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"HOME, SWEET HOME": DO RESIDENTIAL PROJECTS PROVIDE ACCESSIBILITY FOR PEOPLE WITH REDUCED MOBILITY?

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Abstract

In Brazil, housing is a social right and the dream of owning a home creates expectations and desires. To be efficient, housing must take into account the needs of the people who will use the built spaces on a daily basis and, eventually, for their entire lives. The objective of this study is to verify whether residential projects are accessible and/or adaptable for people with reduced mobility. This research is basic in nature and, in relation to its objectives, is descriptive. The analysis and discussion of data is configured as a qualitative approach. As a data source, 61 projects approved by the Architecture Department of the Municipal Government of Linha Nova/RS, between 2015 and 2020, were analyzed. According to the data found, a probable or inevitable future adaptation will be costly and time-consuming in most of the residences, since 75.41% have unevenness in the main access; 62.30% have bathrooms with doors smaller than 80 cm; 93.40% have toilets with the door opening into the space; 82.05% have corridors that do not allow wheelchairs to turn and adequate access to adjacent spaces; and 63.21% of bathrooms do not have the possibility of safe and comfortable wheelchair access. It is clear that municipal legislation does not comply with the NBR and, as a result, few buildings are fully suitable for the needs of people with reduced mobility.

Keywords: Residential projects; Accessibility; Universal design; Adaptation; People with reduced mobility.

1. INTRODUCTION

In Brazil, home ownership has an important dreamlike character, in addition to being a constitutionally guaranteed right. Carli (2010) comments that this view of a social instrument and of law creates an expectation that accompanies the individual during his or her life, with a large part of the population having the maximum desire to acquire their own home. Therefore, the acquisition of the dream house should completely satisfy the desires and desires of the residents, however, as the author points out, often the conquest of the residence is based on the price and payment conditions, leaving aspects such as quality, comfort, safety, habitability and adaptability in the background.

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Housing, in order to be efficient, must take into account the expectations and needs of the people who will enjoy the built spaces daily and, eventually, throughout their lives. However, Carli (2010, p. 131) mentions that "when designing a residential building, the physical abilities and limitations of the potential residents are not taken into account". This situation becomes even more striking in the case of inhabitants with reduced mobility or even in the event that a member of the household needs an accessible residence at some point in life. Law 13.146/2015, known as the Statute of Persons with Disabilities, defines, in Item IX, that people with reduced mobility are those who have, for any reason, "difficulty in movement, permanent or temporary, generating an effective reduction in mobility, flexibility, motor coordination or perception" (BRASIL, 2015, p. 2). Therefore, in addition to wheelchair users and people who use assistive technologies to aid mobility, this definition also includes the elderly, pregnant women, breastfeeding women, people with infants and obese people.

According to the 2010 Demographic Census carried out by the Brazilian Institute of Geography and Statistics (IBGE), about 23.9% of the Brazilian population has some type of disability and around 7% of the population says it has motor disabilities, representing more than 13 million people in the country. Also in the 2010 Census, people over 60 years of age, considered elderly by the Statute of the Elderly (BRASIL, 2003), are about 10.79% of the population of Brazil, that is, more than 20 million people. For comparison purposes, in the State of Rio Grande do Sul, the population with disabilities corresponds to 23.8%, which is very close to the national average. However, the elderly population in RS corresponds to about 13.68%, slightly above the Brazilian average. In this way, the universe of people with reduced mobility encompasses more than 58 million people in the country and around 4 million people in Rio Grande do Sul, for whom the residence needs to be even more adaptable and efficient. Closs and Schwanke (2012) confirmed the trend of population aging in Brazil, pointing out that the state of Rio Grande do Sul has the greatest acceleration in the Aging Index of the population. However, according to Carli (2010), a major challenge for the domestic environment is precisely to compensate for the limitations and promote independence in use, and the characteristics of the occupants have a profound influence and guide the project, without which the architect will probably design spaces that are not accessible.

The search for built spaces that are accessible is directly related to and encompasses the main concepts: Universal Design. According to Mace (s/a, *apud* JORDAN, 2008), Universal Design refers to the design of products and environments that can be used by all people, as far as possible, without the need for adaptation or special design. For a space to have these characteristics, seven principles of universal design are applied (JORDAN, 2008): equitable

use; flexibility in use; simple and intuitive use; clear and comprehensive information for all; tolerance to error; use without physical effort; and size of spaces suitable for approach and use. Even if accessibility is not immediately necessary, the home environment based on universal design can, as Carli (2010) corroborates, provide flexibility and the possibility of future adjustments. This condition is particularly important considering that the residence, given the costs involved, is usually acquired or built at the beginning of adulthood and economically active, housing the residents for years, including old age.

