



## “HOME, SWEET HOME”: DO RESIDENTIAL PROJECTS PROVIDE ACCESSIBILITY FOR PEOPLE WITH REDUCED MOBILITY?

Christian Albers<sup>1</sup>  
Michele Barth<sup>2</sup>  
Jacinta Sidegum Renner<sup>3</sup>

**SUMMARY:** In Brazil, housing is a social right and the dream of owning a home creates expectations and desires. Housing, to be efficient, must take into account the needs of the people who will use the built spaces daily 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 it is descriptive. Data analysis and discussion is configured as a qualitative approach. As a source of data, 61 projects approved by the Architecture Sector of the Municipality of Linha Nova/RS, between 2015 and 2020, were analyzed. According to the data found, a likely or inevitable future adaptation will be costly and time-consuming in most homes. , since 75.41% have unevenness in the main access; 62.30% have bathrooms with doors smaller than 80cm; 93.40% have toilets with the door opening into the space; 82.05% have corridors that do not allow wheelchair rotation 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 interact 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.

### INTRODUCTION

In Brazil, owning a home has an important dreamlike character, in addition to being a constitutionally guaranteed right. Carli (2010) comments that this vision of a social instrument and law creates an expectation that accompanies the individual throughout their life, with a large part of the population having the ultimate desire to acquire their own home. Therefore, the acquisition of a dream home should completely satisfy the desires and desires of residents, however, as the author points out, often the acquisition of a residence is based on price and

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<sup>1</sup> Universidade Feevale, [calbers@feevale.br](mailto:calbers@feevale.br)

<sup>2</sup> Universidade Feevale, [mibarth@feevale.br](mailto:mibarth@feevale.br)

<sup>3</sup> Universidade Feevale, [jacinta@feevale.br](mailto:jacinta@feevale.br)

payment conditions, leaving aspects such as quality, comfort, safety, habitability and adaptability in the background.

Housing, to be efficient, must take into account the expectations and needs of the people who will use the built spaces daily and, eventually, for their entire lives. However, Carli (2010, p. 131) mentions that “when designing a residential building, the physical abilities and limitations of potential residents are not taken into account”. This situation becomes even more pressing in the case of inhabitants with reduced mobility or in the event that a member of the household needs an accessible residence at some point in their life. Law no. , motor coordination or perception” (BRASIL, 2015, p. 2). Therefore, this definition includes, in addition to wheelchair users and people who use assistive technologies to aid mobility, also elderly people, 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), around 23.9% of the Brazilian population has some type of disability and around 7% of the population is said to have motor disabilities, representing more than 13 million people in the country. Still in the 2010 Census, people over 60 years of age, considered elderly by the Elderly Statute (BRASIL, 2003), make up around 10.79% of Brazil's population, 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%, very close to the national average. However, the elderly population in RS corresponds to around 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 population aging trend in Brazil, highlighting that the state of Rio Grande do Sul has the greatest acceleration in the population's Aging Index. However, according to Carli (2010), a major challenge for the domestic environment is precisely to compensate for limitations and promote independence in use, given that the characteristics of the occupants have a profound influence and guide the project, without which the architect will probably design non-accessible spaces.

The search for built spaces that are accessible is directly related to and encompasses the concept of 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 universal design principles apply (JORDAN, 2008): equitable use; flexibility in use; simple and intuitive use; clear and comprehensive information for everyone; fault tolerance; use without physical effort; and size of spaces suitable for approach and use. Even if accessibility is not immediately necessary, a domestic 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 normally acquired or built at the beginning of adulthood and economically active, sheltering residents for years, including in old age.

As we get older, physical capacity usually decreases, sometimes disabling 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. Still according to the author, people's needs and capabilities change as they progress from childhood to old age and vary substantially according to age and, even though they are small in 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, developers adapt the units based on the Brazilian Standard 9050:2020 (NBR 9050), more focused on public and

private spaces for public use, in addition to common areas of condominiums and residential buildings and multi-family housing complexes. Although it does not apply specifically to private residential spaces, the standard has a similar character to universal design, especially as it is oriented to “provide the autonomous, independent and safe use of the environment, buildings, furniture, urban equipment and elements to the greatest extent possible for people, regardless of age, height 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 technical, human and economic aspects, thus achieving the necessary efficiency and quality. A quality project foresees future situations in which adaptation can be made without extraordinary costs and with simple solutions. Corroborating, Carli (2010) highlights that possible adaptation residential projects must consider the physiological, physical, sensory and psychic changes of users and, if based on universal design, adaptation happens in a more natural and economical way, ensuring greater satisfaction and quality to the residential project.

