World Conference on
Timber Engineering
Oslo 2023

HIBIWOOD – DIDACTIC APPROACHES FOR ACADEMIC EDUCATION ON MULTI-STOREY TIMBER BUILDINGS

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ABSTRACT: Due to climate change, political and societal demands for the greening of the building sector are increasing. The use of regionally renewable building materials, such as wood, is recognised as one of the main strategies whose potential cannot be fully exploited due to the lack of specialised know-how in the building sector. The present project responds to this challenge through a cross-border cooperation between five European universities. The partnership aims to conduct strategic research on the conditions necessary for the design and construction of multi-storey timber buildings, and to develop guidelines and principles to align the demands of the building sector with current academic education. The transdisciplinary elective module, developed through three international workshops and combined with innovative teaching and learning methods such as problem-based learning (PBL) and integral planning, provides students with specialized training in timber design methods and prepares them for the global requirements and changing demands in the construction industry.

KEYWORDS: cross-border academic cooperation, multi-storey timber buildings, transdisciplinarity, problem-based learning, integral planning, didactic approaches, academic education

1 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.

2 HIBIWOOD – PROJECT DESCRIPTION AND OBJECTIVES

The project HiBiWood is implemented within the framework of ERASMUS+ Strategic Partnerships for Higher Education. It 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 five European universities (FH Campus Vienna, Austria; HAMK Finland; RBC Latvia; Cracow University of Technology, Poland and KVK 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.

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https://doi.org/10.52202/069179-0598

Focus of the project is the assessment of the framework conditions and requirements for planning and implementation of multi-storey timber buildings in the partner countries. A comprehensive survey was conducted among over 100 companies and experts within the timber construction industry, using a combination of questionnaires and expert interviews as the data collection methods. The results of the survey indicated a critical need for skilled workers within the timber construction sector. Over 70% of the respondents indicated that recent graduates lack the fundamental knowledge and expertise in timber construction. An analysis of the data revealed that a lack of familiarity with the matter among architects is crucial for the timber construction industry, as architects who were not well-versed with the material were unlikely to design wooden buildings due to time and respectively financial constraints. Furthermore, architects who are specialized in the subject often face challenges in finding contractors to execute their buildings.

A comparison of the markets in Austria and Finland with those in Poland, Latvia, and Lithuania showed that the former had a significant advantage due to the presence of companies producing high-quality timber building products. In contrast, the need to import them in the latter countries results in increased costs for erecting timber buildings and consequentially in a significantly smaller percent of constructed multi-storey timber buildings nationwide. Although all the analysed countries have traditional wooden constructions, projects of modern high-performance timber buildings are still mainly limited to the scale of single-family houses. Multi-storey residential buildings and larger-scale structures using wood construction are scarce in the case of Poland, Latvia, and Lithuania, and underrepresented in the case of Austria and Finland. However, due to political interest and related strategic programs promoting timber construction in Austria and Finland, there has been a growing trend of constructing multi-storey wooden buildings in these countries.

This tendency is also reflected in the education and training programs for timber construction specialists. Strategic research on available timber-related education in the respective countries is conducted with the aim to identify gabs and inconclusiveness with the requirements of the construction industry. In Poland, Latvia, and Lithuania, timber construction topics are minimally included in educational programs, while in Finland and Austria, they are widely offered as part of the bachelor's and master's programs in architecture and civil engineering at various universities and universities of applied sciences. In some cases, the topic is becoming increasingly essential to construction studies due to the high demand for multi-story timber buildings.

However, educational analysis and company surveys indicate an inconsistency between the programs offered and the graduates' perceived lack of real knowledge and know-how by the companies. The complex nature of timber construction may explain these results, as the design and implementation of timber buildings require a comprehensive understanding of various legal, planning, technical, economic, and logistical aspects. Knowledge transfer of these aspects should occur gradually and simultaneously, as close to reality as possible and in an interdisciplinary way, to create a tangible and long-term understanding of the matter.

Based on the analysis, guidelines and principles are developed jointly by the universities. 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. 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.

3 DIDACTIC APPROACH AND METHODOLOGY

At the core of the didactic concept of the module is the PBL method (problem-based learning) [5] [6] – 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. Three workshops are held as part of the project (Vienna 2021, Cracow 2022, and Riga 2023), which serve as test runs for the development of the module curriculum. Each workshop focuses 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 workshops require the collaboration and mutual understanding of the different disciplines involved, while visits to timber construction companies provide a realistic picture of acute challenges in the timber construction industry. The following subchapters will give an overview of the concrete didactic approaches and the tasks of the individual workshops.

