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HOUSING IMPROVEMENTS AND COMMUNITY ERGONOMICS: ANALYSIS OF SELF-BUILT HOUSING IN BAIRRO ALTO DO CÉU

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Abstract

This study analyzes self-built homes, highlighting the importance of community ergonomics and the active participation of residents in improving construction quality. The research employed exploratory-descriptive methods and involved nine self-built residences located in the same neighborhood between 2022 and 2024. Data collection methods included observational techniques, interactive approaches, and document analysis. Floor plans of the residences were developed, along with observations and photographic records to analyze architectural features, space dimensions, and room layouts. Conversational actions with the residents aimed to understand the construction process and their perceptions of the comfort and functionality of their homes. It was found that many constructions do not meet minimum technical standards, resulting in issues such as inadequate ventilation and natural lighting, which affect residents' health. The ergonomic analysis revealed significant barriers, such as a lack of technical knowledge and financial resources. The results underscore the need for effective communication to enhance residents' understanding of potential improvements. It is concluded that community ergonomics can be a powerful tool for creating healthier, safer, and more comfortable environments.

Keywords: Community ergonomics; Self-built housing; Community participation; Housing improvements.

1. INTRODUCTION

Self-construction is a common practice in many Brazilian communities, especially in areas of socioeconomic vulnerability. Self-construction is the process in which "[...] the inhabitants themselves directly assume the management of the production of their homes, acquiring material, hiring professionals or working directly in the construction or renovation works of their homes [...]" (SÁ, 2009).

Although self-construction is a response to the lack of effective housing policies, this practice often results in precarious housing and without proper technical monitoring, despite Federal Law 11.888/2008, which ensures the right to housing and Technical Assistance in Social Interest Housing (ATHIS).

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The Technical Assistance in Social Interest Housing (ATHIS), guaranteed by Federal Law 11.888/2008, is a milestone in the promotion of the human right to decent housing, as guaranteed by article 6 of the Federal Constitution. This legislation aims to offer free public technical assistance to families with an income of up to three minimum wages, covering activities such as project preparation, monitoring and execution of works aimed at the construction, renovation, expansion or land regularization of housing. By ensuring access to free architecture, urbanism and engineering services, ATHIS seeks to value areas of social interest, promoting housing improvements and contributing to social inclusion. Despite being a significant achievement, the practical implementation of this law still faces challenges, with limited experiences and divergences among professionals regarding its implementation, evidencing the need for greater articulation and strengthening of initiatives related to ATHIS.

In the Alto do Céu neighborhood, in João Pessoa-PB, self-construction is prevalent. With an area of 252.3 hectares and a population of 16,557 inhabitants, the neighborhood is characterized by allotments from the Mandacaru do Meio Farm and the Forest Allotment. The neighborhood is predominantly residential and low-income, with few economic activities and facing challenges, such as the emission of methane from a local shrimp farm, which affects air quality (PREFEITURA MUNICIPAL DE JOÃO PESSOA, 2024).

In this context, the application of ergonomic principles can contribute to the improvement of these homes, making them safer, more comfortable and functional. The ergonomic analysis of the built environment goes beyond purely architectural issues, focusing on the adaptability and conformity of space to the tasks and activities developed by users, mediated by the feeling and perception of the individual (VILLAROUCO, 2007). The user's daily interaction with the built environment is crucial to assess its adequacy, as this assessment must reflect human feeling, transcending pre-established indices or legislation, and interfacing the limits between reason and emotion, incorporating the cognitive baggage acquired in the individual's experiential trajectory (VILLAROUCO, 2004).

The ergonomics of the built environment studies human interactions with space, incorporating knowledge from various disciplines, such as anthropology, anthropometry, sociology, psychology and design, in order to analyze and adapt the environment to the human being (MARTINS et al., 2006). According to Buti (1998), it is essential that ergonomics deals with who will use the space, what will be used and, especially, where it will be used, analyzing the physical and sociocultural environment that conditions this interaction.