As the years advance, physical capacity usually decreases, sometimes incapacitating the elderly or severely restricting their actions. In this sense, Magalhães dos Santos Filho (2010) emphasizes that, although not all elderly people have disabilities, there is a predominance of limitations in this demographic group. Also according to the author, people's needs and capacities change as they advance from childhood to old age and vary substantially with age and, even though they are of a small nature, if combined with old age, they can represent a significant problem.

Unlike some countries, Brazilian legislation does not specifically contemplate residential buildings for private use. In this way, as Carli (2010) indicates, entrepreneurs adapt the units based on the Brazilian Standard 9050:2020 (NBR 9050), more focused on public and private spaces for public use, as well as common areas of condominiums and residential buildings and multifamily housing complexes. Although it does not apply specifically to private residential spaces, the standard has a character similar to universal design, especially because it is oriented to "provide the autonomous, independent and safe use of the environment, buildings, furniture, urban equipment and elements to the largest possible number of people, regardless of age, stature or limitation of mobility or perception" (ABNT, 2020, p.1), that is, covering a large part of the principles of universal design.

A well-planned project takes into account the technical, human and economic aspects, thus achieving the necessary efficiency and quality. A quality project foresees future situations in which adaptation can be done without extraordinary costs and with simple solutions. Corroborating, Carli (2010) points out that residential projects that can be adapted must consider the physiological, physical, sensorial and psychic changes of the users and, if it is based on universal design, the adaptation happens in a more natural and economical way, ensuring greater satisfaction and quality to the residential project.

Thus, by considering the constant increase in life expectancy and the consequent increase in the number of people with mobility restrictions, in addition to the interrelationships

between residential projects, adaptability, accessibility and universal design, the present study aims to verify whether residential projects are accessible and/or adaptable for people with reduced mobility.

2. METHOD

This research is basic in nature and in relation to the objectives it is descriptive. As for the procedures, it is documentary. Prodanov and Freitas (2013) explain that the "use of documentary research is highlighted when we can organize information that is dispersed, giving it a new importance as a source of consultation". The analysis and discussion of data is configured as a qualitative approach. Bardin (1979) points out that qualitative analysis has certain particularities, being especially valid in the elaboration of specific deductions about an event or precise variables.

The field of study was the municipality of Linha Nova, located on the slope of the Serra Gaúcha, about 80km from the capital Porto Alegre. According to IBGE estimates (2021), the municipality has 1724 inhabitants. According to data from the 2010 Census, the city has 21.12% of the population aged 60 and over, that is, almost double the national average. This higher proportion of elderly people means that 8.31% of the city's population has some motor difficulty (IBGE, 2010), directly impacting daily activities, especially in the interaction with the residential environment.

As a data source, the projects approved by the Architecture Sector of the Municipality of Linha Nova/RS, between the years 2015 and 2020, were used. Only single-family residential projects were selected, and new projects, regularization and/or regularization and expansion projects approved within the defined period were added to the sample. Expansion projects in which the original project had been approved prior to the chosen period, as well as projects changed and reapproved during the period, were excluded, in which case only the last approved version was considered. In this way, the final selection resulted in 61 projects.

The following accessibility criteria were analyzed: occurrence of unevenness in the main access of the building; occurrence of unevenness, steps and stairs internal to the building; width of internal and external doors; width of corridors or circulations; size of shower stalls; and size of the bathrooms. Due to the diversity of designs and configurations of the projects, to

ascertain the size of the bathroom, in addition to the information contained in the floor plans, two reference modules were elaborated, as shown in Figure 1.

