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WOODEN CITIES FOR CHILE: RESEARCH AND PROJECT WORKSHOP TO OPT FOR THE TITLE OF ARCHITECT AND MASTER DEGREE.

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ABSTRACT: After completing a three-year cycle, the "Wooden Cities" Research and Project Workshop proposed a field of experimentation that went back and forth between the training of a professional specialized in wood and an intellectual capable of looking at the cultural dimension of his work, providing valuable tools for professional life, linking theory and practice. From the premise of the existence of an adequate scale for new construction with wood - the district - and the knowledge of two main drivers of construction with this renewable resource - sustainability and productivity - the students designed master plans for medium-sized cities or suburbs, well connected and aimed at a new generation of professionals; and also medium-rise wooden buildings, mixed-use and different typologies that - with criteria of structures, sustainability, and construction management - were able to accommodate this new demand. This teaching methodology trained a new generation of professionals with tools for designing, calculating, and detailing new projects. It gave rise to a new formulation of this workshop, focusing on densification in consolidated cities, whose results are also part of this article.

KEYWORDS: Teaching Wood Technologies, Education Theory, Architectural Education.

1 – INTRODUCTION

1.1. THE MASTER'S PROGRAM

The Master's in Sustainable Architecture and Energy (MASE UC) at the Pontificia Universidad Católica de Chile is a postgraduate program with a mixed character—both professional and academic—aimed at training professionals capable of addressing contemporary challenges in sustainability and energy within the built environment.

Through an integrative approach, the program promotes an ethic of environmental responsibility and the conscious use of natural resources, in alignment with the university's institutional mission.

1.2. TRENDS IN SUSTAINABLE ARCHITECTURAL EDUCATION

The need to train architects specialized in designing tall timber buildings has become a global priority. Mitrenova, Aichholzer, and Santana-Sosa [1] highlight the importance of innovative pedagogical approaches in university-level education for projects involving timber structures, reinforcing the relevance of educational methodologies such as those applied in the "Wooden Cities for Chile" workshop. In the same line, Al-Attili et al. propose an educational model focused on the integration of timber technology, engineering, and design, aligned with the workshop's training objectives [2].

One example of current key topics is the concept of flexible modular timber construction, which arises as a strategic response to contemporary urban dynamics. Research by Huang and Meng [3], using multi-criteria analysis tools (AHP-TOPSIS), helps evaluate modular systems that could be replicable in urban densification contexts like those addressed in the workshop.

1.3. SPECIFIC CHALLENGES IN CHILE

Despite the country's vast forestry potential and the ecological benefits of timber construction, its use remains limited. Currently, only around 20% of homes in Chile are built with timber structures, and its presence in buildings over four stories is virtually nonexistent [4].

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Within this context, the workshop takes on the challenge of promoting architectural design in timber as a relevant response to both sustainability and productivity in construction.

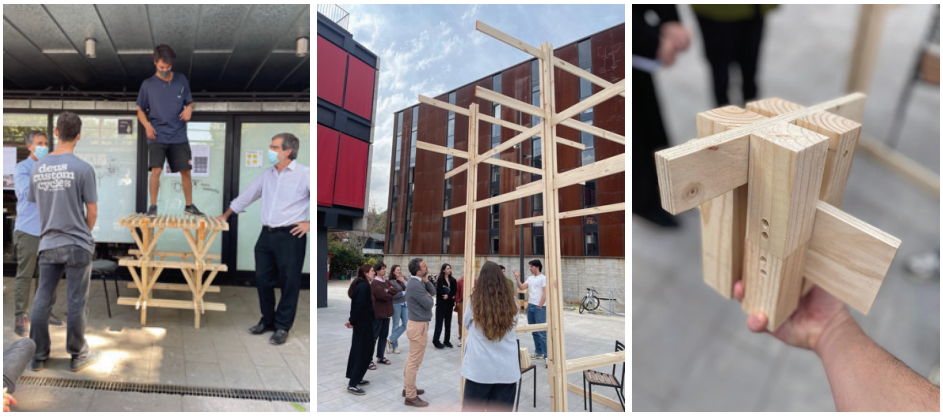

Figure 1. Use of prototypes and models

2 – METHODOLOGY

2.1. ACADEMIC APPROACH

The Research and Project Workshop is structured around a methodology that combines architecture, structural engineering, and critical thinking, developed at three interrelated scales: district, building, and construction detail. Each student defines their own research framework by choosing a specific topic, an architectural program, and a structural-constructive typology, all addressed through an iterative design process.

