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Retrofit and life cycle assessment: Sesc Paulista Building

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SUMMARY

Through the ratification of Brazil in the Paris Agreement in 2015, targets were established for Sustainable Development (SD) in several areas, including Architecture and Urbanism. Brazil has committed itself among the Sustainable Development Goals (SD) to the search for Sustainable Cities and Communities in SD 11. In this context, the SESC Paulista building located on Paulista Avenue in São Paulo, underwent a retrofit intervention concomitant to the Life Cycle Assessment (LCA) methodology. In it was applied techniques, technologies, products and equipment, which together resulted in the reduction of environmental impacts for the new phase of life and use of the building. The objective of this work is to demonstrate what were the intervention strategies applied in the building and the achievement in relation to the reduction of negative environmental impacts. In this way, the article discusses how retrofitting carried out with the LCA can be alternatives to the built heritage of the metropolis, preventing buildings from falling into disuse, extending operational longevity and reducing negative impacts to the environment, contributing to the ODS of Agenda 2030.

KEY WORDS: Retrofit. Life Cycle Assessment. Sustainability. Contemporary Architecture.

INTRODUCTION

During the context of global concern about carbon emissions at the Rio de Janeiro Conference in 1992 (Rio 92/ Eco 92 or Earth Summit), Brazil began to understand the concept of Sustainable Development. However, according to Boff (2016)[1], the results of Rio 92 were not so promising, because the capitalist system with economic predominance generated a conflict in the search to strengthen profit on natural resources and the necessary balance to restore the environment, which demands the collaboration of the nations mainly in the emissions of polluting gases. In this sense, Brazil only positioned itself in the world scenario on Sustainable Development in 2016, when the country became a signatory of The Paris Agreement.

The consolidation of the city of São Paulo as a metropolis occurred due to the industrial growth, trade and services, far from the discussions on Sustainable Development of the international scenario, such as the discussions of Ecologism in the context of the counter-culture of the 1960s, which brought alternative visions to the status quo (CARRANZA, 2013).

With an urban structure that, according to Biderman (2001)[2], benefits from the city's expansion in gains over urbanization. The function of specialized trades and services for consumers and firms has led to a new economy, which has solidified thanks to the city's growth, undergoing remodeling over the years. The first remodeling arose by moving part of the financial activities from downtown to Avenida Paulista in the 1960s, which reflected in new sectors in the city during the 1970s and 1980s, such as Avenida Faria Lima, Itaim and the region of Marginal Pinheiros that were consolidating.

From the Modern movement, precepts such as constructive rationalization allied to technological advances allowed the architectural expression in the new sectors: free façades incorporated as 'glass skin' with high performance glasses (low-e) and aluminum frames; larger spans with greater flexibility of the office layouts, equipment for lighting with better performance coefficients in fluorescent lamps; new air conditioning systems and elevators with lighter materials and speeds that allowed to meet the demands of vertical displacements, which reflected in higher gauges; besides the incorporation of new computer technologies for control

[1] Leonardo Boff, Theologian and Philosopher, since 1980 has been dedicated to ecology.
[2] Ciro Biderman is a professor at Fundação Getulio Vargas (FGV) Graduate and Pos-Graduate courses in Public Administration and Economics.

and building automation. Such issues are a challenge to the built patrimony of the Metropolis in order to avoid that technologically outdated buildings go into disuse or collapse as occurred Wilton Paes da Almeida (2018).

Based on the full understanding of the theme Sustainable Development in the 1990s, the city already faced problems of obsolescence of the central areas by the expansion of the new zones of centrality. The news zones can be understood in three aspects: in the first, Bonates (2008)[3] points out problems related to the conditions of Feasibility for building reform, such as Most of them were privately owned or were in embargoed conditions; the change of use of the buildings to multifamily residences; the economic results presented by the reformed buildings pointed out low profit due to the destination of the low income population, with a value of up to R$ 40,000.00 per housing unit. The second problem faced by the reforms was due to the Projects, which according to Silva[4] and Sigolo[5] (2007), caused the units to end up having their dimensions reduced, impairing the quality of the units due to the costs. The third point is related to the Management, done by Devecchi (2010)[6]. The refurbishments of buildings were managed as new constructions, without a preliminary study that observed the characteristics of the conditions of the buildings and directed an adequate degree of intervention, which caused excessive expenses with the need of activities identified in the period of works.