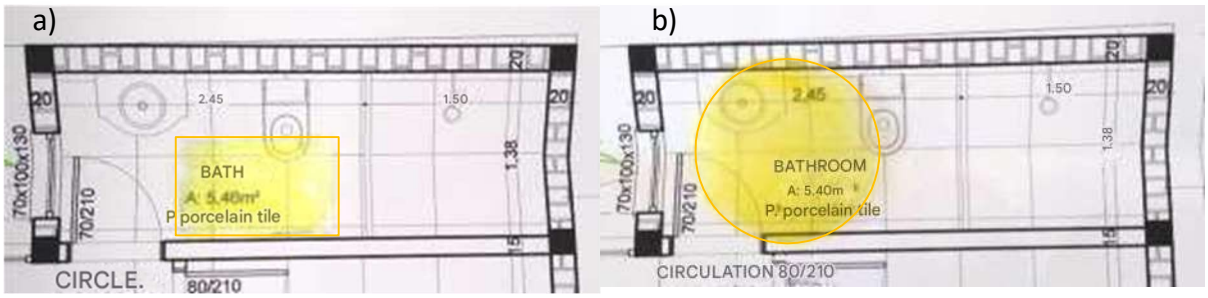


Figure 1. Modules used
80x120cm module in 1/50 scale b) Ø1.50m module in 1/50 scale
Source: The authors (2021)

It should be noted that the adoption of these modules in the analysis of the projects has as a parameter the use of wheelchairs, since this condition has implicit the most pressing needs in relation to the size of the space, although larger environments also help and favor the mobility of other people with restrictions, such as the elderly. The modules, on the same scale as the projects, were used on the floor plans to analyze the interaction with the equipment and spaces designed. They were made with the measurements recommended by NBR 9050, that is, a module of 80x120cm, the minimum parameter occupied by a wheelchair, and a module of 1.50m in diameter, the minimum parameter for the rotation of a wheelchair.

The data were evaluated and later discussed using triangulation, which allows a joint analysis under three aspects: the data collected, the researcher's perception and the theoretical argumentation. Prodanov and Freitas (2013) point out that triangulation is a "process of comparison between data from different sources in order to make the information obtained more convincing and precise" (p.129).

3. RESULTS AND DISCUSSION

Of the 61 drawings analyzed, 78.68% (48) are new projects and 21.32% (13) are regularization projects, with or without expansion of the built area. Regarding the type of construction, 67.21% (41) are houses with one floor; 27.87% (17) have two or three floors; and 4.92% (3) are residences allocated on the second floor of a mixed building, with a commercial area occupying the ground floor. In relation to the built area, 31.15% (19) has up to 100.00m²; 49.18% (30) have between 101.00m² and 200.00m²; and 19.67% (12) have more than 201.00m². Considering the construction material, 85.25% (52) of the residences are made of masonry and 14.75% (9) are mixed, with the use of masonry and wood or plasterboard. It is noteworthy that the choice of construction materials has an important weight in the future adaptability of an

environment, since they can influence the speed, cost and ease of an adaptation. Carli (2010) points out that adaptability is a quality of the environment that allows the easy rearrangement of space or equipment at some future time, enabling adaptation to new needs that arise.

The first aspect analyzed refers to the unevenness in the accesses to the buildings. Jordan (2008) suggests that the house should have at least one entrance without stairs and with flat thresholds or with very little unevenness. NBR 9050 considers that a difference of more than 20mm is considered and should be treated as a step. It was observed in the analyzed projects that only 3.28% (2) have access considered flat, allowing access to the interior of the residence for people with reduced mobility without difficulty. Most of the projects analyzed, i.e. 75.41% (46), have from 2 to 25 cm of unevenness at their main point, usually composed of a step to access the balcony and another to the interior of the building. Although it is possible to easily adapt with the construction of short ramps and with relatively low costs, a construction designed to be accessible from the beginning ends up being more economical and with the spaces being visually and functionally better. In this sense, Carli (2010) points to adaptability as the key to the quality of the project, since the initial investment is derisory, and it is only necessary to foresee future adaptations, avoiding additional expenses with eventual repairs. Corroborating, Magalhães (2010) comments that universal design has proven to be a factor of economy compared to conventional solutions of adaptations and removal of barriers.

Regarding the internal unevenness in the buildings analyzed, it was found that 35 (57.58%) of the 61 projects do not have any type of unevenness, usually composed of steps connecting environments, thus facilitating the movement between rooms and dispensing with future adaptation. On the other hand, it is verified that only 16.40% (10) of the buildings have some type of internal unevenness, which makes an eventual adaptation more difficult. Regarding the internal stairs, present in 16 (26.22%) projects, Jordan (2008) recommends that they have deeper and lower steps, with handrails on both sides and, if possible, an elevator or space for future placement of one. NBR 9050 stipulates the minimum measurements for the design of stairs in its item 6.8.2, where the floor (step width) must vary from 28 to 32cm and the mirror (step height) from 16 to 18cm (ABNT, 2020).

