



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

**THEMATIC Research Field: SUSTAINABLE MOUNTAIN HUTS. GUIDELINES AND
TECHNOLOGIES FOR INCREASING THE ENERGY EFFICIENCY AND THE RESILIENCE OF
THE NATIONAL MOUNTAINEERING TOURISM INFRASTRUCTURE**

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	<p>From the collapse of a serac on Marmolada Peak to the closure of mountain huts after rock falls on Mont Blanc, the impacts of climate change have never been more apparent in Western Europe's highest mountain range. Data revealed to Reuters reportedly shows the Alps' glaciers are on pace for their most significant loss of ice mass in the last 60 years. These melting glaciers and the global warming effects, in general, have a profound effect on the surrounding communities and significantly impact mountaineering tourism infrastructures.</p> <p>Measures to increase the energy resilience of those are vital for the development of mountain regions. Many scientists believe that the changes occurring in mountain ecosystems provide an early glimpse of what could come to pass in lowland environments. The mountains, therefore, are dually the areas most at risk and those most capable of providing answers to the dangers posed by climate change. How are mountain huts or bivouacs designed? How are they integrated with their fragile surroundings? How can functional requirements be synthesized with a focus on sustainability and energy efficiency? These are just a few of the questions that have activated the debate of specialists with public opinion in</p>



	<p>recent years. Mountain huts are in fact usually isolated from heating and electricity grids due to their location, and their energy supply mainly relies on fossil-fuel-powered generators and boilers, which need respective equipment and fuel often supplied by helicopters, which are another high-impact source of CO₂ emissions and pollution. Studies on how to decline and improve the efficiency of existing mountain huts suggested developing their own self-sufficient energy supply, through renewable sources like wind and solar, coupled with a reduced consumption scheme. Moreover, the thermal and energy performances of existing hut envelopes are often poor, due to a lack of thermal insulation or high deterioration of the envelope due to the exposition to extreme thermal conditions. The development of energy-saving measures, to improve the sustainability and resilience of the overall mountain infrastructure system, (considered as a whole by the building huts plus the off-grid systems) will contribute not only to the general EU decarbonization path of the construction sector but also to the climate change mitigation, the nature conservation and the biodiversity goals. Achieving sustainable and nearly zero emissions mountain huts will impact on several other relevant aspects such as safety, accessibility, local development and economy, in line with the visions for a New European Bauhaus of the Alps.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research program deals with the sustainable design and monitoring of mountain architectures in the Alpine context to investigate the potentialities for isolated alpine huts? systems from multiple points of view. The research will develop a methodology for analyzing the offer and the demand of the alpine mountain hut ecosystem and it will produce a set of scalable solutions feasible for mountain huts renovation (from a sustainable, functional, safe, and energy-efficient point of view). The project proposal will be organized on a three-year timeline according to the following three main objectives:</p> <ul style="list-style-type: none"> •systemic analysis and geoclusterization of the mountaineering infrastructures located in the Alps with a multidisciplinary and ad hoc developed method based on



	<p>specific KPIs;</p> <ul style="list-style-type: none"> •study of functional, technological and energy-efficient upgrading solutions; •implementation and development of the overall developed methodology: from the current state audit to the renovation roadmap definition on a demonstrative mountain hut pilot for the application and validation of the identified technologies. <p>The research plan activities will be reviewed whenever it is required or useful and, at least, during the periodic meetings with the Board and their representatives (Milestones).</p> <p>SDGs related to this research: GOAL 3: Good Health and Well-being GOAL 7: Affordable and Clean Energy GOAL 9: Industry, Innovation and Infrastructure GOAL 11: Sustainable Cities and Communities GOAL 13: Climate Action</p>
<p>Educational objectives</p>	<p>The results of the thesis should lead to a better understanding of: (i) how the effects of global warming may jeopardize mountaineering activities, (ii) applying energy efficiency measures to huts and infrastructures, and more generally (iii) maintaining accessibility to high mountain environments. The thesis’s statements will also contribute to shaping transformation towards a more sustainable situation by increasing awareness and understanding of the issues analyzed in the study.</p> <p>The core educational objectives will be the development of a modular decision-making tool for the audit of the existing mountain huts in the Alpine area and the consequent derivation of set-of replicable renovation actions for their decarbonization and functional transition. The thesis will provide an original and comprehensive technological study on mountain architectures analyzing firstly their current state through a set of specific and identified KPIs, suitable for the mountain environment, and secondly, their future scenarios facing the climate change challenges, through the definition of multidisciplinary guideline for sustainable and resilient</p>



	building renovation, supporting owners/organizations (such as Club Alpino Italiano) to implement, realize and programming the maintenance of those infrastructures over the time.
Job opportunities	PhD graduates in this research field can be very competitive in both national and international Research centers or Academic Institutions, as well as in Research & Development departments (SMEs, public institutions or large companies).
Composition of the research group	2 Full Professors 1 Associated Professors 1 Assistant Professors 2 PhD Students
Name of the research directors	Prof. Graziano Salvalai

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

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Additional support:</p> <p>Budget for the research activity (only for positions supported by scholarship): total amount Euro 5197.60 per student In detail: - 1st year Euro 1732.53 - 2nd year Euro 1732.53 - 3rd year Euro 1732.53</p> <p>Additional information about the organization and regulations of ABC-PhD programme can be found in the Regulations for the 39th Cycle of ABC-PhD:</p>



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.