEARNING HOURS

Lectures + Excursion	Individual work	Practical project work (Project based learning)	Total
75	54	96	225

[1] 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

[2] 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

[3] 1 academic learning hour is equal to 45 minutes

ANNOTATION OF THE MODULE

In the European Union (EU), the construction sector is the largest consumer of raw materials as well as construction, and demolition activities account for about 33% of waste generated annually.

The implementation of policies to cut greenhouse emissions is acting as one of the key drivers for the modernization of the EU economy, directing investment and innovation to sectors with huge potential for growth and employment in the future. It is one of the core themes in any credible strategy to build sustainable prosperity for the future.

To reduce dependency on the non-renewable resources, it needs new alternatives especially in the construction sector. The demand can be relieved by recycling and substitution. Wood as a sustainable and an ecological material has an excellent chance to be an alternative construction material in urban areas. The renewable raw material wood is available in a sustainable way; the basic technologies are well known and good examples of timber-based building already exist. In the past few years, an increasing number of timber-based buildings have been constructed in Central and Western Europe e.g., multi-story condominiums, office buildings, single-family houses, schools and hospitals.

AIM OF THE MODULE

The aim of the module is to enable students to receive deeper professional knowledge, skills and competences on design and construction of engineered hybrid timber buildings, which will meet the needs of the HEIs and labor market representatives.

After successful completion of the **theoretical part + excursion**, students should be able to assess and evaluate the possible fields of application of hybrid timber buildings. They should be able to use basically the repertoires of hybrid timber constructions and they should also obtain the necessary knowledge in order to be able to develop and roughly dimension the structure and details of common hybrid timber constructions. Learning how to search and find the needed materials and tools for the purpose of design should also be trained.

By successful completion of the **practical project work (supported by the individual work using internet resources)** students should be able to acquire architectural and design possibilities of sustainable timber hybrid construction in the context of the requirements for flexible and adaptable buildings in order to optimize construction costs and time. Considering the aspects of statics, physics, adequate details and site management should be in focus, but also sustainability construction concepts like adaptation, design for disassemble, recovery and reuse of components and materials, as well as recyclability, are objectives of the course. The course offers a deepening in hybrid timber construction with regional regenerative building materials with high recycling potential.

LEARNING AND TEACHING STRATEGIES

The new module was developed in close consultation and cooperation with the business sector. The topic of education is focused on sustainable hybrid design and construction of multi-storey buildings from environmentally friendly material, timber.

A module of 9 ECTS in one semester is recommended.

Starting with **theoretical part (face to face Lectures)** in

-Architectural design with Timber (principals, case studies),

-Hybrid-Timber as a building Material (products, building physics),

-Construction with Timber (statics, facades, details, LCA),

-Cost estimation and Site Management (assembly and logistics)

will help students to get basic knowledge for their further work. If the course is held in one semester, the lectures can be held at the beginning, or can be spread over the semester.

If the course is spread over three semesters, the lectures can be held at the beginning of each semester, as it is shown in the table "LECTURE TOPICS". **One major excursion** (or many smaller excursions) can be the final event of the block "theoretical part". This (these) Excursion(s) to construction sites, architecture and engineering offices and production plants of wood products should be organised in order to gain practical experience.

The course is based on the education methodologies "project-based learning" and "learning by doing". A practical project work supported by the individual work of students using internet resources (blended learning). The students have to deliver and present three phases their final project. These phases are named and described in the table "TASKS FOR PROJECT-BASED LEARNING" (practical project work and individual work).

The students work in groups under supervision. All real-life phases should be experienced: Preliminary design, detailed planning and building site management. Through 3 presentations, the students should practice presenting their project as well as possible.

INTENDED LEARNING OUTCOMES AND ASSESSMENT

Learning Outcomes of the module[4]	***Methods of studies***	***Assessment methods of student achievements***	***Assessment criteria of students' achievements***
LO1. Knowledge and ability to assess and evaluate the possible fields of application of hybrid timber buildings. Learning how to search and find the needed materials and tools for the purpose of design.	Face to face lectures Excursion Blended learning Preparation for examination	Problem-based questions Written exam for theoretical part	Evidence of knowledge and understanding for architectural design of multi-storey buildings with timber products in addition with supplementary materials, statics and dynamics of hybrid-timber structures, developing of timber details in combination with other materials, LCA, cost estimation and site management.
LO2. Ability to design a multi-storey hybrid-timber building considering all relevant aspects; Ability to develop a building site management concept.	Project based learning Learning by doing Group work Blended learning	Project Problem-based questions Peer evaluation Evaluation of project presentations	Evidence of understanding of the strengths and weaknesses of hybrid timber construction and the proper application of acquired knowledge to implement a multi-story project, taking into account all important and relevant issues such as sound/heat/fire/moisture control concepts and load transfer. The construction phase should also be planned realistically.
LO3. Group work skills: Group work, critical thinking, problem solving skills	Project based learning Learning by doing Group work	Project Problem-based questions Peer evaluation Evaluation of project presentations	Evidence of group work, critical thinking, problem solving skills.

[4] 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.

