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ergonomics, sustainability, environmental impact and performance. She currently participates in two research projects, the first being with NCSU - North Carolina State University "Bringing environmental quality and new life to city centers of emerging economies in the climate change scenario - The case of São Paulo" (2018/2019) and the second, entitled "Built Environment, Physical Activity and Nutritional Status in Adults: A Longitudinal Study" (2019/2022) - FAPESP Thematic Project, coordination by Alex Florindo (EACHUSP). She is co-author of the book "Towards Green Campus Operations - Energy, Climate and Sustainable Development Initiatives at Universities" (Springer International Publishing, 2018).



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Graduated in Architecture and Urbanism from the Faculty of Architecture and Urbanism of the University of São Paulo, also holds a Master's degree in Architecture Technology at the same faculty, in which developed a research entitled "Rehabilitation of São Paulo's city center buildings – New houses in ancient spaces: performance evaluation under the ergonomic approach of housing functions and activities" under the guidance of Dr. Roberta Consentino Kronka Mulfarth. Currently a professor of design, sustainability, environmental comfort and methodology at the Architecture and Urbanism course at Estácio College in Carapicuíba, in addition to Coordinator of the Design and Architecture and Urbanism courses. Also taught postgraduate classes entitled "Architecture, City and Sustainability" in the discipline "Guidelines for Bioclimatic Architecture" of the Belas Artes University in São Paulo.

Reuse of Existing and Vacant Buildings in the city center of São Paulo

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Abstract: The incompatibility between the vacancy of built edifications and the demand for housing in the central region of São Paulo is the prime motivator of this work. The purpose of this article is to prove, through spatial and ergonomical analysis, how urgent it is to rehabilitate buildings produced between 1930 and 1964, for residential purposes. The methodology involved the selection of two commercial buildings which are currently in state of disuse, and whose typologies strongly resemble the majority of buildings constructed in the same period. Through rehabilitation, these constructions have been improved and have had their qualities 'exploited' to the fullest, in order to contribute to their overall autonomy and energetic efficiency. The ergonomic performance was studied through the analysis of tasks in order to assure it is possible to realize both conventional and non-conventional tasks in the residential environment. The article concluded that the constructive characteristics of the buildings, ergonomic performance improvements and users' behavioral changes have a strong influence on the overall performance of the units, increasing the potential for housing in the center of the city.

Keyword: *Retrofit. Environmental performance. Ergonomic comfort.*

Introduction

A compact urban space doesn't necessarily mean twenty-story buildings around every corner. In fact, exploring the possibilities of mixed-use buildings so that the infrastructure can be exploited to its fullest is what defines a city's body. Having a transportation system operating optimally not only reduces the average time of daily trips, but also renews parts of the city who have been neglected by public administration.

It is known that great densities are causes for various disturbances in life in society. However, the need to maintain certain areas covered, or to be able to determine the places with conditions and potential for this, are possible challenges that require ample planning to minimize the impacts on quality of life within the city.

This is one of the challenges this work proposes. The need to reurbanize and transform single-phase central areas, which cater only to work, in multifunctional, adding housing and leisure, maintaining its continuous use.

Vacance of buildings X housing deficit

The number of initiatives aimed at bringing more residents to the central areas has increased over the last few years. This is justified through the housing deficit allied to the wear of daily shifts that led to an understanding of the need to make the center be viewed differently. The great availability of collective public transport, when compared to other areas of the city, and the vacancy of a huge number of buildings stimulated the creation of these initiatives that exploit this underutilized potential in order to bring new residents to these areas, applying the concept of compact city, as well as

attracting "life" to some of these spaces that ultimately lost all urbanity.

As a consequence of these new initiatives, the issues related to the population density of the center gained prominence and enabled the evaluation of the concept of compact city. Along with density, other factors such as mobility, pollution emitted due to the shifting, quality of life, among others, have become part of this scale that seeks to optimize the activity of "living" in a city like São Paulo.