With the collapse of the Wilton Paes de Almeida building (Figure 1), the problem of obsolete buildings in the central area becomes an imminent issue for the architectural scenario at Sao Paulo.

Figura 1 – Fases do Edifício Wilton Paes de Almeida.

Fonte: Elaborado por FERREIRA, 2020. A partir de São Paulo Antiga, 2018; VejaSP, 2018.

[3] Mariana Fialho Bonates is an associate professor at the Federal University of Paraíba (UFPB).
[4] Helena Maria Menna Barreto Silva is an independent researcher and from the University of São Paulo (Labhab).
[5] Letícia Moreira Sigolo is a researcher, since 2003, of the Housing and Human Settlements Laboratory (Labhab) of FAUUSP.
[6] Alejandra Maria Devecchi, currently teaches disciplines related to urban design and environmental studies at São Judas Tadeu University.

Designed by architect Roger Zmekhol in the 1960s, with 22 floors and 2 basements, the building was located in Largo do Paissandu, on a 650m² plot of land with a constructed area of 10,000m², made of a mixed structure of concrete and steel with glass skin surrounding the facade (FIALHO, 2007, p.108).

After exposure of the building without a destination for 9 years (2009-2018) and occupied irregularly, the risks increase, and the probability of a disaster is confirmed in 2018. An electrical overload on the fifth floor resulted in a fire as the building collapsed. In terms of Sustainable Development, how could the building be reversed and prevented from collapsing?

While São Paulo faces problems with the use of buildings, in the international scenario the retrofit technique has been put into practice since the early 1990s, when the first application processes in the civil construction sector emerged. According to the Brazilian Council for Sustainable Construction (2013) retrofitting is identified in Europe and USA in cities that have consolidated urban centers with little offer of land for new construction.

According to Moraes and Quelhas (2012, p. 449), the practice of retrofit covers 50% of works in Europe, France and Italy this percentage already reaches 60%, proving to be a more appropriate alternative to demolition and new construction, promoting in some cases changes in uses according to the evaluation of the degree of intervention and financial cost to repair products. This process gives back to the building its lost functionality and attends to criteria established in the Brazilian Regulatory Norms (NR) that provide for minimum conditions of Occupational Safety and Health (OSH)

In Brazil, there is still no consolidated tradition in building maintenance and operation. Benedito Lima de Toledo (1983)9, in the 1970's, already mentioned the need to look at the city from the urban, architectural, economic, social, environmental and cultural point of view. Thus, the dissemination of the retrofit technique has not yet been properly explored.

The Brazilian Council for Sustainable Construction (CBCS, 2013) justifies the non-dissemination of the retrofit by the lack of specific legislation, because it understands that if the civil construction sector does not have a legal parameter that defines and regulates the technique, the use of buildings becomes unfeasible both for the investor and the consumer. Some factors are cited as examples of the lack of propagation of the retrofit: financial return; legislations that cover the retrofit; available technological resources adequate to existing works; the architects' lack of knowledge of the technique's potential; the lack of manufacture of specific new materials originated from partial dismantling for reuse with the same or other purposes.

However, some organizations and associations seek to understand and base the retrofit technique, including the analysis of environmental impacts through the Life Cycle Assessment methodology. International and national certifications have been accepted in the architecture and used as guiding parameters when establishing criteria for effective intervention. There are several organizations that chancel the certifications focused on retrofit techniques such as Leadership in Energy and Environmental Design (LEED), Well Building Standard and High Environmental Quality (AQUA).

