THE INFLUENCE OF THE URBAN IMPLANTATION IN THE THERMAL COMFORT OF THE HOUSING SECTOR JARDINS MANGUEIRAL IN BRASILIA.

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ABSTRACT

This article aims to analyze the performance of thermal comfort in one of the three main types of social housing located in Brasilia, Brazil. This analysis has as main parameter the influence of the implantation of these buildings in the urban area. In a second step part to check the adequacy of how the housing units work in relation to solar orientation while city. Through literature review, comparison of the thermal energy performance in relation to four main solar orientation through computer simulation with DesingBuilder version 2.2.5.004 software and check the percentage intend to obtain the analysis of the building relationship with the implantation and better orientation in sustainable terms in the Jardins Mangueiral neighborhood houses as well obtain the link between the urban implantation and the best orientation in the scale of the city.

Keywords: computer simulation, thermal comfort, urban implantation, social housing.

INTRODUCTION

One of the important architectural features since the past is to create a safe and comfortable houses for the man, considering the climatic aspects and less impactful solutions for the nature, being cited for example the applied concepts and building of vernacular architecture (Heywood 2015).

Ancient people kept implantation studies and solar orientation when new towns were designed, making the best use of resources left by nature, such as homes inside the caves and the rational use of mountainous topographies for the sun protection strategies.

In the end of twentieth century, the oil crisis and concerns about the new sources of energy, was born in architecture and urbanism a new strand aimed at rational energy use building a strong link between architecture, urban planning and climate seeking new methods to create a human comfort with little dependency on electricity.

According to ASHRAE, cited by Lamberts 2013, the thermal comfort is defined as the state in which the individual or user of a building reflects satisfaction with the thermal environment in which it operates. Also according Lamberts (2013), energy efficiency "can be understood as a service with low energy expenditure", in the other words, buildings that offer a certain level of comfort with lower energy expenditure may be considered more energy efficient.

In Distrito Federal is a tropical savanna climate. So you can see two variations well defined throughout the year, a rainy in the summer and other dry in winter. The rainy season begins in October and ends in April and the dry season is from May to September. The average annual temperature ranges from 18 to 22 ° C, being the months of September and October the hottest, with averages exceeding 22 ° C. It is considered the month of July the coldest with average temperatures ranging between 16 and 18ºC. The prevailing winds are more often in the east, northeast and northwest directions. During the rainy season the dominance from the North quadrant, with northwest and northeast variation. From March predominantly eastwards winds. During the dry season increases the incidence of south and southeast winds (Romero 2013).

There are several factors that can design a bioclimatic building, which is more efficient. The factors take into account the climate of knowledge, solar trajectory studies, predominant wind direction and especially the guidance, implementation and building relationship with the urban surroundings. (Romero 2011). It can conclude that the building implantation linked the immediate urban planning and solar orientation can affect the thermal performance of buildings.

Figure 1. *Condominiums Jardins Mangueiral. Highlighted in red is the studied implantation condominium. Source: Jardins Mangueiral.*

The thermal properties of materials (Table 1) used in the simulation have direct influence in the thermal comfort hours inside the building, because depending on the material used in the building envelopment the heat flow that focuses directly on the facades and cover can move on to the indoors. Adequate knowledge of the thermal properties, thermal resistance of the materials and heat transfer are essential for a good architectural design that has as objective to bring the thermal comfort. According to Heywood 2015, the walls with fifteen centimeters thick concrete have a low heat resistance and a low relative thermal storage making the materials of the envelope of buildings of Jardins Mangueiral (figure 1) are not the most suitable for the type of hot and dry climate which is found in the city of Brasilia.

Table 1. *Characteristics of the materials used in computer simulation. Source: ABNT NBR 15220.*

Envelopment	Material	Thickness (cm)	Thermal transmittance (W/m²K)	Thermal Delay (Hours)
Walls	Concrete block	10	4,4	2,7
Openings	Simple clear glass	0,6	8,35	0,0
Coverage	Asbestos Cement Air Gap	Roof tile = 0,6 Air Gap = 45	2,3	0,0
Slab	Slab of concrete and Plasterboard	Slab = 20 Plasterboard= 0,25	2,4	7,5
Floor	Not considered	Not considered	Not considered	Not considered

OBJECTIVE

This article aims to verify the performance of thermal comfort in one of the three main types of social housing in Jardins Mangueiral, located in Brasília – Brazil. The main factor analysis is the implantation of this type and their thermal comfort in long-stay indoors rooms and the influence received of the urban area. In a second moment, the analysis of the urban implantation and verification of how housing units work in relation to solar orientation while urban set.