The contribution of community ergonomics to the improvement of housing conditions in self-built housing is undeniable. CE arose from the need to develop solutions to socioeconomic problems that involved poor communities in American cities (COHEN, 2000; DERJANI-BAYEH, 2000). CE is a bottom-up, participatory and reflective approach, which involves the active participation of the community, aiming to improve social integration and promote collaborative problem solving, promoting the quality of community services (SALDANHA, 2023). For a good development of CE, innovative thinking is necessary, which seeks to develop activities that involve ergonomic strategies of the community, involving people, using information and knowledge, and providing changes and improvements within the community (SMITH; SMITH, 1994).

The proposal of this article is also aligned with the proposal of "Ergópolis - an ergonomic approach applied to the city" (CARVALHO, 2012). According to the Ergópolis proposal, the projects designed for the city must be developed based on the criteria of effectiveness and the commitment that people and the environment are considered in a harmonious way to provide human beings with a socially dignified life. It seeks to understand some issues that cause harm to the population, from the interdisciplinary approach of ergonomics, focusing on human activities, seeking to improve the comfort, safety and quality of life of people, through the adaptation of the city based on its characteristics, capacities and limitations.

This work proposes to analyze, from an ergonomic perspective, the inadequacies and opportunities to improve housing conditions in self-built housing in the Alto do Céu neighborhood, in João Pessoa-PB, seeking to contribute to the construction of a safer, more comfortable and functional built environment.

2. MATERIALS AND METHODS

The study carried out is exploratory-descriptive in nature, and is also characterized as applied, since, in addition to presenting a detailed diagnosis, it proposes viable alternatives to solve the problems identified. Exploratory research, according to Gil (2019), seeks to understand topics that are still little investigated, focusing on knowing the characteristics of a given sample and is strongly based on bibliographic reviews. This approach is often a starting point for explanatory research, providing descriptions of the situation studied and raising relationships between the elements involved. On the other hand, descriptive research, according

to Prodanov and Freitas (2013), records and reports the observed events without the researcher directly interfering in them, ensuring an impartial and systematic analysis of the data.

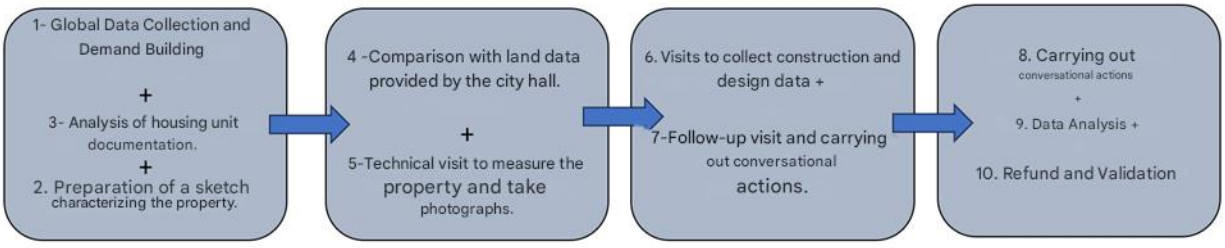
The analysis focused on nine self-built residences located in the Alto do Céu neighborhood, in João Pessoa-PB, between 2022 and 2024. The initial demand arose from the owners themselves, who sought the preparation of *as-built sketches* for judicial purposes for the acquisition of the right of adverse possession.

This work aimed to deepen the knowledge about the construction processes of these houses and the perception of the residents in relation to their comfort and functionality. The methodological basis of the research was based on the Ergonomic Analysis of Work - AET (WISNER, 1987; GUÈRIN et al. 2001; VIDAL, 2003; GONÇALVES et al., 2015). The focus groups involved in social construction were the owners, builders, and residents of the dwellings.

