

# THE HOUSING UNITS OF THE POSITIVE CLIMATE NEIGHBORHOOD PEDRA BRANCA SC/BR: A TYPOLOGICAL AND MORPHOLOGICAL ANALYSIS

*AS UNIDADES HABITACIONAIS DO BAIRRO DE CLIMA POSITIVO PEDRA BRANCA SC/BR: UMA ANÁLISE TIPOLOGICA E MORFOLÓGICA.*

*LAS UNIDADES HABITACIONALES DEL BARRIO DE CLIMA POSITIVO PEDRA BRANCA SC/BR: UN ANÁLISIS TIPOLOGICO Y MORFOLÓGICO.*

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## ABSTRACT

In response to the global climate crisis, urgent measures are required to reduce greenhouse gas emissions in alignment with the goals of the Paris Agreement. As energy consumption accounts for 36% of total emissions, and buildings contribute significantly to both direct and indirect emissions, it is crucial to enhance the energy efficiency and self-sufficiency of buildings. This article conducts a case study to evaluate the formal structure, spatial layout, and sustainable strategies employed in residential units within the Pedra Branca neighborhood (Santa Catarina, Brazil), using the methodology developed by Brandão and Schneider. The findings indicate that the housing units predominantly consist of three bedrooms, along with two to four bathrooms. The analysis revealed partial integration between the kitchen and service areas, with full integration being less common. Corridor layouts were found to make the greatest contribution to sustainability and internal space quality. Although some configurations did not directly support cross-ventilation, there was a clear focus on environmental comfort and the use of passive design strategies. This study highlights the potential of such configurations to improve energy performance and contribute to the development of climate-positive neighborhoods.

## KEYWORDS

Typology of the building; spatial arrangement; sustainable neighborhood; positive climate; Pedra Branca neighborhood.

## RESUMO

A crise climática global exige ações imediatas para reduzir as emissões de gases de efeito estufa, em alinhamento com as metas do Acordo de Paris. Dado que o consumo de energia é responsável por 36% das emissões globais e os edifícios desempenham um papel significativo nessas emissões, é essencial promover a eficiência energética e a autossuficiência. Este artigo examina um bairro sustentável e positivo para o clima, com foco no estudo de caso das unidades habitacionais do bairro Pedra Branca, em Santa Catarina, Brasil, utilizando a metodologia de Brandão e Schneider. A análise abrangeu a estrutura formal, a distribuição espacial e as estratégias sustentáveis das habitações. Identificou-se que a maioria das unidades apresenta três quartos, dois a quatro banheiros, além de uma integração parcial entre cozinha e área de serviço,



*sendo rara a integração completa. As plantas de corredor foram apontadas como as mais adequadas para garantir a sustentabilidade e a qualidade do espaço interno. Embora outras configurações de planta não tenham favorecido diretamente a ventilação cruzada, constatou-se uma preocupação consistente com o conforto ambiental. Também foram aplicadas estratégias passivas para melhorar a eficiência energética e o bem-estar dos moradores, mesmo nas disposições menos otimizadas.*

## **PALAVRAS-CHAVE**

*Tipologia do edifício; arranjo espacial; vizinhança sustentável; clima positivo; Bairro Pedra Branca.*

## **RESUMEN**

*La crisis climática global exige acciones inmediatas para reducir las emisiones de gases de efecto invernadero, en alineación con las metas del Acuerdo de París. Dado que el consumo de energía es responsable del 36% de las emisiones globales y los edificios desempeñan un papel significativo en estas emisiones, es esencial promover la eficiencia energética y la autosuficiencia. Este artículo examina un barrio sostenible y positivo para el clima, con enfoque en el estudio de caso de las unidades habitacionales del barrio Pedra Branca, en Santa Catarina, Brasil, utilizando la metodología de Brandão y Schneider. El análisis abarcó la estructura formal, la distribución espacial y las estrategias sostenibles de las viviendas. Se identificó que la mayoría de las unidades presentan tres dormitorios, dos a cuatro baños, además de una integración parcial entre la cocina y el área de servicio, siendo rara la integración completa. Las plantas de corredor fueron señaladas como las más adecuadas para garantizar la sostenibilidad y la calidad del espacio interior. Aunque otras configuraciones de planta no favorecieron directamente la ventilación cruzada, se constató una preocupación constante por el confort ambiental. También se aplicaron estrategias pasivas para mejorar la eficiencia energética y el bienestar de los residentes, incluso en las disposiciones menos optimizadas.*

## **PALABRAS CLAVE**

*Tipología del edificio; disposición espacial; vecindario sostenible; clima positivo; Barrio Pedra Branca.*

## 1. INTRODUCTON

The pursuit of sustainability and environmental quality is a pressing concern today. In this context, the United Nations (UN), through the Sustainable Development Goals (SDGs) outlined in the Development Agendas, provides guidelines aimed at promoting sustainable urban management. These guidelines advocate for strategic urban planning and the design of built environments that can significantly reduce the ecological footprint and minimize environmental impacts across various settings.