Despite its apparent intense use, the center is composed with partially idle infrastructure, since, in daytime periods, its use exceeds the nighttime in up to 400%. This is justified by the fact that the central areas hold more than 24% of the jobs, while the vast majority of their workers come from distant regions of their workplaces (data from the Renova Centro program). In addition, currently, the vacancy rate of the central region is approximately 30%. This vacancy demonstrates the possibility of rehabilitation of these buildings, optimized by the existing infrastructure.

Rehabilitation as a mechanism for "redensification " and revitalization of the center

The requalification allows to reintegrate the buildings that have been losing the desired performance characteristics over the years that are usually related to changes in users' needs or even the region itself and its demands. However, also very recurrent are the technological changes, degradation generated by daily use and lack of maintenance.

The analysis of environmental comfort is also important in the Retrofit process given that environmental conditions are altered

with the verticalization of the environment and the increase in the flow of vehicles causing stress by noise, as well as the increase in temperature due to soil density and poor ventilation between neighboring buildings. In addition to the user's aspects, the recognition of natural resources as limited and that it should be preserved makes equipment and systems of low energy and water consumption to be implemented in order to improve building performance.

The favorable location and the small time in shifts began to directly influence the concept of "living well", reflecting a quality of life where mobility exerts greater influence, not only referring to urban planning and infrastructure, but also as a motivator of users' choices, which become hostages of a city with serious recurring problems of transport, since they do not support the current demand (Kronka Mulfarth, 2015).

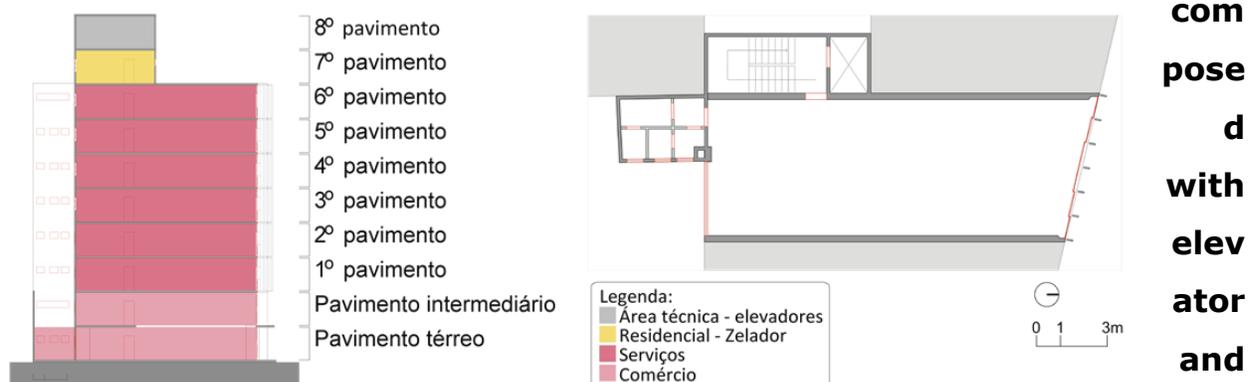
Building-choice standards

For the research that originated this article, the objects of studies were the characteristics of the buildings that compose the historical center of the city of São Paulo. Some of them are common to the constructions of the time when the buildings were built, such as the large spans, possible through the construction characteristics of the time, and the use of reinforced concrete, large openings, right foot of 3.00 meters or more , concrete slab, among others. These characteristics are some of the main construction aspects that devolves on buildings that were built between the years 1930 and 1964.

When it comes to buildings aimed at trade and services, the floors are more unblocked, which facilitates the layout solutions for the

proposed residential use. However, the intent of this research's design is to keep the proposed spaces the most adaptable possible in order to meet the most diverse activities inserted in the domestic environment, whether for hobbies or even for the resident's work.

For the choice of the research's building, some characteristics were considered as more reoccurring to this majority, such as the mixed use of the building, ground floor for commercial use, other pavements focused on services and vertical circulation area



ladder. For the purpose of this article, we explored the building on Paula Souza Street, which carries a greater amount of solutions given the obstacles when rehabilitating it.