The work is organized into successive review and adjustment cycles—usually three—which allow students to refine the project parameters they have defined. This iterative logic enables them to link research hypotheses with concrete design solutions, reinforcing the connection between conceptual thinking and technical resolution.

2.2. INTEGRATION BETWEEN ARCHITECTURE AND ENGINEERING

The workshop promotes a deep understanding of the relationship between architecture and technology, following Adolf Loos's idea that an architect is "a mason who knows Latin" [5]. This articulation between technical knowledge and cultural reflection is essential to forming professionals who master both the material and its symbolic and territorial projection.

Although it is not a structural calculation course, the workshop introduces students to fundamental principles of timber engineering, approached with technical language that is accessible to architects. In this way, it fosters a dialogue between disciplines that usually operate in a fragmented manner.

2.3. LEARNING STRATEGIES AND TOOLS

From the first weeks, the course incorporates theoretical classes, site visits, and practical exercises with physical models and specialized software. The initial module, called the "Wood Cycle," includes visits to forests, sawmills, board factories, and built works, allowing students to understand the material from cradle to cradle [6], in a circular economy framework.

The use of prototypes and models (Fig.1) enables students to experiment with different structural typologies (such as beams and columns, light-frame systems, CLT, or NLT), under criteria of economy, resistance, replicability, and industrialization. This is complemented by the use of digital simulation tools that quantify environmental impacts, model material flows, and evaluate prefabrication strategies.

Additionally, in terms of design strategies, Zernicke et al. propose, for example, a Web-GIS tool to estimate the reduction of greenhouse gas emissions through timber use in urban environments [7], which serves as a reference and an example of the kind of strategies this approach entails.

2.4. ENGAGEMENT WITH LOCAL STAKEHOLDERS AND SITE SELECTION

Study sites are selected based on criteria of territorial relevance, links to forestry production, and replicability potential. In each edition of the workshop, students work in intermediate cities associated with the timber sector—such as Laja-San Rosendo, Talca, Curicó, or Villa Mininco—where direct interaction with local authorities and industry representatives is also encouraged.

This engagement ensures that the projects are not merely academic exercises but proposals rooted in real needs, thereby strengthening professional training and opening possibilities for future impact.

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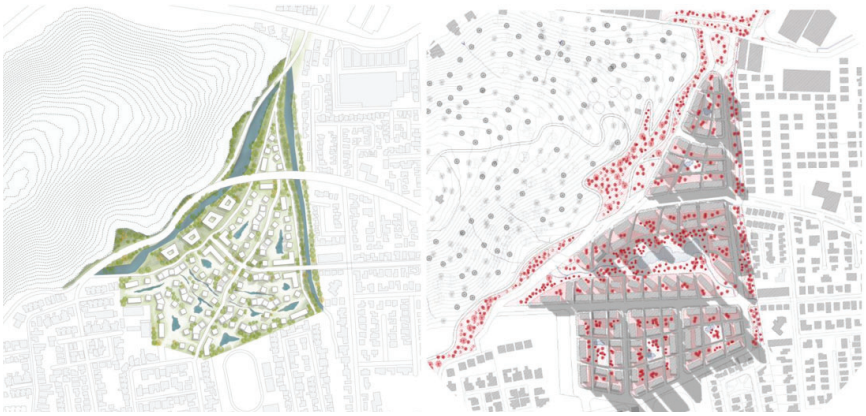

Figure 2 Cerro Condell, Curicó, proposals.

3 – DESIGN PROCESS: WOODEN CITIES

The workshop is framed within a crucial goal for Chile: achieving carbon neutrality by 2050, as established in the Framework Law on Climate Change [8]. This target presents a strategic opportunity for the development of timber construction, considering that forest biomass is composed of approximately 50% carbon and that one ton of dry matter can store up to 500 kg of this element. Within this context, and in light of a housing deficit exceeding one million homes, the workshop proposes a provocative hypothesis: today, "eight houses grow per minute" in Chilean forests.

This conceptual framework drives the development of projects that integrate urban planning, timber architecture, and environmental evaluation, articulated through the design of sustainable districts. Each edition of the workshop selects an intermediate city linked to forestry activity, where strategic sites are identified for urban renewal proposals—including housing and public facilities—developed in coordination with local public and private stakeholders.

3.1. VILLA MININCO

Located in the Araucanía Region, Villa Mininco is a town of 5,500 inhabitants adjacent to pulp and panel plants owned by CMPC. The workshop took place after an unprecedented season of wildfires, prompting critical reflection on the relationship between forests, territory, and community. Student projects focused on proposing housing, educational, and public infrastructure solutions that foster a more harmonious and resilient relationship with the forest environment.