In line with these principles, several development programs have emerged, including the C40 Cities initiative, which aims to create more sustainable urban environments. One of its key efforts is the Climate Positive Development Program (CPDP), which provides financial support for the creation of neighborhoods that implement climate-positive measures. Neighborhoods participating in the CPDP must adhere to sustainable urban models from environmental, economic, and social perspectives, while also incorporating the principles of New Urbanism, which gained prominence in the 1980s [1]. This approach ensures the effectiveness of urban revitalization projects [2].

The CPDP neighborhoods focus on meeting specific sustainability criteria, including: (a) fostering user integration with the environment; (b) improving quality of life; (c) enhancing connectivity; (d) facilitating pedestrian and general user mobility; (e) promoting mixed-use development; (f) providing well-structured urban blocks; (g) ensuring diverse housing options; (h) prioritizing low-emission transportation (e.g., bicycles, public transit); and (i) managing resources such as energy, water, and waste efficiently [3].

Some buildings within these neighborhoods have been submitted for LEED (Leadership in Energy and Environmental Design) certification to either guide or verify that optimal sustainability levels have been met. This is achieved through the use of passive design strategies, innovative technologies, and sustainable materials to promote efficient and environmentally responsible construction practices [4].

For this study, the Pedra Branca neighborhood (Palhoça, Santa Catarina, Brazil), which is part of the CPDP, was selected due to its status as the first Brazilian example of this program and its international recognition. The study aims to analyze the predominant living patterns in the neighborhood, the architectural structure of multifamily buildings, and the typological and morphological trends, drawing on the research of Brandão (2008) and Schneider (1998).

## 2. METHODOLOGICAL PROCEDURES

This article uses the case study methodology, which consists of an empirical investigation of "a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly defined" [5, p.32]. For Yin (2005), a case study investigation:

- faces a technically unique situation where there will be many more variables of interest than data points, and as a result,
- based on multiple sources of evidence, with data needing to converge in a triangle shape, and, like, another result,
- it benefits from the previous development of theoretical propositions to conduct data collection and analysis [5, p. 32-33].

In line with the points mentioned above, the study was developed by a set of methods of different processes, in which the case study was used as a methodological basis, based on Brandão (2008), to identify the frequency that the different spatial arrangements are adopted in the elaboration of the projects. In this way, the morphological aspects of the floor plans are classified, according to the book *Atlas de Plans*, by Schneider (1998), in which the residential buildings were organized into eight conceptions of standard plans.

The process began with the selection of the Pedra Branca neighborhood, on which bibliographic, documentary and architectural surveys were carried out. Subsequently, the residential buildings Pátio da Pedra, Pátio Civitas and Pátio das Flores were selected for systematic observations, for which data from the respective housing units were collected.

The systematic analysis was composed of the following steps: a) Organization of the data collected; b) Description of the concepts, and historical approach of the neighborhood under study; c) Analysis of the projects of the apartment models in the study.

The data collected for the projects of the 13 apartment models were carried out through the sales websites and the construction company responsible for the construction of the planned neighborhood, as it was not possible to acquire the official documents of the designers.

The systematic studies were carried out through intensive observation of the project and the design guidelines of the PDCP with a focus on the critical analysis of the project, verifying the morphology of the plans, the

spatial configuration, passive strategies, the distribution of openings, the materials and technologies focused on sustainability.

## 2.1 Study Area Analysis

Pedra Branca is in the municipality of Palhoça, Santa Catarina State, Brazil (Figure 01). It began in 1997, from the partnership between the owners of the rural land and the University of Southern Santa Catarina (UNISUL). The proposal modified the socio-spatial dynamics and urban development of the region.



