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Optimisation of Heat Loss in Cities in Different Climatic Zones in a Mediterranean Climate

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Abstract

This article presents a study of different housing blocks in the city of Soria and Cadiz Spain, in which effective interventions are carried out not only for energy savings within the requirements of the Technical Building Code in Spain, but also for system saving in the short term. Various thicknesses of several types of insulation are analyzed, evaluating the resulting energy savings for each case, but not without leaving aside the economic aspect of the installation; and obtaining asymptotic values, in which the marginal cost of the investment will not be as variable. The article tries to exemplify how, by means of small interventions, savings could be high. They can be applied in many different types of buildings and contribute to reduce the demand of energy; is a breakthrough in the study of

alternative home energy saving, serving as a basis for a performance design study in residential buildings.

Keywords: sustainability; energy efficiency; energy Saving; sustainable buildings

1 Introduction

This paper aims to analyse how the national regulations could focus on the ideas of "sustainability" or "energy efficiency" not only in new buildings but, also in existing ones. It tries to give a response to the question: must energy saving measures be huge and the interventions equal for every building, or should they be small actions designed according to the specific characteristics of each construction?

After analyzing several housing blocks, we reflect the need necessity of new regulations that ensure high levels of sustainability. Nowadays, it would mean significant economic benefits, considering the importance of the desirable monetary reinforcement in the construction sector. This paper provides economic saving data based on Spanish building regulations [1-3]. Usually, current regulation establishes big large interventions; at to the contrary, this research paper shows that small ones contribute to high energy savings and low energy demand. We aim to demonstrate that current Spanish building regulations should be designed according to the geometric morphology, use, construction methods and others so forth, following insulation[4].

It is commonly known that energy saving supposes economic benefits, which are reached by reducing operating costs (adopting passive solutions), reducing waste (having major savings in construction and demolition costs), or by enhancing productivity and learning [5]. Another important factor for the economic benefit is also the legislation. This aspect is shown in 'Sustainable Construction' by Sandy Halliday: 'legislation is now a vital consideration as environmental bodies show increased willingness to introduce and use the law to prevent poor environmental practice. Future-proof is important, as changes in regulatory requirements can have significant associated costs if they lead to major contract variations' [6] [7].

The adopted measures are significant because they have direct impact on the environment, thus they must be studied taking into account as many fields of knowledge as possible. In 1992, the UN Conference on Environment and Development (UNCED) or Rio de Janeiro Earth Summit brought together 170 heads of state and government [8]. One of the main principles adopted by the Conference was the following: "where there are threats of serious or irreversible damage to the environment, lack of scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation" [9]. In accordance with this, this paper tries to demonstrate that there are several measures that could be applied in order to achieve the best results in the energy saving field [10-15].

2. Methodology

First identify the different climatic zones of Spain, to know what type of data we must obtain from the different zones:

Figure 1. Climate zones in Spain according to the Technical Building Code (CTE DB-HE)

According to the CTE DB-HE (Energy Saving), the climate zone of the different areas of Spain can be obtained using table a-Annex B. Climatic zones.
For the calculation we will obtain values from two very different climatic zones of Cádiz (Zone A) and Soria (Zone E)
From both places we must obtain the composition of materials for a possible facade, this data is obtained from the CTE catalog of construction elements.
For the Cádiz area, the F 3.2 façade is chosen from the catalog. Main factory façade with continuous cladding, being:

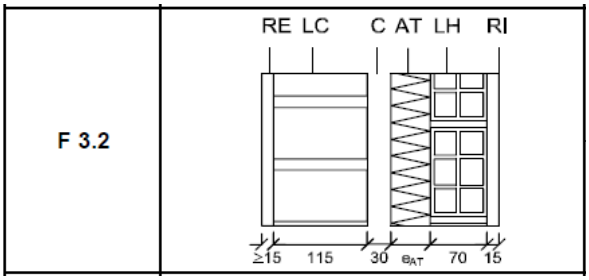

Figure 2. Construction detail F 3.2 according to the Technical Building Code

RE continuous external coating; LC ceramic brick factory; C non-ventilated air chamber; AT Non-hydrophilic insulating; LH hollow brick factory, RI interior plastering

For the Cádiz area we will also take façade F 1.1 Facade Main factory sheet seen, being:
LC ceramic brick factory; RM intermediate coating; AT Non-hydrophilic insulating : LH hollow brick factory; RI interior plastering