3.1 WORKSHOP VIENNA 2021 – ARCHITECTURAL DESIGN AND "THINKING" IN TIMBER

Bachelor students of architecture, building site management and civil engineering enrolled in the 2nd and 3rd year of their respective programs were brought together within an international and integral design workshop. Having a team of different disciplines involved and working together from the conceptual phase is essential for optimizing the design process and increasing prefabrication level of timber buildings. A well-coordinated team encourages creativity while simplifying the design. This approach minimizes confusion and misunderstandings between team members, resulting in a more streamlined planning process. The diverse

https://doi.org/10.52202/069179-0598

perspectives of an interdisciplinary team allow for early identification of interdependent planning decisions and their consequences, providing a solid foundation for making informed decisions in the early stages of the project.

Nevertheless, the project faced some challenges regarding this approach. A comprehensive knowledge across various disciplines simultaneously, including structural systems, building physics, and timber technology is required for the design phase of wooden buildings. The lack of education in timber construction offered in the partner universities resulted in limited prior knowledge among the participants. To adequately apply the PBL-method in the design of a timber building, students must be brought up to an appropriate level of knowledge and taught how to "think in timber" – conceptualize construction using timber as a primary material. The issue was addressed through a preparatory exercise in which students were organized into groups of 5 and assigned the task of analysing an existing timber building using specified criteria. The parameters for analysis were: 1) architecture: concept, typology, plans, urban integration, flexibility; 2) structural system: vertical and horizontal load transfer, bracing; 3) building construction: timber technology, details, assembly site and construction process, tendering process, joining technology; 4) building physics: sound, head and moisture management, fire protection; 5) sustainability concept: social, ecological (life cycle assessment), and economical; dismantling strategies. The comprehensive theoretical and technical research and analysis served as a foundation for future elaboration of the workshop assignment.

The two-week workshop was conducted in September 2021 at the University of Applied Sciences Campus Vienna. The thirty students from the five universities who participated in the project were organized into six multidisciplinary teams. Each team was composed of three architects and two representatives from the fields of civil engineering and/or building site management.

The primary objective of the project was to create high-quality residential units with flexible planning and direct access to outdoor spaces. To achieve this, the focus of the project development was to explore and exploit the potential of industrial prefabrication, including an organized configuration grid with high architectural quality that allows modular-based construction with the possibility of small modifications for customisation. The workshop tasked the students to design a multi-storey timber building with 3 to 4 storeys tailored to the needs of young people and young families. The design should include individual flats with sizes of 30 to 45 m2 and larger ones of approx. 60 to 90 m2, with the possibility that two small flats could be merged into one bigger flat. Additional common areas, community rooms, gardens and a bicycle storage room should be included for better usability of the residential area and staircase. The construction should meet the criteria of an Austrian construction class III and the maximum building height should not exceed 11 meters. Furthermore, the design had to be quick and cost-effective, with innovative serial or modular construction, high architectural quality, and the greatest possible conservation of resources in production, construction, operation, and dismantling. In terms of sustainable conceptualisation, the life cycle aspect, and the question of reuse (resource-saving, dismantling, and recycling) were also highlighted.

The project partners provided continuous guidance and supervision to the students throughout the duration of the assignment, as well as face-to-face lectures that covered the essential planning aspects of timber buildings. These lectures were introductory in nature and aimed to provide a comprehensive understanding of the various criteria needed for the design process of timber constructions, such as architectural planning and specific requirements for the design process; forestry and sustainable aspects; structural systems and static requirements; timber technology and products; tendering, structural systems and elements; building physics - sound, moisture, heat, fire protection.

To ensure a real-life learning experience, two field trips were organised. The students visited the timber production hall of the Austrian company "Handler Group" and were given an inside-view of the prefabrication process of building elements. Additionally, a visit was paid to the timber construction site of "Forum Am Seebogen" in Seestadt Aspern, Vienna, which was designed by the architectural studio "heri @ salli" and executed by the construction company "Strobl Bau GmbH". This gave the students a first-hand experience of a timber and modular construction site.

As the final output of the workshop, the students prepared a presentation of their projects, along with a poster containing all plans, basic calculations, and a physical model. This was then presented and defended in front of a jury.