The data collection process was structured in three main stages. In the first stage, the initial survey of the information necessary for the preparation of the floor plans of the residences was carried out, enabling the analysis of the architectural characteristics, dimensions of the spaces and organization of the environments. In the second stage, visits to the buildings were carried out, with the objective of observing the structural conditions, identifying constructive and ergonomic inadequacies, and recording the evidence through digital photographs. The last stage consisted of conversational actions with the residents that enabled the collection of reports on daily experiences, the processes of project design and construction of the houses, and the perception of comfort and functionality of their homes.

Figure 1 shows the methodological flow followed in the research.

Figure 1 – Step by step of the data collection process



Source: Author, 2024

After meetings to understand the demands of the owners/residents, the existing documentation of the housing units was received, which allowed a preliminary analysis of the scenario. Next, the need to prepare the sketch of the characterization of the property was

identified, a demand that emerged from the residents themselves in search of land regularization.

Subsequently, the data obtained were compared with the information on land made available by the city hall, ensuring the consistency of the surveys. Subsequently, technical visits were carried out to remove the measurements of the properties and a photographic survey, which documented in detail the structural conditions and constructive aspects of the houses. There was also the possibility of complementary visits and requests for additional photos from the owners, especially in cases that required greater accuracy or complementation of the data. Finally, the research included carrying out conversational actions with the owners and residents, creating a participatory and collaborative environment, essential for the collection of perceptions and experiences of the residents.

Content analysis was used to analyze conversational actions and verbalizations, enabling the organization and systematization of information into thematic categories. This approach facilitated the detailed interpretation of the results, allowing a comprehensive and structured view of the phenomenon studied.

The joint analysis of the floor plans of the houses, the photographic records and the content analysis allowed a comprehensive understanding of the conditions of the self-built houses, while ensuring the integration between technical observations, spatial documentation and the perception of the users. Thus, the methods applied provided a robust and grounded diagnosis, serving as a reference for the proposition of housing improvements in line with the principles of community ergonomics.

Finally, the results were returned and validated with the participants.

3. ANALYSIS AND DISCUSSION OF THE RESULTS

The Alto do Céu neighborhood, located in the city of João Pessoa-PB, is characterized by a regular territorial planning, with all the analyzed land duly registered with the city hall, including a clear organization of blocks and lots duly cataloged. This regularity in land registration provides an important basis for future urban and housing interventions in the area.

Predominantly residential, the neighborhood is inhabited by a mostly low-income population, reflecting socioeconomic conditions that often limit access to basic services and improvements in urban infrastructure. In this context, self-construction is presented as the main form of housing provision, with the residents themselves directly assuming the management of

the works, either through the purchase of materials, hiring labor or carrying out the services with their own efforts.

This scenario is common in socially vulnerable communities, such as Alto do Céu, where the absence or insufficiency of effective public housing policies and the scarcity of specialized technical assistance become determining factors for the perpetuation of self-construction practices. Under these conditions, the houses erected, although they meet the basic need for shelter, often present a series of structural and functional inadequacies, compromising the safety, comfort and quality of life of their residents. The lack of technical monitoring results in constructions that do not follow the minimum standards required by safety and ergonomics standards, leading to problems such as poor distribution of spaces, insufficient ventilation and natural lighting, in addition to the use of inadequate or low-durability materials.

The main characteristics of the self-built buildings analyzed highlight relevant issues, such as the oversizing of some spaces while others are below the appropriate dimensions (Table 1). According to the building code of the city of João Pessoa (2001), a residence with two bedrooms, a kitchen, a bathroom and a living room should have, on average, 42 m², using the minimum dimensions provided for in the legislation. However, it is observed that the buildings analyzed present significant disproportions, evidencing the lack of knowledge and planning and technical monitoring.