METHODOLOGY

The present work method was divided into four stages:
1. Literature review;
2. Comparison of the thermal-energy performance of long term environments in relation to four major solar implantation through computer simulation with DesignBuilder version 2.2.5.004 software together with the EnergyPlus 4.0 (computational model);
3. Comparison of the percentage of thermal comfort hours of the remaining environments in relation to solar orientation;
4. Check percentage of each house orientation in the neighborhood.

The simulated building is a popular family house located in the housing sector Jardins Mangueiral that corresponds to a series of social housing condominiums located in Brazil's capital, Brasilia. As part of a government program to encourage the purchase of social housing for the population, its construction was marked by the use of prefabricated concrete slabs, which accelerated the pace of construction. The residences have exterior walls of ten centimeters of concrete, simple glass window openings and colorless six millimeters, cover composed of asbestos cement and fourth five centimeters of air gap (average height) and concrete slab cast in place with plasterboard two point five centimeters of thick.

It was created a computer model (figure 2) with similar features described above, which are of a housing block containing two single-family units of three bedrooms, living room, kitchen, service area and three bathrooms. The model shows the true volumes, percentage of openings, the envelope materials, solar orientation and the climate of Brasilia. For the purpose of comparison, the following concepts were established: The cloning of two housing blocks, one to left and one to the right of the block to be simulated, because according to Gonçalves and Bode 2015, simulations that are inserted only building alone is not entirely valid, because there is no way to think of a solitary building in inserted in the urban environment, the separation of the blocks by thermal zones as shown below.

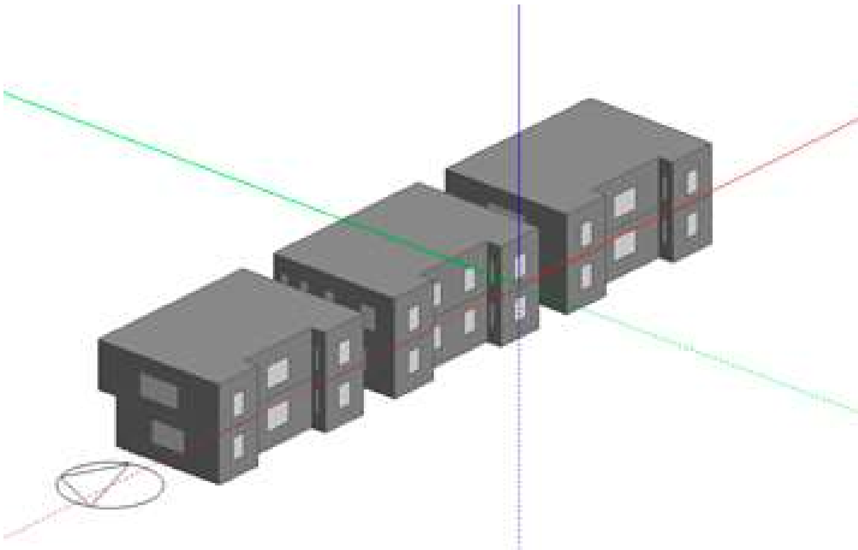

Figure 2. Simulation model perspective with neighboring buildings
Source: DesignBuilder version 2.2.5.004.