Therefore, when 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 the residential projects are accessible and/or adaptable for people with reduced mobility.

## **METHOD**

This research is basic in nature and in relation to its objectives it is descriptive. As for the procedures, it is documentary. Prodanov and Freitas (2013) explain that the “use of documentary research is highlighted at the moment when we can organize information that is dispersed, giving it new importance as a source of consultation”. Data analysis and discussion 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 slopes of Serra Gaúcha, about 80km from the capital Porto Alegre. According to an estimate by IBGE (2021), the municipality has 1724 inhabitants. According to data from the 2010 Census, the city has 21.12% of the population aged 60 or 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 interaction with the residential environment.

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

The following accessibility criteria were analyzed: occurrence of unevenness in the main access to 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 boxes; and size of bathrooms. Due to the diversity of designs and project configurations, to determine the size of the bathroom, in addition to the information contained in the floor plans, two reference modules were created as shown in Figure 1.

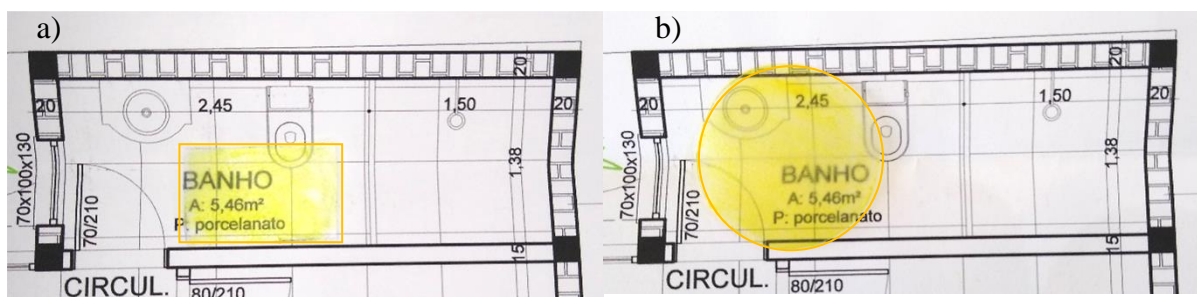


Figure 1. Modules used  
 a) 80x120cm module in 1/50 scale b) Ø1.50m module in 1/50 scale  
 Source: The authors (2021)

It should be noted that the adoption of these modules in the analysis of projects has as a parameter the use of a wheelchair, as this condition implies 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 designed spaces. 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 turning a wheelchair.

The data were evaluated and subsequently discussed using triangulation, which allows a joint analysis under three aspects: the data collected, the researcher's perception and theoretical argumentation. Prodanov and Freitas (2013) emphasize that triangulation is a “process of comparing data from different sources with the aim of making the information obtained more convincing and precise” (p.129).

## RESULTS AND DISCUSSION

Of the 61 designs analyzed, 78.68% (48) are new projects and 21.32% (13) are regularization projects, with or without expanding the built area. In relation to 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 located 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 100.00m<sup>2</sup>; 49.18% (30) have between 101.00m<sup>2</sup> and 200.00m<sup>2</sup>; and 19.67% (12) have more than 201.00m<sup>2</sup>. Considering the construction material, 85.25% (52) of the residences are made of masonry and 14.75% (9) are mixed, using masonry and wood or plasterboard. It should be noted that the choice of construction materials has an important impact on the future adaptability of an environment, as they can influence the speed, cost and ease of adaptation. Carli (2010) highlights that adaptability is a quality of the environment that allows the easy rearrangement of space or equipment at some point in the future, enabling adaptation to new needs that arise.

The first aspect analyzed refers to the differences in level at the entrances to the buildings. Jordan (2008) suggests that the house has at least one entrance without stairs and with flat thresholds or very little unevenness. NBR 9050 considers that a difference in level of more than 20mm is considered and must be treated as a step. It was observed in the projects analyzed that only 3.28% (2) have access considered flat, allowing access for people with reduced mobility without difficulty to the interior of the residence. Most of the projects analyzed, that is, 75.41% (46), have a difference of 2 to 25 cm in level at their main point, normally consisting of a step to access the balcony and another to the interior of the building. Although easy adaptation is possible with the construction of short ramps at 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 negligible, and it is only necessary to predict future adaptations, avoiding additional expenses with possible repairs. Corroborating, Magalhães (2010) comments that universal design has proven to be a saving factor compared to conventional adaptation and barrier removal solutions.

