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Thermal Performance of Social Housing– A Study Based on Brazilian Regulations

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Abstract

This paper aims to discuss how the propagation of a house design adopted by federal programs to solve Brazil's housing shortage can affect human thermal comfort. The study was based on Brazilian regulatory instruments and analysis from computer simulations. Comparisons were made between concrete and brick walls; as well as ceramic, concrete and fiber cement tiles.In general, results indicate that the use of ceramic tiles, light colors on walls and roofing and aluminium sheeting for roofs provide the best thermal performance. Concrete and dark colors on walls and roofs tend to cause inferior thermal performance. Correct use of materials together with a good implementation strategy that prioritizes location-specific factors is essential to provide comfort and energy efficiency to dwellings.

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Keywords: social interest housing; housing deficit; thermal performance; brazilian regulatory instruments; computer simulation.

1. Introduction

According to a research based on data provided by a Federal Savings Bank referred as CAIXA, the Brazilian housing deficit reached 5.7 million in 2009, decreasing to 5.2 million in 2014 [1]. This topic is one of the main

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barriers to break through in order to aim a full development of the country. Brazilian government has taken action on this issue by creating public policies, such as social programs that would fund the building of low-cost houses for people with less financial power [2].

One of them, called "Programa Minha Casa, Minha Vida", was created in 2009 by the Ministry of Cities and it's considered to be one of the biggest national programs related to social interest housing, for its amount of available funding and also for the area that it covers. This program in under management of CAIXA and, together with another strategy created in 1964 called COHABs - Companhias de Habitação Popular (Social Housing Companies, in free translation), they are responsible for controlling the housing programs in the country and also for managing financial funds destined to these projects [3].

As they have to cover a big territory, these houses are made in large scale and the construction system is reproduced in similar way, in different locations and contexts. The house design complies with traditional construction standards, but it neither takes into account the important binary materials vs. environment nor how the thermal comfort is affected in each type of climate depending on which building process is chosen. As an expected consequence, the houses built usually present some problems related to thermal performance [4].

As a result, there are many types of problems regarding housing, including the discomfort of the residents and high energy consumption, which represent a large burden on the power grid. According to Edwards, responsible energy consumption is essential for promoting sustainability in any context [5]. More than a decade ago, Brazil formally instituted the promotion of energy efficiency in buildings constructed in Brazil through Law 10.295 of 17 October 2001 [6]. After passing this law, regulations were made to favor efficiency in buildings, imposing standards and methods that are applied differently in each of the various Brazilian climates. The regulations are considered to favor energy efficiency in buildings and set out qualitative and quantitative criteria, premises and evaluation methods [7].

Accordingly, both the effectiveness of these energy efficiency measures and residents' comfort are related to the fulfillment of the efficiency standards outlined in the regulations as well as those required by sustainability certifications. Because of the territorial and financial breadth of the program, change in the PMCMV public housing construction sphere is an important challenge and would have considerable impact in regards to the housing shortage and energy consumption in buildings.

In this context, this paper presents an analysis of a standard house design based on Brazilian Regulations (NBR 15575, NBR 15220-3, Technical Quality Regulation for the Energy Efficiency Level of Residential Buildings - RTQ-R) and a national building certification called Selo Casa Azul (Blue House Seal, a sustainability certification), showing how the project would behave in different climates depending on the materials used and how they affect the users thermal comfort. The analysis has got two specific paths: a prescriptive assessment using the regulations mentioned and computer simulations. Each reference used in the analysis was presented in the methodology section.

2. Objective

This paper aims to discuss how the generalization of a typical habitation from the national program "Minha Casa Minha Vida" can affect the thermal performance beyond the eight Brazilian bioclimatic zones. The focus is, above all, on the data gathered from the computer simulations.

3. Methodology

In order to proceed this research, a computer simulation analysis was carried out according to Brazilian standards for a building sample design. The method for evaluating the case study chosen was based in three steps, each one picking a different form of analysis. They are: Part 1 - Analysis of thermal performance according to Brazilian regulations (NBR 15220-3, NBR 15575, Blue House Seal and RTQ-R Requirements); Part 2 - Computer simulation, also taking into account the solar orientation of the building and its geometry.

3.1. NBR 15220: Thermal performance (Part 3)