In São Paulo, we have some examples of retrofitting that have already used the certification criteria as a guide in the application of the technique, in search of longevity and approximation with the sustainability, as shown in most of these buildings are located at Avenida

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Paulista (Table 1).

Table 1 - List of certified buildings on Paulista Avenue.

LEED ENTERPRISES - 10/10/2019 20H10					
PROJECT ID	PROJECT NAME	ADDRESS	CITY	FU	TYPOLOGIES
10101825	Torre Matarazzo e Shopping Cidade de SP	Avenida Paulista, 1230	Sao Paulo	Sao Paulo	BDC
10234501	Condomínio Edifício Eluma	Avenida Paulista,1294	Sao Paulo	Sao Paulo	OM
10493164	CYK	Avenida Paulista, 901	Sao Paulo	Sao Paulo	OM
1000016587	Sesc Avenida Paulista	Avenida Paulista, 119	Sao Paulo	Sao Paulo	BDC
1000020386	Paulista 2028	Avenida Paulista, 2.028	Sao Paulo	Sao Paulo	BDC
1000020476	Ed. Paulista 867	Avenida Paulista, 867	Sao Paulo	Sao Paulo	BDC
1000031517	CYK - Recertification	Avenida Paulista, 901	Sao Paulo	Sao Paulo	OM
1000038648	Edifício FIESP	Avenida Paulista, 1313	Sao Paulo	Sao Paulo	OM
1000042290	Citi center (Sede Citibank)	Avenida Paulista, 1111	Sao Paulo	Sao Paulo	OM
1000059081	Quem Disse, Berenice? Shopping Cidade SP	Avenida Paulista, 1230, loja 2113, Shopping Cidade Sao Paulo	Sao Paulo	Sao Paulo	IDC
1000075232	Sub-Condomínio Edifício São Luís Gonzaga	Avenida Paulista, 2300	Sao Paulo	Sao Paulo	OM
1000104270	Madero - Shopping Cidade São Paulo	Avenida Paulista, 1230	Sao Paulo	Sao Paulo	IDC

Source: Elaborated by FERREIRA, 2020. From GBC, 2019.

Next, we will discuss the application of the retrofit carried out with the Life Cycle Assessment in the SESC Paulista example (Figure 2), as example of alternatives to the built patrimony of the Metropolis.

DISCUSÃO: HISTÓRICO DO SESC PAULISTA

Figure 2 - SESC Paulista Building

Source: FERREIRA, 2020.

TECHNICAL DATA

Architectural design (1970): architects Sérgio Pileggi and Euclides de Oliveira.

Architectural design (2018): Königsberger Vannucchi Associate Architects

Location: Avenida Paulista, 119, São Paulo – SP

Owner: SESC

Built area: 12 thousand m²

Year of construction: 1973

Year of *retrofit:* *2011 - 2018* **Construction:** Omar Maksoud **Luminotechnics:** Carlos Fortes Luz Studio

Landscaping Albuquerque Architecture

Sustainability Consultant: CTE

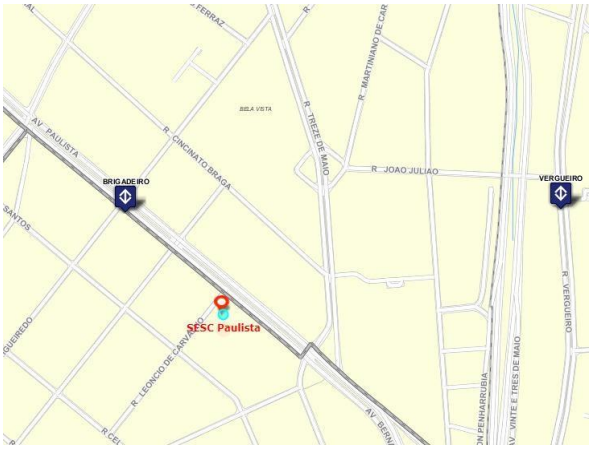
System and level of certification: LEED NC BD+C Silver

