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THE ADOPTION OF CITY BLOCKS AS A STRATEGY FOR SUSTAINABLE RENOVATION IN NEIGHBORHOODS: A CASE STUDY IN COPACABANA, RIO DE JANEIRO, BRAZIL

ADOÇÃO DE QUADRAS COMO ESTRATÉGIA PARA RENOVAÇÃO SUSTENTÁVEL DE BAIRROS: ESTUDO DE CASO EM COPACABANA, RIO DE JANEIRO, BRASIL

Marcelo de Mattos Bezerra [1]
Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, RJ, Brasil, mmb@puc-rio.br

Alfredo Jefferson de Oliveira [2]
Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, RJ, Brasil, afferson@puc-rio.br

Abstract

This article presents a strategy in which urban blocks of buildings are adopted as the unit for renovation projects of built-up neighborhoods. The renovation of buildings and neighborhoods in order to achieve sustainability is a common practice in many cities and has been subject of various studies presented in the literature on urban renewal. In this paper, the renovation of an apartment building in Rio de Janeiro, Brazil, focusing on sustainability and quality of life, brought about a change in scale, from building to urban block in the investigation. During the process of surveying the case in question, the uniformity of the buildings of Copacabana, the neighborhood chosen for the study, stood out. The majority of buildings use similar construction techniques, are 50 or more years old, have 10 to 12 floors and have courtyards in the center of the urban block. In most cases too, no gaps exist between buildings. The change in scale for renovation projects from single buildings to city blocks has important advantages. Renovation administration can be unified, greater financial and political cohesion can be achieved and infrastructure and services can be consolidated, among other benefits. The Smart Grid and Smart Cities concepts can be adopted for the existing buildings as well as future constructions within a block, since they are independent and can be integrated into complementary projects. In this study, the renovation projects considered: ground floors, basements and rooftops as connecting points for the development of a consolidated design. Selected solutions, made possible by adopting urban blocks as building units, are demonstrated, including their strategic potential.

Keywords: City Block. Housing, Sustainable Renovation. Copacabana. Rio de Janeiro.

Resumo

Este artigo apresenta a estratégia na qual as quadras urbanas são adotadas como unidade para projetos de renovação de bairros consolidados. A renovação de edifícios e de bairros visando a sustentabilidade são práticas comuns em diversas cidades e escopo de textos acadêmicos e projetos em elaboração e concluídos. Neste artigo, a renovação de edifícios de apartamentos no Rio de Janeiro, com foco na sustentabilidade e na qualidade de vida, será apresentada a mudança de escala proposta, do edifício para a quadra urbana, com base na pesquisa desenvolvida. No levantamento de objetos para estudo de caso, deparou-se com a uniformidade de características dos edifícios. A quase totalidade dos edifícios tem a mesma técnica construtiva e foram construídos há mais de 50 anos, 10 a 12 pavimentos, enquanto as quadras possuem espaços vazios no interior. Na maior parte dos edifícios são tem afastamentos entre si. A mudança de edifícios para quadras como unidade para projetos de renovação apresenta importantes benefícios: Um novo modelo de administração unificada, força econômica e política para iniciativas e projetos, soluções únicas de infraestrutura e serviços, entre outros. Os conceitos de Smart Grid e Smart Cities podem ser adotados entre os edifícios atuais assim como nas futuras construções nas quadras, com as quadras, atualmente independentes e que podem ser integrados em projetos complementares. Neste estudo, para os projetos de renovação das quadras, os pavimentos que tem áreas comuns, como térreos, subsolo e de cobertura, foram considerados com alto potencial de integração e de projeto único. Serão expostas as soluções selecionadas, viabilizadas pela adoção da quadra como unidade nos estudos conceituais para demonstrar o potencial da estratégia.

Palavras-chave: Quadra Urbana. Habitação. Renovação Sustentável. Copacabana. Rio de Janeiro.

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Introduction

The retrofitting of existing buildings, for the purpose of improvements, represents a second chance for the existing construction stock of a city. Many buildings in Europe, built between 1950 and 1980, will be renovated in the decades to come, due, not only, to their natural deterioration, but also to technical, architectural and social aspects.

