Integrated Environmental Assessment of Hemocentro Ceara (Blood Center): Sustainability and Space Quality Guidelines

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ABSTRACT HEADING

The inclusion of sustainability and humanization in Health Care Facilities is critical for the welfare of staff and users. These elements are part of rehabilitation programs undertaken by the Ministry of Health of the Brazilian Federal Government, in partnership with the University of Brasilia, developed by the Laboratory for Applied Sustainability to Architecture and Urbanism, LaSUS, for the network of blood centers in Brazil. In this sense, this article discusses the presentation of the methods used in integrated environmental assessment of the building from the Blood Center of Ceará (HemoCE) to improve environmental quality and energy use of the building. Results obtained confirm the validity of these integration methods in the construction of guidelines for the rehabilitation design of the building, in order to enhance environmental quality and humanization of space. Finally, through the guidelines identified for the HemoCE building, intervention solutions were proposed for specific areas, according to its peculiarities, as well as for the building as a whole, based on sustainability and humanization.

INTRODUCTION

Currently in Brazil, the health care facilities (EAS) are undergoing a development process mainly in technology and physical structure of the buildings. This process aims for the environmental rehabilitation of their buildings with the application of concepts of space humanization, environmental comfort and energy efficiecny. The Blood Center of Ceará (HemoCE) building is located at Avenida José Bastos, in the city of Fortaleza in the state Ceara. The HemoCE building is basically composed of four blocks united by a central courtyard with a wing regarding the collection and processing of blood, and another wing related to the Day Hospital (treatment of blood disorders); composing a building area of approximately 8,617m². The building is spread over three floors and a half-buried ground floor. The original design of the building is characterized by elements of brutalist modernism; with the strong presence of concrete and apparent masonry. The building possesses an appropriate concept in relation to the characteristics of the local climate, where the facade orientation, glass area positioning and courtyards were well employed.

INTENT AND OBJECTIVES OF INTEGRATED ENVIRONMENTAL ASSESSMENT (IEA)

Aiming for sustainable environmental rehabilitation of the EAS, the Laboratory for Sustainability Applied to Architecture and Urbanism (LaSUS), with the support of the Brazilian Ministry of Health, has developed a method of Integrated Environmental Assessment (IEA) that seeks sustainable rehabilitation by the humanization of spaces. This study presents design guidelines proposed for the case study of the headquarters of the Institute of Hematology of the State of Ceara - HemoCE. Intentions included the use of accessibility features throughout the building, quality of spatial fluxes, the insertion of greenery in the working areas, energy cost savings for the building, and better envelope performance thus improving space quality with the use of natural lighting and ventilation .

PROCESSES/APPROACH FOR INTEGRATED ENVIRONMENTAL ASSESSMENT

The methods used for conducting the integrated environmental assessment involved Post-Occupancy Evaluation (POE), Energy Rating of the building based on Retrofit, the assessment of energy efficiency of the envelope based on the Brazilian labeling system label PROCEL/INMETRO for commercial buildings, and computer simulations in ENVI-met, EnergyPlus and Autodesk Ecotect Analisys 2011 softwares.

Post-Occupancy Evaluation

The process of Post-Occupancy Evaluation (POE), is the analysis of the physical/environmental performance and user satisfaction of the building through on-site survey, interviews with users, data tabulation and arrays of indicators. The methods and techniques of POE, diagnose positive and negative factors in the course of use, from the analysis of socioeconomic, infrastructure, user satisfaction, building systems, functionality, energy consumption and environmental comfort, and finally, the relationship between costs and benefits of buildings [1].

For the POE standard environment typologies of the building were selected where the researchers collected data on the levels of satisfaction and comfort conditions of users, applying specific questionnaires and performing *in situ* measurements of the variables of temperature, humidity, natural ventilation, natural lighting levels and artificial noise in the workplace. Measurement procedures were applied according to the present Brazilian norms on the subject [2, 3 and 4] and used the following equipment: thermo-hygrometers; lux meters; sound level meters; and anemometers.

