



PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 38th cycle

**THEMATIC Research Field: A HOLISTIC APPROACH TO THE DECARBONIZATION OF
CONCRETE CONSTRUCTION INDUSTRY**

Monthly net income of PhDscholarship (max 36 months)

€ 1195.5

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 research aims at integrating into a holistic approach different contributions to the decarbonization of the concrete construction industry as developed so far within the different sectors and by the different stakeholders. This will be also performed through the implementation of additive manufacturing (3Dprinting) as Key Enabling Technologies to spread the use of advanced cement based materials and exploit specific functionalities of material constituents also to obtain self-healing and self-sensing properties in multifunctional building products and structural elements able to combine structural, multi-physics and aesthetic performance. Reference will be made to benchmark structures, including, among the others:

- Structures for green energy transitions, e.f wind towers for on- and off-shore application where materials like UHPC and topological optimization will allow to go beyond 100 m height;
- Multifunctional elements designed through topological optimization to be employed for a new structural concept in façade engineering and seismic/energetic retrofitting of the existing built environment, including cultural heritage. Circular economy topics will be addressed, to reduce the dependence on raw materials, by incorporating into the



	<p>composition of the investigated materials of secondary raw materials. This will also be instrumental towards the implementation of 0km zerowaste construction job sites, with almost integrale recycling of construction and demolition waste.</p> <p>All information related to product and process will be integrated into a holistic approach which combines structural design with durability mechanisms and the analysis of environmental, economic and social impacts throughout the whole service life of the intended applications (LCA/LCC/SLCA).</p>
Methods and techniques that will be developed and used to carry out the research	<p>The candidate will tackle the problem of structural optimization as a function of the advanced mechanical performance of cement based materials (e.g. Ultra High Performance Fibre Reinforced Concrete) and of the employed (digital) fabrication technology. The aim is to demonstrate the feasibility of implementing, in the concrete construction industry practice novel structural concepts inspired to biomorphology/biomimesis. This is meant as the possibility of exploiting at their best the superior mechanical performance of advanced cement based materials with the aim of employing the material where structurally needed, in the framework of the overall sustainability of the engineering artefact.</p> <p>The research will also tackle the integration of different components/materials in the structural fabrication process, with dedicated attention to connection devices among different structural parts, also with the aim of a multimaterial digital fabrication process.</p>
Educational objectives	<p>The candidate will be trained in advanced topics related to the structural design and applications of advanced cement based materials, including durability testing, life-cycle analysis and advanced manufacturing techniques.</p>
Job opportunities	<p>The topics of the proposed PhD scholarship are crucial in the development of the construction sector. The candidate, once graduated, can spend his skills into a broad portfolio of engineering firms and construction companies and the healthy relationships of the research group with industry will surely open broad possibilities.</p>



Composition of the research group	0 Full Professors 4 Associated Professors 3 Assistant Professors 12 PhD Students
Name of the research directors	Liberato Ferrara and 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 (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	597.76 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>The PhD position is funded by the Italian National Social Security Institution (INPS): the candidate must be an Italian citizen and must satisfy peculiar requirements. Please check carefully such requirements before applying.</p> <p>The candidate will be provided of a desk and a personal pc required for his/her work. He/she will interact with the community of PhD students active in the same Department for fruitful help and exchange at a personal and scientific level. Numerous educational activity are organized at Politecnico di Milano and offered in particular to PhD students, of which only a few are mandatory.</p> <p>Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): 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.</p> <p>Teaching assistanship (availability of funding in recognition of support to teaching activities by the PhD student): Ph.D. students are encouraged to apply, upon prior authorization, to the calls to support teaching activities at the undergraduate and Master levels at Politecnico, being paid for that. The teaching assistantship will be limited up to about 80 hours, maximum half of them</p>



devoted to teaching and classroom activities and the rest to support classworks and exams.