



PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 39th cycle

**PNRR 117 Research Field: VALORIZATION OF MUNICIPAL SOLID WASTE ASH AND
WASTE FROM STEEL PRODUCTION AS A CARBON SINK SECONDARY RAW MATERIAL IN
CONCRETE PRODUCTION**

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**

The possibility of replacing cement in concrete with supplementary cementitious materials (SCMs) originating, as waste, from other industrial products is well known, fly ashes, silica fume and slag being the most commonly employed SCMs and the benefits their use brings to concrete in terms of multiple performances are well known. Nonetheless, since the aforesaid SMCs originate from energy production processes employing fossil fuels or from “conventional” steel production, which are gradually but unavoidably going to be abandoned, their availability is becoming questionable, and with it the possibility of achieving the zero or nearly zero carbon targets in the production of concrete and cementitious materials. At the same time new waste materials are emerging as promising candidates to the same purpose, including electric arc furnace slags as well as municipal solid waste incinerator ashes. The PhD projects aims at investigating the possibility of employing these materials in the production of concrete and cementitious composites, also incorporating, and assessing the feasibility, of an industrial process which provides a tuned early “carbonation” of the raw materials, as a function of the desired level of delayed hydraulicity of the same.

Methods and techniques that will be

The candidate will work on the characterization of the



developed and used to carry out the research	The candidate will work on the characterization of the mechanical and durability performance of cementitious materials with the new supplementary cementitious materials, working on state of art facilities of the Testing Laboratory for Materials, Buildings and Structures at Politecnico di Milano. He will acquire solid knowledge in experimental mechanics, concrete material science and technology as well as in the characterization of the microstructure of cement based materials, also during his foreseen stay at EPFL. The training period at the company will be instrumental at garnering knowledge and expertise on the patented process for the early carbonation of the SCMs.
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, 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	0 Full Professors 2 Associated Professors 2 Assistant Professors 11 PhD Students
Name of the research directors	Liberato Ferrara

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	637.5 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Resilco s.r.l. Società Benefit
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	EPFL Lausanne
By number of months abroad	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 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, 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

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.