In the IEA the method of the POE was complemented with the use of computational tools for environmental assessment of external and internal aspects regarding temperature, humidity, lighting and ventilation. Thus, ENVI-met, EnergyPlus and EcotectAnalisys 2011 programs were used. For analysis concerning the urban scale of the building under study, the computational model was developed in ENVI-met program representing environmental conditions (characteristics of the climate of the city), soil surface composition; and characteristics of the built volumes present in the fraction of the immediate surroundings; aimed to simulate aspects of air temperature, wind speed, relative humidity, CO_2 concentration, and the Sky View Factor - SVF. With EcotectAnalysis a virtual building model was developed to determine the levels of direct solar radiation of facades, design of shading devices (checking the efficiency of the proposed elements), and verification of the potential use of natural lighting in certain environments (Day Light Autonomy – DA).

The simulation results of solar radiation incidence on building facades indicate high levels of heat load which directly influence the comfort of building users. Figure 1 illustrates how we analyzed the incidence of solar radiation on the ground level plane and on the facades, with the worst northwest facade. Therefore the simulations guided the proposition for sun protection elements (louvers).

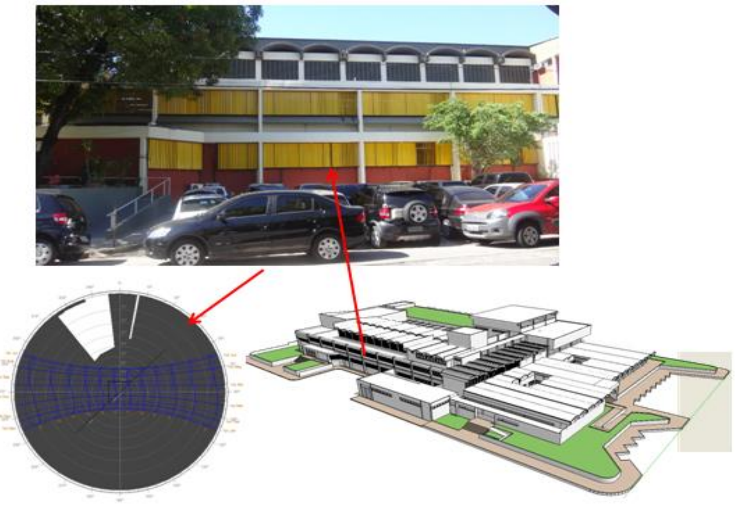

Figure 1 Assessment of incident solar radiation on the northwest facade.

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Energy Diagnosis (Retrofit)

With regards to lighting, it was recommended to continue conducting Energy Diagnosis-Retrofit involving a diverse set of activities that vary according to the purpose and the type of occupancy of the facility. In the case of the facility in study, retrofit can be divided into the following steps: preliminary visit and inspection; architectural surveys such as the electrical which include installations and equipment; measurement of electrical quantities; and study of technical and economic feasibility. Measurements of electrical quantities of interest were performed using power equipment analyzers with mass memory, installed at important points of the electrical system, more specifically in the transformer primary booths, tables of distribution and consumption of large electric equipment.

With the information provided by energy analyzers it's possible to determine irregularities in the operation of systems and equipment, through the detection of low power factor, high harmonic distortion and imbalance between phases. Based on measurements and survey data during technical visits, a virtual model of the building from the Blood Center was developed where it was possible to insert envelope data and end uses of the two blocks of the Blood Center. From the developed model stategies were simulated aimed in reducing energy consumption and established three types of intervention: 01 - Changes in air temperature control systems of 24 ° C to 25 ° C; 02 - retrofit of air conditioning systems for equipment with Procel A and 03 - retrofit of the refrigeration system with an average increase of the equipment efficiency of 10%. It was also suggested the gradual replacement of the current fluorescent system (40W) for systems that use 32 and 28W lamps. There was the need to segment the circuit into smaller groups of luminaires, particularly in large environments, as well as segmenting the electrical system of the lights near the windows allowing these to be off when the illuminance levels are acceptable.

As for the air conditioning systems, it was recommended that when new purchases are made, that the energy efficiency label be considered and only level A equipment be acquired. Regarding refrigeration systems, it was observed the demand fluctuation throughout the day due to the frequent removal and storage of materials used in the Blood Bank and requiring strict maintenance of its temperature for the conservation of its properties. It is also recommended the gradual retrofit of condensing units.

For aspects of eletric energy quality, it is recommended to pay attention to the current imbalances in the electrical panels, always trying to keep balanced phase currents (better load distribution). The use of electronic equipment with power factor within the standard limits (> 0.92) is also recommended.

