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Editorial

Novel Technologies to Enhance Energy Performance and Indoor Environmental Quality of Buildings

Alessandro Cannavale [1,2,*], Francesco Martellotta [1] and Francesco Fiorito [3]

[1] Department of Civil Engineering Sciences and Architecture, Polytechnic University of Bari, 70126 Bari, Italy; francesco.martellotta@poliba.it
[2] National Research Council, Institute of Nanotechnology (CNR-NANOTEC), Via Monteroni, 73100 Lecce, Italy
[3] Department of Civil, Environmental, Land, Building Engineering and Chemistry, Polytechnic University of Bari, 70126 Bari, Italy; francesco.fiorito@poliba.it
* Correspondence: alessandro.cannavale@poliba.it; Tel.: +39-080-596-3718

Here, we overview the Buildings journal Special Issue dedicated to the following topic: "Novel Technologies to Enhance Energy Performance and Indoor Environmental Quality of Buildings" (https://www.mdpi.com/journal/buildings/special_issues/Energy_Indoor_Environmental, last access on 7 July 2021) and the scientific papers it hosts. The aim of this Special Issue was to report current trends in the investigations dealing with emerging materials and devices, aiming at an increase in energy performance of buildings and indoor comfort. We are currently facing an epochal transition, involving a compelling change in the way we produce and use energy: in this roadmap, low impact buildings might play a relevant role. The enhancement of energy efficiency, in the construction sector, can be obtained by the development of new materials, with improved properties, spanning from chromogenics [1–3] to semitransparent photovoltaics [4–7], superinsulating materials [8,9], and phase change materials [10,11]. Novel technologies may also increase comfort, indoor environmental quality and safety as well. Ten original research studies have been published, with the contributions of international research groups, from Italy, Poland, Australia, United Kingdom, Croatia, Spain, and Taiwan. All these contributions address the main topics of the Special Issue, with an effective and targeted effort.

Cannavale et al. [12] proposed an innovative aerogel-based "thermal break" for window frames, to effectively reduce the frame conductance of regulation compliant reference windows. The thermal performance of this new window was assessed by finite element method. Furthermore, numerical simulations were carried out to assess energy savings for heating and cooling, for several international locations, confirming the potential of this novel building component, embodying super-insulating materials, which revealed its suitability for extremely rigid climates.

Mainka et al. [13] reported a study about homemade air purifiers, namely low-cost ozone generators to decrease the level of contaminants. In their experimental activity, they investigated the reduction of bacterial and fungal aerosol by using two available technological solutions of air purifiers. They observed a decrease by 78 % of bacteria concentration, after 20 min of ozone generation. The authors of also point out that ozone has the property of destroying the coronavirus, at the basis of the global SARS-CoV-2 pandemic. This aspect could justify a particular interest in the proposed device.

Kuru et al. [14] investigated the possible transfer of multifunctionality in nature into biomimetic strategies for engineered systems, by creating an effective framework to develop multifunctional biomimetic adaptive building skins. Such a framework may become a systemic collection of biological information. Numerical simulations proposed a comparison between the base-case building and a case study, demonstrating a decrease of discomfort hours by 23.18 %. The authors proposed biomimetic design as a suitable approach for future buildings.

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Roy et al. [15] proposed a review paper dealing with perovskite solar cells, whose rapid worldwide diffusion in scientific research has attracted the attention of industries and governments. The authors investigated the main issues about building integration of perovskite-based solar cells, showing their main features, opportunities but also critical issues and current limits, which perhaps will soon be overcome, thanks to future scientific efforts.

Franco et al. [16] investigated the relevant role of ventilation rate, to achieve air quality in public buildings, with special attention to the required compromise between indoor air quality and the control of energy consumption. The authors proposed a method for the definition of optimal values of air exchange rates and found lower air flow exchange rates, compared to current Technical Standards, sensitive to occupation profiles. The authors claim that their adaptive solution represents a considerable progress, being based on simple measurements of carbon dioxide concentration, by means of commercial sensors.

Ćorić et al. [17] proposed a research article dealing with the application of seismic energy dissipaters based on a cost-effective copper-based shape memory alloy. The ausforming process was suitably optimized by controlling the parameters, achieving both adequate strength and suitable transformation behaviour.

Ciampi et al. [18] reported their experimental tests on extruded Acrylonitrile–Butadiene–Styrene, used in form of panels as a second-skin layer in a ventilated building façade, to be applied in eight refurbishment cases, analysed by means of a numerical simulation software platform. In comparison to the reference case study, the proposed system allowed reduction of energy demand for heating (−6.9 %) and for cooling (−3.1 %).

Zsembinszki et al. [19] studied a Deep Reinforcement Learning architecture, able to solving complex control problems and applied it to the control of novel hybrid energy storage systems. They found that a suitable strategy may reduce the system operating costs of cooling by more than 50 %, in residential buildings located in the Mediterranean climate.

In their work, Morano et al. [20] focussed their attention on one of the most relevant environmental factors, affecting human health: noise pollution. Its effects on the real estate market were investigated, by analysing functional relationships between noise pollution and selling prices in the city of Bari, in Apulia (Italy).

Hwang et al. [21] investigated the energy saving potential due to the integration of Phase Change Materials in rooftops, so as to reduce indoor temperatures in schools of Taiwan. The ideal melting temperature was found to be 29 °C, whereas the effective thickness of the material was 20 mm, for the selected locations, in Northern Taiwan.

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