The constructability of the project was evaluated through a structural analysis and design, which identified the vertical and horizontal load transfers and estimated the dimensions of the main elements. As a result of the workshop, the students gained an excellent understanding of timber constructions systems, their load bearing properties, and its effect on the design requirement. This understanding enabled them to creatively incorporate the analysis into the design process, resulting in the design of multi-storey timber buildings with high architectural quality.

3.2 WORKSHOP CRACOW 2022 – CONSTRUCTION SOLUTIONS AND DETAILING IN TIMBER

The second instalment of the HiBiWood workshops took place over a period of two weeks, commencing in May of 2022, at the Cracow University of Technology (CUT). It was attended by thirty-six participants, two-thirds of whom were architects. The task of the workshop was to build on the projects designed in Vienna and develop details of building elements (superstructure catalogue) considering the physical and technical properties of timber. Of the participants, eight had also attended the workshop in Vienna and were able to explain the peculiarities and development of the projects to the additional participants.

During the workshop, the lecturers encountered again the issue of heterogeneous knowledge levels among the students regarding timber buildings. To mitigate this discrepancy, a preparatory exercise was conducted. The students were divided into pairs and assigned to write a two-page short paper in response to a question focused on either building physics or structural aspects of timber constructions. The aim of these questions was to equip the participants with a foundational understanding of the aspects, prior to engaging in the main workshop task. The questions covered the topics of vertical and horizontal load transfer and bracing; cantilever structures; roof, ceiling, and wall systems; airborne and impact insulation; decoupling; summer suitability in timber buildings; moisture protection; air tightness; systematization and prefabrication. The students who effectively addressed these questions were designated as subject matter experts and were available to provide guidance and support to their peers besides the supervisors during the workshop activities.

The initial phase of the main workshop assignment involved a comprehensive static analysis of the projects. This analysis comprised of the explanation of the structural grid, the transfer of vertical and horizontal loads through the primary and secondary constructions and bracing concept, and the examination of the foundation and roof system spanning. Based on the results of this assessment, the selected timber technology was re-evaluated, and necessary modifications were made to the architectural plans and building element dimensions.

Subsequently, informed decisions regarding the building systems were made, including the selection of roof systems (warm roof vs. cold roof) and the explanation of ventilated structures, the selection of wall systems (bar-shaped, flat components, mixed forms) and their bracing, prefabricated elements and modules, and constructive moisture protection. The facade design was also evaluated with regards to its energy efficiency, and the construction system of cantilevers was considered. These decisions were based on a sustainability concept that emphasized the temporary approach, combinability, and dismantling potential of the building.

The final objective of the task was to develop a superstructure catalogue that detailed the connections of exterior wall-roof, exterior wall-ceiling, interior wall-ceiling, plinth (exterior wall), interior wall-roof, and cantilever components. These details were created in a scale of 1:10 or 1:5 considering important aspects such as the thermal insulation (u-value) and thermal envelope, seals and thermal breaks, impact and airborne sound insulation (Rw, Lnw), and moisture protection.

The task was executed through comprehensive, in-depth face-to-face lectures that built on the knowledge acquired during the first workshop. They had a profound emphasis on construction engineering and building physics, encompassing topics such as structural systems and mechanics, Eurocodes, thermal insulation, soundproofing, and moisture management. Additionally, they were specifically geared towards the elaboration of constructive details. The deepened examination of roof, ceiling, wall systems, openings, facade finishes, interior finishes, and cantilevers was emphasized in the context of prefabrication and utilization of digital tools. Furthermore, a practical exercise was provided to the participants aiming to reinforce their understanding of how to develop appropriate details that meet project specifications and technical requirements.

The examination of building physics with regards to longevity, durability, and sustainability was performed. An assessment of appropriate regional and low-carbon materials was carried out and fire protection, noise insulation, and moisture control were analysed. In addition, initial considerations were made regarding the assembly sequence of the construction elements. Skills related to communication and project management were developed, including the ability to plan collaboratively, make informed decisions, and integrate interdisciplinary knowledge.

As a result, the students demonstrated an in-depth understanding of timber's physical and technical properties. They were capable of effectively incorporating sound, heat, fire, and moisture protection concepts into the projects, which were successfully integrated into the elaborated constructive details.