Date of certificate: 31/10/2018

The SESC Paulista building located at 119 Paulista Avenue (Figure 3) was designed by architects Sérgio Pileggi and Euclides de Oliveira in the early 1970s. The SESC Paulista has been operating in the building since 1975, when it acquired the building from the Federação do Comércio de Bens, Serviços e Turismo do Estado de São Paulo (FecomercioSP). After FecomercioSP left the building, the building began operating as SESC's administrative hub until it was relocated to the Belenzinho SESC unit in 2005. In the same year, the building becomes a temporary unit, operating until 2010, when the building's retrofit activities begin.

It was a long-retrofit process carried out by Königsberger Vannucchi Arquitetos Associados in the period 2007-2011 and the work carried out in the period 2011-2018. Inaugurated on April 29, in 2018, the building contains 17 floors plus 2 basements and has a floating population of 18,000 people per week in its 12,000 m² constructed area. Designed to become a cultural landmark in front of Paulista Avenue (Figure 4) (Vasconcelos, 2018).

Figure 3 - Location map of SESC Paulista



Source: GEOSAMPA , 2019.

Figure 4 - Façade of the SESC Paulista Building..

Source: FERREIRA, 2020.

The interventions were carried out on all floors of the building, adapting each floor to a specific type of use, containing: children's space, course rooms, sports and physical practices, flexible studios for theater and exhibitions, stores, library, cafeteria, wisdom, dental office to the accredited, as well as the creation of a 70m high belvedere with a panoramic view to Paulista Avenue and other points of the city, which has been the main attraction of SESC.

As far as Sustainable Development is concerned, two issues deserve to be highlighted in the SESC Paulista project: first, regarding environmental issues. Due to the absence of a norm that directs this type of retrofit intervention with Life Cycle Assessment, SESC sought the direction through LEED certification. In consultancy to the Center for Building Technology (CTE), the retrofit was carried out so that the strategies could be applied and directed to results according to the Sustainable Development for the operation of the building. The building is located on an avenue considered a symbol of the city of São Paulo, stage of several cultural events (PIMENTEL, 2019). This way, the project brings a proximity with the external public by breaking limits between public and private spaces, bringing fluidity of the external scenery into the building, which makes the unit promote its role of social sustainability through the creation of a multipurpose living space on the first floor with spaces for 40 bicycles, 6 elevators and escalators for vertical connection (Figure 5).

Fiigure 5 - SESC Paulista Living Area.

Source: Archdaily, 2019.

According to the architect Vera Lucia Tusco, from Königsberger Vannucchi Office, in an interview with Infra Magazine (2018), some aspects were relevant for the elaboration of the project, in her words:

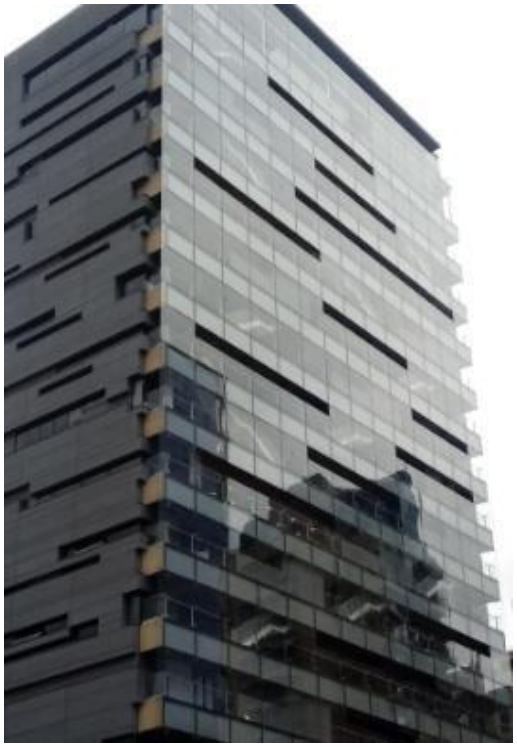
> [...] the spaces and services of the new unit were distributed over the 17 floors, considering four basic aspects: the neighborhood between similar activities, the noise levels produced by the activities, the volume of public accessing the unit and the external visuals (TUSCO, 2018, p.1).