Energy Efficiency Assessment (National Certification of Energy Efficiency)

The Brazilian certification for energy efficiency in buildings is based on the Technical Regulation on Energy Level Quality of Efficiency for Commercial Buildings, and Public Service (RTQ-C) [5]. In RTQ-C, the building is evaluated in three items, with different weights in the overall standings of the building: envelope (30%), lighting system (30%) and air conditioning system (40%) system. From the analysis of these instances the building can receive the National Energy Conservation Label.

For this case study we used the prescriptive method of RTQ-C to evaluate the envelope of the building, consisting of the roof, facades, and openings; floor area and volume; façade orientation; checking of the thermal properties of materials and construction systems of facades and roofs, defined in the project specifications or site visits. The prescriptive method calculates the consumption indicator of envelopment (CI), which is a dimensionless parameter for benchmarking the energy efficiency of the envelope. The consumption indicator establishes the behavior of the envelope on the energy consumption of the building

From the collection of data and calculating intervals of energy efficiency in the building, in its current state the efficiency level of the envelope is B. This is mainly due to aspects of absorptance and transmittance of the building materials. Given the absorptance of the surface materials, it was observed that the facade with dark colors, would not meet the limit values for label A. Thus, it was recommended the rehabilitation of the exterior walls with light colors and use of materials with low transmittance, as required by the RTQ-C for Bioclimatic Zone 8.

INTEGRATED ENVIRONMENTAL ASSESSMENT DIAGNOSIS

The Integrated Environmental Assessment resulted in a diagnosis of the reviewed elements. From this diagnosis it was possible to extract guidelines upon the assessment of functional and humanizing aspects evaluated *in situ*. Based on these guidelines, an intervention for the sustainable rehabilitation of Hemoce was proposed. The diagnosis obtained for aspects evaluated (Post-Occupancy Evaluation, Energy Diagnosis - Retrofit, and Energy Efficiency Label Level for the envelope), has established intervention points both in the main and anex buildings

Building of the Blood Center of Ceara (HemoCE)

Based on the guidelines outlined, the proposals for the ground floor were towards spatial organization according to their functions; humanization and integration of spaces with green areas and courtyard; and other operational issues such as the reactivation of service lifts and creating specific areas such as childcare; rest areas for patients/visitors/employees; sanitization area of containers; relocation of environments for better fluxes.

These interventions were based on surveys carried out *in situ*, and especially with the help of staff from each sector. Another important point was the intention in maintaining areas considered irreplaceable as toilets and the central of computer systems (Figure 2).

The guidelines proposed for the first floor aim to solve the major problems identified in surveys. First it was sought to improve the flux of donors and employees of the building keeping in view the requirements of the Ministry of Health. It was suggested a much needed accessibility improvement for donors (currently done only by stairs) by creating ramps for people with special needs (PSN); and creating bathrooms for PSN in the waiting area of the donor; plus a separate output for donors; improvement and expansion of the area of service; creation of receiving results from the examination room; among others. Moreover, in the donation area, sectors for processing blood were thought; better distribution and segmentation of spaces associated with the Hemoce board; and search of humanization and integration with green spaces, revitalizing the inner courtyard (Figure 2).