3.3 WORKSHOP RIGA 2023 – BUILDING SITE MANAGEMENT AND BUILDING PROCESS WITH TIMBER

The final HiBiWood workshop, the third in a series of two-week workshops, will be held at the Riga Building College (RBC) in March 2023. It will concentrate on the aspects of required planning processes and building site management in the construction of timber buildings. Thirty-three bachelor students of architecture, building site management and civil engineering from the five partner universities will continue the work on the projects in small international and interdisciplinary groups, following the didactic approaches (integral planning and problem-based learning) of the previous two workshops. For the successful elaboration of the tasks is to be ensured that at least one participant per group is enrolled in a program of building site management.

To establish a shared knowledge base among the participants, the topics/ fact sheets developed during the second workshop are peer-reviewed by the project partners and utilized as teaching materials. Participants should familiarize themselves with the materials as preparation for the third workshop. During the workshop a random assignment process is to be employed to allocate a topic to each student. Subsequently, the students will be expected to collaboratively present the main points of the assigned topic, alongside some of their peers. This method will provide a solid knowledge foundation, which will be built upon by the lectures and workshop activities.

The assignment during the workshop involves the development of preliminary building site management concepts for the projects. Students are expected to consider various factors such as: 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. By incorporating these aspects, students will be able to transition from planning to implementation and erection phase of the buildings. This know-how will have several benefits for the building process, including reduced time and costs, improved quality and life-cycle

https://doi.org/10.52202/069179-0598

optimization, and enhanced communication and transparency.

At the conclusion of the workshop, students will be able to understand the workflow of construction processes in timber, assess the advantages and disadvantages of various structural systems and building components, understand the impacts of changes, and make informed decisions. They will submit and present a report to a jury, including the topics of: 1) construction: level of prefabrication, modularity, selected products, applied digital processes; 2) logistics: dimensions of building components, transportation, assembling, timeline and coordination of trades, moisture protection and management of the building site; 3) assembly sequence from the foundation to the roof in chronological order; 4) rough cost estimation; 5) sustainability concept: temporary approach and combinability, dismantling concept, life cycle considerations; 6) reflection on the design mistakes from the first workshop that could be identified as roots of the encountered challenges and rectified in light of the acquired knowledge.

In addition to the report, students are expected to select one of the projects and construct a physical 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. The model should be capable of being disassembled into the individual components, visualizing the chronological order of erection, building element dimensions by the transportation, prefabrication level, assembly process, and dismantling concept.

These assignments aim to create a tangible understanding of the process of erecting a timber building and require effective coordination, time management, and teamwork. Through implementation of this approach, the participating students can acquire and enhance their abilities in communication, project management, and interdisciplinary planning.

The elaboration of the assignments will be supported by in-depth face-to-face lectures on cost estimation, digital approaches, prefabrication, transportation, logistics, and dismantling. Leading timber construction companies are invited to present their building site processes, as well as best-practice examples of successful large-scale international projects in timber, with the aim to provide students with real-world insights. A comprehensive training session will be held at the beginning of the workshop with the aim to illustrate the corelation between the parameters: physical properties, costs, and sustainability of building materials. This approach will equip students with the crucial abilities to make well-informed choices regarding building material selection during the implementation phase of the projects. Continuous oversight by the supervisors aids in the elaboration of the assignments and guarantees the high quality of the completed projects.

As a result of the workshop, students will have a holistic and tangible understanding of the planning and execution process of multi-storey timber buildings. They will be able to make informed decisions and changes considering costs, logistics, and sustainable requirements, and incorporate them into a rough building site management concept.

4 RESULTS

The present publication reports on the outcomes of the first two international workshops that were completed at the time of writing.

Following the completion of the workshop in Cracow, six design projects were developed with a high level of detail. The didactic approaches implemented in the workshops demonstrated significant advantages in the elaboration of these projects. The use of wood as a building material motivated the students to incorporate sustainable aspects in their designs and to minimize the impact of the buildings on the environment. Sustainability concepts, such as green roofs, unsealing and leaving green areas free, screws instead of glue for joining components, sustainable insulation materials, and self-generated energy systems (including solar panels, heat pumps, district heating, and rainwater collection ponds) were integrated into the projects.

The students' elaborated plans, characterized by a compact design and simple shape, won the jury's approval. This simplicity encouraged cheaper and more creative solutions, and the projects included flexible internal walls that allowed for adaptation to the residents' needs and living situations. Furthermore, smaller units were designed to optimize cost and space efficiency.

