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The recurrent characteristics of historic buildings as a support to improve their energy performances: the case study of Palermo

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Abstract

The analysis of the recurrent characteristics of the local historic architecture is useful to develop large-scale energy analyses, regulations and financial strategies, but also to support technical guidelines for an energy improvement balanced with conservation. For this purpose, a multi-scale methodology ranging from envelope components to the urban dimension is necessary. In the research here exposed, this approach is investigated by focusing on the historic architecture of Palermo. For this heritage, the collection of thermal and hygrometric data for envelope components is combined with the examination of representative constructions, based on building stock categorization. Intended as a contribution to the overall energy analysis of the architectural heritage of Palermo, this case study shows that examining the recurrent characteristics of historic architecture in a local context may promote energy improvements compatible with the material and aesthetic conservation of historic buildings.

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Keywords: historic architecture; traditional building; energy efficiency; thermal properties; building categorization; Palermo

1. Introduction

The European Directive 2010/31 on the energy performance of buildings and the majority of its national implementations exempt officially protected buildings from the achievement of minimum energy requirements, if this may alter their character or appearance. Indeed many energy refurbishment techniques have been developed for recent constructions, which are not subject to conservation needs and differ from traditional buildings in thermal and hygrometric features.

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However, for a significant proportion of historic constructions, preservation restraints are limited to the external appearance, while several constructions have to comply with normative energy requirements because not protected. On the other side, both fiscal incentives and the exemplary role attributed to public institutions by the energy efficiency Directive 2012/27/EU might stimulate the retrofit of monumental buildings, without necessary concern for conservation.

Besides these risks, several reasons foster the current interest in the energy efficiency of the architectural heritage. Since it is a relevant part of the European building stock [1] and because of the energy consumption related to the hazards of climate change [2], historic architecture could give a considerable contribution to EU sustainability targets. Furthermore, in the perspective of a growing gap of performance with refurbished recent constructions, increase in energy efficiency would support the use and consequently the conservation of historic buildings [3].

In the scientific literature, it is widely accepted that the approach used for the last decades in the fields of accessibility and structural reinforcement is appropriate to make energy efficiency compatible with the aesthetic and material features of the architectural heritage. This criterion consists in improving the energy performance of historic constructions in so far as it respects their conservation, without necessary compliance with normative requirements [4]. Consequently, it is essential to analyze the peculiarities of each building, which are also related to the construction, typology and aesthetic features of the local building tradition.

In the research here described, the locally recurring characteristics of historic buildings are examined in order to assess their current energy performances and to find energy efficiency strategies and practices compatible with conservation. This approach has been explored through an application on the historic architecture of Palermo.

2. State of the art

Scientific and normative guidelines have been recently proposed for the energy efficiency of the architectural heritage [5, 6] but, since referred to a general level, they are not connected to the peculiarities of historic buildings, which significantly influence the possibilities of energy enhancement. Two relevant paths can be observed in the scientific literature in order to fill this gap.

A first research approach consists in the analysis of case studies, usually monumental buildings, where thorough energy diagnosis is conducted and improvements of envelope and energy systems are designed or carried out. Confronting the purpose of energy efficiency with the characteristics of single buildings highlights the feasibility and compatibility of different retrofit options. These researches are intended to create a collection of case studies, aimed to inspire upgrade measures and approaches transferable to other projects [7]. From this perspective, they follow a criterion typical of architectural restoration.

The energy assessment of heritage constructions is meant also for the development of regulations, financial strategies, technical guidelines, which cannot neither neglect the upgrade restraints connected to conservation nor be based on the detailed analysis of a large number of buildings. Therefore, a second research path focuses on recurrent characteristics of the historic architecture rather than on single buildings. Within this approach different methods have been proposed, whose purposes and limits strictly depend on the scale chosen for the analysis [8, 9].

Several researches deal with the recurrent characteristics of a historic building stock by following a typology approach. By means of building categories, based on features related to energy performance, these studies aim to achieve general results for the entire stock by identifying and analyzing in detail a limited number of representative constructions. When the application of the typology approach is carried out on a large scale, for instance at national level as in the French project BATAN [10], the main outcome is an assessment of the overall stock energy demand or the development of models to be specified on a smaller scale.

On the contrary, limiting the analysis to a local context, where the construction features of historic architecture are sufficiently homogeneous, is essential to the development of technical guidelines for energy efficiency. Representative buildings may perform this function, as evident in the iterative method proposed in [11], aimed to balance the technical performances and economic feasibility of energy improvements with the protection of cultural heritage. Notably, the European project Effesus has developed a method to categorize the building stock of historic districts. This categorization is based principally on the geometric features of buildings and on protection restraints [12]. Therefore, a detailed analysis of materials and construction characteristics is necessary and is expected from the examination of representative buildings.