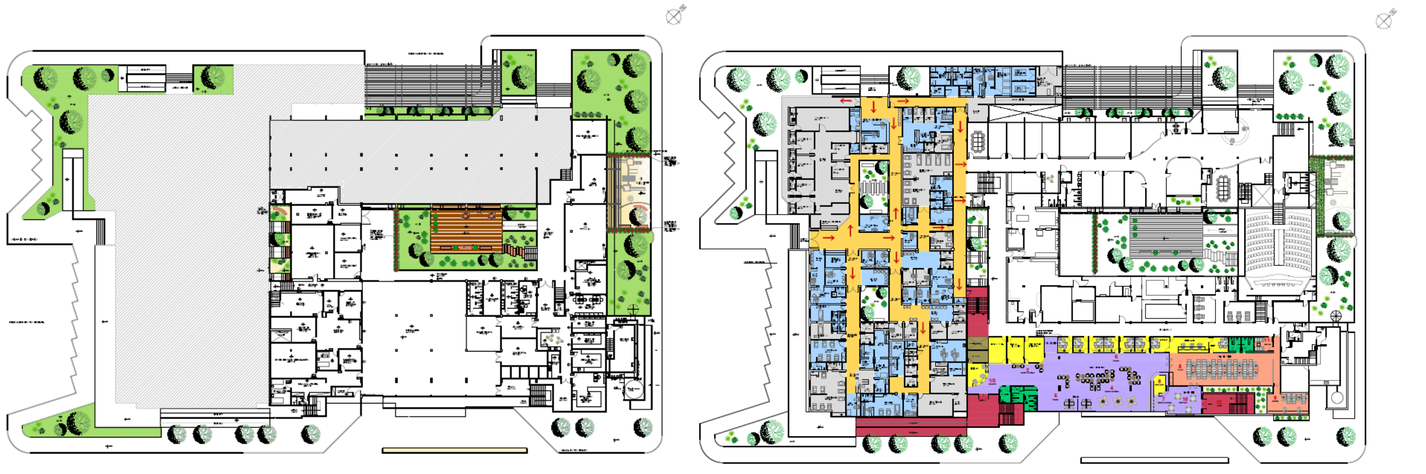

Figure 2 (a) Floor plan of ground level and (b) and floor plan of the first level of HemoCE blood center.

Interventions on the second floor were given towards the organization and segmentation of activities, concentrating the laboratory and administrative activities. As this floor has undergone a recent renovation in a considerable area, interventions sought maximum improvement with minimal demolition. Another important point was the integration of environment with green areas and gardens; also enabling the use of natural light and ventilation (Figure 3). The third floor focused on the reuse of underutilized spaces, such as deposit areas. There was also the inclusion of the financial administrative sector, living area and gymnastics, restaurant for employees; and areas for garden and green roof (Figure 3).

Figure 3 (a) Floor plan of the second level and (b) floor plan of the third level of HemoCE blood center.

For the top of the building green roofs were created to contribute for the reduction of outdoor air temperature and heat load transmission to the environment. In some sections these green roofs became gardens with access by employees. These gardens contribute to the humanization concept proposed in this paper, in addition to promoting harmony and wellbeing. Simple modular elements are proposed for the composition of green cover. Such elements are now easily found in the market and have easy implementation and maintenance.

Annex Building

For the annex building proposed the same concepts of HemoCE main building were looked; humanization, sustainabilities, and use of local climatic aspects. The internal spaces were intended to house some activities removed from the existing building; areas such as housing; training rooms; library, etc.. Moreover, the new block houses a museum of HemoCE and areas that can be used for meetings and multipurposes (Figure 4).

Figure 4 (a) Floor plan of ground level, (b) Floor plan of the first level, (c) floor plan of the second level, and (d) annex building facade.

INFERENCES AND CONCLUSION

The policy of humanization of public health units, coupled with the need to reduce the action of infectious agents in health care facilities, and the impact these environments imposes its users and the environment, are requesting more and more efficient facilities. An efficient building is one that is thought out and executed under bioclimatic strategies such as the use of passive environmental conditioning systems, renewable energy and building materials which are suitable to the climate in question, performs its functions maximizing the safety and comfort of its users, and finally saving energy and reducing the impact on the environment.

In order to ensure the vitality of the future use of the building, the program was organized to be flexible meeting the basic needs and transcends it to incorporate elements of humanization in the form of fresh, colorful and friendly open spaces, not leaving aside its functionality and meeting norms and regulations. The building's current transparency remained, sun protection devices have been improved to allow daylight access and the perception of diurnal changes of light, so it offers a continuous outdoor relation. Bright city light is filtered, softened and introduced from the inner courtyards that continue to contribute to create a pleasant working atmosphere.

The management floor which houses the executive offices and protocol, as well as the legal spaces, opens to an interior garden, where the presence of greenery is present to restore the balance of the current environment and the building functions.

Climatological criteria guide the construction of green roofs to mitigate the strong incident heat load, but humanization criteria also contribute for environmental comfort of the health facilities. Greenery appears in the quotidienne visuals and also in spaces designed for leisure and amenities.

To achieve high level quality, the Ministry of Health is advising the National Public Blood Centers to seek certification of their services as a way to ensure quality. Herein lies the challenge: to advance the issues of quality management, allowing the pursuit of service excellence and ensuring blood safety to public health users. Therefore, the General Coordination of Blood and Blood Products of the Ministry of Health, has developed the National Qualification Program of Blood Centers. The development of this work aims at the continuous improvement of services, as well as the ability to collaborate effectively with the process of external accreditation. The scope of this study shows the actions to be developed with the National Public Blood Centers with the aim of expanding and improving not only blood services but also the buildings which provide these services, ensuring safety and environmental comfort in all levels to public health users.

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