The third aspect verified refers to the width of the doors, an essential factor to enable the full and satisfactory use of the spaces. The Brazilian Standard recommends that "doors, when opened, must have a free span, greater than or equal to 0.80m wide and 2.10m high" (ABNT, 2020, p. 70). Even in sliding and folding doors, a minimum span of 80cm must be guaranteed, with a variation of up to 20mm being allowed, that is, eventually the door can have a minimum of 78cm of free span.

It was found that only 14 projects, that is, 22.95%, have all the doors in compliance with the Standard, that is, allowing comfortable access for the person who needs the use of a wheelchair or other assistive mobility technology. It is verified that most of the projects have a forecast of 80cm doors in internal compartments, such as bedrooms, and 90cm or more in the main accesses, however, they provide for 70cm or even 60cm in the bathrooms, all measures provided for in the city's Construction Code (LINHA NOVA, 2013). A more complete analysis of the doors in the bathrooms will be made later, in the subtitle dedicated to these spaces.

As a fourth item, circulation was analyzed, which is directly linked to the usability of the spaces, just as the width of the doors is directly linked to the access to the rooms. Jordan (2008) recommends a free space of at least 1.50 m in diameter for circulation in the environments, enabling, for example, the maneuvering and complete rotation without obstacles of a wheelchair. In this sense, NBR 9050 also adopts the diameter of 1.50m as a standard for rotation and maneuvering of a wheelchair (ABNT, 2020). Regarding corridors, the Standard establishes a minimum width of 90cm when there is only movement in a straight line, without the need for turning, and 1.20m when there is a 90º displacement and rotation of a wheelchair or use of two crutches. For people who need wheeled or rigid walkers or canes, the Standard indicates between 75 and 90cm (ABNT, 2020). Thus, among the corridors, in this study considered as the spaces referred to in the projects as "circulation", 82.05% (64 out of 78) have a width between 1.00 and 1.20 m, thus making it impossible for wheelchair users or crutches to use them safely, although they allow the use by people who need other assistive mobility technologies, such as walkers and canes. It is noteworthy that these spaces serve as a transition and access area to the other rooms of the residences, especially bedrooms and bathrooms, and it is common to need a 90º turn to access them, as shown in the example that can be seen in Figure 2.

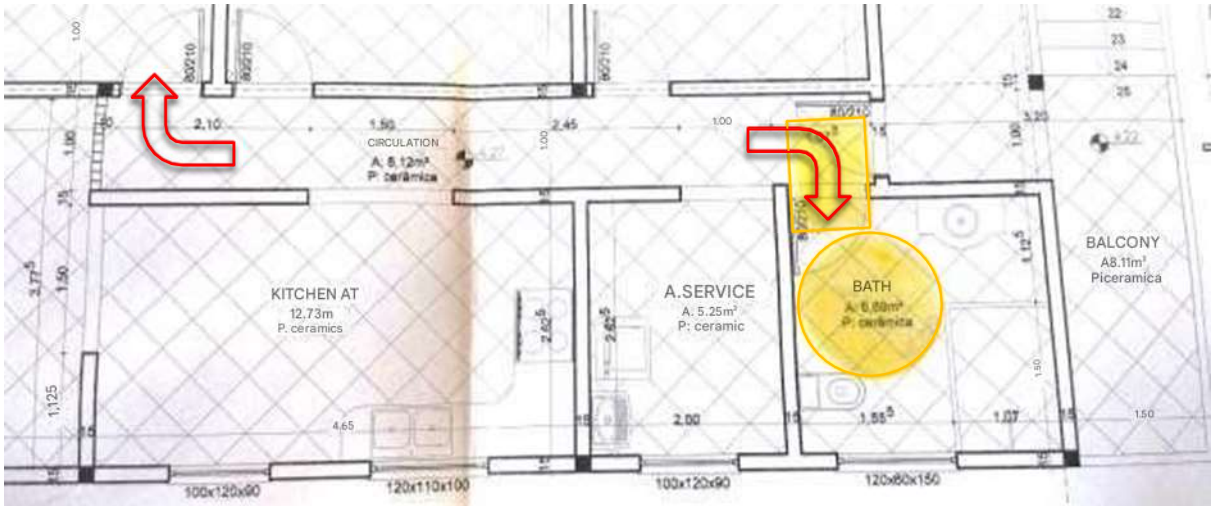


Figure 2. Circulation as an access area to the other rooms. 150.10m² project

Source: The authors (2021)