**Figure 01:** Location map of the municipality of Palhoça-Santa Catarina, Brazil.  
**Source:** Author.

With an area of approximately 250 hectares (2,500,000 m<sup>2</sup>), the neighborhood received innovative solutions, linked to sustainable principles, and was conceived from the integration of mixed use with an adequate urban density. The public open spaces were designed to make the neighborhood "walkable", with comfortable distances for travel (approximately 10 minutes walked or 800 meters), to prioritize pedestrians and cyclists [6], as well as the use of more sustainable transport.

In 2,300 lots, single-family and multi-family units were distributed, most of which were designed for mixed use, in which shops and services were located on the ground floor and houses on the other floors.

The design of the neighborhood was based on New Urbanism and on the book "Place Making: Developing Town Centers, Main Streets, and Urban Villages" [9]. In this sense, the concern of the proposal became the creation of compact, dense, complete and connected centralities [7,8].

The urban proposal was helped by eleven national and international architecture and urbanism studios, such as architects Jaime Lerner and Jan Gehl. They used the Charret Design methodology and had the collaboration of

Federal University of Santa Catarina (UFSC) laboratory in the development of studies and evaluations of the site [8].

The project's guiding guidelines considered items such as: attractiveness, pedestrian priority, mixed use, diversity of residents, sense of community, balanced density, harmony between nature and urban amenities, connectivity and lifestyle [6,8].

In the implementation of the neighborhood the most important part of the project is the central nucleus, built in the second phase of the project, which corresponds to the Central Square, the Passeio Pedra Branca (shared street) and the first blocks with residential and commercial condominiums. In this region the study buildings were identified and selected (Figure 02).



**Figure 02:** Implementation of the Pedra Branca neighborhood, Palhoça-SC/Br.  
**Source:** Author.

Figure 02 shows the existence of well-defined commercial areas, leisure areas, wooded areas, and vertical buildings, with a predominance of buildings with more than three floors. Public sidewalks provide good circulation for pedestrians and cyclists. The streets were organized to allow the slow circulation of local vehicles.

The selected buildings are in the central area of the neighborhood and have commercial areas on the ground floor and, on the other floors residential or commercial use. These stand out for the constructive quality of the buildings and the concern with solar orientation, natural lighting in most environments, natural cross ventilation within the units, as well as the use of some techniques and technologies with low environmental impact such as the use of photovoltaic panels, solar heating, rainwater harvesting, economical public lighting, differentiation of typologies and flexibility in apartment plans [10].

As mentioned, the premises of sustainability achieved by the application of LEED certification punctuate actions in terms of energy, water, environmental comfort, materials, technologies and other resources. Aiming at these aspects, the buildings prioritized passive strategies, the use of technology, the awareness of users and

residents, and the effective management of water and energy resources.

The research carried out on the real estate sales sites in the region showed that the values referring to the residential units in the neighborhood varied between 190,000.00 and 1,500,000.00 reais (equivalent to 37,540.50 and 296,372.40 dollars). It was possible to conclude that the predominant social classes in the neighborhood are the upper-middle classes and the upper class [6].

It was also noted that after the implementation of the neighborhood project, in addition to the significant increase in the population with about 9,500 inhabitants/users since 2014, evidencing the demand during its development, there was also a significant improvement in the quality of life of the surrounding neighborhood, which until then was configured as one of the most marginalized. Such improvement was favored by paved streets, expansion of access roads, greater flow of people from the center of Florianópolis to the center of the neighborhood, improvement of the region's infrastructure, consequently the commercial sector of the neighborhood became busier and more prosperous.

## 2.2 Typology in Architecture: Concept

When it comes to the concept, the typological approach in architecture began in the 60s disseminated by Aldo Rossi and Giulio Carlo Argan, and since then it has continued to be the object of study in academia [11,12,13].

The term typology is used to designate the basic form of buildings, the internal structure of the form, the infinite possibilities of formal variations, the idea or reference that serves as a rule for the final model [14]. It is the area of knowledge that study types, through the analysis of ordering, systematization of knowledge and architectural classification of elements. The typological classification is essential to define the needs of the architectural project [12, 15].

To design means to create typologies, to satisfy the socio-cultural changes, the functional and technological problems of each project. In the real estate sector, the patterns of apartments present typologies with great similarities in the design and partition of intimate, social and service areas, differing by the number of rooms [15, 16].

Focusing on the plan of the apartment, this study is based on the typology that admits variations in levels of detail, the simplest: number of bedrooms, bathrooms; and more complex: shape of the apartment, internal circulation and other distribution and interconnection

criteria. For this analysis, the focus of authors such as Schneider [19] and Brandão [17,18] was considered, with adaptations by the authors.