Table 1 – Characterization of Housing Units

Housing	Land (m²)	Built Area (m²)	No. of Housing Units	No. of Floors	No. of Rooms	No. of Suites	No. of Bathrooms
House 1	200,00	201,11	2	2	3	1	3
House 2	161,21	113,03	1	1	2	1	2
House 3	102,13	151,58	2	2	4	1	4
House 4	312,45	232,16	3	2	6	1	4
House 5	142,28	130,55	1	2	2	1	3
House 6	167,23	87,55	1	1	1	1	2
House 7	257,50	235,53	4	2	6	2	6
House 8	273,00	140,37	2	1	5	3	2
House 9	250,00	130,62	1	1	2	1	2

Source: Authors, 2024

The analysis of the floor plans of the houses revealed that, in general, the internal spaces are undersized, which compromises the usability, ergonomics, safety and comfort of the residents. As illustrated in Table 1, the built areas vary considerably among the nine residences analyzed. For example, House 1, with a plot of 200 m², has a built area of 201.11 m², while House 6, with 167.23 m² of land, has only 87.55 m² of built area. This disparity reflects improvisation and the lack of compliance with technical standards, which guide ergonomic and constructive aspects.

The inadequacy in the sizing of spaces and in the arrangement of furniture impairs circulation, directly affecting the comfort and functionality of the environments. In addition, problems such as insufficient ventilation and natural lighting were frequent. Inadequate ventilation, caused by the absence or inadequate location of windows, compromises indoor air quality, generating inadequate and uncomfortable environments. These conditions were confirmed by Martau (2009), who highlights the importance of natural lighting and ventilation for human well-being.

Most of these residences do not follow the minimum parameters established by technical standards, resulting in implications for the health and well-being of residents. One of the main problems observed was the lack of ventilation and natural lighting. From the fenestrations, that is, openings such as windows, the presence of natural light contributes to health and well-being (MARTAU, 2009), whether in homes or businesses, the absence of adequate ventilation can lead to unhealthy environments.

Another factor that deserves to be highlighted is the absence of technical monitoring in the execution of the works, especially in areas of Social Interest Housing (HIS). Federal Law 11.888/2008, which regulates Technical Assistance in Social Interest Housing (ATHIS), provides for the provision of free architectural and engineering services to low-income families, aiming to ensure decent and safe housing. However, the limited application of this legislation results in constructions that often disregard technical parameters, amplifying problems related to the functionality, comfort, and safety of housing. The lack of technical knowledge results in the inadequate choice of materials, layout of spaces and execution of structures, amplifying the challenges of vulnerable communities.

Chart 1 presents the problems identified in the houses, with detailed descriptions of the visual inspections, possible causes, diagnoses and proposed solutions. This analysis aims to adapt the environment to improve the well-being of the residents, aligning with the premises of

the ergonomics of the built environment, which must be applied at all stages of planning and evaluation of the environment (MORAES, 2004).

Chart 1 – Ergonomic Analysis of Self-Built Housing

Photo	Problems Identified	Possible Causes	Diagnosis	Possible Solutions
	Undersized spaces and poor arrangement of furniture affecting circulation	Inadequate planning of internal spaces.	Reduction of functionality and comfort of environments.	Reorganize the arrangement of the furniture and consider a renovation to make better use of the spaces.
	Lack of adequate natural and artificial lighting in all rooms	Small and poorly positioned windows; absence of efficient artificial light sources.	Dark and unhealthy environments, increased vision problems and domestic accidents.	Increase the area of the windows and install appropriate luminaires for each environment.
	Environments with insufficient ventilation.	Lack of windows or small, poorly positioned windows.	Unhealthy and uncomfortable environments, increase in respiratory diseases.	Enlarging or repositioning windows to improve natural ventilation.
	Infiltrations and drafts.	Lack of proper sealing in openings (doors and windows).	Thermal discomfort and increased energy consumption for heating/cooling.	Install proper sealing on all doors and windows.
	Moisture and mold on the interior walls of the house	Lack of waterproofing in the foundation and use of inappropriate materials.	Compromise of the structure of the house and risks to the respiratory health of the residents.	Perform proper waterproofing and use moisture-resistant materials.

