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La eficiencia energética del centro comercial - un análisis entre el confort térmico y la ganancia del inversor

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RESUMEN

En los últimos cinco años el mercado brasileño de centros comerciales ha crecido cerca de 32% de superficie bruta alquilable (SBA) con la expansión de los ya existentes y la construcción de 94 nuevos centros. Esta situación puede ser descrita por dos grandes factores: el fuerte aumento del volumen de ventas ocurrido por el aumento de consumo de las familias brasileñas, en especial las de la clase C; y la mayor capitalización de las empresas del sector debido a la oferta de acciones en la Bolsa de Valores e inversiones de empresas extranjeras en el mercado interno.

Este crecimiento de área ha generado mayor demanda de energía eléctrica y por lo tanto aumento de los gastos energéticos direccionados al desarrollo de confort térmico dentro del edificio. Investigaciones de Procel indican que 48% hasta 60% de estos gastos son usados por el sistema de aire acondicionado, donde en vista a la gestión de un centro comercial estándar brasileño, los altos costes de energía tienen un peso considerable en los valores de funcionamiento del centro y pueden alcanzar hasta 45% de los gastos pagados por las tiendas al propietario del centro comercial.

Este trabajo ofrece un panorama general del mercado brasileño de centros comerciales frente al confort térmico del edificio, partiendo del presupuesto de que con una correcta aplicación de estrategias bioclimáticas de confort, pueden incrementar la rentabilidad al reducir los costes energéticos pagos por las tiendas a los propietarios de los centros.

Palabras-clave: Confort térmico, método de capitalización por rentas, inversión en centros comerciales, estrategias bioclimáticas.

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Shopping centre energy efficiency – an analysis between thermal comfort and yield

ABSTRACT

In the last five years, the Brazilian shopping centre sector has grown about 32% of gross leasable area (GLA) as a result of the expansion of some existing shopping centres and the construction of 94 new ones. This increase has come up due to two mains factors: [i] - the volume of retail sales has risen according to the enhanced consumption of Brazilian families, especially the ones included in the Class C; [ii] - higher Companies capitalization caused by the offer of shares in the stock market and foreign companies investments in the domestic market.

This situation has been generating more energy demand to provide comfort inside the shopping centre building and consequently, the increase of operating costs. Research made by PROCEL indicates that 40% to 60% of these costs are caused by the air conditioning system. In view of the average management of a Brazilian shopping centre, this increase has a great impact on the operation budget and can reach up to 45% of the costs paid by the tenants to the landlord.

According to these issues, this paper provides an overview of Brazilian shopping centre sector over the thermal comfort, based on the assumption that the right application of bioclimatic comfort strategies can increase profits by reducing energy costs and as a result, the shopping centre operating costs.

Key-words: Thermal comfort, income approach, shopping centre analysis, bioclimatic strategies

1. INTRODUCTION[1]

1.1. Shopping centre investment market and energy use

Shopping centre as a real property asset is labelled as income property. This sort of long term investment is developed to generate earnings through rental income from the management of a particular activity. In the case of the shopping centre, this one is the retail market. Furthermore, according to the American Appraisal Institute, shopping centre is a co-venture between retailers and developers, thus entrepreneurs and appraisers should know something about the retailing business as well as understand the behaviour of the tenants and the customers at the centre.

Currently, the shopping centres are not only a retail space but also one of the most important community option for leisure activities as well as a gathering place. They are complex commercial establishments comprising a wide range of tenant mix among which there are daily services, entertainment and heath care. The building is usually designed to be a safe closed climate-controlled space. This is one way which developers and owners have been using to enhance their shopping centres (see VERNOR, 2009) and to attract increasingly visitors that spend a long time inside the building.

Regarding the Brazilian market, according to ABRASCE [2] (The Brazilian Association of Shopping Centres), in the last five years, the monthly number of customers has grown about 22% as well as the shopping centre sector has grown about 32% of gross leasable area (GLA) as a result of the expansion of some existing shopping centres and the construction of 94 new ones. Currently, the sector presents a customer´s traffic of approximately 398 million people that spend an average of 79 minutes walking through 11, 3 million GLA.

Carrying the information above a bit further, if we consider that a typical Brazilian shopping centre consumed an average of 70kWh per sq.m of GLA and approximately the consumption of electricity person per hour used to generate thermal comfort is 1.9 kWh, Comparing the monthly numbers of customers with the current Brazilian population (193,946,886), this value can be considered extremely high.

Besides, this situation has been generating more energy demand to provide thermal comfort inside the shopping centre building and consequently, the increase of operating costs. Research carried by PROCEL[3] indicates that currently, 48% to 60% of electricity costs are caused by the air conditioning system. In view of the average management of a Brazilian shopping centre, this increase has a great impact on the operating cost budget which nowadays can reach up to 45% of the occupancy expenses [4] paid by the tenants to the landlord.