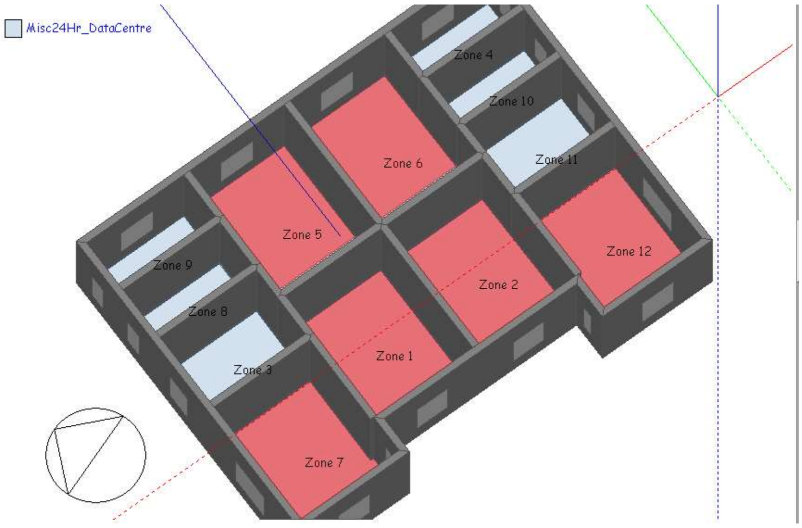

Figure 3*. Top thermal zones. Source: DesignBuilder version 2.2.5.004.*

It were considered only the zone of areas upstairs, because the ground floor there is a predominance of not long term environments, being only analyzed the thermal areas of the bedrooms. The areas that were simulated are red and have zones one, two, five, six, seven and twelve (Figure 3).

In the simulations we used the weather file of Brasilia for the year 2015 and the soil temperature provided by the software. The materials used were defined according to the existing in the housings. It were used for facades concrete walls ten centimeters thick, colorless plain glass openings six millimeters, six millimeters of asbestos cement tile roof with a fourth five air gap of medium height and the concrete slab with a thickness of twenty centimeters with the addition of twenty five millimeters of plasterboard.

While the internal thermal heat gains were set to use the building for twenty four hours per day, being setting as Data Center type and population density of 0,065 people per square meter resulting in five people per family house and were not calculated values heat gain by electrical equipment such as lamps and appliances.

Almost all HVAC systems (Heating, ventilating and air conditioning) were turned off, only activating the natural ventilation system entering as a value of 1.0 air changes per hour for all areas, which is the minimum amount established by Resolution No. 9 (ANVISA 2003). The percentage of areas of openings was calculated according to the executive design resulting in apertures 15% relative to the total area of the façade (figure 4).

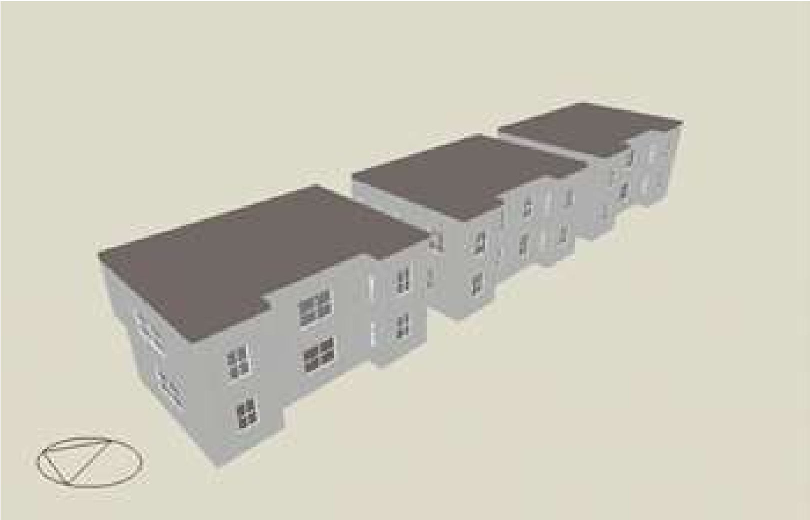

***Figure 4**. The block of houses of Jardins Mangueiral with all the entered parameters. Source: DesignBuilder version 2.2.5.004.*

After performed simulations to compare total of thermal hours of comfort per year of the proposed zones and the direct relationship with the four main solar orientations, it was produced one result of the comparison table for checking the best relationship between orientation and thermal comfort of simulated environments.