Schneider [19], presented eight conceptions focusing on the floor plan organization of the residential buildings: 1) corridor type; 2) type box inserted or with central core; 3) with central living room; 4) with separation of functional areas; 5) organic; 6) fluid; 7) circuit; 8) Flexible.

In his research Brandão [17,18] presented the study of the typologies of the Brazilian real estate market using about three thousand floor plans in different cities. He established a classification considering the number of rooms, suites and bathrooms, establishing a numerical convention to identify the typologies. This classification was the basis of this study and used the number of bathrooms, with the toilet being considered as "0.5" (half a bathroom). Next he considered the number of rooms, and how many of these are suites, and the kitchen and service dependency. For example, the 1.5/3.1.1 configuration can be read as being a bathroom apartment plus a toilet, with three bedrooms, one suite and a service dependence. Thus, the term typology is used to identify the basic variants that make up the apartments, considering the combination of the number of bedrooms, suites and bathrooms and the degree of integration between kitchen and service area.

For the following analyses, the description of the compartments will be read according to the nomenclatures (Figure 3):

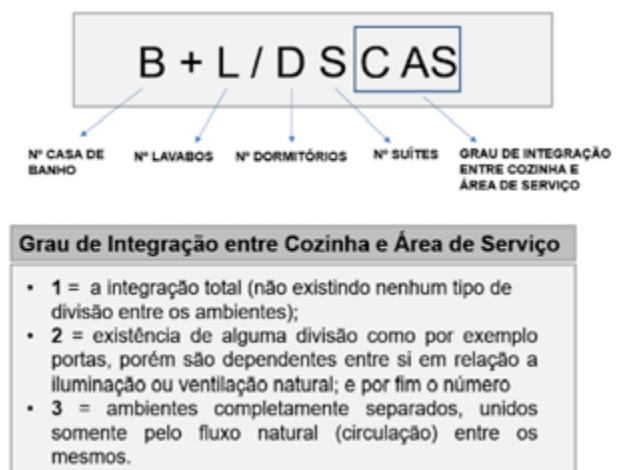


Figure 03: Coding for nomenclatures.

Source: Author.

### 3. APPLICATIONS AND/OR RESULTS

#### 3.1 Identification of Typologies

For the construction of the database for this study information was collected from three residential developments in the Pedra Branca neighborhood, with 13 different housing units, and floor plans with footage between 68m<sup>2</sup> and 220m<sup>2</sup>.

##### a) Pátio da Pedra Development:

Located in the center of the neighborhood, it was designed by the Marchetti + Bonetti office and consists of four towers of buildings (Dolomites, Icarai, Carrara and Travertine) (Figure 04). It has a total of 217 apartments, 24 of which are garden apartments, and eight shops distributed in a built area of about 42 thousand m<sup>2</sup>. The apartments have two to four bedrooms, the floor plans provide the flexibility of integration with the balconies, their infrastructure provides the use of bicycles, renewable energy, water reuse, efficiency technologies and other sustainable resources.



Figure 04: Pátio das Pedras Condominium.

Source: APrepared and adapted by the authors [8].

##### b) Civitas Patio Development:

With a built area of 19,459m<sup>2</sup>, it was designed by the ARK7 Architects office and has two towers of 14 floors, 11 floors, ground floor and two basements, with apartments ranging between 68 m<sup>2</sup> and 140m<sup>2</sup>. The arrangement of the towers on the land is parallel, forming a central courtyard, where there are leisure spaces, adult and children's swimming pools and a playground (Figure 0). The commercial areas on the ground floor have direct access to public roads, contributing to the dynamics of the neighborhood. The first floor is different from the others and consists of a terrace for private use, while the others have openings to the outside and the organization of the floor plan allows for rearrangements. As for the sustainability issue, the project is equipped with technology to control the automation of the common area, avoiding excessive expenses, reuses rainwater to supply the toilets and irrigation of the garden, has a

photovoltaic panel and contributes to the awareness of the inhabitants for selective waste separation.



Figure 05: Pátio Civitas Condominium.

Source: Prepared and adapted by the authors [8].