Source: Authors, 2024

The results of the analysis of the houses, detailed in Chart 1, revealed recurrent problems, such as infiltrations, high humidity and poor sealing of doors and windows. These deficiencies contribute to thermal discomfort and increase energy consumption, since residents often resort to fans or other air conditioning equipment to compensate for adverse conditions. The lack of adequate technical planning is a critical factor, aggravated by improvisation in the construction stages.

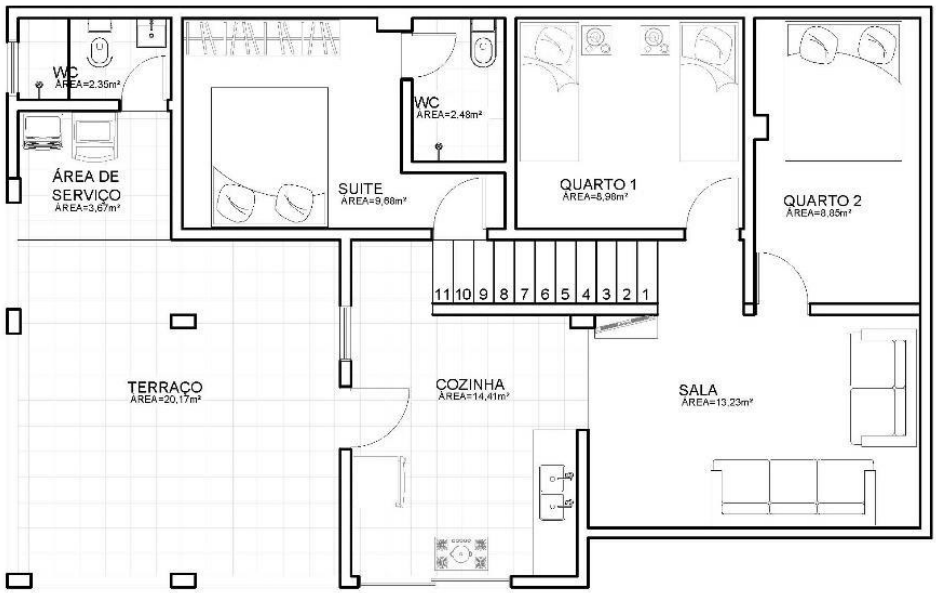
In addition, residents reported difficulties associated with the use of inappropriate materials, a direct consequence of limited financial resources. The case of Casa 1 exemplifies this reality: the person responsible for the work admitted that all the footage was made without any technical criteria, stating, "I took all the footage out of my head [...] At the end of the work

I had no money, I had to put some hollow bricks." This report highlights the need for technical assistance to ensure safer and more comfortable constructions.

In the specific case of House 1, represented in Figure 2, the lack of ventilation and natural lighting in the rooms is directly related to the topography of the land and the way the building was designed and executed. The house is located on a lot with significant unevenness, where the land has a height difference of about 2 meters between the street level and the bottom of the land. The owner used this feature to build a two-story residence, with the ground floor being semi-buried and used as a living area, while the first floor is still under construction.

This semi-buried condition of the ground floor compromises access to cross ventilation and natural lighting, since the external openings are largely blocked by the proximity to the ground or retaining walls. According to local construction standards, the area of the windows must be at least 1/6 of the floor area of the room (JOÃO PESSOA, 2001). Thus, in a room with 12 square meters, the window should be at least 2 square meters to ensure adequate conditions. However, the absence of windows or the presence of insufficient openings in the semi-buried walls makes ventilation and lighting practically non-existent, aggravating the feeling of confinement and unhealthiness in the environment. This situation is a clear example of the need for adequate technical planning to take advantage of the topography in a functional way, without compromising the minimum requirements of comfort and habitability.