3.2. LAJA–SAN ROSENDO DISTRICT

This territory is characterized by a strong railway and industrial identity. While Laja has consolidated around CMPC's pulp mill, San Rosendo has experienced demographic and economic decline.

The workshop addressed this unequal relationship by proposing a master plan that activates the Biobío riverfront, integrating heritage railway infrastructure, residential zones, and timber-based public facilities, in dialogue with the ecological cycles of the wetland and the area's industrial legacy.

3.3. TALCA REGIMENT SITE

In the northern outskirts of Talca, the workshop explored the development of an innovative district on the 58-hectare grounds of the former 16th Regiment. The proposal

included a mix of uses—residential, commercial, and innovation—and design strategies that enabled densification with energy efficiency criteria, use of NLT systems and light-frame construction, and harmonious integration with the Claro River landscape.

3.4. CERRO CONDELL, CURICÓ

On land owned by the Pontificia Universidad Católica de Chile, located south of Cerro Condell, students developed a master plan prioritizing environmental integration, sustainable mobility, and innovation in mid-rise social housing.

The proposals included timber towers with commercial bases and mixed uses, emphasizing the role of public space and energy efficiency through passive design strategies (Fig.2).

3.5. A NEW FOCUS: WOOD CITY METRO

In its most recent iteration, the workshop has evolved toward exploring remnant and vacant sites within the consolidated fabric of Santiago, aligning with the global trend toward more compact, resilient, and sustainable cities. This new line of work—called Wood City Metro—raises critical questions about the insertion of timber buildings in dense urban contexts, the utilization of existing infrastructure, and the adaptation of technologies to demanding regulations.

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The transition toward urban projects in consolidated cities therefore enables a new pedagogical approach, preserving its core principles while opening new opportunities for transfer and scalability.

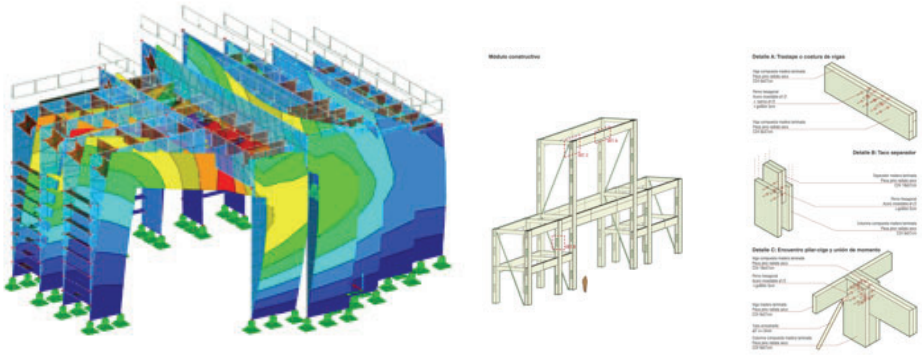

Figure 3 Architectural decisions with performance and prefabrication criteria.

4 – RESULTS

Throughout its different editions, the workshop has proven to be an effective platform for integrating architectural design, timber technology, and critical reflection on urban sustainability. Graduates who participated in this intensive course have developed competencies at three complementary scales: urban planning, timber building design, and construction detail resolution.

This experience has enabled them to design with technical knowledge on structural systems, component sizing, joint design, thermal and acoustic analysis, fire resistance, and cost estimation. Through the use of specialized software, digital simulations (including DfMA models and digital twins), and physical exercises in model and prototype laboratories, students have aligned architectural decisions with performance and prefabrication criteria (Fig 3)

4.1. POLYTECHNIC HIGH SCHOOL IN VILLA MININCO (ANDRÉS MORELLI)

Addresses a deficit in educational infrastructure through a modular system using laminated and sawn timber, optimized for prefabrication, assembly, and programmatic flexibility.

4.2. HOUSING BUILDINGS WITH RIGID I-JOIST FRAMES IN LAJA–SAN ROSENDO (SOL VILLANUSTRE)

Develops a lightweight structural system that enables an adaptable open plan with flexible interior configurations and efficient thermal comfort and material usage.

4.3. MASS TIMBER MIXED-USE HOUSING IN TALCA (CRISTIÁN LEFEVRE)

Integrates NLT posts and beams, prefabricated cores, and light-frame systems, articulating community spaces, neighborhood commerce, and innovation labs through passive energy efficiency strategies.

