Abstract

The aim of this paper is to highlight the potentialities for supporting the decision making process and design activities, for the case of retrofit projects with alternative technological solutions to compare. A multidisciplinary approach was adopted, involving the contribution of Real Estate Market and Economic Evaluation of Project, Architectural Technology and Building Physics. A simplified application of the Life Cycle Costing methodology was used, in synergy with energy analyses, to select, among different scenarios, the most viable solution for the retrofitting project of a single house in Northern Italy.

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Keywords: Energy Retrofit, Energy Efficiency Scenarios, Economic Sustainability, Life Cycle Costing, Global Cost

1. Introduction

The building and the construction sector, and consequently the real estate market, have been largely impacted by the economic-financial crisis effects over the last years. In fact, the collapse of permits for the construction of new buildings has been about 80% in Italy. On the contrary, interventions of restoration and energy requalification of the built heritage has shown a positive trend. As a result, the energy requalification of the built heritage represents an opportunity for construction enterprises to get over the crisis. This condition is of particular interest in Italy: over...
half of buildings were erected before the Seventies, and currently they need strong and possibly low costs interventions aimed at architectural and technological improvements, in an energy requalification perspective. Furthermore, the Italian governance policies have been moving toward regulations that limit the use of Greenfield for new constructions, strengthening the interest of operators and practitioners for the restoration of the built heritage.

The energy requalification of the built heritage can generate positive effects not only from an economic viewpoint, but also in environmental terms. It is well known that the construction sector is one of the major responsible for the global pollution and CO2 emissions. The annual energy use in the construction sector in Italy is almost half of the entire national consumption, with values higher than what recorded for the transportation and industrial sectors. Both economic and environmental reasons have led the research toward highly efficient buildings, able to limit the use of energy resources and polluting emissions, while reducing the ground consumption. The objective to "rethink the built" can be pursued through punctual interventions on buildings, which are aimed at optimizing the global energy efficiency and at creating enlargements and elevations of buildings, with an impact on their architectonical quality and usability.

Within this context, the paper deals with the topic of the energy requalification of buildings, focusing on the typology of single houses. About 85% of the Italian built heritage includes residential buildings, and about three quarters of this share consists of single or double family houses. For these reasons, the following aims are assumed as fundamental:

• to define sustainability strategies to address interventions on the built heritage, with special attention to the typology of residential single houses. This typology is particularly suitable for enlargement, considering that the increase in the volume could be coupled with an increase in the energy efficiency
• to define a methodological framework concerned with retrofitting of existing buildings, especially when in the presence of alternative technological solutions. Such framework should assist practitioners and administrators in defining, evaluating and selecting the optimal scenario, from both an economic and an environmental viewpoint

The goal of this paper is to explore the application of a multidisciplinary approach to a real case-study (a double-family single house located in a municipality near Turin, Northern Italy), taking advantage of the contribution of three disciplines: Architectural Technology, Real Estate Appraisal and Economic Evaluation of Project, and Building Physics [1,2]. The contribution of these disciplines is finalized to define a methodology simple and easy to be replicated, also considering the general difficulty – particularly in Italy – in data collecting. Specifically, the Life Cycle Costing approach, well known and extensively investigated in the international context but not so commonly treated in Italy [3], is here adapted and applied to a case-study. A simplified modality of the classic Global Cost calculation is proposed.

Starting from the Standard ISO 15686:2008 - part 5, and from the Global Cost calculation as defined in Standard EN 15459:2007, the Life Cycle Costing methodology was used in synergy with an energy evaluation procedure to compare different technological solutions for the considered case-study, so as to define the most viable solution not only in technological and energy terms, but also from an economical viewpoint.

2. Methodology

In this work, a ‘simplified’ application of the LCC methodology was used to identify the optimal scenario among a set of different technological solutions aimed at reducing the energy requirements for heating and at including the use of renewable energy sources. The Standard ISO 15686–5:2008 - Buildings and constructed assets – Service-life planning (prepared by Technical Committee ISO/TC 59, Building construction, Subcommittee SC 14, Design life), specifically the Part 5: Life Cycle Costing, was used as the methodological reference [4].

LCC is an approach for quantifying costs and benefits, with a special attention to the relevant costs along the whole life cycle [5,6]. This approach is used for supporting decisions among alternative design solutions, or components, or single materials, on the base of efficiency and effective criteria. Furthermore, it is a technique for economic evaluation of a project in the case of new projects or retrofitting of existing buildings: it allows considering individual products or components, or an entire building systems (e.g. HVAC and lighting systems), as well as immediate and/or long term costs and benefits (usually savings). The approach can be applied with different purposes: to compare alternative technical solutions to assess the relative difference in terms of their life cycle costs;
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