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[1] This paper is part of a PHD thesis, which has been done at the University of Madrid whose the aim is study the impact of the energy performance over the financial performance of the shopping centre

[2] The Brazilian Association of Shopping Centres

[3] The National Program for Energy Conservation (Procel) was established by the Ministry of Mines and Energy and Industry and Trade of Brazil in order to promote efficient use of electricity

[4] According to the American appraisal institute these expenses includes the aggregate occupancy costs for all comparable mall tenants including minimum rent, percentage rent and expenses recoveries, but excluding tenant specific utility changes.

From the investor´s point of view, this raise in percentage can reduce his profit margin as these changes in the occupancy expenses have a direct outcome over the profit margin. Moreover, considering that the minimum rent and the percentage rent paid by the tenants relate to the retailing business performance, it is important to understand their relationship with the occupancy expenses to the monitoring the continuing ability of the tenants to support this cost and whether they have the capability to absorb some raise at CAM/Taxes/Insurance/utilities.

In order to try to reduce the energy use and other utility savings of the buildings as well as their CO_2 emissions, quite a few income properties worldwide (including commercial, offices and hotels) have some environmental label such as BREEAM and LEED. The drawback noticed in this labelling is that usually the investments applied to attend the assumptions required to get a efficiency label are high and the investor find no evidence of their effects on Market Values and Market Rents (see Fuerst, McAllister, Van der Wetering and Wyatt, 2011 for a detailed discussion).

Based on the issues described above, this paper describes the methodology and aim of the PHD research that has been developed focusing on investigating whether the right application of bioclimatic comfort strategies can increase profits by reducing energy costs and as a result, the shopping centre operating costs.

1.2. The research aim and objectives

The aim of the research investigating in the PHD Thesis at the University of Madrid, is to evaluate the standard shopping centre´s thermal comfort performance with the intention of proposing bioclimatic strategies, which improves this one as well as decreases the operating costs, that means the way thermal performance can enhance the financial performance of a shopping centre with enclosed pedestrian way.

In order to achieve the aim of the study, four objectives are set as follow:

- Describe the standard design characteristics and invoicing profile of the Brazilian shopping centre;
- Evaluate the thermal comfort problems, according to the comfort requirements;
- Determine design criteria and bioclimatic strategies connected with investments and profits;
- Determine the most attractive strategies from the investor´s point of view;

2. METHODOLOGY

The methodology used to carry the PHG research is based on the one set in the work *"Eficiencia Energética en el Mercado Inmobiliario de Rio de Janeiro"* (see VIEIRA DE CASTRO, 2011).

Besides defining and colleting the object of study, this is divided in two major steps. The first one evaluates the thermal comfort performance of the standard shopping centre buildings and how it implies the increase/ decrease of energy use. The second one appraises the financial performance of the shopping centre according to the thermal comfort strategies and how it impacts over its value/ profits.

2.1. Definition and selection of the object of study

The portfolio of a holding company headquartered in the city of Rio de Janeiro which currently has been managing about 20 shopping centres in Brazil has been used as a basis for this research.

The selection of the object of study was carried according to the following analysis on this Company portfolio:

- Shopping Centres whose design have standard characteristics; shopping centres with GLA around 30,000 sq.m and same retail cluster;
- Invoicing Profile – shopping centre that presents the relation between % rent invoicing per occupancy cost (CAM w/ occupancy expenses) lower than portfolio average;
- Geographic position - the shopping centres were chosen according to bioclimatic zones set in Brazil.
- Restrictions of data – The shopping centres that are currently managed by the firm have been eliminated due to a small amount of data.

2.1.1. Brazilian Shopping centre standard type

Regarding the design, the sort of shopping centre most encountered in Brazil is built around three or more full-line department stores with thermal conditioned enclosed walkways that can be constructed in various shapes and reflects the called mall configuration of building, according to the Urban Land Institute´s definitions (see VERNON 2009 for more details).

The internal building has to be flexible to create tenant spaces of different sizes. To accomplish this characteristics the use of load bearing walls, concrete or brick walls between the stores should be inexistent. Usually these internal walls are built using dry wall without any thermal isolate.

In relation to the building volumetric, usually the shopping centre presents multiple levels. This configuration can provide marketing benefits whether the stores are displaced to take advantage of the interplay between the floors.

The external materials are selected to create an attractive visual image according to the community standards. Usually, the building structure is of concrete and the walls have high thermal load.

2.1.2. Invoicing Profile

It is an indicator used by investors to measure the amount of rental income that exists within the occupancy expenses paid by the tenant. The higher indicates that costs are lower than the rent lease. Regarding the Portfolio of the scrutinised Company, the average is 53%, the lowest value is approximately 38% and the greater is 63%.