It should be noted that the frequent occurrence of measurements between 1.00 and 1.20m in these spaces is probably due to Municipal Law No. 680/2013, known as the Building Code, which in article 148 determines the minimum width of 1.00m for corridors in single-family homes (LINHA NOVA, 2013). This law is used by architecture and engineering professionals to guide the minimum requirements for project approval in the municipality. This occurs due to the saving of material and labor so as not to burden the construction. According to Carli (2010), there is a prejudice in the real estate market that units built to be affordable have a larger built area and are more expensive, therefore, considered unviable as an investment. The same author also advocates for the adoption of universal design precisely because of the savings in future adaptations that may be necessary and Castro (2013) observes that investing in accessibility is synonymous with cost reduction, since building a property prioritizing accessibility increases the value of the work by an average of 1.5%, unlike the cost of a later adaptation, which can reach 25% of the value of the building.

3.1. Bathrooms: the biggest problem

The bathroom is one of the main residential spaces in which usability and functionality are essential for user satisfaction. For Logsdon et al. (2019), functionality is a principle related to the quality of space, regardless of the construction system adopted, inserted in the project to improve housing. Of the residential projects analyzed, 30 (49.18%) have only one bathroom; 18 (29.50%) have two; and 13 (21.30%) have three or more.

It is observed that only two bathrooms are in accordance with the modules used in the analysis, allowing a 360º rotation with a wheelchair and use of the equipment in a comfortable way. It should be noted that this analysis considered the ideal situation of doors opening outwards in all compartments, since, according to the survey, only one toilet has the door opening outwards and, therefore, not conflicting with the use of spaces.

It is verified that 45.29% (48) of the sanitary compartments have a diameter equal to or greater than the minimum required by the Standard (Ø1.50m). However, it is found that, even within the minimum measurements, the spaces do not allow the safe and comfortable use of the equipment. Another five bathrooms allow entry and 180º rotation and four allow a 90º rotation inside. It is observed that 63.21% (67) of the toilets do not allow access, either through the narrow door, or through the internal circulation environment of less than 80cm, the minimum width of the module used. Finally, 28 bathrooms were found in which the wheelchair user has

the possibility to enter in a straight line, either forward or backward, use the equipment and then exit again in a straight line, but without the possibility of turning inside the compartment. This situation is illustrated in Figure 3.

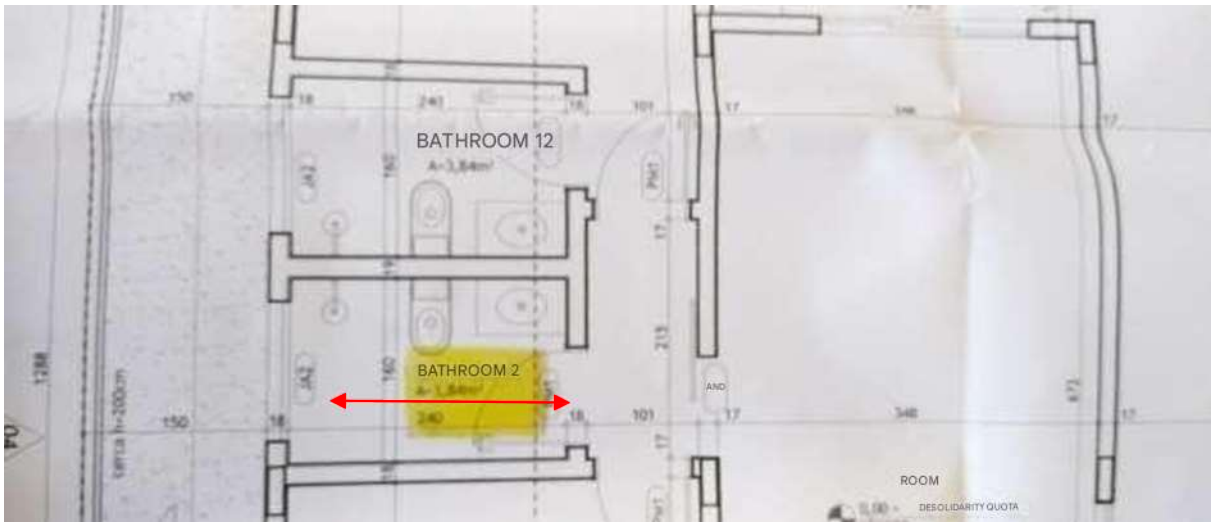


Figure 3. Bathroom 1.60m wide with no possibility of turning
Source: The authors (2021)