##### c) Pátio das Flores Development:

Composed of five towers with apartments and duplexes with two to four bedrooms, it includes mixed use with shops and offices (Figure 06). It was designed by Ruschel and Teixeira Netto Architects with a central leisure patio, providing privacy for users. The apartments have between 80 m<sup>2</sup> and 183 m<sup>2</sup>, with bedrooms, living room, kitchen, bathroom, service area and garage spaces. The project also encourages the selective separation of waste, uses renewable energy sources, automation and reuse of rainwater.



Figure 06: Pátio das Flores Condominium.

Source: Prepared and adapted by the authors [8].

#### 3.2 Typological method of plans

The term typology is used in this work in a specific way to identify the basic variants that make up the apartments, considering the combination of the number of bedrooms, the number of suites and bathrooms and the degree of integration between kitchen and service area.

Evaluating the behavior of the variables, it was possible to observe that the number of bathrooms and the number of bedrooms is the items that best explain the size and size of the apartment (Chart 1).

Typology by enterprise					
Ventures	Bathroom	Washbasin	Rooms	Integration to Service and Kitchen	Typological configuration
<b>a) Pátio das Pedras</b>					
Dolomitas	2	0	2	2	2.0/212
Icarai	3	.5	3	2	3.5/332
Travertino 01	2	0	3	2	2.0/412
Travertino 02	2	.5	4	2	2.5/412
<b>b) Pátio Civitas</b>					
Civita (68m <sup>2</sup> )	2	0	2	1	2.0/211
Civita (101m <sup>2</sup> )	3	0	3	1	3.0/321
Civita (140m <sup>2</sup> )	4	0	3	1	4.0/331
<b>c) Pátio das Flores</b>					
Gardenha 01	3	.5	3	1	3.5/331
Gardenha 02	3	0	2	1	3.0/421
Gardenha Duplex	3	.5	3	1	3.5/331
Orquídea	2	.5	2	1	2.5/221
Bromélia	2	0	1	1	2.0/311

**Chart 1:** Number of rooms per development and configuration of the typology of the apartments of each development by Brandão's analysis [17,18] and adaptation by the authors.

**Source:** Authors.

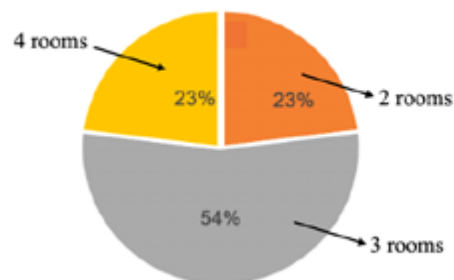
The general characteristics found in the analyzed plans were:

- More than 54% of plans have three quarters, and plans with two or four represent 23% each;
- 100% of the floor plans have at least one suite;
- 30.78% of the apartments have a partially integrated kitchen and service area, and 61.53% of the apartments have a fully integrated kitchen and service area, and 7.69% have both areas completely isolated;
- 100% of the units do not have service dependencies;
- 38.46% of the apartments have areas smaller than 100m<sup>2</sup>, 30.76% have between 100 m<sup>2</sup> and 150m<sup>2</sup>, 23.07% have between 150 m<sup>2</sup> and 200 m<sup>2</sup>, and 7.69% have areas above 200 m<sup>2</sup>.

In all the projects analyzed, all housing units had a single suite, even in the smaller apartments. The integration between kitchen and service area in the Pátio Civitas and Pátio das Flores developments, have a total integration in 100% of the apartments, while in Pátio das

Pedras 100% of the apartments have a partial integration with some relationship of integration between them.