Image 1: Section with usage labels and typical floor plan of the building located on Paula Souza Street.

Through thermal studies carried out with the EDSL/*Bentley Thermal Analysis Simulation Software*, TAS, of thermal performance simulation of buildings available for academic use at the Faculty of Architecture and Urbanism of the University of São Paulo, at LabAUT-Laboratory of Environmental Comfort and Energy Efficiency, it was explained the high temperature that remains in the internal environment, in relation to external. This is due to the façade with

large clear openings and facing north, resulting in a direct radiation heat gain practically all day.

As the direct solar radiation is the largest contributor to the increase in temperature, horizontal brises were implanted in the façade in order to minimize the heat in the periods near the middle of the day, when there is a higher incidence of direct solar radiation and with higher intensity. However, in the winter periods, this radiation is positive since it maintains the internal environment with higher temperature than the external and, for this reason, such brises act only for a few hours. They were projected with stems of 30 cm of width and distance of 64 cm in between, according to the studies of Uzum (2017).

Ergonomic study and layout proposal

When it comes to ergonomic analysis, given the large spaces without obstructions resulting from structures of reinforced concrete, the buildings allow a wider range of solutions. To contribute and improve the aspects related to thermal comfort, the ergonomic design was aimed to facilitate the performance of the user on the issues related to the incidence of sunlight and the control of ventilation, keeping the space obstructed in proximity of these elements so that there is no risk to security, whether it is the result of an improvisation in the way of handling it – for lack of sufficient space to do it correctly – or even by not achieving such an element, allowing users to modify the angle of the proposed brises, as well as to control the window opening. These facilities ultimately encourage and make this user's autonomy the best tool so that the internal spaces have the best possible internal conditions.

The space designated as the living/dining room were thought to serve other activities that can be implemented in the domestic environment, even for the purpose of complementing income, such as Home Office, craftwork, cooking, among others. In addition to this, the kitchen was also thought in a wider and open way – without walls limiting its extension – so that, with an appropriate layout, it can be easily adapted.

To prove the ergonomic quality of the proposals, analyses of the circulation areas were carried out through the units, allowing all daily routes, without causing risks or discomfort. In addition, studies were made concerning the area of use of equipment and furniture according to Panero (2002) that determine these areas through the analysis of the task when using each of these elements, and thus, this use becomes viable with safety and ergonomic comfort.

Also, the laundry space was proposed as a common space and, for this, the top floor was chosen, being therefore equipped with washing and drying machines. In addition, in the not covered area of this floor was proposed a community garden for common cultivation.

For the building on Paula Souza Street, two different occupations were proposed for the floors, one of them housing two units of kitchenettes and one with only one unit with three dormitories. This allows the building to house different types of users and families, serving a wider range of people. The two options can be switched along the floors.

Image 2: Longitudinal section portraying the proposed usage for the Paula Souza Street building. Drawing made by the author.