Regarding internal differences in levels in the buildings analyzed, it was found that 35 (57.58%) of the 61 projects do not have any type of difference in level, normally consisting of steps connecting rooms, thus facilitating movement between rooms and eliminating future adaptation. On the other hand, it appears that only 16.40% (10) of the buildings have some type of internal unevenness, which makes eventual adaptation more difficult. In relation to internal stairs, present in 16 (26.22%) projects, Jordan (2008) recommends that they have deeper and less high steps, with handrails on both sides and, if possible, an elevator or space for future placement of stairs. one. NBR 9050 stipulates the minimum measurements for sizing stairs in its item 6.8.2, where the floor (step width) must vary from 28 to 32cm and the riser (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 spaces. The Brazilian Standard recommends that “doors, when opened, must have a free space, greater than or equal to 0.80 m wide and 2.10 m high” (ABNT, 2020, p. 70). Even in sliding and accordion doors, a minimum clearance of 80cm must be guaranteed, with a variation of up to 20mm less being permitted, that is, eventually the door may have a minimum clearance of 78cm.

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

As a fourth item, circulation was analyzed, which is directly linked to the usability of spaces, just as the width of doors is directly linked to access to rooms. Jordan (2008) recommends a free space of at least 1.50m in circulation diameter in environments, enabling, for example, the maneuver and complete turn of a wheelchair without obstacles. In this sense, NBR 9050 also adopts a diameter of 1.50m as the standard for rotation and maneuvering of a wheelchair (ABNT, 2020). In relation to 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 movement and rotation of 90° in a wheelchair or the use of two crutches. For people who need walkers with wheels or rigid or canes, the Standard indicates between 75 and 90cm (ABNT, 2020). Thus, among the corridors, considered in this study as spaces referred to in the projects as “circulation”, 82.05% (64 of 78) have a width between 1.00 and 1.20m, therefore, making safe use by wheelchair users impossible. using wheels or crutches, despite allowing use by people who require 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, mainly bedrooms and bathrooms, and it is common to need to turn 90° to access them, as per the example that can be seen in Figure 2.



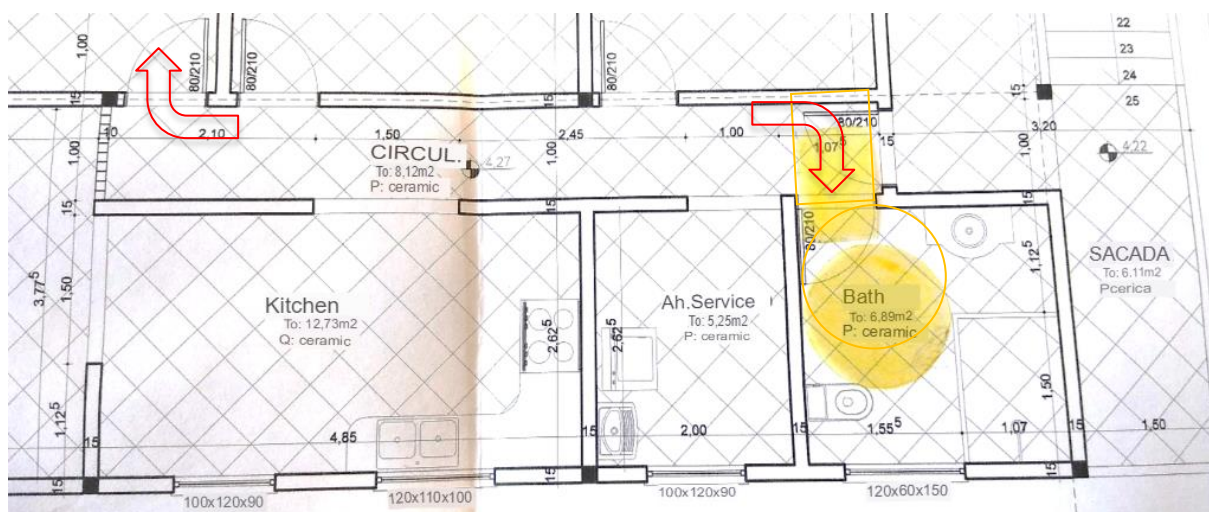


Figure 2. Circulation as an access area to other rooms. 150.10m<sup>2</sup> project  
Source: The authors (2021)

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 n° 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 approval of projects in the municipality. This occurs due to savings in material and labor so as not to burden construction. According to Carli (2010), there is a prejudice in the real estate market that units built to be accessible have a larger built area and are more expensive, therefore, considered unviable as an investment. The same author also advocates 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 on average by 1.5%, unlike the cost of a subsequent adaptation, which can reach 25% of the value of the building.

