



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

Number of scholarship offered	6
Department	DIPARTIMENTO DI INGEGNERIA CIVILE E AMBIENTALE

Description of the PhD Programme
<p>General description</p> <p>Structural, Seismic and Geotechnical Engineering - SSGE - encompasses the disciplines and techniques to understand, model and control the behavior of: (a) structural materials (concrete, steel, masonry, composites, bio-materials and materials for micro-systems), (b) structural systems (from constructions to bio-mechanical systems and micro-systems), (c) soils and (d) environment-construction interaction. Being deeply-rooted in the civil engineering which is, by its very nature, highly inter-disciplinary, SSGE also focuses on environmental actions, either external (such as earthquakes, vibrations, irradiation, wind and fire) or ensuing from soil-structure interaction (such as those caused by retained-earth thrust, landslides and water-table fluctuations). Because of their generality in materials and structural modeling, the methods developed within the domain of SSGE are also very useful in other technical-scientific fields, whenever understanding and controlling mechanical aspects is necessary to guarantee design reliability and structural safety, serviceability and durability. Many are the examples of typical SSGE issues: from tall buildings and bridges to industrial bio-mechanical and micro-electromechanical systems, from off-shore structures and dams to the rehabilitation of monumental buildings, from seismic design and structural dynamics to slope stability, tunnel behavior and foundations, not to mention many issues in common with several branches of industrial engineering.</p> <p>List of topics and research areas</p> <p>Advanced computational methods for coupled problems in porous media - Advanced computational methods for the simulation of complex flows with moving boundaries - Cementitious materials and concrete structure under extreme and exceptional loading - Computational and experimental mechanics - Computational mechanics of materials and structures - D-zones and anchorages under severe conditions - Earthquake engineering and structural dynamics - Fire safety of concrete structures - Geotechnical earthquake engineering -</p>



Life-cycle performance of bridges and structures - Micro Electro-Mechanical Systems and micromechanics - Microseismic monitoring of unstable rock slopes - Smart materials and structures - Structural analysis of built heritage - Theoretical modelling and mechanical characterisation of biomaterials - Topology optimization for structural design.



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

**THEMATIC Research Field: A DURABILITY AND LIFE CYCLE BASED APPROACH TO ZERO
CARBON STRATEGY IN CONCRETE CONSTRUCTION INDUSTRY**

Monthly net income of PhDscholarship (max 36 months)
€ 1195.0
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

Context of the research activity	
<p>Motivation and objectives of the research in this field</p>	<p>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. Still, concrete is used to make structures: this on one hand implies that the environmental sustainability assessment has to be performed with reference to the intended application, which cannot disregard the structural performance of the material and the way it is used in the same structure. Moreover, besides the impact of the material per se, the construction process (including hauling of materials) and the service life stage have to be considered in an overall consistent evaluation.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research hence proposes a holistic approach to be developed, able to integrate different contributions and methodologies developed by both the industry and academia for both:</p> <ul style="list-style-type: none"> - the reduction of the CO2 sequestration and the integral recycling of dismissed concrete structures - the assessment, validated via structural health monitoring, of the long term performance, as affected also by aggressive scenarios (chloride and sulphate attack), as it can be required by structure applications which can be



	<p>crucial to support decarbonisation goals (including renewable energy harvesting structures, structures supporting blue economy)</p> <ul style="list-style-type: none"> - the validation of the environmental, economic and social impact of the solutions developed and their final incorporation into a multidimensional Building Information Modelling framework, including the possibility of comparing different solutions or approaches, accounting for the entire life cycle of the structure.
Educational objectives	The candidate will be trained in advanced topics related to the structural design and applications of advanced cement based materials, including durability testing, both at the material and at the structural member scales, life-cycle analysis and advanced manufacturing techniques.
Job opportunities	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.
Composition of the research group	<p>0 Full Professors 2 Associated Professors 2 Assistant Professors 9 PhD Students</p>
Name of the research directors	Liberato Ferrara and Giovanni Muciaccia

Contacts	
liberato.ferrara@polimi.it	
giovanni.muciaccia@polimi.it	

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	597.50 €
By number of months	6



Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities

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

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, and they are paid for that. 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

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.