4.4. INTEGRATION OF VERNACULAR ARCHETYPES IN MID-RISE BUILDINGS IN CURICÓ (MARÍA JESÚS CORNEJO)

Evaluates the incorporation of traditional elements such as corridors, roof overhangs, and double skins, with results showing up to a 69% reduction in heating demand through passive strategies, without compromising local identity (Fig. 5).

4.5. SYNTHESIS

Beyond individual results, the workshop has enabled reflection on both the limitations and opportunities of the proposed approach. In its initial version, difficulties emerged in addressing such diverse scales (city and detail) simultaneously within a limited time frame. This observation led to the evolution toward a new phase focused on sustainable densification in existing cities, currently under evaluation.

The replicable nature of the model—based on active learning, territorial engagement, and multi-criteria analysis—opens the door to its application in other architecture schools in Latin America, and reinforces the role of academia as an active agent in the transition toward sustainable urban environments built with timber.

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Figure 4. Mass timber mixed-use housing in Talca (Cristián Lefevre)

5 – CONCLUSIONS

The "Wooden Cities" workshop demonstrates that teaching architectural design in timber—integrated with digital tools, sustainability criteria, and territorial articulation—can train professionals capable of leading a transformation of the built environment toward more sustainable and efficient models.

The methodology developed allows for the combination of theory and practice in a real application context, covering everything from the scale of the master plan to that of construction details, with design outcomes that respond to both environmental and social criteria. This multidimensional approach—linking design, structural analysis, construction management, and energy performance—has resulted in relevant proposals from a new generation of architects committed to carbon neutrality, sustainable industrialization, and territorial identity.

From a pedagogical standpoint, the workshop has consolidated a replicable model based on:

- Active learning through iterative design, simulations, and prototyping.
- Engagement with real stakeholders (municipalities, companies, ministries) that contribute context and feasibility.
- Quantitative evaluation of the environmental impact of design decisions, including carbon flows, energy efficiency, and passive strategies.
- Interdisciplinary education that integrates architecture, structural engineering, and urban planning.

In response to the growing demand for sustainable housing solutions in Chile and Latin America, this type of educational experience fosters not only technical training, but also critical awareness about how we inhabit, build, and plan our cities.

It is therefore recommended to:

- Expand this pedagogical model to other universities in the region, adapting it to local contexts through academic partnerships and public-private alliances.
- Strengthen the connection between applied research and teaching, incorporating tools such as digital twins, LCA analysis, and DfMA from the early stages of the design process.
- Consolidate links with public agencies to translate workshop results into pilot policies or territorial strategies.
- Promote timber construction as a structural component of the national climate agenda, through technical and professional training programs aligned with carbon neutrality goals.

Ultimately, Wooden Cities not only trains architects with advanced design capabilities but also helps establish a new vision of urban development in timber as a structural strategy for a just and efficient ecological transition.

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Figure 5. Integration of vernacular archetypes in mid-rise buildings in curicó (María Jesús Cornejo)

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- Generation 2018 (“Villa Mininco”): Silvia Barrera, Patricio Daher, Sofía Ebner, Daniela Falck, Joaquín Gago, Gonzalo Layera, Diego Maige, Andrés Morelli, Pilar Soffia;
- Generation 2022 (“Laja–San Rosendo District”): Ronald Ambler, Belén Barahona, Alessandra Botello, Francisca Carbone, Constanza Delfau, Alessandro Grossi, Julio Illanes, Juan Ignacio Ovalle, Margarita Porzio, Sol Villanustre;
- Generation 2023 (“Talca Regiment District”): Sebastián Daher, Aníbal Gallardo, Cristián Lefevre, Agustín Lemus, Pedro Mercado, Vicente Muñoz, Manuel Peró, Macarena Sandoval, Gabriela Tapia, María Asunción Vergara;
- Generation 2024 (“Cerro Condell District, Curicó”): Macarena Cáceres, Santiago Cadagán, María Jesús Cornejo, Jairo Delgadillo, Daphne Graves, Josefina Marambio, Belén Peña, Constanza Stuardo, Vicente Urrutia;

- Generation 2025 (“Wood City Metro, Santiago” – in progress): Allan Cruz, Macarena Díaz, Javier Espinoza, Francisca Guzmán, Natasha Lyon, Consuelo Prieto, Sebastián Salas, Sebastián Valenzuela. (Fig. 6)

Figure 6. Generation 2025 Wood City Metro, Santiago

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