### **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 the 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 360° turn with a wheelchair and comfortable use of the equipment. 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 bathroom has a door opening outwards and, therefore, not conflicting with the use of the spaces.

It can be seen 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 appears that, even within the minimum dimensions, the spaces do not allow for the safe and comfortable use of the equipment. Another five bathrooms allow entry and rotation of 180° and four allow for a 90° 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 space of less than 80cm, the minimum width of the module used. Finally, 28 bathrooms were found in which the wheelchair user has the possibility of entering in a straight line, whether forward or backward, using the equipment and then exiting again in a straight line, however, without the possibility of rotating inside the compartment. This situation is illustrated in Figure 3.

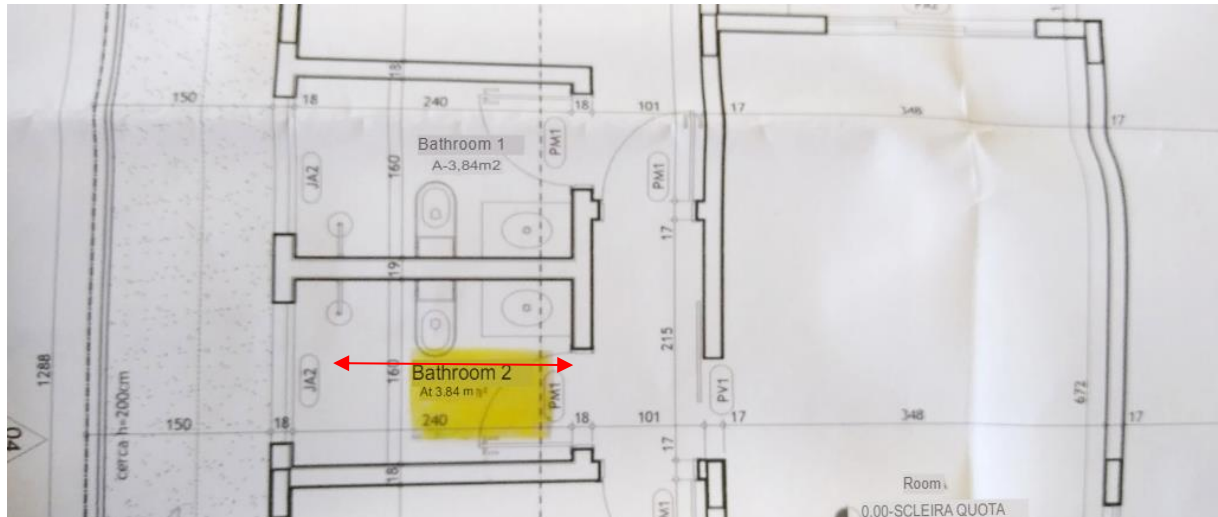


Figure 3. Bathroom 1.60m wide with no possibility of turning  
Source: The authors (2021)

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 measures for the dimensioning of “sanitary compartments”, requiring a circulation of at least 60cm in diameter near the equipment and a minimum size 80x80cm shower box (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 bench and support bars (ABNT, 2020). A situation closer to that idealized by the Standard for shower boxes 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 a possible adaptation. In a study on adaptations carried out 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 reducing the height of the shower, removing the glass or acrylic shower stall and installing 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 shower floor as a simple adaptation to be made, as it is flexible, preventing water from escaping and also allowing the passage of a chair bath. It should be noted that this simplicity in adaptation is only possible if the building has the prerequisites for it.

Also noteworthy, within 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 equipment arranged on one side and circulation and use taking place in front of it, as shown in Figure 4.