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

THEMATIC Research Field: MULTI-HAZARD ASSESSMENT, CONTROL AND RETROFIT OF BRIDGES FOR ENHANCED ROBUSTNESS, USING SMART INDUSTRIALIZED SOLUTIONS

Monthly net income of PhDscholarship (max 36 months)

€ 1195.0

In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field	I am coordinating a PRIN (2020) on this topic involving Geotechnics (Galli), Topography (Pinto) and LCA assessment (Pittau, ABC) for Milan Unit. The main objective will be SMART SOLUTIONS of Retrofit.
Methods and techniques that will be developed and used to carry out the research	Experimental activity as well as numerical modelling will be used to check the reliability of the solutions proposed.
Educational objectives	The idea is to prepare a new PhD researched able to consider soil-structure interaction problems and used to adopt a LCA analysis to judge the sustainability of the solution investigated.
Job opportunities	In many company managing the maintenance of the bridges.
Composition of the research group	1 Full Professors 2 Associated Professors 2 Assistant Professors 2 PhD Students
Name of the research directors	Marco Di Prisco

Contacts

marco.diprisco@polimi.it

<https://www.dica.polimi.it/persona/?uid=59385>



--

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	597.50 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Prof. Marco Di Prisco is coordinating the activity of a larger group involving Parma, Napoli, Roma and Pavia. Many universities like EPFL Losanna (Aurelio Muttoni), Madrid (Hugo Corres), Budapest (Balazs) and Repubblica Ceca (Vitek) are in contact for the same topics inside of fib community.

Educational activities

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

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, and they are paid for that. 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

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.



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

**THEMATIC Research Field: SIMULATION OF FLUID-STRUCTURE INTERACTION
PHENOMENA WITH LAGRANGIAN TECHNIQUES**

Monthly net income of PhDscholarship (max 36 months)
€ 1195.0
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	<p>Many engineering applications require the simulation of fluid-structure interaction phenomena with lagrangian techniques. For instance, in the automotive industry, the door opening and closing effort is an index of the vehicle's quality. Besides the mechanical contributions (e.g. the hinge friction), the force needed to close the door is mainly influenced by the pressure build-up due to the air pushed into the cabin. Moreover, this phenomenon is strongly affected by the difference between outdoor and indoor temperatures. In the proposed PhD thesis the problem will be studied with a numerical approach and extended to other similar applications.</p>
Methods and techniques that will be developed and used to carry out the research	<p>The coupled problem will be addressed using a fluid-structure interaction framework, where the fluid will be the air inside and outside the cabin and the structure will be the car door. The possibility of introducing deformable parts in the structure will be also considered (the hinges, for example). Given the complexity of the problem at hand, to treat the fluid part two different finite element approaches will be proposed: (i) a fully Lagrangian method; (ii) an Arbitrary Lagrangian-Eulerian (ALE) method. The fully Lagrangian approach is based on efficient continuous remeshing, it allows for an easy treatment of the interface between fluid and solid and it will be also able to describe the complete closing of the</p>



	door. The ALE approach guarantees a better quality of the computed pressure but can have some difficulties in the complete closing of the door. During the development of the work, the two proposed ideas will be tested and validated to find the best solution to the problem.
Educational objectives	Since the proposed research project is highly multi-disciplinary, the candidate will have the opportunity to collaborate with a number of laboratories and research groups either in the Department of Civil and Environmental Engineering or in other Departments of the Politecnico di Milano, in industries and in international research centers. He/she will acquire specialized knowledge on fluid structure interaction and on coupled numerical techniques.
Job opportunities	Direct employment in automotive industries or research centers.
Composition of the research group	1 Full Professors 1 Associated Professors 1 Assistant Professors 1 PhD Students
Name of the research directors	Attilio FRANGI, Massimiliano CREMONESI

Contacts	
attilio.frangi@polimi.it	
http://frangi.faculty.polimi.it/	

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	597.50 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

List of Universities, Companies, Agencies and/or National or International Institutions that



are cooperating in the research

Universitat Politècnica de Catalunya - CIMNE

Université Paris-Saclay - LMT

Educational activities

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

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, and they are paid for that.

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

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.