RESULTS

One table was produced with the values of the percentage of thermal comfort hours during the year in areas one, two, five, six, seven and twelve. The highest values are painted in blue and the lowest values in red, each table refers to a zone and contains the values of the thermal comfort hours adopted according to the implantation and also contains the amplitude values, or differences between the larger and smaller percentages. It is located in a very hot climate the values of the simulations were adapted to two degrees above the real temperature to the comfort zone. The results of simulations were based according to the main facade, turning for each solar orientation (table 2).

***Table 2.** Table of Thermal comfort hours. Source: Produced by the authors.*

Orientation	Thermal comfort hours - Zone 1(%)	Thermal comfort hours - Zone 2(%)	Thermal comfort hours - Zone 5(%)	Thermal comfort hours - Zone 6(%)	Thermal comfort hours - Zone 7(%)	Thermal comfort hours - Zone 12(%)
Northwest	77	77	59	60	78	78
South-west	54	58	64	63	61	69
Southeast	63	62	80	75	67	60
Northeast	65	62	61	53	77	60
Amplitude	23	19	21	22	17	18

CONCLUSIONS

Considering all the areas studied and the simulations, it was checked hat the best implementation is with the main facade turned to the northwest, because this was the most appropriate implantation for four of the six areas evaluated. This implantation favors rooms that are next to the main facade, in the others word, two of three bedrooms of single-family housing are be protected from excessive sunlight.

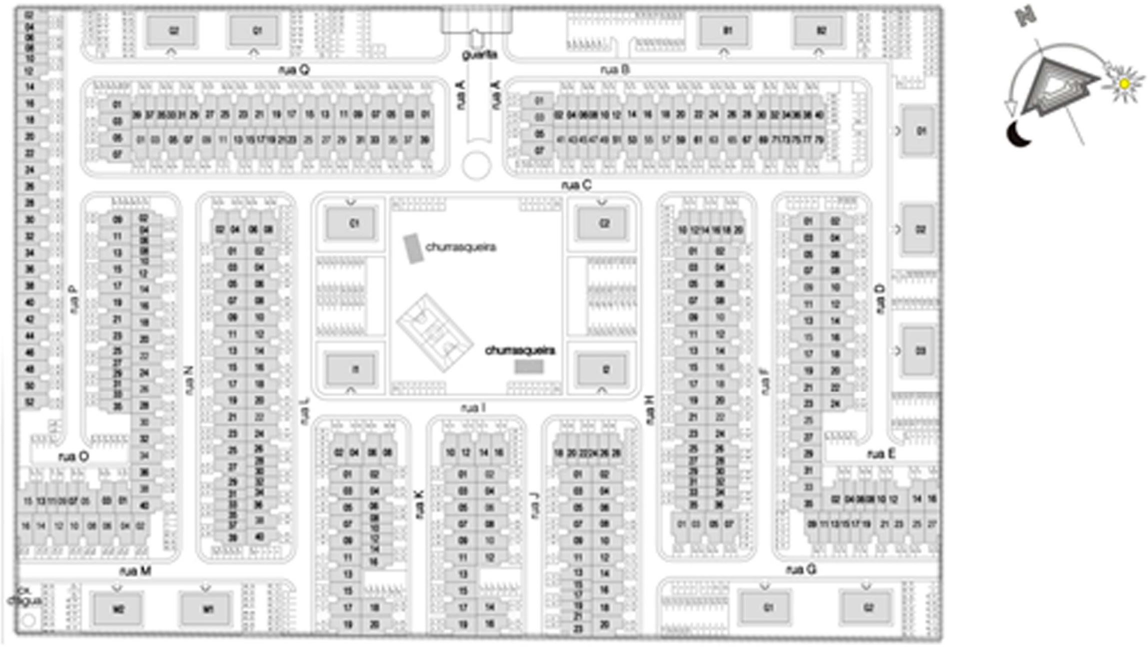

Figure 5*. Condominium chosen for implantation study. Source: Jardins Mangueiral.*

In the studied typology, detached houses of three bedrooms, the main facade facing north was more comfortable for protecting the rooms and the room. On the other hand, the kitchen is more exposed to heat. It was noticed that a minority of only sixteen percent of housing have this orientation, which shows that in the case of this type was not explored the best implantation in this neighborhood (figure 5).

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