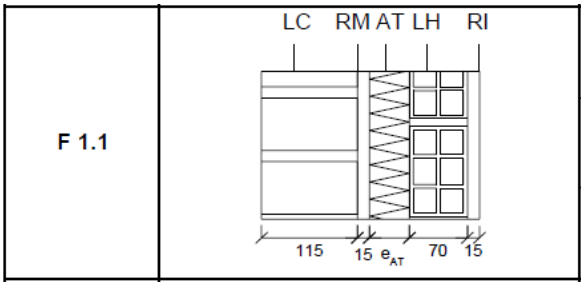

Figure 3. Construction detail F 1.1 according to the Technical Building Code

Both examples are chosen taking into account the typical construction of the area where most homes are built with a continuous white exterior coating, to avoid excessive capture of solar heat.
We also find exposed brick buildings, although to a lesser extent.

Figure 4. Buildings in Cadiz

For the Soria area, the F 4.2 facade is chosen from the catalog of construction elements.
RE continuous external coating; AT Non-hydrophilic insulating ; LC ceramic brick factory; RI interior plastering

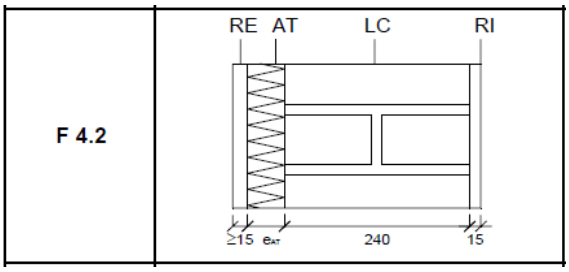

Figure 5. Construction detail F 1.1 according to the Technical Building Code

The façade F 6.1 is also taken as the base. Main factory sheet with discontinuous coating, being:
RE discontinuous outer coating; LC ceramic brick factory; AT Non-hydrophilic insulating ; LH hollow brick factory; RI interior plastering

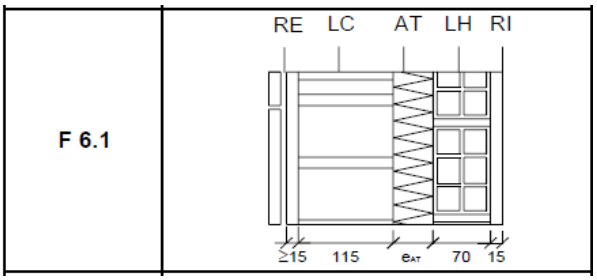

Figure 6. Construction detail F 1.1 according to the Technical Building Code

Both examples are chosen taking into account the typical construction of the area where the majority of houses are built with a continuous exterior covering and the walls are thicker due to the cold winters of Soria. We also find exterior coatings that are discontinuous to give aspects of town houses in most cases.

Figure 7. Buildings in Soria

First we must know the temperature of Cadiz in winter, for which we access meteoblue and obtain the data:

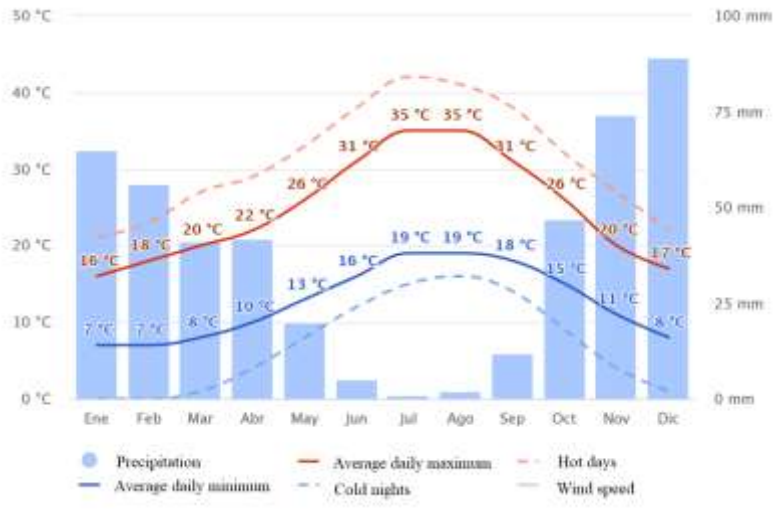

Figure 8. Meteorological information of Cadiz according to meteoblue

From where it is obtained that the minimum average temperature in winter is 7ºC
Next, we must know the temperature of Soria in winter, for which we access meteoblue and obtain the data:

