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Towards high energy performing historical buildings. A methodology focused on operation and users' engagement strategies.

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Abstract

"Historical evidence indicates that when man first considered settlements and the order pertaining the rein, he showed concern for the conservation of this order and of monuments" [1].Today, the conservation of historical buildings involves also the necessity to adapt them to the current lifestyles and legislation in order to maintain them, wherever possible, as living evidences of the past. One of the most important challenges of adapting historical buildings to future usages is represented by the enhancement of energy performances of these building, that is crucial both for environmental and economic reasons. The aim of this paper is to outline a methodology to investigate the potential energy savings and the enhancement of historical buildings' livability by acting only on their operation, so that the building fabric could be maintained as much as possible as the original evidence. Furthermore, an example about methodology's application on a real case study will be described in order to translate the theoretic phases into an operative plan.

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Keywords: Historical buildings' energy retrofit; Operation strategies for historical buildings; Users' engagement.

1. Introduction

Nowadays, there is an increasing consciousness about the importance of energy performances and indoor environmental conditions' enhancement of historical buildings. At the same time, one of the main issues of energy retrofit design of historical buildings is to provide energy-saving solutions trying to preserve as much as possible

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their architectural and historical evidence. In this direction, the following paragraphs will show the potential of strategies addressed to energy efficiency by acting on users' education and adaptation opportunities. The main aim of this methodology is to investigate the potential of energy and economical savings by acting only on the building use, with a special focus on occupant behaviour and awareness. In particular, users' behaviour and preferences in terms of indoor environmental conditions will be investigated and strategies of users' engagement and education will be elaborated and tested. To understand users' necessities and behaviour theories from the field of psychology will be taken into account, e.g. Theory of Planned Behaviour or Social Cognitive theory. In addition, systems' management strategies and feedbacks to and from building managers will be provided and tested. In the following paragraphs, a concise literature survey concerning the main scientific topics involved in the methodology assumptions and development is provided.

2. Energy performances of historical buildings

2.1. Energy performances of historical buildings

The relentless gait of history has always dealt with the concept of continuity; the tradition is in continuous development. The appearance and quality of historical buildings is enjoyed by a countless number of people who live them in daily life or who travel around the world in order to experience these memories. Nowadays, the necessity to conserve historical buildings is dictated mostly by the moral commitment to transfer the knowledge of what history left to future generations. In addition, the topic of valorization, sometimes seen controversial, involves the adaptation of these buildings to the current necessities, both in cultural and legislative terms. At present, the increasing sensibility to the architectural heritage has to deal with the current economical crisis that concerns particularly the building sector. In addition, it has to deal with the environmental emergency known under the key word climate change that has attracted the attention of international authorities for many years. For these reasons, the management of any confined environment has to deal with the contemporary necessity to reduce energy consumptions and to search for the maximum optimization of costs. Moreover, historical buildings, as cultural palimpsest, are a source of cultural identity, so they could contribute to a collective education and awareness on energy savings' and sustainability's themselves. Despite that the majority of legislative requirements in terms of energy performances are not addressed to historical buildings, there is an increasing consciousness on the importance of their relevance to reach the European CO2 emissions' reduction goals. In fact, statistical data show that 14% of the European Building stock dates from before 1920 [2]. Moreover, this percentage could dramatically grow in some historical cities; in Bologna (Italy), for example, around 80% of city center buildings were built before 1949 [2]. Currently, heritage preservation and energy efficiency measures are often conceived as mutually exclusive purposes. Often the enhancement of energy performances involves some actions on the building fabric. These interventions, if not well designed, could damage the monumental value and the static stability of historical buildings [3]. Instead, it should be considered also that energy retrofit measures could contribute to historical buildings' preservation by enhancing their liveability and economical sustainability, improving structural protection and enhancing comfort for users. According to the Italian national agency for electrical energy (ENEA), these operations should have a multidisciplinary approach, e.g. by considering microclimatic characteristics of the confined environment in relation with the degradation dynamics of the building fabric [4]. In conclusion, the enhancement of energy performances of historical buildings should be conceived as a reasonable integration of valorization and conservation operations; the aim should be to lower energy consumptions and ameliorate the indoor environmental conditions respecting as much as possible the original architectural evidence of the building.

2.2. Energy performances in relation to building use

According to the Annex fifty-three's project of the International Energy Agency, the energy consumptions of buildings are affected by six factors: climate (1), building envelope (2), building services and energy systems (3), building operation and maintenance (4), occupants' activities and behaviour (5) and indoor environmental quality (6). In particular, the last three factors could be considered as part of the category related to occupant behaviour that