



DOTTORATO DI RICERCA IN TECHNOLOGY, INNOVATION AND MANAGEMENT (DTIM)



PHD PROFILE, II YEAR STUDENTS, A.A. 2018/2019

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- *From energy refurbishment of existing buildings to Nearly Zero Energy ones*
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OUTLINE OF THE RESEARCH

In the face of pressing economic and environmental challenges, national and international efforts to promote sustainable growth have been intensifying in recent years. Building sector can help to accelerate progress towards sustainable development through, for example, more sustainable use of natural resources, efficiencies in the use of energy, and valuation of ecosystem services. Buildings are responsible for more than one third of the total energy use and associated greenhouse gas emissions in society, both in developed and developing countries. While buildings embody significant environmental impact, they also represent one of the few sectors where significant mitigation can be achieved at no or low cost to society.

The current legislation in terms of energy efficiency has led research and the construction market towards the design of hermetic and hyper-insulated buildings. However, the developed technologies often are not suitable for improving the energy performance in Mediterranean climate; herein the summer conditions and the related air-conditioning needs require permeable and active envelopes. Research is focused on this topic with the aim of analysing and developing innovative solutions to lead to Net or Nearly Zero Energy Buildings in the Mediterranean climate context, reducing the "from-cradle to grave" environmental impact and maximizing indoor comfort conditions. According to the recast of the Energy Performance of Buildings Directive (2010/31/EU), "nearly zero-energy building" means a building that has a very high energy performance, and the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

More in detail, the aims of research activity, is to bridge the gap among technology, business and society and to support the development and diffusion of innovative and sustainable solutions and technologies as well as design logic aimed at optimizing energy consumption and of indoor living in the building-plant system, both with reference to the design of new buildings and to the energy refurbishment of the existing buildings.

The research line is characterized by a dual approach - experimental and theoretical - aimed at predicting energy performance through numerical modelling in order to allow the prediction of behaviour under multiple operating conditions and on the other side to experimentally verify the performance in a real context.

Regarding the experimental aspect, the research will be also supported through use of an experimental laboratory built to be a Nearly Zero Energy Building (NZEB) in a typical Mediterranean climate with the purpose to test in a real context the design technologies for the envelope and plant systems. Indeed, the building is designed as a research laboratory, suitable for testing and measuring energy demand, renewable energy conversion, indoor environmental quality and other aspects of performances in a realistic context. In present and future experimental campaigns, this laboratory will be used for different activities concerning the energy efficiency in buildings aimed at being NZEB, with the purpose to identify, if possible, some general guidelines for the correct design of a NZEB in a Mediterranean climate. Indeed, starting from a real project experience, by coupling



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experimental campaigns, numerical studies, investigations of criticalities and successful choices, it will be possible to identify opportunities, gaps and failures of design strategies.

While, two key points for researches in matter of energy refurbishment of existing buildings will be a) show the importance of using validated models to simulate the present energy performance of buildings, because the adoption of simplified modelled brings results for the energy performance also very far from real performance; b) understand the real environmental benefits and the economic implications of a deep energy refurbishment.

The solutions for the building/plant system analysed through a multi-criteria approach in which to take into account the different factors that contribute to the optimization of global energy performance, will allow the development of new technologies that can be functional to participation in future research projects or the dissemination of these solutions on the Italian and European market with the objective of Energy saving and Environmental sustainability, the absolute prerogatives of world and European politics in the near future.

In achieving the established objectives, an interdisciplinary approach and cooperation among researchers in the various disciplinary sectors involved is certainly fundamental.