The average life cycle of a building is from 40 to 50 years, with 80% of its cost being related to usage and operation (CEOTTO, 2006, p.20-21). The main focus of renovation is to reduce the consumption of resources, such as water and energy, and improve comfort conditions.

According to Galvin (2014), homeowners in Germany show a reluctance to retrofit. One of the reasons for this is, that retrofit should not only be based on economic savings (GALVIN, 2012, apud GRAM-HANSSEN, 2014, p.394). Arguments should instead concern environmental aspects, prestige, new life span, increased thermal comfort, and a degree of protection against the price fluctuation of heating fuel (GALVIN, 2014).

Even if projects meet the requirements for reductions in consumption, they must also focus on improving quality of life for the population by improving urban space, thus making the city sustainable and resilient.

> *"(...) Whilst individual action at [a] building level remains important, an overemphasis [on] this scale risks fragmentation and overreliance on individual building owners and tenants. What is required therefore at [a] city level is a much more coordinated, planned and strategic approach so that cities can be re-engineered (or 'retrofitted') for a more sustainable future. Indeed, action at this larger urban scale can also [serve] to involve and motivate a range of stakeholders (e.g. developers, financiers and policy-makers) to create more appropriate alignment, as well as a systematic approach to understanding the most appropriate points of intervention. Moreover, this cannot happen over the short-term: planning future urban transitions is a long-term activity (...) of cities over the next 10–20 years, and beyond, to 2050." (GALVIN, 2014)*

A resilient city is sustainable in its economy, environment, and community, but it has a deeper quality, which enables it to quickly adapt to challenges and rebuild itself for any challenge it faces (NEWMAN, 2016).

As shown by Galvin (2014) and Newman (2016), innovative strategies are needed to solve important urban issues such as climate change and consumption of resources.

Large cities, such as Rio de Janeiro, face issues including a shortage of land for new residential and commercial buildings in built-up areas, along with a dissonant utility network, from the point of view of sustainability. The renovation of existing buildings has the aim of reducing the consumption of resources such as water and energy, as well as upgrading technologies. In Brazil, office buildings have been renovated to upgrade technology and to reduce energy bills.

This research initially focused on single buildings targeted for renovation and interventions. However, the unit for renovation was expanded to the city block and this paper presents a strategy for the sustainable renovation of residential buildings in Rio de Janeiro, Brazil.

Methodology and procedures

In order to achieve the above objective a case study was developed. The case study was based on the following steps: (i) definition of the case unit, (ii) determination of the number of cases, (iii) intervention protocol, (iv) and evaluation. The unit of study was Rio de Janeiro and the neighborhood of Copacabana. The case study was instrumental and the unit of study was a specific case within a universal collection of similar cases. The protocol of the study promoted a conceptual solution for the observed problem. The protocol involved a change in the intervention scale maintaining coherence from the specific to the whole, and emphasis in revitalization and permeability. The evaluation was based on a generalization abstraction.

The case study

Case unit: Identification of the study object

Rio de Janeiro is the capital city of the State of Rio de Janeiro and has a population of more than 6 million people. The housing deficit of the city is considered around 470,000 residential units (SECOVI, 2012). Apartment buildings, or collective housing, first appeared in Rio in the mid-nineteenth century in the city's coastal neighborhoods, such as Copacabana (VAZ, 2002, p.18). This was induced by the limitations of the city's topography, between the ocean and the mountains, with apartment buildings replacing houses, mansions and cottages (CZAJKOWSK, 2000, p.13). The beginning of the construction of residential buildings was concurrent with the adoption of new construction techniques such as reinforced concrete (CADERMAN; CADERMAN, 2004, p. 42) and the installation of elevators.

Taking into account the need to renovate partially or completely buildings aged 50 years or more, different types of buildings are examined in this study. The idea of undertaking a case study on a consolidated neighborhood emerged in order to create a model to be reproduced and analyzed. There are two main types of buildings in the city, freestanding and those sharing common dividing walls. To optimize construction and attain a greater number of apartments per building, buildings were no longer separated from each other. The history of urban development of Rio de Janeiro demonstrates this trend.

The neighborhood of Copacabana in Rio de Janeiro was then chosen as the object of the case study. By 1960 most urban blocks of Copacabana were already made up of joined homogeneous buildings with a height of 10 to 12 floors, using construction techniques such as reinforced concrete with infill masonry walls.