**Percentage of typologies by number of bedrooms**

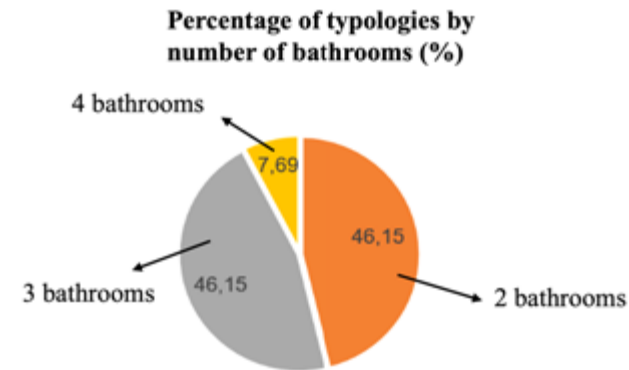


**Graph 1:** Percentage of typologies by number of bedrooms.

**Source:** Elaboration by the author.

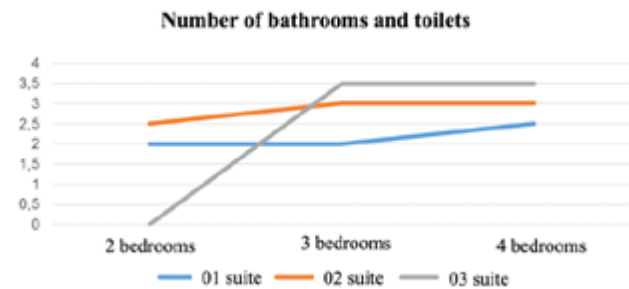
Graph 01 above shows the predominant existence of typologies with 3 bedrooms, and those with 2 and 4 bedrooms are presented with 23% each in a tie. This factor is due to the demand in the Brazilian market for apartments with a larger number of bedrooms in search of

greater comfort due to the average number of inhabitants per family predominates in the country.



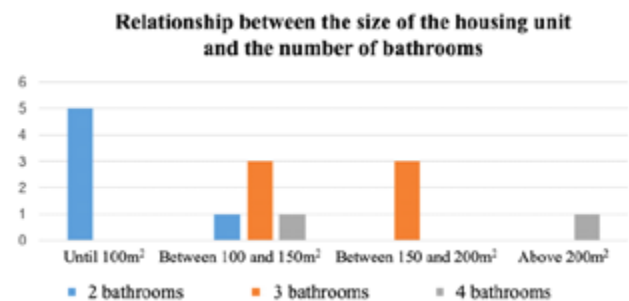
**Graph 2:** Percentage of typologies by number of bathrooms.  
**Source:** Elaboration by the author.

When analyzing the number of bathrooms in the housing units, it can be observed in Graph 02 that most of the units evaluated have between 2 and 3 bathrooms, and these environments are also part of the suites, or even many times, the social bathroom also serves the bedroom, which was verified in most of the cases presented.



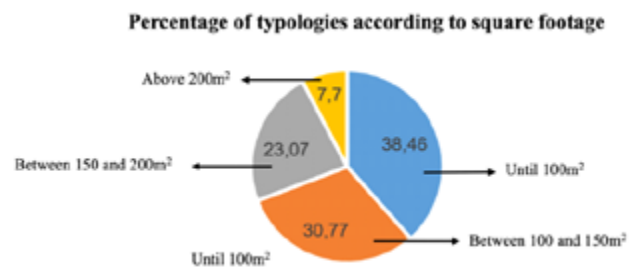
**Graph 3:** Number of bathrooms and toilets.  
**Source:** Elaboration by the author.

Graph 03 in line presents the study of the typologies and it is noted the compensation made by the functionality of the project in balancing the relationship between the number of bedrooms, bathrooms and toilets, where in most cases a greater number of bathrooms and toilets prevails in addition to the number of bedrooms and suites.



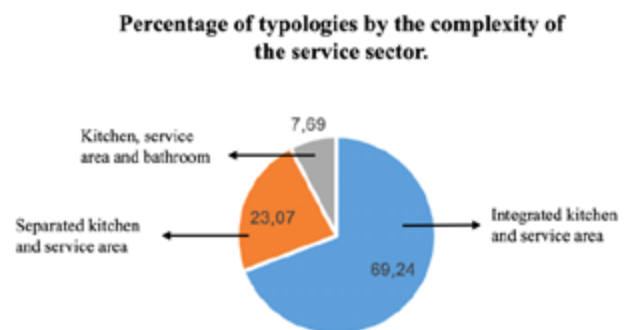
**Graph 4:** Relationship between the size of the housing unit and the number of bathrooms.  
**Source:** Elaboration by the author.

The relationship between the size of the housing units and the number of bathrooms, when we look at Graph 04, it can be seen that the intermediate apartments with an area between 100m<sup>2</sup> and 200 m<sup>2</sup> are provided with at least 3 bathrooms, including toilets. The smaller apartments have up to two bathrooms with the toilet. The apartments with the largest dimensions, consequently, have more bathroom units to the detriment of the others.



**Graph 5:** Percentage of typologies according to square footage.  
**Source:** Elaboration by the author.

It is observed in Graph 05 above, a greater supply of units that have up to 150m<sup>2</sup>, covering dwellings with two or three bedrooms, with three-bedrooms being the majority of the typologies verified in this study.