It is important to highlight that the Construction Code of the city of Linha Nova, Law 680/2013, in its article 158, provides for the minimum measurements for the dimensioning of the "sanitary compartments", requiring a circulation of at least 60cm in diameter next to the equipment and a shower box of 80x80cm in minimum measurement (LINHA NOVA, 2013). This situation conflicts with what is recommended by NBR 9050, which proposes minimum measurements of 90x95cm for the box, thus allowing the placement of an articulated or removable seat and support bars (ABNT, 2020). A situation closer to that idealized by the Standard for shower stalls was found in 72.73% (72) of the toilets analyzed, in which the measures are higher than the minimum proposed and, therefore, contributing positively to an eventual adaptation. In a study on adaptations made by wheelchair users in their homes, Albers, Barth, and Renner (2020) found that the bathroom is among the rooms with the greatest need for adaptation. According to the authors, adjustments were made such as lowering the height of the shower, removing the glass or acrylic shower and putting a curtain. These adjustments can be minimized if the building is already built in an accessible way. Jordan (2010), for example, suggests small interventions, such as the use of a rubber rail fixed to the floor of the shower as a simple adaptation to be made, as it is flexible, preventing water from escaping and also allows the passage of a shower chair. It should be noted that this simplicity in adaptation is only possible if the building has preconditions for it.

Also noteworthy in the scope of this study is the recurrent adoption of a design typology for bathrooms, found in 87 (87.87%) of the 99 environments analyzed. It is a rectangular space with the arrangement of the equipment on one side and the circulation and use taking place in front of them, as shown in Figure 4.

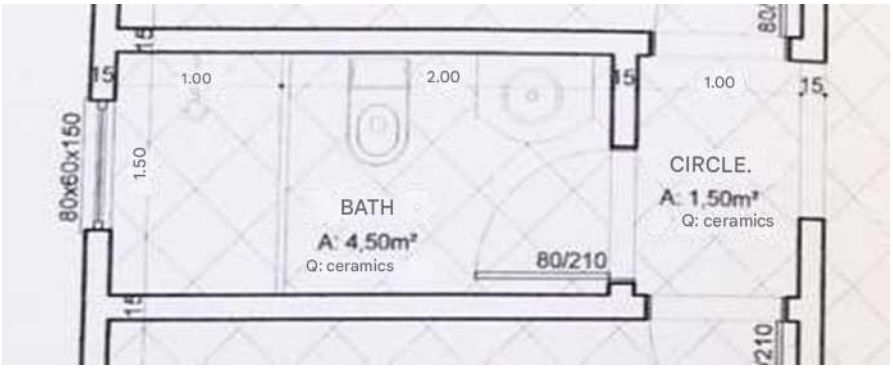
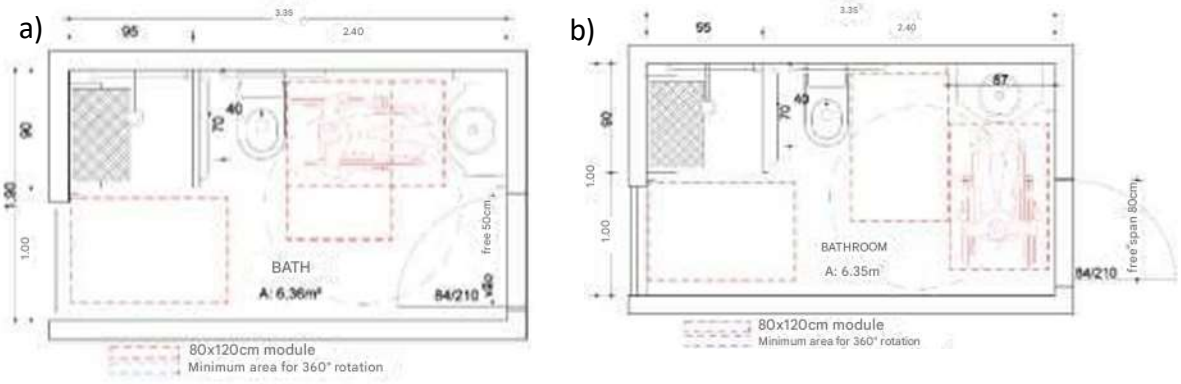