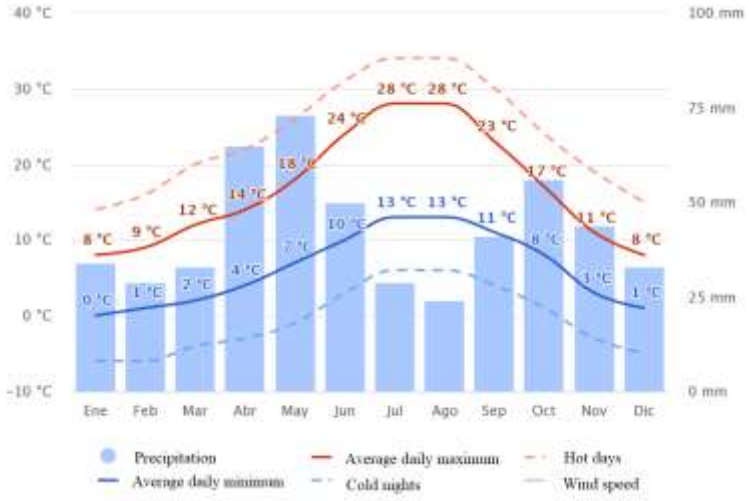

Figure 9. Meteorological information of Cadiz according to meteoblue

From where it is obtained that the minimum average temperature in winter is 0ºC
The transmittance of closings depending on the thickness of the insulation. Identify examples of the most commonly used by climatic zone (2 or 3 per zone at

least), and probe with insulation thicknesses from 1mm to 20mm, the loss of heat in winter per unit area, the saving of heat (energy) per unit area and percentage savings from not having insulation. The winter comfort interior temperature for both places is 25ºC.

3. Results

It is known that insulation must be placed on the hot or cold side of the protected space, and also in façades. There are different positions in which to place the insulation [16-18]:
-When locating it on the external face, the wall absorbs inner energy. On the one hand, energy consumption decreases; on the other hand, the cost of the installation is higher, due to the high thermal inertia [19-21].
-When placing insulation integrated in the external walls, this layout works as a thermal barrier between the external and the internal flows. The insulation cost could be compensated by means of the starting and during the permanent functioning of the heating system. According to that, the sensation of comfort is almost immediate. [22-27]
-When the insulation is located on the internal face of the wall, it generates a very low thermal inertia with immediate results. The cost of the start-up and the permanent functioning of the heating system are low and the sensation of comfort is immediate. [28-31]

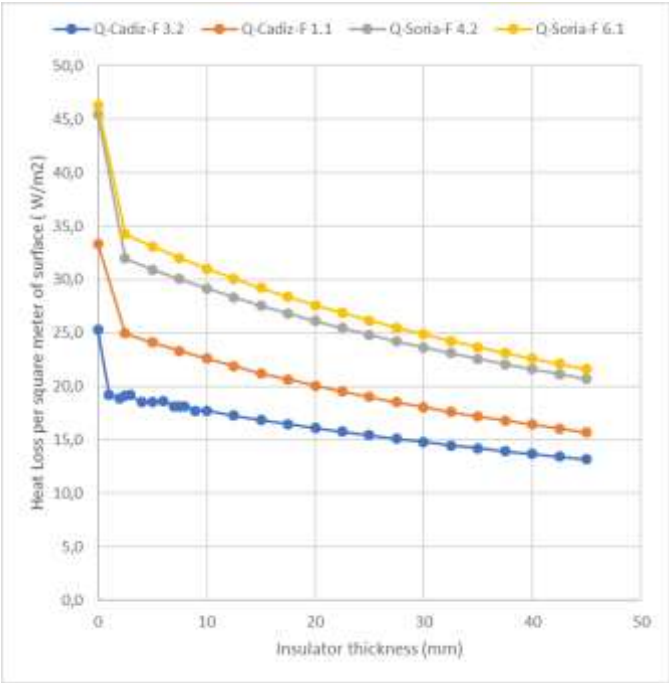

Figure 10. Heat loss per square metre of surface according to different thicknesses of insulation, for Soria and Cadiz according to different types of construction.