In sustainability terms, Copacabana features important aspects such as high density, multi-functional constructions comprising housing, commercial services and entertainment. The neighborhood is accessible by the city's public transportation system.

Copacabana, Buildings and Microclimate

The neighborhood of Copacabana is a narrow 5.2-km^2 piece of land between the Atlantic Ocean and the mountains (VELHO, 2002, p.17). The first apartment buildings were built near the Copacabana Palace Hotel, and after that, the neighborhood quickly reached a high density (CZAJKOWSK, 2000, p.13). In the 1940s, the requirement for open spaces inside the blocks resulted in the patterns observed today. The inner courtyards, were intended for the buildings' own use (CADERMAN, 2010 p.68-75).

92.09% of housing is in the form of apartments in Copacabana (IBGE cited in SECOVI, 2012, p.69-70). Due to the virtual lack of vacant land for new construction, Copacabana is an established neighborhood in terms of population (SECOVI, 2012, p.71). It has the highest proportion of elderly people in Brazil within the same neighborhood (IBGE apud in SECOVI, 2012, p.69), with almost one third of the 146,000 inhabitants (fixed population; tourists are not included) above the age of 60.

Most of the residential buildings in the neighborhood were built between the 1930s and the 1960s. They usually include the ground floor (entrance, doorman, parking and common areas), a basement (parking area), and apartment floors. Vertical circulation is through stairs and elevators. The buildings have a structure made of concrete and walls made of brick masonry. Each building has various owners and tenants, which implies that it is rare to find buildings owned by solely one owner or a governmental entity.

The main features of the buildings in this neighborhood are the following (BEZERRA, 2013):

- The same construction techniques (the construction features and some other characteristics are common to other buildings in the city), consisting of concrete structures (pillars, beams and slabs), brick masonry walls, and plumbing pipes inside the walls;
- Most buildings were constructed more than 50 years ago;
- 10 to 12 floors;
- Retail stores on the ground floor;
- Mix of residential and commercial buildings facing the main and secondary streets as well as mix of residences on higher stories and commerce on lower stories within the same building;
- Great variation in the type and number of apartments in each building;
- Absence of spacing between most buildings;
- Absence of balconies.

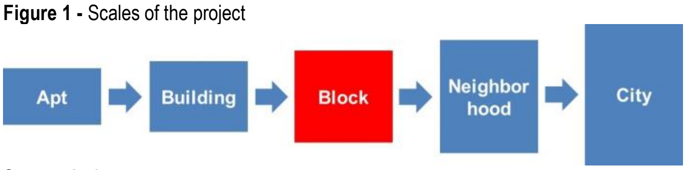
The city blocks in this neighborhood have in common an open area in the middle and a lack of spacing (setback) between the façade and the sidewalk. Several buildings have small internal shopping arcades on the ground floor, which in most cases do not continue through to the next block. The ground floors are closed off from those of neighboring buildings, thereby reducing cross ventilation and stopping people from passing through them, for security purposes and to create separate, unconnected environments.

The following factors determine Copacabana's microclimate: the ocean; the prevailing wind patterns; the beach; the asphalt of avenues and streets; the intense traffic of vehicles; and the height of the buildings. The daily traffic of vehicles is extremely intense, creating noise and air pollution. The buildings on the Atlântica Avenue form a barrier against the ocean breeze. This wind flows into the streets perpendicular to the beach, while on the streets parallel to the beach the circulating wind follows the direction of the traffic at a pedestrian level (CORBELLA; YANNAS, 2007, p.122-126).

Selection of case: scaling from the Building to the Block

Initial observations indicated the need to study renovation strategies for increased sustainability, not on the scale of an individual apartment or building, but on the scale of an urban block as shown in Figure 1.

Figure 1 - Scales of the project



Source: Author

The common challenges, problems and opportunities identified in the diagnosis and, further, the potential solutions, helped to confirm that renovation and sustainability can be achieved if the blocks rather than isolated buildings are adopted as a unit, mainly in neighborhoods and blocks similar to those in Copacabana.

Copacabana has more than 100 blocks and Leme, which is a smaller neighborhood located further along the coastline, has another 15 blocks.