Figure 4. Bathroom design typology
Source: The authors (2021)

Considering this design model, the ideal cross-sectional measurement to allow at least the 180º rotation (Ø 1.20m) of a wheelchair should be around 1.90m, considering 70cm of space for the implementation of the equipment. Regarding the longitudinal measurement, regardless of whether the door opens inwards or outwards, the measurement would be around 3.35m. In these minimum measures, the 360º turning area within the environment would be guaranteed, generating the possibility of access to the equipment and its use in an efficient and safe way. Figure 5 presents two simulations of floor plans using the measurements idealized by the authors for this typology, considering the criteria of NBR 9050:2020.

Figure 5. Idealized measurements for bathroom typology



a) Bathroom with the door inside; b) Bathroom with door out
Source: The authors (2021)

It should be noted that this project typology does not find an equivalent in the images used as examples in the Standard, but only approximates what is proposed in NBR 9050 in item 10.9, which refers to lodging locations, as can be seen in Figure 6. However, it is possible to observe in the image that the arrangement of the equipment is different from the typology commonly observed in the single-family homes analyzed in this study, which has the shower on the opposite side of the entrance door, making it difficult to reach the shower, which is only possible by passing through the other equipment, such as the washbasin and toilet.

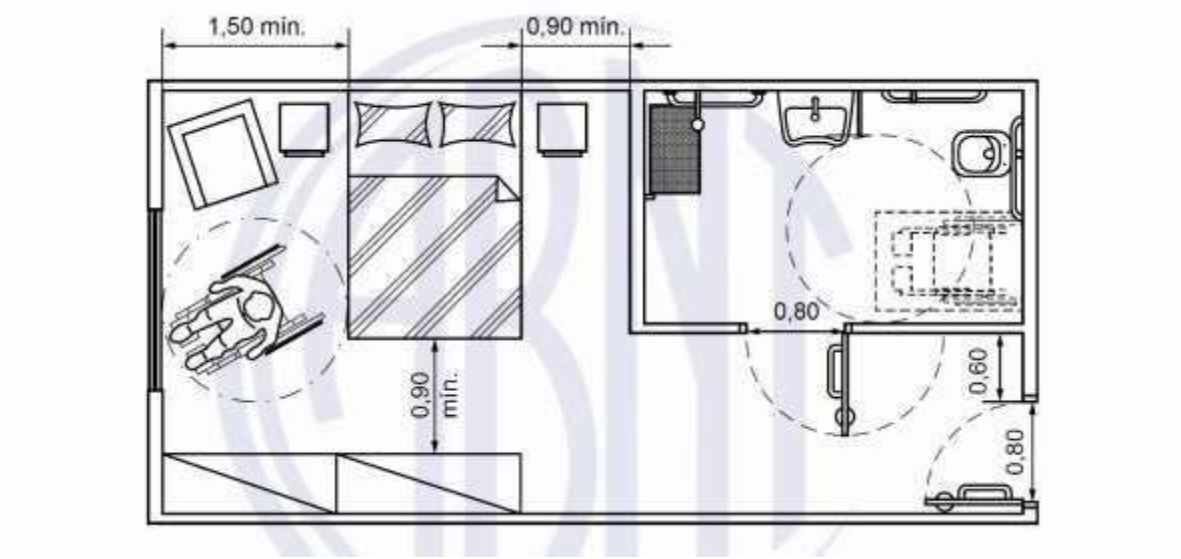


Figure 6. NBR 9050:2020 – Accessible dormitory
Source: ABNT (2020, p.129)

Leite (2016) in his study on public bathrooms – which are indeed required to follow the NBR – points out that "not only do the barriers remain, but the legislation itself is not always complied with and even faces impediments to impose itself" (p. 140). It is undeniable, according to the author, that laws and standards helped in the implementation of adjustments that made public places partially accessible. However, it is evident that this same accessibility, even if partial, was not found in the vast majority of the residential projects in this study.

A total of 45 projects (73.77%) were found in which at least one bathroom in the residence has a door smaller than 80cm, usually in the case of toilets and suite toilets. It was also found that 38 projects (62.30%) have access to all bathrooms in the residence with a width of less than 80cm. In some cases, as in the project presented in Figure 7, the only toilet in the residence has a 60cm wide door. In this way, in case of future adaptation, a more extensive

work will be necessary with higher costs, however, still without ensuring the comfortable and safe use of the spaces.