Throughout the building, the areas of use put the user in contact with other looks, reinforcing the user's connection with the external landscape and internal settings. The

circulation through the stairs can be made between the balconies that connect the 3rd floor to the 17th until the access to the lookout (Figure 6), promoting the user a look at the city through the subtraction of glass plates that allow the external vision on each floor, as well as those that are outside the building can visualize the whole vertical route, the proposal refers to the counterpoint of the closed circulation nuclei commonly found in proposals of modern architecture of the twentieth century.

Thus, SESC Paulista incorporates concepts that are being adopted in the 21st century architecture of the international scenario, such as the Health Building (healthy building in free translation), Smart Building (intelligent building in free translation). These are concepts that, when associated have the objective of valuing the well-being of the user incorporating the most advanced technology for thermal-acoustic comfort, automation and control.

Figura 6 – Circulação Vertical do SESC Paulista.



Fonte: FERREIRA, 2020.

THE RETROFIT

The intervention carried out at SESC Paulista was guided by the parameters of the Green Building Council Brazil certifications, more specifically LEED category BD+C. In this category, the building accumulated 54 points in the checklist of the category in 6 areas of evaluation of the 9 possible, receiving the silver level of certification. The analysis of the results follows the order of the evaluation areas established by LEED certification. The points obtained refer to the results in each question: Integrated Project Design and Planning, Location and Transportation, Energy and Atmosphere, Materials and Resources, Internal Environmental

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Quality, Sustainable Sites, Water Efficiency, Innovation in Design and Regional Priority (Figure 7).

Figura 7 – Pontuações obtidas do SESC Paulista.

Fonte: GBIG, 2019.

The strategies and scores obtained by SESC Paulista will be described below:

1- Integrated Process Design and Planning

In relation to the question, due to not applying strategies – graphics, reports, spreadsheets – of integration between the planning stages until the execution of the activities, so that they allowed to manage reports of evaluation of productivity, risks and techniques of optimization of the activities. The SESC Paulista did not obtain evaluation in this question.

2- Location and Transportation (LT):

Aiming at reducing the distances covered using cars and favoring alternative transportation, although SESC Paulista is located near the Brigadeiro do Subrô station and has implemented vacancies for 40 bicycles, it did not score. This is because the action fits in the diversity of modals already existing in the urban structure, not characterizing an initiative that promotes the reduction of car use in the context of Paulista Avenue. Therefore, it was not evaluated in this aspect.

3- Sustainable Land (SS):

In this area some SESC strategies have resulted in meeting specific objectives: The creation of the living area on the first floor of the building promotes actions of social interaction between the building and the street, providing frequent activities; the internal living areas favor the approximation of nature and biodiversity with the inclusion of internal zones with Atlantic Forest species, this structure also favors the reduction of heat zones in the spaces of public concentration; in the tower of the building, the glazed facade contributes to visual permeability; the glasses with solar factor and low thermal conductivity, joined the creation of the balconies in the floors with ventilation through the subtraction of some plates have provided the reduction of the building's in- ternal heat. According to Tusco (2018), it reduces heat from 40% to 70%, also contributing to the energy consumption of air conditioners. And yet, with the capture of rainwater the building can reduce 25% of the volume of surface runoff of the land, preserving the quality of water resources of the land. Being well evaluated in this item, the strategies added 22 points in the LEED system (GBIG, 2018).