MARK CALCULATION (IF THE MODULE IS OFFERED IN ONE SEMESTER):

Type of assessment	Weighting, %	Duration *(if exam)*	Component pass required
Written exam for (theoretical part) Hybrid Timber Structures + Excursion (3 ECTS)	34	90 minutes	Yes
First period assessment of the practical project work and individual work (2 ECTS)	22	30 minutes, including questions	Yes
Second period assessment of the practical project work and individual work (2 ECTS)	22	30 minutes, including questions	Yes
Third period assessment of the practical project work and individual work (2 ECTS)	22	30 minutes, including questions	Yes

LECTURE TOPICS *(theoretical part)* Hybrid Timber Structures + Excursion (3 ECTS)

No.	Topic	Number of hours
1.	PBL and sustainability	5
2.	Architectural design with Timber (principals, case studies)	10
3.	Hybrid-Timber as a building Material (products, building physics)	10
4.	Construction with Timber (statics, facades, details)	25
5.	Site Management (assembly and logistics)	8
6.	Excursion(s)	17
	Total:	**75**

TASKS FOR PROJECT-BASED LEARNING *(practical project work and individual work)*
Because the course must be structured in such a way that a 9 ECTS course could be held in one semester as well as 3 times 3 ECTS courses, the structure is made this way:

No.	Task	Number of hours
1.	**Phase I:** In the first period, the students work on a (semi-) real hybrid timber building project and share different skills according to their specialization and prepare Brief and Outline proposals that will include Clients' and Architects' project program, location and floor plans, facades and sections, room and wet room layouts, structural design, fire precautions, floor and wall partitions, acoustic airborne and impact sound, moisture and cold bridge prevention, building services pathways, choice of materials and building components, important key assembly details (sketches to scale), façade cladding, roof construction, balcony design and construction, external building components insulation and stair enclosure and stairways.	**50 (32+18)** (Practical project work + individual work of students by using internet resources)

2.	**Phase II:** In the second period, the students scrutinize and analyze Brief and Outline proposals from the period 1, and produce the following: drawings, documents, buildability, solving key construction details, module grid, floor plans, room drawings including kitchen and bathroom, roof plan and construction, east elevation, west elevation, north elevation, south elevation; structural calculations and load bearing fittings, cross section and part sections, building component log, calculation of CO_2 emissions regarding production and transport of building materials including dimensions, sizes and modules engineered timber system(s) and group project planning.	**50 (32+18)** (Practical project work + individual work of students by using internet resources)
3.	**Phase III:** In the last period, the students scrutinize and analyze the scheme design phase from phase 2 and produce documentation/drawings/calculations for implementation on the building site consisting of: life-cycle costing, cost estimation, bills of quantities, bidding lists, material specification/work specification/quantity surveying; construction technology, timber erection plan, cranes/lifting gear, temporary structural support, moisture protection and control on site, recycling; construction management, safety on site and site meeting, construction time chart/manning plan, building site plan/organization on site, plant & plant hire, tender contract/subcontractor work, invitation to tender/tender time line, quality assurance on site, negotiations and group planning.	**50 (32+18)** (Practical project work + individual work of students by using internet resources)
	Total	**150**

LEARNING MATERIALS

Core materials

1. Moodle platform: **https://www.hybridtimber.eu/moodle/**
2. Kaufmann, H., Krötsch, S., & Winter, S. (2022). Manual of Multistorey Timber Construction. Principles – Constructions – Examples. DETAIL. https://doi.org/10.11129/9783955535827
3. Swedish Wood. (2011). Design of timber structures. https://www.swedishwood.com/publications/list_of_swedish_woods_publications/design-of-timber-structures/
4. Forest Products Laboratory. (2021). Wood handbook: Wood as an engineering material (General Technical Report FPL-GTR-282). Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. https://www.fs.usda.gov/research/treesearch/62200
5. Thomas, H. R., & Ellis Jr., R. D. (2017). Construction Site Management and Labor Productivity Improvement: How to Improve the Bottom Line and Shorten the Project Schedule. ASCE.

6. Trade working environment council for Building and Construction. Manual - working environment in building and construction (1st ed.). https://bfa-ba.dk/wp-content/uploads/2020/12/Haandbogen-2020-engelsk.pdf
7. Cooper, R., & Murphy, E. (2016). Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry in the Classroom (Hack Learning Series). Times 10 Publications.

Online resources

1. ARUP. Rethinking timber buildings. https://www.arup.com/perspectives/publications/research/section/rethinking-timber-buildings
2. Swedish Wood. https://www.swedishwood.com/
3. Binderholz. Glulam. https://www.binderholz.com/fileadmin/user_upload/pdf/products/glulam.pdf
4. Hasslacher. Glued ceiling systems. The high-performance ceiling system. https://www.hasslacher.com/data/_dateimanager/broschuere/HNT-Brettstapelsystemdecke-EN.pdf
5. Stora Enso. CLT by Stora Enso. Technical brochure. https://www.storaenso.com/-/media/documents/download-center/documents/product-brochures/wood-products/clt-by-stora-enso-technical-brochure-en.pdf
6. KLH. Rib elements. https://www.klh.at/wp-content/uploads/2019/09/klh-rib-elements-en.pdf
7. Think Wood. Mass timber. https://www.thinkwood.com/mass-timber
8. Værdibyg. The sustainable construction process. https://vaerdibyg.dk/vejledning/the-sustainable-construction-process/

REQUIRED IT RESOURCES

No.	Software, manufacturer
1.	MS Office (Word, Excel, Power Point, Project)
2.	Adobe Acrobat Reader
3.	Finite element software Dlubal Rfem
4.	Revit/ArchiCad/AutoCad
5.	https://www.klhdesigner.at
6.	https://calculatis.storaenso.com/