POLITECNICO DI MILANO

PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 41st cycle

THEMATIC Research Field: DESIGN OPTIMIZATION OF RECONFIGURABLE STRUCTURES FOR CIRCULAR CONSTRUCTION

Monthly net income of PhDscholarship (max 36 months)
1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The motivation behind this research stems from the urgent need to transition the construction industry toward climate-neutral and circular practices. Traditional building methods rely heavily on virgin materials and linear production models, which contribute significantly to greenhouse gas emissions and resource depletion. By contrast, this research explores how selective dismantling, reuse of structural and technical components, and sensor-enabled hybrid reassembly can dramatically reduce the environmental footprint of buildings. The objective is to develop scalable, data-driven strategies that extend the service life of components, enable modular and reversible construction, and support industrialized workflows. Through advanced monitoring, digital twins, and multi-criteria design optimization, the research aims to validate reuse protocols, paving the way for widespread adoption and systemic change in the built environment.
Methods and techniques that will be developed and used to carry out the research	The research will develop and apply a range of advanced methods and techniques to enable circular and sensor-enabled construction practices. Central to the approach is the creation of a multi-criteria design optimization engine that matches reclaimed and virgin building components with demand from renovation and new construction projects. This involves parametrizing both supply and demand sides, modelling performance indicators, and

	generating optimized design solutions that balance structural, environmental, and economic criteria. The project will also prototype and validate innovative dry and hybrid connection systems to facilitate rapid and reversible assembly and disassembly of building elements. Embedded sensors and digital twins may be used to monitor structural health and lifecycle performance, enabling predictive maintenance and iterative design improvements.
Educational objectives	The educational objectives for a PhD student pursuing this research focus on developing a comprehensive understanding of circular construction principles, industrialized building processes, and multi-criteria design optimization. The student will gain expertise in modeling and evaluating reclaimed and hybrid building components, learning how to balance environmental, structural, and economic performance across the building lifecycle. The student will be trained in advanced computational techniques to support decision-making in design and renovation, and will engage in experimental activities such as material testing, prototype development, and validation of connection systems. The program will also foster skills in collaborative design, stakeholder engagement, and the development of scalable solutions suited to diverse climatic and regulatory contexts.
Job opportunities	Graduates of this PhD program will be equipped for a wide range of engineering-focused career opportunities in the construction and building technology sectors. They may pursue roles in structural or civil engineering firms, specializing in the reuse and optimization of building components, modular systems, and industrialized construction workflows. Their training in experimental validation, material testing, and multi-criteria design optimization will prepare them for positions in product development, R&D, and innovation management within companies developing prefabricated or hybrid building solutions. Opportunities also exist in engineering consultancies focused on lifecycle performance, sustainability, and regulatory compliance. Additionally, they may contribute to public or private research

	institutions working on circular economy strategies or engage with standardization bodies and technical committees shaping future construction practices. The interdisciplinary and applied nature of the research ensures that graduates are well-prepared to lead engineering innovation in sustainable and scalable building systems across Europe and beyond.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 9 PhD Students
Name of the research directors	Giovanni Muciaccia

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): financial aid per Ph.D. student per year. The Ph.D. course supports the educational activities of its Ph.D. students with an additional funding equal to 10% of the scholarship, starting from the first year. Teaching assistantship: availability of funding in recognition of support to teaching activities by the Ph.D. student. There are various forms of financial aid for activities of support to the teaching practice. The Ph.D. is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: each Ph.D. student has his/her own computer for individual use.

Desk availability: each Ph.D. student has his/her own desk, cabinet and locker.