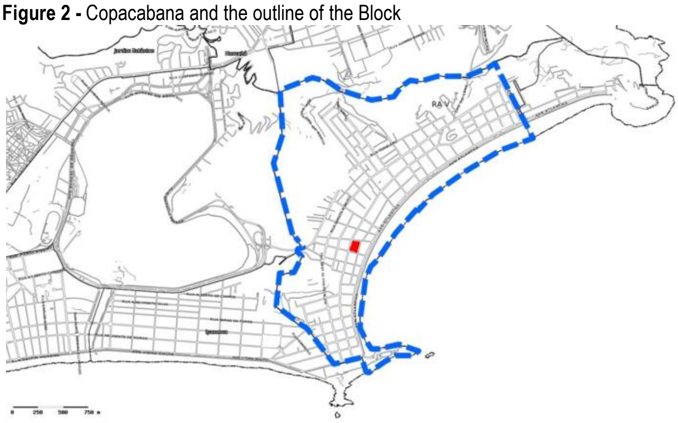
The similar characteristics of the buildings and blocks are the key issues that reinforce the perspective of a block as the unit for renovation of built-up neighborhoods such as Copacabana.

Buildings have spatial, functional and technical preconditions and characteristics. An interdisciplinary approach, rather than a project for a new building, is required here in this case (HAUSLADEN; TICHELMAN, 2010, p.6-7).

The Setting of the Block

For this case study, a survey was conducted on a standard block, so that proposed solutions have the potential to be replicated for similar blocks. Blocks facing the Atlântica Avenue were not considered – as they constitute exceptions in terms of climate (beachfront blocks) and room size – as well as blocks with primarily commercial buildings, – as we are focusing on housing units here. Find below in Figure 2 a map of Copacabana and the outline of the Block.

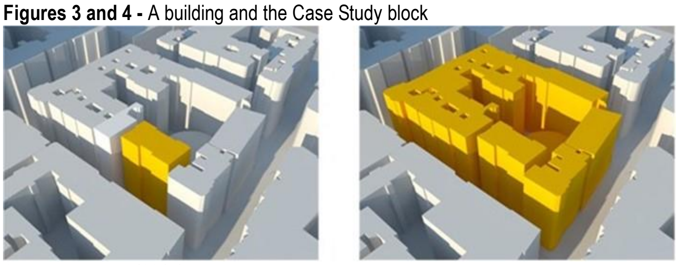
Figure 2 - Copacabana and the outline of the Block



Source: Bezerra (2013)

The block surrounded by Nossa Senhora de Copacabana Avenue, Bolívar Street, Aires Saldanha Street and Xavier da Silveira Street is made up of 14 buildings. It features a predominance of commercial establishments on the ground floors, one being the Cine Roxy (traditional movie theater in the neighborhood, whose rooftop occupies part of the block's interior); in some buildings, there are commercial suites on the first floors and apartments of different types on the upper floors. Figure 3 depicts a highlighted building on Aires Saldanha Street and Figure 4 features the block from the Case Study.

Figures 3 and 4 - A building and the Case Study block



Source: Bezerra (2013)

Altogether, the 14 buildings have 388 housing units and an estimated population of 1,000 people within an area of 9,923.04 m^2 with a density of 1,013.8 persons/km^2. The buildings' capacity ranges from 9 to 54 apartments. Table 1 below depicts the quantities of buildings and apartments, and an estimate of residents.

Table 1 - Estimated quantity of residents in the Block

Address		Apartment Type	Units Quantity	Residents / Apartment (average)	TOTAL
N. Sra Copaca-bana Ave.	959	LR 3 BR	20	4	80
	967	LR 2 and 3 BR	20	3	60
Bolívar Street	27	LR 1 BR	44	2	88
	35	LR 2 BR / SA	33	2	66
	45	LR / BR	27	1	27
Aires Saldanha Street	36	LR 2 and 3 BR	34	3	102
	34	LR 2 BR	22	3	66
	28	LR 1 and 2 BR	41	3	123
	24	LR 1, 2 and 3 BR	32	2	64
	16	LR 3 BR	20	4	80
Xavier da Silveira Street	40	LR 1, 2 and 3 BR	54	2	108
	34	LR 2 and 3 BR	22	3	66
	28	LR 3 BR	10	4	40
	22	LR 3 BR	9	4	36
Total			388		1006

LR: Living room BR: Bedroom SA: Studio Apartment
Source: Bezerra (2013)

As already mentioned, one third of the residents in Copacabana are aged over 60, thus requiring special needs. For example, in one of the buildings in the case study block, 12.5% of the units have residents under medical care in their own homes. As such, changes and improvements for handicapped accessibility are important in the blocks, buildings and apartments, to enable services such as home care with the inclusion of specific facilities and first aid with qualified professionals.