According to the American appraisal institute these expenses include the aggregate occupancy costs for all comparable mall tenants including minimum rent; percentage rent and expenses recoveries, but excluding tenant specific utility changes. Thus it is important understand the relationship between the rental income and the occupancy expenses in order to enhance the profit in accordance with the ability of the tenants to support these expenses.

2.1.3. Position Geographic's election and bioclimatic zones

According to Olgyay (1998), the climate is defined by the set of four parameters: air temperature, humidity, wind flow and solar radiation. The combination of these factors leads to different dynamic characteristics in each Global region that affect thermal sensation perceived by humans. Therefore to determine the comfort zone, it is necessary to evaluate each specific data area, and the microclimate generated in environment.

The climate classification of W. Koppen was adopted by the Brazilian Institute of Geography and Statistics - IBGE to split the climatic zones of Brazil. This classification is based on temperature variations and precipitation for climatic regions divided according to the vegetation that predominates in each zone.

This classification does not provide sufficient information for the development of bioclimatic strategies, as it is not related to the needs of human thermal comfort. Moreover, it is focussed just on a type of application and consequently the climatic groupings produced are questionable since their classification does not consider all human factors and climatic elements.

This research uses the zone classification considering the thermal needs specified in the Brazilian code NB 15220-3, to determine the different location of the shopping centres. This code uses a bioclimatic chart adapted for Givoni chart ("Comfort Climate Analysis and Building Design Guidelines" Energy and Building, 23.11.1992) in order to organize the Brazilian cities according to climatic variables.

The purpose of this selection of process is electing each shopping centre with different thermal needs in order to study individual bioclimatic strategies.

2.2. Thermal analysis

The thermal performance of a building depends on its structure characteristics, the load thermal density, its use parameters and the solar protection. The adoption of each parameter must be used in accordance with the weather and can result in more efficient buildings energetically

Evaluate the thermal performance of a building, means evaluate its thermal loads over requirements established to respond the thermal needs of the humans according to the weather of where that the building is located.

In addition, Thermal performance evaluation of a building is connected with the calculation or measurement of energy consumed by the equipment used to condition thermally space. The most common method to evaluate this performance uses the air´s temperature frequencies distribution, the average of comfort hours and discomfort degree per hour.

This research uses the method above that is required to the PROCEL Label and is specified in the American code ASHRAE Standard 55/2004 whose previous review has adopted the adaptability principle proposed by DEAR e Branger. This principle proposes a thermal zone, which relates the average temperature of the outside air with a temperature range of internal operations.

The comfort limit presented to 90% of thermal satisfied people is determined by the sum or subtraction of 2.5 °C from the comfort temperature found by the following calculation.

$$Tc = 0.31\ Te + 17.8$$

Where:
Tc is the comfort temperature (° C) (form 01)
Te is the monthly average external temperature (° C)

2.2.1. Prescriptive analysis

This analysis is used to observe thermal physical characteristics of construction materials, the openings for ventilation, insolation and also shading in relation to the characteristics recommended by the codes.

In addition, this one make possible the verification whether the materials characteristics and the design type of the building are appropriate are appropriate to the requirements detailed in energy performance code chosen to this analysis.

2.2.2. Software simulation analysis

The program Designer Builder has been used in this analysis to simulate the thermal loads of the buildings chosen. This type of analysis is used to evaluate the characteristics described below:

Thermal Loads - shows the amount of heat gained or lost by the walls and roof of the building;

Solar Gains for exterior openings – shows the number of Kwh per sq.m acquired by the lack of shading of the openings.

Discomfort degree – hour (ºc.hs) – this represents the amount of the average temperature degrees noted in the period of a day that are below or above the limits maximum and minimum degrees of the comfort zone;

Energy consumption – though the calculation of the discomfort hours, it is possible to determine the use time of air conditioning system in order to reach the thermal comfort required by the bioclimatic zone.

2.2.2.1. Climate data to thermal simulations

The research has been used climate data for the reference year TRY (Test Reference Year), according to each city to make thermal and energy simulations. The TRY files were taken in the web page of the research group LABEE[5].

[5] This research group is linked to the Centre for Research in Construction, Department of Civil Engineering, Federal University of Santa Catarina.

2.3. Bioclimatic Strategies - Design Criteria

After the generation of the analyses described in item 2.2.2, the deficiencies and thermal comfort of the building at each location shall be evaluated in order to develop bioclimatic strategies.

These strategies will be developed specifically for each location based on bioclimatic analysis generated by the program ISOPLETAS (developed by the research group ABIO[6]) in order to complement the information contained in the Brazilian code NB 15220-3.

Therefore with the needs analysis of ventilation and thermal loads criteria will be created that specify the characteristics of the building envelope and climate criteria as described below.