Figure 2 – Semi-buried basement floor plan House 1



Source: Author, 2023

One of the residents, responsible for the construction of Casa 1, reported on how he planned the spaces: "I took everything out of my head, which I thought would be enough to put 2 beds, a living room to watch the soap opera and a kitchen for the woman to make food." This statement highlights the lack of technical knowledge and improvisation in the process of self-construction, a common practice among residents. Another aspect reported by this resident was the use of improvised materials: "I wanted to have put everything in glass windows in my house, but at the end of the work I had no money, I had to put some hollow bricks." These testimonies demonstrate the limitation of financial resources, which directly affects the quality and safety of the constructions.

Although the residences analyzed present several problems, it was possible to identify the residents' ability to adapt, who seek to make improvements as financial conditions allow. For example, one of the residents proudly reported the renovations carried out in House 1: "I have already enlarged my entire house, a little money has come in and I have already made another room." This ability to adapt, although positive, does not eliminate the need for more efficient initial planning and adherence to technical standards. Investments in simple solutions, such as furniture reorganization, window enlargement, and waterproofing improvements, can significantly increase the quality of life of residents.

In addition, during a follow-up visit in 2024, another resident expressed pride in reporting the improvements he made to his residence: "I've already enlarged my entire house, a little money came in and I've already made another room." This report reflects the residents' ability to adapt, who, even in the face of financial difficulties, continue to modify their houses according to their needs and possibilities.

Albers, Barth, and Renner (2021, p. 14) point out that, although the elimination of barriers in cities is much discussed, little is said about accessibility within homes. They state: "Giving the opportunity for this public to live in an adapted and designed space, respecting their limitations, is to give these people the opportunity to develop their potential, beyond the limits imposed by the body, giving rise to quality of life and belonging to the place where they live." This understanding reinforces the importance of designing housing spaces that can meet the needs of residents, including the elderly and people with disabilities.

4. CONCLUSIONS

The study carried out on self-built housing in the Alto do Céu neighborhood, in João Pessoa-PB, revealed a series of design, construction and ergonomic problems related mainly to

the lack of technical knowledge on the part of the residents and the limited availability of financial resources. This situation makes it difficult to implement improvements in environments and often results in buildings that do not meet the minimum standards established by technical regulations. The analysis showed that the lack of knowledge and adequate planning compromises fundamental aspects, such as usability, comfort and safety, which directly reflects on the quality of life of residents.

The contribution of the ergonomics of the built environment together with community ergonomics can contribute to the improvement of self-built housing by seeking the adaptability and conformity of the space to the needs, activities and the socioeconomic and cultural context of the users, ensuring a healthier and safer environment for all. The active participation of residents in the design, construction and modification of their housing and the development of creative and low-cost solutions that can be implemented with the direct involvement of the community should be promoted and encouraged.

Understanding users' perception is crucial to identify their needs and adapt the built environment, generating belonging for residents and the community as a whole. According to Villarouco (2004), the aspects involved in the adequacy of the environment should come from the feeling that the user acquires with the daily interaction with the built environment. Its evaluation does not depend on pre-established indices or legislation, bringing to the decision-making level the feeling of man, interfacing the limits between reason and emotion, also having as a mediating element the cognitive baggage acquired in his experiential trajectory

Therefore, the active participation of users in the process of design, construction and renovation of self-built housing is fundamental. This approach not only increases the knowledge and empowerment of residents, but also fosters a sense of belonging and responsibility, which are essential for the sustainability of the improvements implemented. Community ergonomics, with its focus on the adaptability and conformity of space to the needs of users, presents itself as a powerful tool to achieve healthier, safer and more comfortable environments for all.

This work contributes to the discussions about self-built housing, highlighting the need for greater technical guidance and collaborative actions that can optimize the quality of constructions, making environments more comfortable and safer. It also highlights the relevance of community ergonomics, which not only seeks technical solutions, but also considers the socioeconomic context, the living experiences of residents and their active participation in the process of designing, building and modifying their homes.

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