Conceptual solution

Advantages of a Block Strategy

Different types of renovation require specific planning methods and constructive actions. The level of changes required ranges from minor repairs to full refurbishment or restoration of a building for aesthetic, technical and functional reasons. According to Giebeler et al. (2009 p.10-15), the two main aspects orienting the planning of renovation are:

- the scope of the work;
- the scale of the project.

The adoption of a block as the renovation unit seeks to implement new management models that will enable integration among buildings with the rationalization of the environment and services therein, the connection of floors between different buildings, and the inclusion of new elements such as common vertical circulation. The changes in the management model and the benefits of the change in scale can be seen in Table 2.

Table 2 - From the Building to Blocks

Building	Block
Units	
Several Administrative Bodies	Central Administration
Buildings Managers	Block Manager
Separate Facilities	Common Facilities
Lesser Representation	Greater Representation
Partial Renovation Design and Project	General Renovation Design and Project

Source: The authors

In addition to functional and constructive aspects, the adoption of an urban block as a renovation unit has the potential for greater representation and economies of scale to perform jobs and maintenance on the various buildings and apartments in a collective manner.

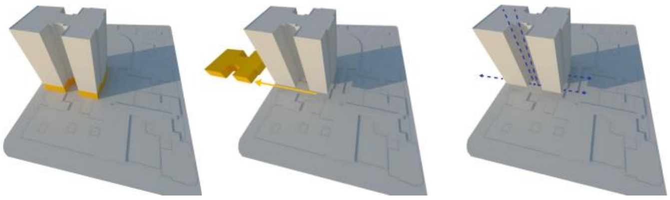
Solutions and Concepts for the Block based on the case study

Here, we will present a few main solutions made possible by adopting a city block, such as the revitalization and permeability of the ground floor, and a few examples of concepts. We will examine these solutions more closely and present others in a general form in future papers, projects, and studies. The reason for choosing the ground floor, basement and rooftops as the principal renovation targets is that these main floors can be integrated horizontally with greater urban and comfort benefits.

Ground Floor - Revitalization and Permeability

Revitalization of ground floors consists of opening up the ground floors by removing the obstructive rooms and partitions and by reorganizing spaces. Overhead roofing of internal courtyards would be removed to facilitate air circulation as can be seen in Figure 5. A change in the configuration and location of vertical circulation areas (stairs and elevators) is not part of the renovation strategies proposed here, but ground floor entrances for two or more buildings could be joined.

Figure 5. Removing the obstructive rooms and partitions and by reorganizing spaces



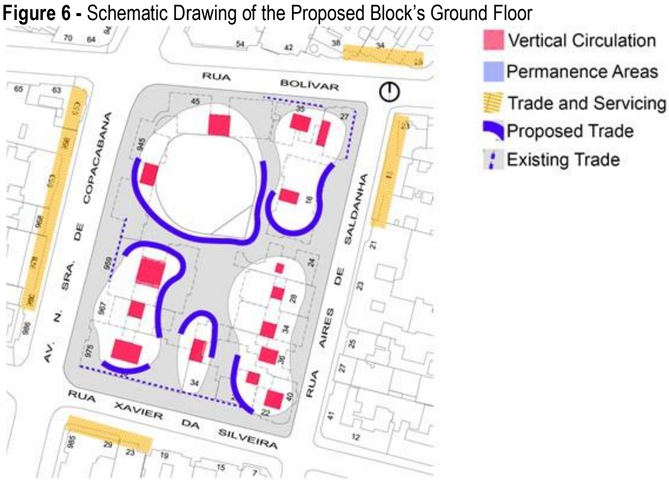
Source: BEZERRA, 2013.

With the implementation of this solution to all blocks, opening them up at the ground level, the ocean breeze could reach non-coastal streets at the pedestrian level.