Building envelope is the physical and thermal properties of the materials. In order to specify these characteristics, this research has been using the rules seen in the code NB 15220-3. Materials will be specified for each% of comfort being sought.

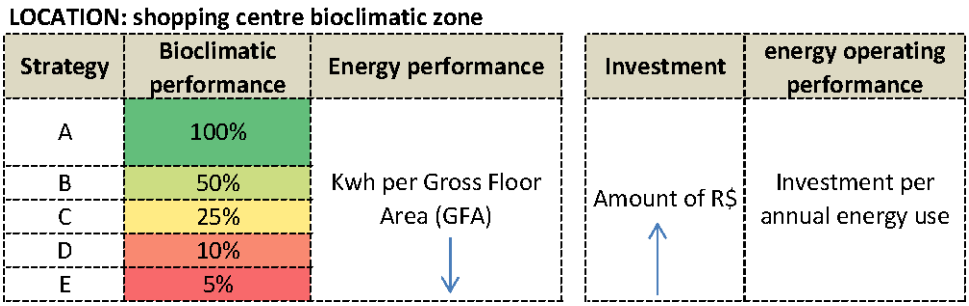
Criteria climate are mechanical strategies and / or natural wind control, solar control, humidity control, specified according to bioclimatic research methods used for each type of climate.

Each strategy will have its criteria evaluated in the Design Builder where the evaluating of the time comfort amount will be used to create an index called bioclimatic comfort performance (form 02) which together with the evaluation of Kwh per built area (energy efficiency performance), will aim to measure the thermal efficiency and comfort of building in the specified location and then it will be connected to the evaluation of the financial performance of the shopping centre, discussed in the next item.

$$\frac{\text{Amount of comfort time}}{\text{Occupancy time}} = \text{Bioclimatic comfort performance} \qquad \text{(form 02)}$$

For each bioclimatic performance will be created a relationship of how it impacts on annual operating costs and return on investment (detailed in the topic below), through the measurement of the economic values of kWh per hour (figure 01) and the investment required for each.

Figure 01



[6] Bioclimatic Architecture in a Sustainable Environment is a Research Group officially recognized by Madrid's University Polytechnic.

2.4. Income approach analysis and rate return– the impact of the bioclimatic strategies over the yield

The Income Capitalization approach is a sort of valuation approach, which is used particularly to assess rental properties. It is based on the concept that the property´s value can be determined as a function of its net operating income (NOI) produced.

Bearing in mind that the NOI is the net income minus the operating expenses (form 03), this approach will be used as the method to evaluate the impact of the decrease of energy use (Kwh) on the Market value of the shopping centres selected. It is important to notice that this research has been considering the occupancy expenses as a stable number supported by the tenant; therefore the decrease of the energy use value will not reduce this occupancy expenses.

Scheduled Gross Income
(-) Vacancy Losses
(=) Effective Gross Income
(-)Operating Expenses
(=)Net Operating Income (form 03)

Where:
Scheduled Gross Income is
Effective Gross Income is
Operating Expenses is

In accordance with the research carried by Fuerst at all, the energy labelling is not having the effects on Market values when the commercial property value is determined by the hedonic regression modelling. That is to say, the isolated effect of the energy labelling is not a relevant determinant value in real estate appraisal.

Based on this assumption this research focus on seeking the impact of the thermal comfort on the Market value reducing the operating costs in proportion to the desire of the investor. Besides, it focuses on investigating how bioclimatic strategies applied in a close building can be an option of developers and investors to enhance their profits.

Using strategies described above, the research aims create a flexibility of investment´s options to reduce expenses. To reach the best way for each investor´s point of view and how the investment´s amortization selected is connected with the return expected, it has to be considered the measuring the Rate of return of the standard shopping centre and as consequence measuring the sensitivity analysis of the investment amount related to each bioclimatic strategy

3. DISCUSSION OF THE TOPIC

The assessment of an investment strategy and the investor´s decision are subjective points that require possible economic and marketing scenarios. The making decision to invest in income properties requires a long term vision in which is essential to think about the possible variables that are connected to futures expenses and incomes.

Currently, think of the shopping centre´s development and the way to make it more profitable is important due to this investment market is continually changing and competes directly with other capital markets for the attention of investors (see VERNOR, 2009).

In addition, the current issue of the high energy demand to provide thermal comfort inside the shopping centre building and its high spending is a point that is worth to be studied due to the tenant´s occupancy expenses is directly connected to the energy expenses of the centre and also connected to the rent (market variable).

From the investor´s point of view, control and decrease these costs is crucial when the number of vacancy at the shopping centre is considered.

According to the questions mentioned above, the research that has been carried intends to explore the connection between both themes, establishing decision theory which can suggest ways to deal with possibilities to enhance the property and at the same time create spaces that could be more attractive for the customers when considered the comfort criteria.

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