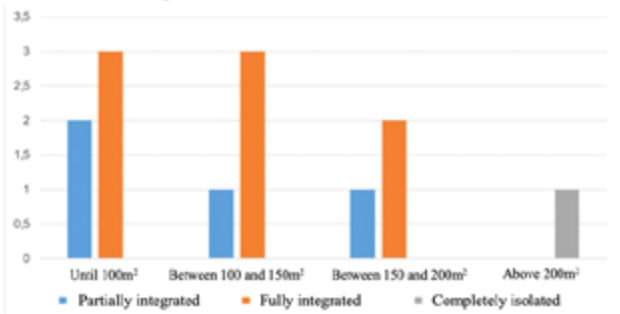


**Graph 6:** Percentage of typologies by the complexity of the service sector.  
**Source:** Elaboration by the author.

The analysis of the data presented in Graph 06 was important for the definition of the methodology for the nomenclature of the typologies, where it was verified that there is no dependence on a maid in the current configuration of Brazilian housing.



**Relationship between the size of the housing unit and the degree of integration between the service elements**



**Graph 7:** Relationship between the size of the housing unit and the degree of integration between the service elements.

**Source:** Elaboration by the author.

From Graph 07, we observe that only buildings above 200m<sup>2</sup> have a service and kitchen sector completely isolated from the social sector and with well-defined environments. We noticed the trend of integration between the social and service sectors, but in a greater proportion in the total integration between the kitchen and service areas of apartments smaller than 150m<sup>2</sup>, in the case of partial integration, its highest proportion is perceived in apartments of a maximum of 100m<sup>2</sup>.

The compensation made by the functionality of the project in balancing the relationship between the number of bedrooms, bathrooms and toilets was identified, where in most cases a greater number of bathrooms and toilets prevails added to the number of bedrooms and suites.

In the relationship between the size of the housing units and the number of bathrooms, it was noticed that the intermediate apartments between 100m<sup>2</sup> and 200 m<sup>2</sup> are provided with at least three bathrooms, including the toilets. The smallest apartments have up to two bathrooms with a toilet. The apartments with the largest dimensions, consequently, have more units.

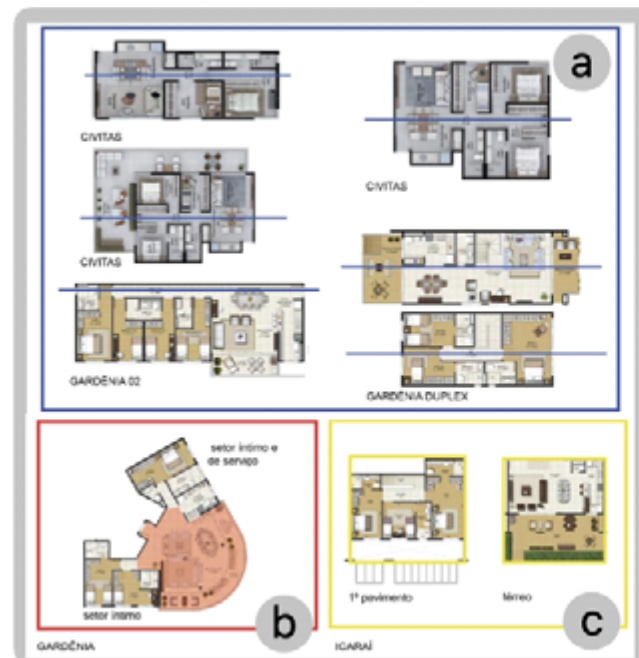
There was a greater supply of units with up to 150 m<sup>2</sup>, covering houses with two or three bedrooms, these are the majority of the typologies verified. Apartments above 200 m<sup>2</sup> have a service sector completely isolated from the social and with well-defined environments, however, there is a tendency for integration between these sectors in units smaller than 150 m<sup>2</sup>, total integration between the kitchen and service areas predominates, partial integration, its highest proportion, is perceived in apartments of a maximum of 100 m<sup>2</sup>.

The direct relationship between the typological method and the issue of sustainability is related to the number of rooms, bathrooms and inhabitants that each housing unit can hold, configuring the average Brazilian

family composed of four and five people. This factor determines the energy expenditure, water consumption and waste of each unit, which may indicate the best use of the urban infrastructure available.

### 3.3 Analysis of morphological aspects

In this step, the Schneider classification [19] was adopted to analyze the morphology of the plans studied, described in Figure 07 and 08, below.