Figure 7. Door with 60cm width in a project of 51.18m²
Source: The authors (2021)

It is noteworthy that the residence used as an example in Figure 7 has only 51.18m², with two bedrooms, living, bath and kitchen, qualifying as "popular housing" according to article 177 of the Building Code, obeying different requirements in relation to the size of the spaces (LINHA NOVA, 2013). These differentiations seek to enable a greater democratization of housing, however, the miniaturization of spaces directly impacts their quality. Palermo et al. (2007) point out that cost reduction can facilitate the acquisition of housing by people with lower incomes, however, this occurs through a strategy of reducing dimensions and quality and excessive standardization. The authors also point out that the environmental conditions of the site of implementation are ignored, in addition to the characteristics and needs of the residents. On the other hand, Carli (2010) points out that it is feasible to create affordable housing even in minimum units of 25m², eliminating the prejudice that affordable units are large and expensive.

Another important point highlighted by NBR 9050 (ABNT, 2020) refers to the direction of opening the doors, especially in the toilets. In its item 7.5, the standard specifies that vertical axis doors must open to the outside of the toilet, facilitating access and internal circulation for people in wheelchairs. In this regard, 99 (93.40%) bathrooms were found with doors with vertical axis and opening into the rooms, making access and use of these difficult, since the space for opening the door overlaps the space necessary for circulation and use of the equipment. Six (5.66%) bathrooms or toilets with sliding doors and only one (0.94%) toilet with a vertical axis door and opening out of the environment were also found. Analyzing the floor plans and simulating an adaptation, it is verified that 58 of the 99 doors with a vertical axis start to open outwards in a circulation of less than 1.20m, that is, the space adjacent to the bathroom does not allow the rotation of a wheelchair, making a probable adaptation work even more expensive. In an ideal situation, contrary to the one mentioned above, there are only five bathrooms. The other 36 doors, with the adaptation, now open to different spaces, such as

bedrooms, garages, balconies, living rooms, etc., giving rise to specific usability situations on a case-by-case basis.

Although NBR 9050 in its 2020 version has incorporated a specific annex with the seven principles of universal design, there is still a long way to go for the real incorporation of this philosophy into everyday design. As corroborated by Leite (2016), by eliminating the conceptual barrier in relation to universal design, it will be possible to produce more inclusive and suitable environments for all in an unrestricted way.

4. FINAL CONSIDERATIONS

This study sought to verify to what extent residential projects are accessible and/or adaptable for people with reduced mobility. It is observed that the spaces analyzed have similar typologies and measures, perhaps induced by local legislation, market and culture. The legislation defines the minimum spaces and design measures and the real estate market and culture impose a construction based on economy, a situation aggravated by the economic situation that induces families to resort to expensive and long financing. Although almost 50% of the residences have between 101 and 200m², there is a miniaturization in the area of important spaces, such as bathrooms and in the circulations that allow access to the rooms. They are spaces with a smaller area compared to the whole, but important and of recurrent use in the daily life of the residence and should not be neglected.

Although many residences have small dimensions, it is added that a good furniture design or changes in the arrangement of equipment, in addition to simple adaptations in circulations and doors, taking into account the specific needs of the residents, can contribute to the residence becoming functional and reasonably adapted.

According to the data found, a probable or inevitable future adaptation tends to be costly and time-consuming in most households. Even more recent projects have presented problems, mainly related to the dictates of the legislation, which induces the professional to adopt pre-established measures in search of economy, usually requested by the client in search of his long-awaited home.

Although NBR 9050 has been in force since 1985, it is clear that its implementation, as well as the adoption of the Universal Design guidelines, is far from common sense among professionals and in the respective projects. It can be seen, in a similar way, that municipal legislation does not dialogue with the NBR and allows projects to be approved that leave spaces tiny and unusable, therefore not suitable for the needs of people with reduced mobility.

Much has been said about the elimination of obstacles in cities, in public areas, such as squares, sidewalks and buildings, but little has been said about accessibility within homes and their adaptability to the needs of residents, especially the elderly and people with disabilities. 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.

Working on the concepts of universal design, accessibility and adaptability in homes with the population can change the perspective of real estate professionals and developers, aiming to reconcile the interests of the market and consumers. Building in a way that allows for quick and economical adaptation means sustainability, since the same house can be used for generations and still be dynamic, comfortable and safe.

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