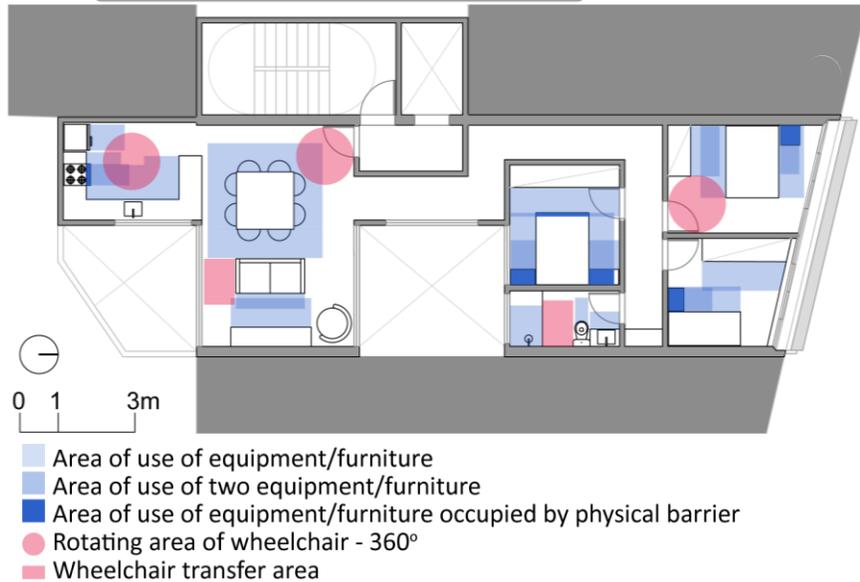
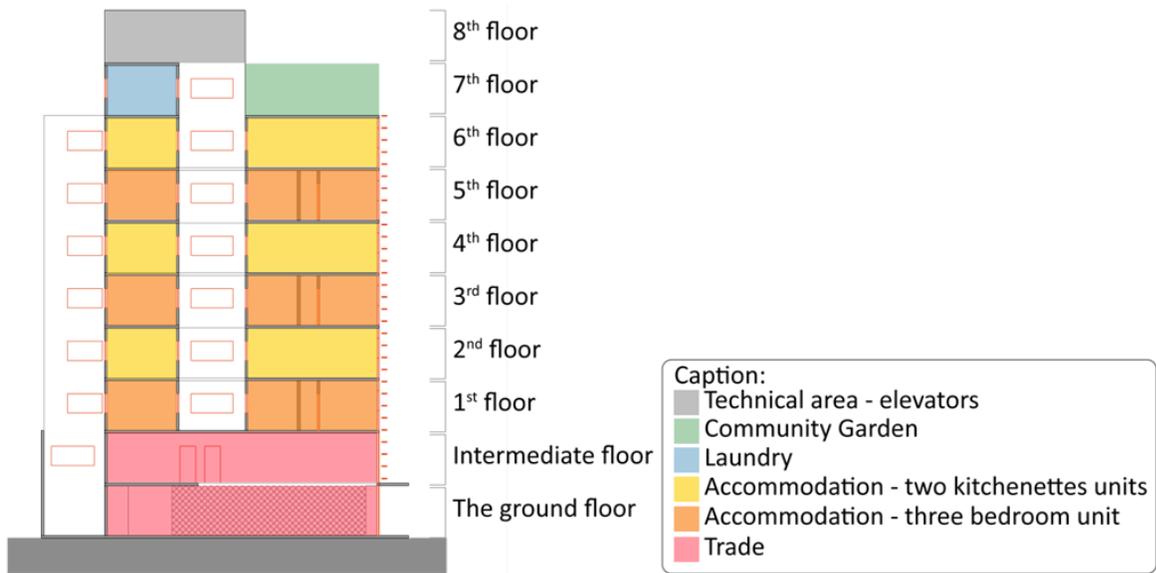


Image 3: Typical floorplan for the rehabilitation proposal, featuring two residential units of the Paula Souza Street building, with highlights on layout and household equipment usage areas. Drawing made by the author.