**Figure 7:** Classification of Typology, according to Schneider [19]. Description: a) Corridor plan – defined by axis defining environments or functions; b) Plan with central living room - privileges the living room and distributes other sectors in the surroundings; c) Inserted box-type plan - environments inside the pre-defined form, simplicity of the divisions and spaciousness of the spaces.

**Source:** Elaboration by the author.



**Figure 8:** Classification of Typology, according to Schneider [19]. Description: d) Floor plan with functional separation – well-divided and independent sectors

**Source:** Elaboration by the author.

By observing the plans, the presence of four typologies was verified, namely: corridor type plan, plan with central living room, inserted box type plan and plan with functional separation.

All the apartments of the Civitas development were considered as a corridor type plan, where the linearity of the central circulation for the distribution of the other juxtaposed environments is noticed, favoring the positioning of opposite window openings to improve circulation, ventilation and natural lighting. The duplex and Gardenia 02 apartments of the Pátio das Flores development were configured in a similar way. The Gardenia apartment, with the largest square footage, was configured as a plan with a central living room, noting the distribution of the other sectors in its "surroundings". As it is a corner apartment, in addition to the large amount of lighting and ventilation in the living room, the positioning of the intimate sector and service do not favor cross ventilation.

In Pátio da Pedra, the analysis of the Icarai plan is represented by the typology of inserted box-type plan, in which the shape predefined by the square developed the internal division without modifying the principle of the initial basic form. In this typology, it should be considered that even if the environments are larger and with fewer rooms, this type of configuration can make cross ventilation difficult.

The Orquídea and Bromeliad apartments in the Pedra das Flores development, and the Dolomita, Carrara

and Travertine 01 and 02 apartments in the Pátio da Pedra development were considered with the floor plan typology with functional separation, where it was possible to notice the division of the sectors through the colors represented in Figure 07. This type of configuration favors the functionality of the environments, as well as the circulation between sectors. Depending on the size and positioning of the units in the building, the apartments may or may not allow the best positioning of the windows for natural and cross ventilation, however a concern with passive strategies was identified.

For the universe of samples in the study under analysis, the presence of the other typologies defined by Schneider was not found, such as: Organic plans; Fluid plans; Circuit plan; and Flexible Plans.

#### 4. CONCLUSIONS

The present study presented the existing architectural typologies in the multifamily residential units of the Pedra Branca neighborhood, carried out by Brandão and Schneider's methodology, to analyze thirteen housing units, ranging from 68 to 220m<sup>2</sup>, among which small and medium-sized units predominated. The conformity of the project with the contemporary Brazilian architectural period was verified.

It was found that the most frequent housing typology is three-bedroom, which reinforces Brandão's result [17, 18] The result reflects a society made up largely of medium-sized families (between four and five people). It is also observed that the number of bathrooms and toilets added together is, for the most part, equal to or greater than the number of bedrooms (between two and four bathrooms). In this sense, it is perceived that, although the size of the housing unit has been reduced, when compared to those of previous decades, the bathroom remains one of the important elements for the residence.

On the other hand, the service sector showed a significant reduction in its area, which differs from the patterns found in previous decades. The units analyzed, for the most part, had kitchens with smaller dimensions, limited to the functional aspect. The service areas, in turn, are partial or completely integrated into the kitchens, sometimes not presenting any division between them. The integrated versions configure the new standard for Brazilian housing, probably linked to the cost of the real estate market.

Regarding the size of the apartment, the reduction in square footage requires a greater amount of common spaces, which can mean a reduction in costs, due to the concentration of simultaneous use of the structures.

When it comes to the floor plan configuration, it was noted that the one that most favors natural lighting and cross ventilation is the corridor type plan, where there is juxtaposition of the environments in the circulation, favoring the opposite positioning of the windows. The floor plan with a central room allows for the best situation for the room, since it is located in the corner. The inserted box-type plan, despite having larger environments, may not favor the best positioning of the windows, since the environments are condensed. The plan with functional separation can favor depending on the positioning of the apartments in the building. These factors contribute to the improvement of the quality of the space of the units, which can contribute to the reduction of energy costs. It is important to note that the patterns studied have good flexibility in relation to the distribution and remodeling of the environments, which can be adapted according to the needs of the owner in their different stages of life, which can favor sustainability, since it will reuse existing infrastructure.

Finally, the present study identifies a concern with solutions aimed at environmental comfort and passive strategies, combined with the processes of rationalization of construction, and as a strengthening of the principles of sustainability, achieved with the implementation of LEED certification in some of the buildings.

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