Cross-laminated timber (CLT) was chosen as the primary construction material for most of the projects due to its durability, sustainability, and personal contact with Stora Enso employees during the first workshop in Vienna. During the second workshop, the students identified some oversized components in their designs, which were corrected to save material according to the corresponding load calculation. Some of the projects had also used CLT in the partition walls, which were replaced with lightweight frame structures in the second workshop.

The projects were characterized by a clear configuration grid with high architectural quality that facilitates the repetition of building elements for a modular-based construction, with small adaptations for customization. The students also prepared detailed planning of the repeating building elements (number, size, and endings for transport purposes), which had a prefabrication degree of over 80%. They selected local production companies to minimize transport costs and relied on a few suppliers. The selection of materials was based on an assessment of the correlation between durability of the materials during the life cycle and their costs. Façades and balconies were designed to be easily degradable and exchangeable due to the different life cycles of the individual building components.

Initial concept for the construction process was also developed that employed cost and time optimization strategies while minimizing the local area's exposure to traffic, noise, and dust due to the high level of prefabrication. The sustainability of the buildings was evaluated throughout their lifecycle, including resource-efficient production, construction, and operation, dismantling, reuse and recycling.

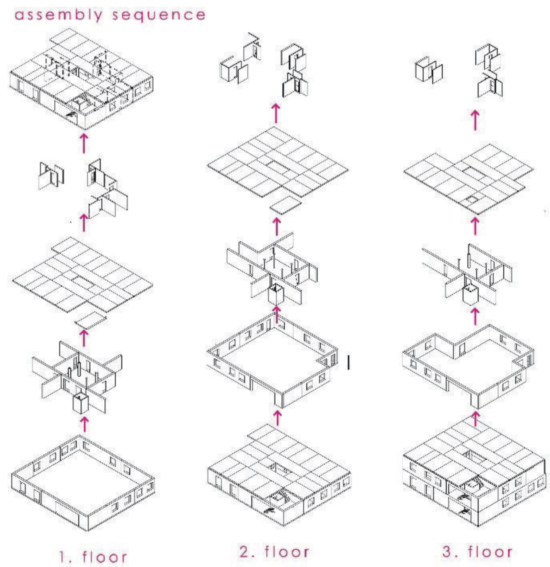

Figure 1: *Assembly sequence of project 4.*

The workshop implemented a didactic methodology where each discipline had predetermined tasks and deliverables that provided structure to the team's work. However, due to the different thematic focuses of the workshops (architecture, construction, site management), collaboration was sometimes challenging, as each discipline had different workloads at different stages of project development. This was particularly evident during the first workshop with focus on architectural design, where civil engineers and building site managers initially contributed less to the project and acted in more of an advisory or observational role. As the workshop progressed, these disciplines became more involved and completed their sub-tasks. Despite these challenges, students from both architecture and civil engineering disciplines gained a mutual understanding of each other's roles and challenges, which was given as feedback by several students at the end of the workshop. Early involvement of the different disciplines during the conceptualization phase prevented collisions and misunderstandings at the technical interfaces and significantly benefited the projects by allowing informed design decisions that facilitated the planning process in further phases. This approach resulted 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 increased shared knowledge, leading to a more collaborative and productive planning process.

The role allocation of the teams greatly influenced the successful completion of the projects. In projects where students lacked leadership positions, coordination of group task distribution and time management suffered noticeably. Significant progress in project development occurred after individual supervisor talks. These talks were conducted informally, at least twice per workshop per group, with lecturers providing direct feedback and answering questions.

The applied nature of the assignments and targeted in-depth input from the project partners had an impressive effect on the speed and the depth at which students acquired knowledge and know-how. This was particularly evident in students with little to no prior knowledge of timber construction, who were able to catch up on gaps in knowledge and get on the same level as their peers with prior know-how by the end of the workshops.

Overall, the workshops were evaluated positively by the students. The applied didactic approaches provided several benefits, including improved and applied knowledge and know-how about timber constructions, quality of designed timber buildings, international exchange, and the ability to act in a global context.

5 DISCUSSION: APPLYING THE DIDACTIC APPROCH TO EXISTING EDUCATIONAL PROGRAMES

The HiBiWood project employed experimental learning techniques in a series of international workshops. They demonstrated significant improvements in learning outcomes and designed timber projects, and thus outlined the need for alternative didactic approaches due to the complexity and diversity of the subject matter. The project's main objective is to implement sustainably the applied didactic approaches in partner universities' educational programs after the end of the project and make them available as open source to the broader scientific and academic community.

