Construction cost and energy consumption resulting from energy retrofitting in an apartment building in Madrid (Spain)

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ABSTRACT: This theoretical study analyzes the relation between the measures necessary for the energy retrofitting of a residential building constructed in Madrid, their cost and the improvement of the energy rating of the dwellings.
The aim of this work is to establish an evaluation methodology that allows developers and architects to obtain conclusions and orientates them in the decision-making process. It will allow finding the most suitable cost-effective solutions in each case.
This paper describes the methodology and the findings obtained. Energy retrofitting and the improvement of the energy behaviour of the building depend on the selection of the retrofitting solutions and also on the investment. In this case study to achieve the best energy rates it is necessary to improve the thermal performance of the envelope as well as the energy systems.
Energy retrofitting means an increase in property value but it can't only be considered in economic terms. It is necessary to take into account unquantifiable aspects as increased comfort, improved sound insulation, livability, health, or the elimination of energy poverty situations.

Keywords: energy retrofitting, energy rating, cost-effectiveness, existing building stock

1. INTRODUCTION

The European Union (EU) adopted in 2008 the communication "20-20 by 2020. Europe's climate change opportunity" which established three goals: 20% reduction of CO2 emissions, 20% increase in energy efficiency, and 20% renewables of total primary energy consumed by 2020 (European Commission, 2008). 40% of total energy in the EU corresponds to buildings. Thus, they are a key element to achieve these goals.

The European Commission approved in 2010 the Energy Performance Building Directive (EPBD) 2010/31/EU. This document establishes energy efficiency minimum requirements and develops the methodology for calculating the energy efficiency of buildings and their energy certificate (European Parliament, 2010).

Buildings represent 26% of final energy consumption in Spain, 17% of homes and 9% of tertiary sector buildings. 53% of those homes, of a total of approximately 25 million (in 2008), were built before 1979, when the first legislation related to energy efficiency was passed. In the last 18 years the energy consumption of households has increased by about 50%.

In order to achieve the 20-20 targets it is necessary that energy retrofitting is taken into account by the Spanish construction sector. The study "Potential energy savings and reduction of CO2 emissions of the existing housing stock in Spain in 2020" (WWF, Adena, 2010) estimates that the Spanish residential sector has technical and economic capacity to reduce at least 30% energy consumption in existing housing at 2020.

In this context this study examines the relation between cost-effective technical solutions that enable the energy retrofitting in a building in Madrid, their cost, the reduction in consumption and the new energy rating of the dwellings. It also establishes an evaluation methodology that allows developers and architects to draw conclusions to guide them in the decision-making process, to find in each case the best solutions from environmental and economic point of view.

2. METHODOLOGY

The steps followed to analyze the case study are:
• The selection of the building and the analysis of its documentation.

compressive requirements: 5.00 and 7.50% with 20-25 mm rubber size.

5. An improved thermal behavior is obtained, decreasing the new composite thermal conductivity as far as the rubber content increases.

For all these reasons, waste foam rubber could be used forming part of core plasterboards, achieving an environmental benefit as well as an improved thermal performance. On the other hand, the resulting lightweight drywall would be easier to handle, making it easy to install too.

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