It is important to stress that one of the aspects in Copacabana's microclimate is that ventilation inside the neighborhood is predominantly from streets perpendicular to the beach (CORBELLA; YANNAS, 2007, p.122-126).

Spaces set aside for parking should also be reorganized, moved or removed, such as by bringing them together in only one block or by moving garages to basement floors; which could also be unified and redesigned. Another alternative could be to build parking structures in spaces available in some blocks or to build public garages. In Figure 6, find a schematic drawing of the proposed Block's Ground Floor.

Figure 6 - Schematic Drawing of the Proposed Block's Ground Floor

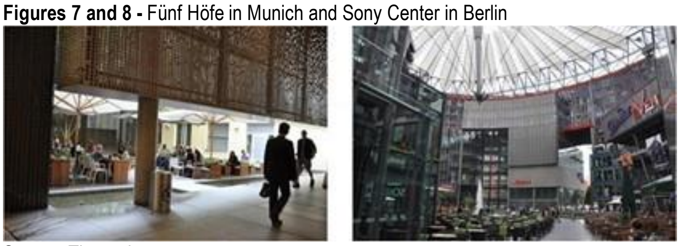


Source: Bezerra (2013)

A unified ground floor in the block would enable the consolidation of services, such as garbage collection, employees' locker rooms and other optimizing areas, thereby reducing costs and maximizing revenue.

There are areas inside the blocks that could be partially covered by transparent and translucent structures, such as in the Sony Center in Berlin and the Fünf Höfe shopping arcade in Munich, as demonstrated in Figures 7 and 8. The inclusion of green spaces inside the blocks would also contribute to establishing a new microclimate and the collection of rainwater.

Figures 7 and 8 - Fünf Höfe in Munich and Sony Center in Berlin

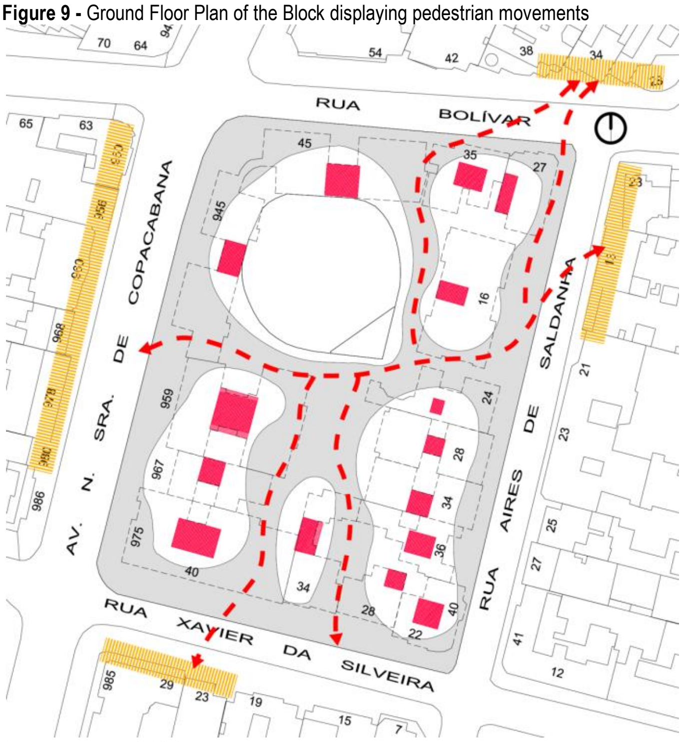


Source: The authors

This solution would offer access to the interior areas of the blocks though the reorganization of existing retail stores and commerce, thereby increasing the opportunity of creating new commercial units (retail stores and restaurants) and attractions such as green areas and spaces for social activities.

Changes inside the blocks would benefit pedestrians and apartments. It would also be an opportunity to overhaul façades facing inward inside the blocks, which are generally poorly maintained compared to those facing outward onto the street. Figure 9 features a schematic diagram displaying the possible circulation of pedestrians inside blocks.

Figure 9 - Ground Floor Plan of the Block displaying pedestrian movements



Source: Bezerra (2013)

The benefit of ground floor revitalization and permeability would be the promotion of a new perspective from the point of view of the pedestrian and the inside of the city blocks, thereby improving the spatial qualities of common areas of urban blocks. These areas would be made attractive for the use of residents and would improve ventilation at the pedestrian level, increasing urban thermal comfort.

