DEVELOPMENT OF METHODOLOGIES AND PROCEDURES FOR ENERGY DIAGNOSIS OF EXISTING RESIDENTIAL BUILDINGS

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ABSTRACT

The progressive development of the countries has led to an increased use of energy resources that are essential to social and economic welfare of populations but has damaged the environment. This raise in energy use has originated the increase of greenhouse gases emissions into the atmosphere from the combustion of fossil fuels like oil or coal.
The theme of the proposed work fits the philosophy of energy efficiency in buildings, especially residential buildings, which has as main objective the energy savings in this sector by reducing energy consumption and greenhouse gases emissions without penalizing the indoor air quality or comfort conditions for users. Another concern that this work intends to address is not only the thermal performance of buildings but also their functional performance and in particular the occurrence of pathologies resulting from a bad design of the envelope.
To achieve these goals, the author is developing a software tool for thermal diagnostics of existing residential buildings taking into account the analysis of the envelope, the systems, existing pathologies and also the proposals to increase their energy performance as well as the resulting benefits.

INTRODUCTION

Since only recently the issues of sustainability and energy efficiency in buildings have gained special relevance in the context of national concerns and policies, there is a great potential for the development of methodologies and strategies to improve the energy efficiency of buildings and to diagnose and repair thermal pathologies.
This problem is even more pertinent in existing buildings as they require, by themselves, the greatest efforts to rehabilitate them and they are the most difficult to diagnose and where it is more difficult to implement repair solutions. In addition, due to the lack of thermal requirements and concerns at the time they were built, these buildings show high energy consumptions when minimum comfort conditions are to be ensured
In this context it is very important to invest in the rehabilitation of existing buildings since this is a rapidly growing market. According to all analysis of the construction industry and also based on the European scene, the rehabilitation sector is one in which the largest increases are expected, giving greater importance to the study of rehabilitation solutions.

CHARACTERIZATION OF THERMAL PATHOLOGIES

To develop the software tool, an initial analysis was undertaken to assess the state of the art regarding the characterization of the existing housing stock and that consisted of a collection that included the exhaustive literature review of the different types of residential buildings as well as the solutions used to characterize and standardize the existing residential buildings.
Based on information gathered within the literature review, in this work it was decided to divide the thermal pathologies encountered in four major groups: facade elements, roofs, floors and glazing. Each of these groups originated subgroups whose most frequent pathologies were graded as shown in the following figures.

Facade elements	Thermal insulation inadequate / nonexistent
	Existence of thermal bridges
	Degradation of the coavering / presence of humidity
Roofs	Thermal insulation inadequate / nonexistent
	Degradation of the coavering / presence of humidity
	Damage / displacement of roof tiles
	Damage to drainage systems for rainwater
Floors	Thermal insulation inadequate / nonexistent
	Degradation of the coavering / presence of humidity
Glazing	Degradation of boxing
	Degradation / lack of sun protection
	Low thermal performance of glazing

Figures 1: Thermal pathologies

Hundreds of cases were analyzed creating an extensive database. Each of the pathologies observed was recorded as well as the improvement measures proposed to eliminate it.

During the study, it was performed a detailed cost-effective analysis of the proposed rehabilitation solutions based on inflation and interest rates. The study also included the assessment of the added value achieved in the building with the rehabilitation process, along with a detailed cost analysis of each task towards the objective.

CONCLUSIONS

From the analysis made so far it appears that, for the facade elements, 37.5% of observed cases, have inadequate insulation and / or non-existent insulation, and in 50% of the cases it was observed the existence of thermal bridges and the degradation of the covering and / or the presence of humidity.
For the roofing, in 53.8% of these cases, there was inadequate insulation and / or non-existent insulation; in 12.5% of the cases it was observed the degradation of the covering and /or the presence of humidity, in 8,3% of the cases it was notice damage and / or displacement of roof tiles-notes and in only 4.2% of the cases it was observed damage in drainage systems for rainwater.
Regarding the floors, a large part, about 70.8%, has no insulation or it is not sufficient, and in 12.5% of the cases it was observed the degradation of the covering.
For glazing, in 12.5% of cases the window frames show deterioration, in 25% there is degradation and / or lack of sun protection and 45.8% of cases show a low thermal performance of the glazing.
It is noted that in the studied sample, most of the observed fractions belong to relatively recent buildings (37.5% between 1991 and 2006 and 33% after 2006) and there are no buildings before 1960.
The data shows that the entry into force of the new thermal regulation, RCCTE, dated from 2006, has not yet been fully assimilated by some of the players, especially those responsible for construction. Too often it appears that buildings constructed after 2006, but before the entry into force of the SCE (Building Energy Certification System), do not meet the minimum requirements imposed by the thermal regulation, thus not complying with the requirements of the projects.

FUTURE PROSPECTS

Following the work done so far, it is expected to draw a flowchart for the thermal diagnosis of residential buildings and to create a software tool for thermal diagnosis of residential buildings as well as applying it to some case-studies to validate it.

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