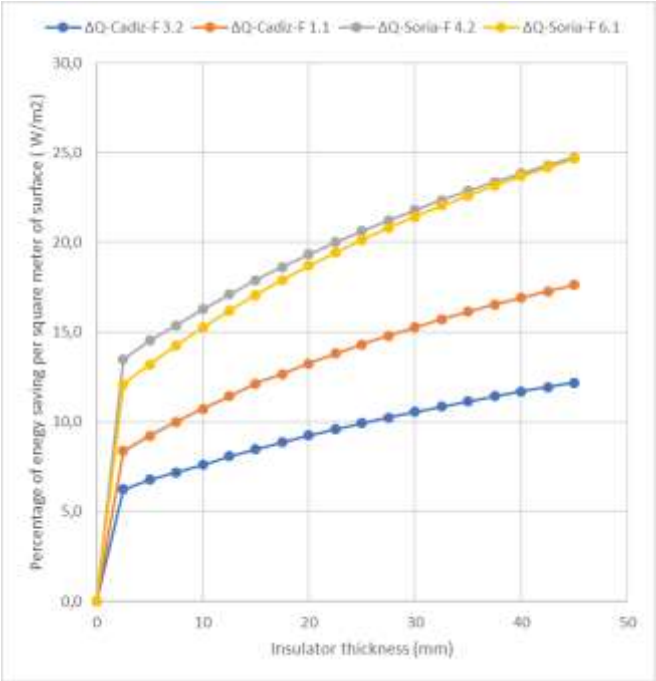

Figure 11. Percentage of energy saving per square metre of surface according to different thicknesses of insulation, for Soria and Cadiz according to different types of construction.

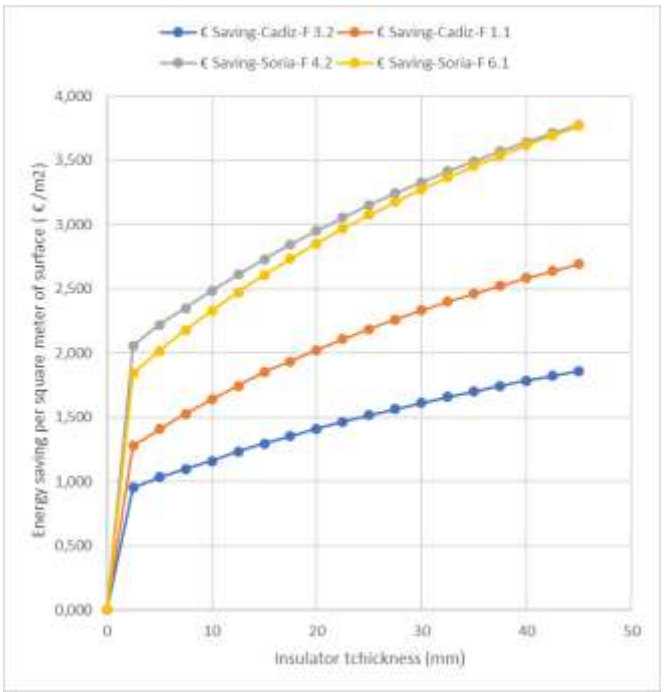

Figure 12. Percentage of energy saving per square metre of surface according to different thicknesses of insulation, for Soria and Cadiz according to different types of construction.

4. Conclusions

Taking all the cases and proposals into account, the hypothesis that initially the insulation is necessary and there is a great saving of energy is demonstrated. But at some point it is not necessary to add excessive mm of insulation, as there is no great saving compared to the previous mm. This paper doesn´t look for illustrating, through a complete study, the numerous proposals that generate adequate energy savings. On the contrary, it tries to exemplify how, by means of small interventions, savings could be high. They can be applied in many different types of buildings and contribute to reduce the demand of energy.

The current regulation must take them into consideration, and act accordingly with the suggested alternatives adjusted to the buildings studied, as shown in the calculations, the alternatives demonstrate that well-implemented small solutions allow energy savings which should be considered in several energy regulations. Some of the proposals are not practical, such as of introducing insulation inside the air cavity of external walls. However, the most efficient solution would be replacing internal partitions by cardboard planes. The classification of building types should be made regarding both the use and the possibility of making changes associated to refurbishment.

Understanding that these contributions are always in the case of existing buildings, in new buildings it is impossible to follow recommendations, since they must be taken from the beginning of the idea of the project. The current regulation, therefore, should be more flexible regarding design, ensuring that with a prior study of energy and economical savings associated to the constructed volume is fruitful, rather than requiring actions that do not consider their operational capacity.

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