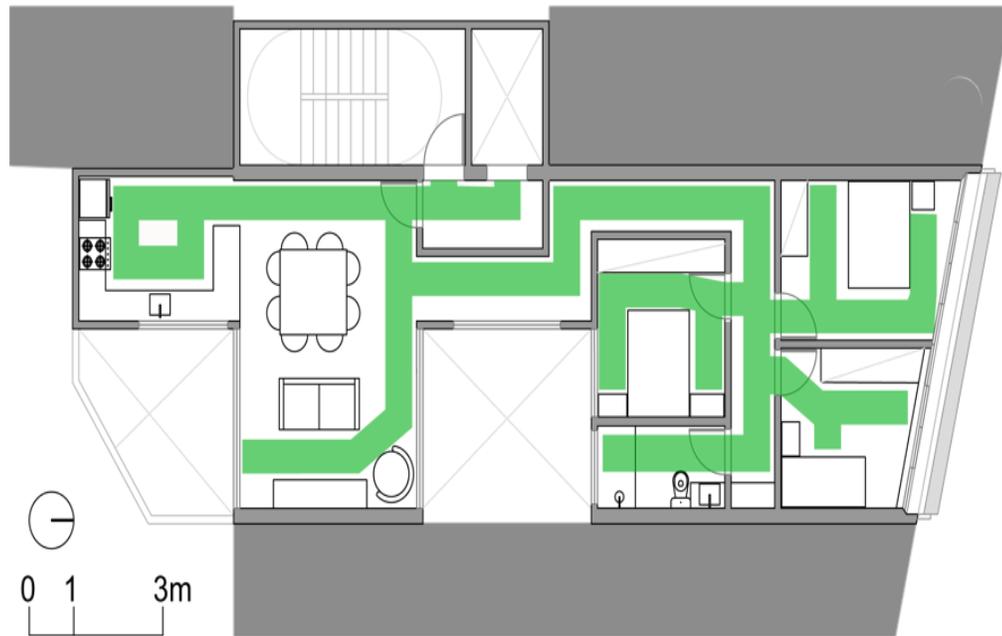


Image 4: Typical floorplan for the rehabilitation proposal, featuring one residential unit of the Paula Souza Street building, with highlights on layout and household equipment usage areas. Drawing made by the author.

It is noted from the plants presented that the space of use of each equipment and furniture remains clear, allowing safe and adequate use. In the floor plan of a housing unit, the circles demonstrate the wheelchair turning spaces, since the unit entails the use by all the proposed environments.



- Area of use of equipment/furniture
- Area of use of two equipment/furniture
- Area of use of equipment/furniture occupied by physical barrier

Image 5: Typical floorplan for the rehabilitation proposal, featuring two residential units of the Paula Souza Street building, with highlights on layout and internal transit areas. Drawing made by the author.

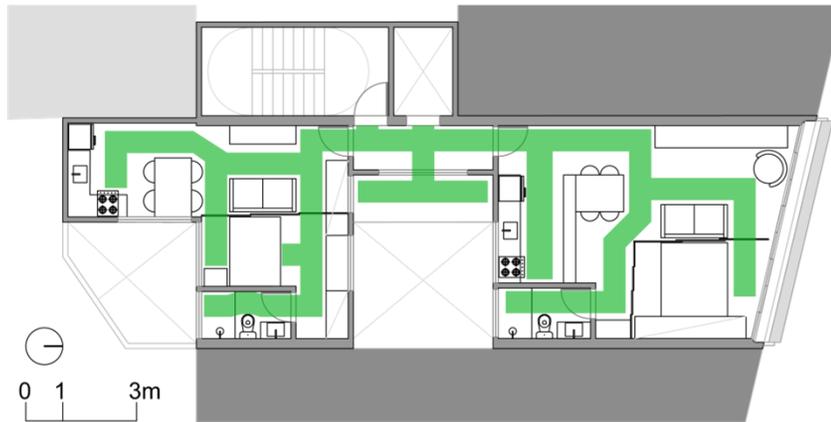


Image 6: Typical floorplan for the rehabilitation proposal, featuring one residential unit of the Paula Souza Street building, with highlights on layout and internal transit areas. Drawing made by the author.

The previous image proves this circulation along the entire pavement, even with two units, in an adequate and unobstructed way. This ensures ease in the mobility of various users.

Conclusion

Through the studies conducted for the building in question, it was possible to demonstrate the capacity that buildings of this time of construction have in being rehabilitated, given the constructive quality, which contributes much to the good quality of the thermal environmental, and their large free spans that allow for a wider range of projectable solutions. Given this, allied to the large stock of buildings in the central region of the city of São Paulo that holds the same constructive qualities and remain in disuse, the rehabilitation of these buildings becomes not only possible but necessary. This is justified by the large number of buildings that remain occupied

illegally in these regions, even with a lack of healthiness and quality of life that these buildings offer.