This challenge is addressed by the development of a BSc/BA module with 9 ECTs (240 academic hours), which has the overall objective to be both flexible and adaptable to meet the varying needs and levels of expertise of the target audience. It aims to provide a comprehensive understanding of timber construction, encompassing both foundational knowledge for those with no prior exposure, as well as more advanced topics for those with existing knowledge on the matter.

This is achieved by structuring the module into two stages, with the first half focusing on introductory concepts, such as architectural conceptualization, sustainable aspects, timber building products, building physics and technical properties, modular thinking, decomposability, and structural systems. The second half deals with the content in much greater detail, and includes additional topics of detail development, logistics, cost estimation, and the consideration of LCA in product selection. The module can be completed in one or two semesters, allowing universities to choose specific parts based on their needs (study program and/or previous knowledge of the students).

The educational module is composed of three distinct components. The first component consists of 25% of the total module duration (equivalent to 60 educational hours), delivered via four lecture courses with different deepening of the content, which provide fundamental theoretical inputs. The second component, also representing 25% of the module, is designed for individual self-directed learning, and comprises provided

https://doi.org/10.52202/069179-0598

learning materials and interactive problem-solving tasks such as in-depth analysis of best-practice timber construction projects or elaboration of timber-specific topics. The remaining 50% of the module follows the problem-based learning (PBL) methodology presented in this paper, centred on the design, and detailed planning of a multi-storey wooden building, covering all (or as needed, individual parts of) real-life project phases.

Ensuring interdisciplinarity and involving students from different disciplines is a key aspect of the module, albeit its implementation may be challenging for certain universities and technical colleges that offer programs only in architecture or engineering disciplines.

FH Campus Wien aims to introduce the second phase of the module in the regular curriculum, with the aim to provide an in-depth understanding of timber construction, building upon the fundamental knowledge and introductory concepts covered in the offered study programs. The module is intended as an optional advanced design exercise for architecture and civil engineering students, which can replace a pre-defined regular course. To maintain the international character of the program, the module is planned to be conducted as a summer school and open to international students from other universities. In the summer semester, students are expected to acquire the necessary background knowledge about timber constructions through blended lecture courses and preparatory assignments. In summer, students from diverse academic and national backgrounds will collaborate for several weeks to complete the practical construction task. The proposed summer academy will take place at the University of Applied Sciences Campus Vienna with the possibility of being hosted by partner universities in the future. It emphasizes practical experience, testing of different building approaches, and the inclusion of additional bio-based materials in the learning content, i.e., straw, clay in combination with timber. The summer school aims at active participation and mutual exchange of students and experts from different international universities, companies, and research institutions. The ultimate goal of this project is to establish an academic and scientific community that promotes the use of timber and other bio-based building materials and sustainable construction practices via interdisciplinary learning approaches.

6 CONCLUSIONS

HiBiWood responds to the increasing demands for greening the building sector by disseminating expert knowledge of multi-storey timber buildings. It promotes international networking, valuable exchange of knowledge and experience, and thus leads to an increased quality in teaching and research. The development and implementation of a module on timber construction in the academic programs of the partner universities ensures sustainable and lasting training of alumni with the required timber construction skills and expertise, which consequentially leads to sustainable promotion of multi-storey timber buildings. The teaching process is supported through innovative teaching methods that allow the students to work internationally and interdisciplinary, elaborate all actual project phases of a timber construction holistically and find solutions to real-life problems. The international teamwork deepens the intercultural competence of the participants and leads to open-mindedness towards others, cross-cultural thinking, and responsible action in a global context. The students are prepared for the future global requirements and changing demands in the construction industry.

Through strategic research, development of guidelines and principles and implementation of an innovative academic module, different actors at local, national, EU and international level are sensitised to sustainable building processes. The project bridges the gap between workforce and education on timber construction by meeting the needs of the building sector, providing university apprentices with actual real-life expertise, and guiding them through the learning process. It empowers the students to take sustainable action and contribute to achieving the climate goals.

ACKNOWLEDGEMENT

The project is funded by the European Union within the framework of ERASMUS+ Strategic Partnerships for Higher Education.

The authors express their gratitude to all students for their active participation in the project and their enthusiasm towards implementing the didactic methods outlined.

Appreciation is extended to MAGK Architektur Aichholzer Klein for facilitating the architectural assignment and construction site documentation.

The authors express sincere gratitude to all lecturers and construction companies who guided the students during the workshops and provided them with a real-life understanding of the subject matter.

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