4- Rational use of water (WE):

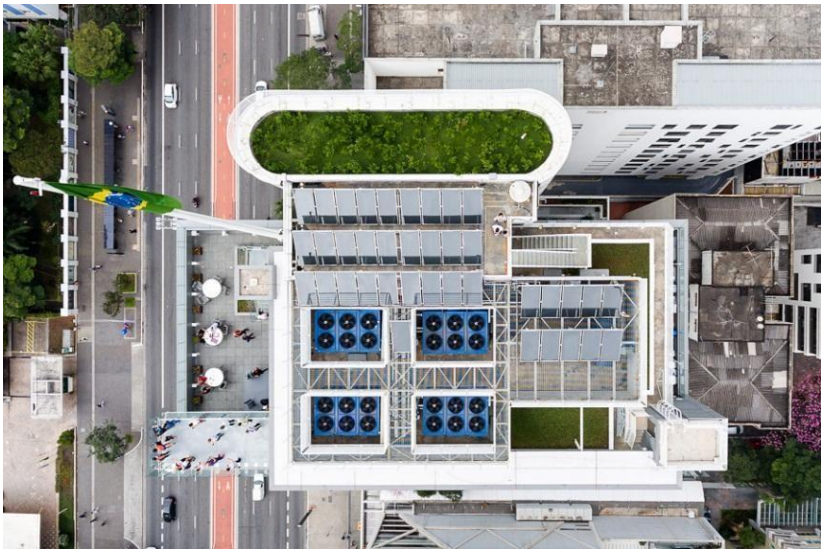
The reduction of water consumption in the SESC building leads to two strategies: the first, by reducing water flows in the washbasins, sinks and discharge with the installation of utilization sensors and timers for the showers; the second, by collecting rainwater in the slabs and gardens, with a storage capacity of 16.56m³, which are used for the irrigation of the building and feeding some toilets. The results have already reached considerable levels in the building, reaching 85% of drinking water consumption according to Tusco (2018). According to GBIG (2018) data, the average results point from 40% of drinking water use to 50% in sewage generation. In this item, the retrofit reached 9 points meeting the prerequisite of reducing water use inside and outside the building.

5- Energy and atmosphere (EA):

The SESC Paulista unit was conceived to be a milestone for the other units in Intelligent Operating Systems as previously mentioned, so several strategies contemplate the building in this regard: the elevators and escalators that feedback energy through a ReGen driver, which generate energy for the system itself; on the roof there are 37 solar heating plates (Figure 8) that work together with a hybrid heating system, connected to 3 electric boilers that meet the demand in the lack of performance reached by the plates, directing hot water to the areas of dressing rooms and Wisdom that work through mixers. (Figure 9); three technologies for audio and video are installed in the logic network of the building: DANTE (audio network), HDBASET (audio and video network) and SDVOE (data network for video), the technologies allow transmission control on all floors of the building, including projections in the living areas of the first floor and coffee unit; the lighting is made by LED connected via DALI system that allows a greater flexibility of the system, allowing the reprogramming of spaces without the use of new circuits for demand; all lamps have Dimmers sensors that adjust the illuminance factor according

to the intensity of natural light that reaches the environment, allowing the optimization of the system even in the areas of scenic lighting. The entire system is controlled by Building Management System (BMS) monitoring - remote control of the mechanical and electrical part - which allows to manage the data in real time and identify failures in the systems that promote actions of loss of performance of the installations, that is, it is possible to monitor and control the systems: water central, energy meters, water heating, lighting, blinds, air conditioners and elevators (EMS system).

Figure 8 - Solar Plates of SESC Paulista.



Source: Archdaily, 2019.

Figura 9 – Boilers do sistema de aquecimento do SESC Paulista.

Source: FERREIRA, 2020.

According to GBIG (2018) data, the actions result in 16% improvement in the performance of the building at the baseline and generate 1% of energy use on site. All actions added up to a total of 6 points for the question.

6- Materials and resources (MR):

According to Tusco (2018), the retrofit kept 85% of the structures and walls in the project, much of the granite applied to the façade was made with existing materials or used from other areas of SESC, contributing to reduce waste. In addition, a radius of 800 km was considered to use materials considered regional with a percentage of recycled content in order to minimize the impact of resource depletion.

