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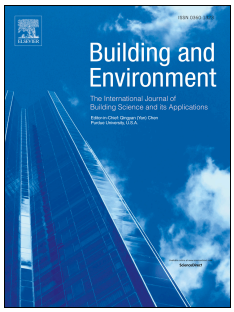

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Thermal Comfort and Energy Performance: Sensitivity Analysis to apply the Passive House concept to the Portuguese climate☆

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Abstract

The need to apply the Passive House concept to Mediterranean countries climate is regarded as being of great importance to support countries such as Portugal to reduce its primary energy demand associated to buildings consumption and thus, devising a cost-efficient strategy to meet the targets pointed out by the recast of the EPBD 2010/31/EU. In this sense, the present research intends to contribute to the implementation of the Passive House concept in Portugal, by means of a detailed study for the Aveiro region and a more broad analysis examination for different district capitals of Portugal mainland.

A detached two-storey lightweight steel structure of contemporary architecture was modelled as case study for the Portuguese climate, based on its original design solutions and resorting to the EnergyPlus® software. From this original model, sensitivity analyses were carried out in order to meet the parameters defined by PH standards.

The improved results from the climate region of Aveiro, in Portugal, have led to a reduction of the 62%, 72% and 4.4% for the heating demand, cooling demand and overheating rate, respectively (comparing the improved solution with the original as reference). It was therefore possible to meet the PH requirements, proving its applicability to the Portuguese climate and for this particular building technology.

Keywords: Energy Efficiency, Passive House, Dynamic Building Simulation

1. Introduction

In recent decades, as societies are increasingly more dependent on energy, the impact resulting from fossil fuels and the nuclear power energy exploitation threats sustainable limits. Recently, substantial efforts have been made by governments, environmental protection bodies and decision-makers to face these threats and the consequences of climate change and shortage of natural resources. Since the 1970s, the need of rationalise the energy consumption and centralise our energy market on renewable energies led to the development of several sustainable strategies, such as loss reduction and both passive and active solar use. During the last decade, the energy consumption in European buildings has not increased significantly, however buildings account for 40% of total energy consumption in this continent [1]. As an example, detailing this indicator for countries as the Netherlands and UK, buildings account for 35% and 47% of the total energy use, respectively [2, 3]. In Portugal, according to the General Division for Energy and Geology (DGEG), the energy consumption in 2009 related to residential buildings represented approximately 17% of the total primary energy supply [4]. Moreover, according to the BPIE [5], in terms of floor area, the EU residential stock represents 75% of the total EU building environment, stressing out the influence of residential buildings over the EU total energy consumption. Therefore, energy reduction in the built environment is a crucial measure to be followed.

Based on these evidences and following the Kyoto protocol, in December 2002, the Energy Performance of Buildings Directive (EPBD) was approved by the EU Parliament aiming to promote the improvement of the energy performance of buildings, considering outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness [6]. Eight years later, the recast of the previous Directive was approved, introducing new requirements, definitions and deadlines. According to this recast, buildings constructed after 2020, or after 2018 in the case of public service

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