



PhD in ARCHITETTURA, INGEGNERIA DELLE COSTRUZIONI E AMBIENTE COSTRUITO / ARCHITECTURE, BUILT ENVIRONMENT AND CONSTRUCTION ENGINEERING - 39th cycle

PNRR 118 INTERDISC Research Field: MULTI-MATERIAL ADDITIVE MANUFACTURING FOR A RESOURCE-EFFICIENT CONSTRUCTION SECTOR

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0
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	<p>Interdisciplinary PhD Grant</p> <p>The PhD research will be carried out in collaboration with research groups of the PhD programme in "MECHANICAL ENGINEERING".</p> <p>See https://www.dottorato.polimi.it/en/prospective-phd-candidates/calls-and-regulations for further information.</p> <p>Construction of new structures will have a vital role in reducing global CO2 emissions and energy consumption. Multi-material additive manufacturing (AM) can enable the creation of parts with customized properties that meet specific performance requirements, while also reduce waste and material usage. To date, multi-material AM research has been tackled from single perspectives mainly concerning processing studies. For full exploitation in the industry, digital tools for geometrical and material design should accompany the advanced AM processes. From this perspective, this PhD project will integrate digital design and manufacturing tools for multi-material processing of steel and aluminum components for lightweight and robust structural parts for the architecture, engineering, and construction (AEC) industry. The proposal is coherent with the PNRR missions regarding "the digital transition" and "green revolution and ecological</p>



	transition".
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The multidisciplinary PhD will involve the competencies from construction and mechanical engineering fields. The PhD project will implement the digital construction methods by employing FE analysis, parametric design, topology optimization, and LCA/LCC assessments. The research will be implemented as a collaboration between Department of Architecture, Built Environment and Construction Engineering and Department of Mechanical Engineering. The project will involve additive manufacturing solutions from a wide range of processes available in our state-of-the-art laboratories. The advanced additive manufacturing systems will involve robotic LMD, WAAM and welding systems. The interdisciplinary project will examine the potential environmental and economic benefits of multi-material steel processing, including reduced energy consumption, lower emissions, and cost savings, by means of LCA/LCC assessments. The project will observe and benefit from ongoing EU research project (ConstructAdd). On the other hand, the use of mixed materials and different alloys will be the innovative concept not explored to the date. At the end of the PhD, the candidate will be able to design multi-metal components topologically optimized in a parametric design environment. The design components will be resource efficient in terms of material and energy usage, as well as their usage in time thanks to the correct implementation of the design for AM rules and integrated LCA/LLA studies.</p> <p>Moreover, the PhD project includes a mandatory period <u>abroad at TU Munich (6 month)</u>. The industrial case study will be supported by Cimolai SpA in terms of industrial feasibility and data for resource usage.</p> <p>The PhD work will pave the path towards a sustainable research framework through the future project proposals in the upcoming calls.</p>
<p>Educational objectives</p>	<ul style="list-style-type: none"> •Parametric design exploiting topological optimization methods for multimaterial AM •Development of multimaterial metal AM processes and process rules for large scale components



	<ul style="list-style-type: none"> •LCA/LCC assessments of the products starting at the design stage •Production of demonstrator cases
Job opportunities	<p>Italy and Lombardy Region have leading positions in construction and manufacturing worldwide. PhD students are employed within the first year in national and international companies and academic and non-academic research institutions, engaged in innovation, research and technical development.</p> <p>List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:</p> <ul style="list-style-type: none"> •Cimolai •TU Munich •BLM Group •Imperial College London •RTWH Aachen University •IMDEA Material Research Centre
Composition of the research group	<p>2 Full Professors 1 Associated Professors 2 Assistant Professors 5 PhD Students</p>
Name of the research directors	<p>Prof. A. Kanyilmaz and A. Gökhan Demir</p>

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	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	TU Munich
By number of months abroad	6

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

Additional support:

Budget for the research activity (only for positions supported by scholarship):

total amount Euro 5707.20 per student

In detail:

- 1st year Euro 1902.40
- 2nd year Euro 1902.40
- 3rd year Euro 1902.40

Additional information about the organization and regulations of ABC-PhD programme can be found in the Regulations for the 39th Cycle of ABC-PhD:

download is available at link:

<https://www.dottorato.polimi.it/corsi-di-dottorato/architettura/architettura-ingegneria-delle-costruzioni-e-ambiente-costruito>

Additional information about ABC department and ABC-PhD programme:

available at link:

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

Desk availability:

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