



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

**PARTENARIATO PNRR Research Field: LIFE CYCLE ASSESSMENT AND MONITORING OF
(DIGITALLY FABRICATED) CONCRETE STRUCTURES IN A DIGITAL TWIN FRAMEWORK**

Monthly net income of PhDscholarship (max 36 months)

€ 1275.0

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**

**ECS-MUSA: ECOSISTEMA DELL'INNOVAZIONE
MUSA - MULTILAYERED URBAN SUSTAINABILITY
ACTION**

CUP D43C22001410007 ? Decreto di concessione D.D.
1055 del 23/06/2022 D.D. 3277 del 30/12/2021

Avviso pubblico per la presentazione di Proposte di
intervento per la creazione di 12 Ecosistemi
dell'innovazione sul territorio nazionale da finanziare
nell'ambito del Piano Nazionale di Ripresa e Resilienza,
Missione 4 Componente 2 Investimento 1.5 - Creazione e
rafforzamento di "ecosistemi dell'innovazione",
costruzione di "leader territoriali di R&S" - finanziato
dall'Unione europea - NextGenerationEU.

Concrete is the most largely used construction material in
the world, with about 10 billion tons produced and
employed every year. The large used volumes and the
production technologies of its constituents imply a
significant environmental impact of the material in terms of
CO₂ tons per unit weight/volume. The service scenarios
of the concrete built environment, exacerbated by climate
change, imply increasing mechanical and environmental
stresses on the buildings and structures, which impair
their service life, resulting into shorter life span than what
predicted at the design stage. In this respect it becomes



	<p>crucial the possibility to manage into an integrated decision making tool information about the evolution of the in structure material performance, as a function of the service scenario as well as of the advanced properties and features that modern concrete and construction material technologies, including hybrid/multimaterial do offer.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The candidate will preliminary work on the integration of information from structural design, mechanical and durability characterization of construction materials, also through the calibration of consolidated and innovative non-destructive surveying/monitoring techniques.</p>
<p>Educational objectives</p>	<p>The candidate will be trained in advanced topics related to the structural monitoring and to the integration of the structural design, structural performance monitoring into a digital twin environment for the management of the built artefacts. Artificial intelligence and machine learning techniques will also be tackled in the framework of the definition of a digital twin of selected representative case studies with the aim of validating and evolving decision making tool for the management of the same pilot structures. These will be chosen among digitally fabricated examples available from existing projects in which the research group and the cooperating institutions are involved. Durability-based Design, Life Cycle Assessment/Life Cycle Cost tools will be part of the digital twin environment to assess on the one hand the benefit of using digital fabrication technologies, as a KET for the use of advanced construction materials (also in a multimaterial concept), and on the other of the use/maintenance options which will be hypothesized as a function of the structural service scenarios.</p>
<p>Job opportunities</p>	<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

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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	638.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:</p> <ul style="list-style-type: none"> •ETH Zurich •TU Dresden •Centre Scientifique et Technique du Bâtiment - Paris •TUDelft •University of Freiburg •University of Loughborough •Arizona State University •Indian Institute of Technology Madras •Hinfra Ltd •Cemex •MX3D •Buzzi Unicem



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.

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

Computer availability and desk availability: Each Ph.D. student has his/her own computer for individual use. Each Ph.D. student has his/her own desk, cabinet and locker.