



PhD in ARCHITETTURA, INGEGNERIA DELLE COSTRUZIONI E AMBIENTE COSTRUITO / ARCHITECTURE, BUILT ENVIRONMENT AND CONSTRUCTION ENGINEERING - 38th cycle

PNRR_352 Research Field: INNOVATIVE BUILDING ENVELOPES WITH FIBER-REINFORCED COMPOSITE MATERIALS AND BIPVS INTEGRATED TECHNOLOGY

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	
<p>Motivation and objectives of the research in this field</p>	<p>Global energy demand is continuously growing, with the building sector consuming one third of the total energy supply in developed countries and one-fourth in developing ones. In order to improve the energy efficiency of buildings and to achieve the global carbon emission target (in line with the European Clean Energy Package and national targets reduction of emissions - PNRR M2C3 mission), the exploitation of a high fraction of locally available renewable energy sources will become necessary, in addition to a significantly reduced energy demand, from the production of the single building components to the end of life of the construction. Over the last years, the integration of solar technologies into the building envelopes has gained traction, becoming a viable option for building designers and a business opportunity for the industry. The integration of photovoltaic systems on the whole building envelope, and not only on the roof, as it mainly happens nowadays, could significantly increase the solar energy output.</p> <p>All the different topics presented above could find a solution in a potentially ground-breaking building envelope that integrates BIPVs and that is obtained by an innovative fibre-reinforced composite material, that allows also to significantly reduce the thermal bridges, via its low</p>



	<p>values of thermal transmittance in comparison with the common construction materials used nowadays, contributing to the improvement of the energy efficiency of buildings in the context of PNRR horizontal principles. The objectives of the proposal are aimed at bringing a significant development of knowledge in the areas of interest of the PNRR. The research programme aims to develop an innovative building envelope solution, optimizing the main variables involved in its production, installation and use. This in order to define tools, technical rules and testing methods suitable to assess the performances of the possible design solutions under specific requirements and boundary conditions. The environmental impact assessment will be always considered as well, since the use of re-usable or recyclable building materials will be even more important in the next future (transition to a circular economy, DNSH principle). In this regard, the research proposal has a strong transversal approach to the M2C2 mission of PNRR 'Increase of the share of energy produced from renewable energy sources (RES)' and M2C3 mission 'Increasing the energy efficiency of the public and private real estate stock'. Finally, in response to the current shortage of high-level researcher profiles in companies in the building envelope sector, the research program will train a high-profile expert, able to meet their needs in 'Research, Development and Innovation' teams, promoting technology transfer and the integration of research results into the production system (PNRR mission M4C2).</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The Candidate will fully investigate the potential and the issues of aluminium and fibre-reinforced composite building envelopes integrated by BIPVs. The building envelopes could be curtain walls, ventilated facades and roofs, linear or free form.</p> <p>The candidate will deal with analytic and experimental aspects of the research. This may include finite elements and thermal simulations, correlated with laboratory tests in order to investigate the best method and tools necessary to evaluate and design (in terms of performance, production, construction and life cycle assessment) the</p>



	<p>optimal solution to fit specific project needs.</p> <p>The research will involve systems' evaluations concerning materials, production and construction processes, life cycle assessment, energy efficiency, in order to optimize them in terms of energy performances, easiness and speediness of installation, disposal and recovery at the end of the life cycle, etc. The research will be developed both at Politecnico di Milano and at Gualini S.p.A. company (https://www.gualini.eu/), and will include a research period abroad of at least 6 months in total.</p>
<p>Educational objectives</p>	<p>The educational goals will concern:</p> <ul style="list-style-type: none"> • Advanced knowledge of the specific characteristics and requirements of fibre-reinforced composite materials; • Advanced knowledge of the specific characteristics and requirements of Building Integrated Photovoltaic Systems; • Methods to set up experimental tests on materials/components; • Methods to evaluate and analyse data from experimental tests in order to obtain results directly useful for the design of innovative products; • Analytical models calibration through the results of experimental test; • Technical solutions design, modelling, installation and maintenance process; • Publishing on international journals and congress proceedings.
<p>Job opportunities</p>	<p>The skills acquired through the research are expected to make the Candidate a highly qualified expert in the field of aluminium and innovative composite materials for the construction sector and of high energy-efficient building envelope systems, either to work in the research and development branch of producer companies or as an independent consultant.</p> <p>The mains skills will be accompanied by a deep knowledge on the sustainability of innovative composite</p>



	<p>materials and the Lifecycle Assessment (LCA) of innovative products.</p> <p>This very advanced knowledge and competence will also be useful to improve the existing standards on the use of such systems and their components and become a reference data for the whole industry in the field, at a national and international level.</p>
Composition of the research group	<p>1 Full Professors 2 Associated Professors 0 Assistant Professors 1 PhD Students</p>
Name of the research directors	Prof. Enrico S. Mazzucchelli

Contacts	
<p>Enrico Sergio Mazzucchelli email: enrico.mazzucchelli@polimi.it</p>	

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)	GUALINI S.p.A. company Via Bartolomeo Colleoni, 24060 Costa di Mezzate (BG)
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Universidade Nova de Lisboa, National Laboratory of Energy and Geology (LNEG) in Lisbon, Italcomposites Doo, Brčko, Bosnia Erzegovina
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>This scholarship is partially funded by GUALINI S.p.A. (Via Bartolomeo Colleoni, 24060 Costa di Mezzate (BG) - https://www.gualini.eu/).</p> <p>Additional information can be found in the Regulations for the 37th Cycle of ABC-PhD: download is available at link: https://beep.metid.polimi.it/web/abcphd/documenti-e-media</p>



Additional information about ABC department and ABC-PhD programme:

available at link:

<https://www.dabc.polimi.it/>

Additional support for the research activity:

a total amount of 5.197,62 Euros per student, available since the first year, to be spent according to the department rules.

Study period abroad:

a period of 6 months of study and research abroad is mandatory at ¿Universidade Nova de Lisboa¿ and ¿National Laboratory of Energy and Geology (LNEG)¿ in Lisbon (BIPV and solar energy research - 3 months) and at Italcomposites Doo, Br¿ko, Bosnia Erzegovina (composite materials research - 3 months).

Internship in a company:

an internship at GUALINI S.p.A. in Costa di Mezzate (BG) is mandatory for a period of 6 months, preferably during the 1st and/or 2nd year.

Desk availability:

the ABC department provides non-permanent desks to be temporarily booked in common PhD rooms.