The revitalization of the inner courtyards could also include new green areas and stimulate urban agriculture, as proposed by Despommier (2010):

> *"(...) Urban agriculture will lead the way to the establishment of a global network of functional food production systems situated directly in the mainstream of a crowded world" (DESPOMMIER, 2010).*

Other important elements to increase aspects of sustainability in city blocks are: nature, balconies and smart grids:

Nature: The inclusion of vegetation and elements of nature, with or without the purpose of generating food, has several advantages such as blocks and streets with less intense traffic. This solution is in line with the following concept:

> *"(...) Nature has the potential to amaze us, stimulate us, and propel us to want to learn more and understand our world more fully; nature adds a kind of "wonder value" to our lives unlike almost anything else" (BEATLEY, 2016).*

Balconies: The inclusion of cantilevered balconies in existing buildings would protect against sunlight and rain, would generate an expanded area, would increase tax collection, and would lead to the renovation and modernization of façades.

Smart Grid: Blocks could have complementary functions among them with distinct projects in each one. The Smart Grid has been adopted in sectors such as energy. Find below a definition of the concept:

> *"(...) The Smart Grid can be defined as an electric system that uses information, two-way, cyber-secure communication technologies, and computational intelligence in an integrated fashion across the entire spectrum of the energy system from the generation to the end points of consumption of the electricity" (GHARAVI; GHAFURIAN, 2011).*

This concept will be applied by considering the potential for blocks with projects for on-site generation systems (e.g. renewable energy generation) to be complemented by the renewal of resources (e.g. waste management and sewage), thereby enabling an integrated network encompassing the blocks..

Conclusion

After identifying the object – Copacabana buildings, – with identical characteristics, such as age, construction techniques and number of floors, the city block was considered an appropriate design unit for the renovation of neighborhoods of a similar type to increase aspects of sustainability and micro-climate conditions. After conducting the case study, we confirmed the potential of adopting city blocks as a unit for renovation.

An important result of this study was the identification of ground floors, basements and courtyard rooftops, even if privately owned, as having the greatest potential for integrating buildings of an urban block and improving pedestrian level conditions. In doing so, unused spaces on the ground levels, in the interior of the blocks and on rooftops can be exploited.

The unification of several services and spaces that are currently autonomous in the buildings will give rise to space optimization and economies of scale after remodeling.

By focusing on sustainability, reduction in the consumption of resources, and improvement of quality of life, the proposed renovations of city blocks in an already established neighborhood such as Copacabana will generate an innovative model for other upcoming renovation projects.

Thinking of city blocks as the new unit for neighborhoods such as Copacabana will generate potential neighborhoods with fewer cars, less pollution, more green areas, accessibility, and sustainability with flexibility for future climate change needs. It will be critical to conduct surveys and interviews before and after renovations, to learn from residents and users, and to identify current problems and opportunities.

Post-implementation evaluation will generate learning among the projects developed for blocks, comparisons and better resource management.

The concept of Smart Grid is essential for integration between potential solutions and city blocks with specific features and designs. The sum of solutions, projects and facilities among blocks will facilitate cooperation among them, the creation of neighborhoods, and consequently the development of more livable and dynamic cities.

The approach of adopting these solutions, which could be expanded to other locations, along with the development of new case studies and permanent search for solutions, will be important for the success of the research, even in different climates and situations with interdisciplinary projects and implementation teams.

Future developments of this research should detail and analyze these solutions and new proposals should be put forward and tested. The intention is to further the current study and to develop new case studies concurrently with the development of the pilot project.

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[1] **Marcelo de Mattos Bezerra**
Architect. PHD. Architecture and Urbanism Department, PUC-Rio, Rua Marquês de São Vicente, 225, Gávea – 331L – Rio de Janeiro, RJ – Brazil – Zip Code: 22451-900

[2] **Alfredo Jefferson de Oliveira**
Designer. PHD. Arts and Design Department, PUC-Rio, Rua Marquês de São Vicente, 225, Gávea – Rio de Janeiro, RJ – Brazil – Zip Code: 22451-900