According to GBIG (2018), 20% of the materials were extracted, harvested, manufactured and recovered regionally. Currently, according to Ferreira (2020), the building contains selective collection points in all the common core areas of the floors, with no dumps in the internal compartments, in order to generate the awareness of users and workers to generate less waste with the locomotion for disposal. In the areas of coffee and Wisdom, SESC adopted the measure of not selling bottled water anymore, because it generated a considerable number of disposals, drinking fountains were installed that allow the user to reuse their bottles inside and outside the building. The efforts mentioned, yielded 6 points in this matter (GBIG, 2018).

7- Quality of the internal environment (EQ):

Some strategies already mentioned refer to the evaluation in this regard. The façade with ventilation coming from the balconies and the installation of CO^2 meters allow the infrastructure team to manage the maintenance of the internal air quality, proposing the internal renovation through the openings themselves or inducing through the air conditioners. The acoustic glasses provide, when necessary, the isolation of the external noises from the avenue, providing internal comfort conditions for the users and workers, without losing the view of the external landscape. All rooms have incidence of natural light. The project reached 3 points for this evaluation area (GBIG) 2018.

8- Innovation (IO):

In this area all the efforts already mentioned plus the consulting done by an accredited LEED professional have earned an evaluation in terms of innovation. Thus, The SESC Paulista won 6 points, maximum score in this area (GBIG, 2018).

9- Regional Priority (RP):

SESC Paulista has not obtained a clinic for this issue, because its project does not participate in public incentives proposed by zoning laws and urban operations that contribute to the social environment, despite being a cultural landmark for the avenue.

In conclusion, as an institution SESC intends to provide cultural, social and environmental awareness in its activities, all the actions undertaken at the SESC Paulista unit meet its intentions and The Sustainable Development Goals.

Today, after the retrofit, SESC Paulista receives around 4 thousand people per day, a number much higher than the 18 thousand weekly visitors foreseen in the project. The surprising use of the building was only possible thanks to the planning of the architectural project allied to the control and automation systems "embarked" - high computational technology. According to Ferreira (2020), the building's operation with predictive maintenance control has been the emphasis on corrective repair minimization actions, directing it to an operation with controlled performance. The LEED-oriented project presented positive numbers for a new Life Cycle of the SESC Paulista building. The result of the intervention with the retrofit demonstrates a trend for the contemporary São Paulo architectural scenario from that 21st century metropolis.

FINAL CONSIDERATIONS

São Paulo's contemporary architecture has been searching for solutions for sustainable architecture after Agenda 2030. Therefore, this work, which is a result of a master's degree, compared to the application of the concomitant with retrofit methodology of Life Cycle Assessment, guided by the requirements of LEED certification in the case of SESC Paulista.

We found that retrofitting and Life Cycle Assessment and LEED can promote the longevity of the built heritage, because they define the degree of intervention and updating. Thus, the intervention in these parameters returns to the building conditions of functional and operational technological performance (Smart Building), it promotes the user conditions of safety and health (Health Building) and gives the building the sustainable character (Green Building) according to the concept of Sustainable Development.

The data collected from the analysis of the case study points out that the use of the built heritage is optimized by some factors such as: the Memory of the City, which dates back its history and goes through social and cultural aspects; the Urban Development, which adds to areas already with infrastructure; the Environment, because the technique allows managing the use of existing products. This results in the reduction of demolition and continuous reconstruction of contemporary architecture, which configures high negative impacts to the built and natural environment in consolidated metropolises such as São Paulo.

We conclude that retrofitting and Life Cycle Assessment can contribute to sustainable construction. The use of existing buildings and is important both for the memory of the city and meeting the Sustainable Development Goals: taking advantage of the built heritage concerning the use of consolidated urban infrastructure: water, sewage, electricity, transportation and various aspects that promote urban development of the city, it is important to highlight the economy of natural resources and also broadens the field of expertise of specialized professionals: architects and engineers.

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