



**POLITECNICO**  
MILANO 1863

**ABC<sup>PhD</sup> DOCTORAL PROGRAM**  
IN ARCHITECTURE BUILT ENVIRONMENT  
AND CONSTRUCTION ENGINEERING

## **ABC<sup>PhD</sup> CALL4SCHOLARSHIP 32b**

Research topic T1: MIXED TECHNOLOGIES BUILDINGS. GUIDELINES AND STANDARDS FOR WOOD-BASED PREFABRICATED BUILDINGS AND BUILDING EXTENSIONS DESIGN

**(32b-T1 Wood Based Prefabricated Buildings)**

# ABC PhD Program – CALL 4 SCHOLARSHIPS 32b

Thematic Scholarship 32b-T1 “Wood Based Prefabricated Buildings”



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**FEDERLEGNOARREDO**

## Funding and management of the thematic scholarships

- Number of scholarships: 1 (one)
- Monthly net income: €. 1.016,37 (max 36 months)  
[In case of a change of the welfare rates during the three-year period, the amount could be slightly modified]
- Additional support: Funding for educational activities<sup>(\*)</sup>: €. 1.370 per student [for the 2<sup>nd</sup> and 3<sup>rd</sup> year]
- Starting of PhD activity: 1/11/2016
- Deadline for application to the call: 9/09/2016
- Research Director: prof. Marco Imperadori
- Research Group: proff. Marco Imperadori, Manuela Grecchi, Gabriele Masera, others to be defined.
- Funding and cooperating Institutions: the scholarship is co-funded by Politecnico di Milano, Department ABC and FederlegnoArredo (FLA), *Federazione italiana delle industrie del legno, del sughero, del mobile e dell'arredamento.*

(\*) (purchase of study books and material, funding for participation in courses, summer schools, workshops, conferences)

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### Context of the research activity

While ambitious goals have been set for the energy efficiency of new buildings, which have to comply with the Nearly Zero Energy standard by the end of 2020, it cannot be underestimated that the substitution rate of existing buildings with new ones is very low, so that 50% of today's building stock will still be in use in 2050. The total share of buildings dating from 1945 to 1970, poorly insulated and often with obsolete heating systems, accounts for around 70% of the total, while those built after 1990 to better energy standards accounts for only 1%.

The energy retrofit of existing buildings is then a crucial strategy that must be implemented at a large scale to achieve the ambitious decarbonisation goals that the European Union has set for 2050. The importance of building retrofit, with a specific focus on the envelope performance, has been recognised widely and renovation activities constitute already around 50% of the turnover of the construction industry in Europe.

The densification of the urban fabric with the addition of new volumes to existing buildings is not just a way to potentially improve their architectural quality and reduce sprawl, but also a strategy to pay for (at least a part of) the energy retrofit works required by the new and future regulations and/or by the market.

The availability of lightweight, high-performance solutions in wood for the volumetric expansion of existing buildings with limited costs for their structural upgrade is an opportunity for the future that the construction sector could seize to get out of the current recession, also considering the increasing number of municipalities that impose severe limitations to the urban sprawl of cities in Europe. This would also help overcome one of the problems leading to the slow rate of renewal of existing buildings, namely the way these retrofit operations are typically conducted, with non-skilled workforce and labour-intensive procedures that make costs escalate.

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## Thematic Scholarship 32b-T1 “Wood Based Prefabricated Buildings”

### **Motivation and objectives of the research**

The objective of this PhD position is to deepen the knowledge in the field of wood-based solutions for the volumetric expansion of existing buildings using lightweight, energy-efficient technologies.

The PhD Candidate will investigate different aspects in this field, such as:

- existing technologies and applications, including their market diffusion, limitations, etc.;
- regulations, current state of legislative development and possible strategies for the development of this kind of works;
- structural issues related to the additional loads and their interaction with the existing structure of the building, especially in case this has to be upgraded on the occasion of the expansion;
- proposal of standardised solutions for construction kits taking into account the typical limitations of retrofit operations, such as construction times, availability of scaffolding, nuisance to users of the building, etc.;
- development of fault-free, standard solutions about the joints to the existing building, connections, etc.;
- understanding and control of the main building physics issues related to wood-based, lightweight additions;
- economic issues (non-technical barriers to the diffusion of retrofit operations), such as investment costs, the limitation of modifications to the structure of existing buildings, innovative financing schemes, etc.

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### **Methods and techniques that will be used to carry out the research**

The research work will start with activities of benchmarking and meetings with the most relevant institutions and companies working with wood in Europe (Austria, Sweden, Finland, Norway, Switzerland, Russia), USA, Canada and Japan.

During the second year of the programme, a research period in one of these advanced research centres will be organised. The direct interaction with producers of innovative components will allow to continuously assess the progress of the research work. Simulations on case studies will be used to prove the reliability and the applicability of the proposed extension strategies.

### **Educational objectives**

At the end of the Doctoral Programme, the Candidate will have a deep knowledge of the technological, structural and energy-related issues related to lightweight, wood-based additions to existing buildings of different sizes. This will also be valuable for the construction market and, in particular, for those companies working with lightweight technologies that are suitable for this kind of retrofit strategies.

The PhD Candidate will also have developed skills in structural and energy modelling, with a specific focus on the Italian Technical Standards and building physics for the retrofit of existing buildings.

Besides acquiring skills in the field of research development and management, it is expected that the candidate will develop a publication record in recognized international journals and conferences.

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### Skills of the candidate

At the end of the research project the candidate will have acquired skills and expertise to operate in the fields of:

1. Market analysis and comparison of alternatives
2. Structural implications of lightweight volumetric extensions
3. Building physics and energy retrofit solutions assessment and optimization
4. Logistics issues, on site assembly and delivery questions etc., lightweight retrofit solutions
5. Economic and financial aspects of energy retrofit

Moreover, he/she will gain a strong attitude of interaction with industries and public bodies in research activities.

### Job opportunities

This research offers PhD candidates, either freshly graduated or professionals, a broad knowledge in the field of wood technologies, that can be used afterwards in academia or in the professional market.

In the first place, the skills of the PhD candidate will be connected to the real construction market, which is becoming more and more concentrated on refurbishment and incremental additions rather than new buildings.

Secondly, a wide range of possibilities is connected with wood industries, which constantly show a trend of economic growth and investments in innovation for sustainability.

Finally, considering the impact on cities and their transformation and densification, the candidate will have the opportunity to work in the public or private sectors in design / construction /management companies.