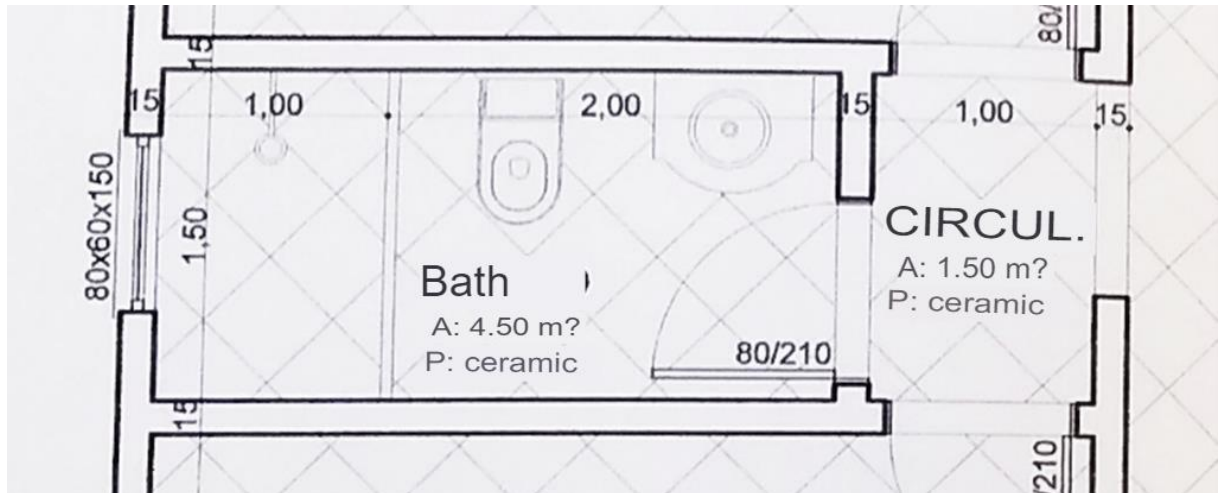


Figure 4. Bathroom design typology  
Source: The authors (2021)

Considering this project model, the ideal transversal measurement to allow at least a 180° turn ( $\varnothing$  1.20m) of a wheelchair should be around 1.90m, considering 70cm of space for installing 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, a 360° rotation area would be guaranteed within the environment, generating the possibility of access to equipment and its use in an efficient and safe way. In Figure 5, two simulations of floor plans are presented using the measurements idealized by the authors for this typology, considering the criteria of NBR 9050:2020.

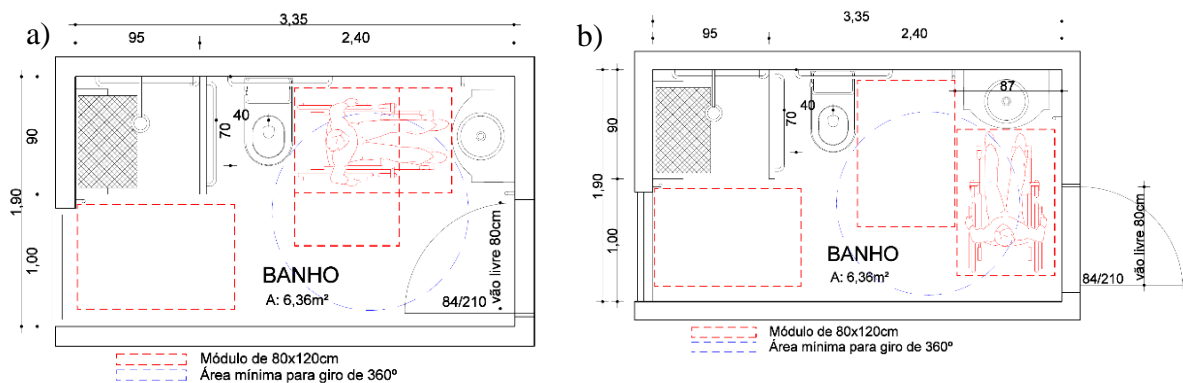


Figure 5. Idealized measurements for bathroom typology  
a) Bathroom with the door facing inside; b) Bathroom with door to the outside  
Source: The authors (2021)

It should be noted that this design typology does not find an equivalent in the images used as examples in the Standard and, yes, only comes close to what is proposed in NBR 9050 in item 10.9, which refers to accommodation 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 stall on the opposite side of the entrance door, making it difficult to reach the shower, which is only possible by passing through it. for other equipment, such as the washbasin and toilet.



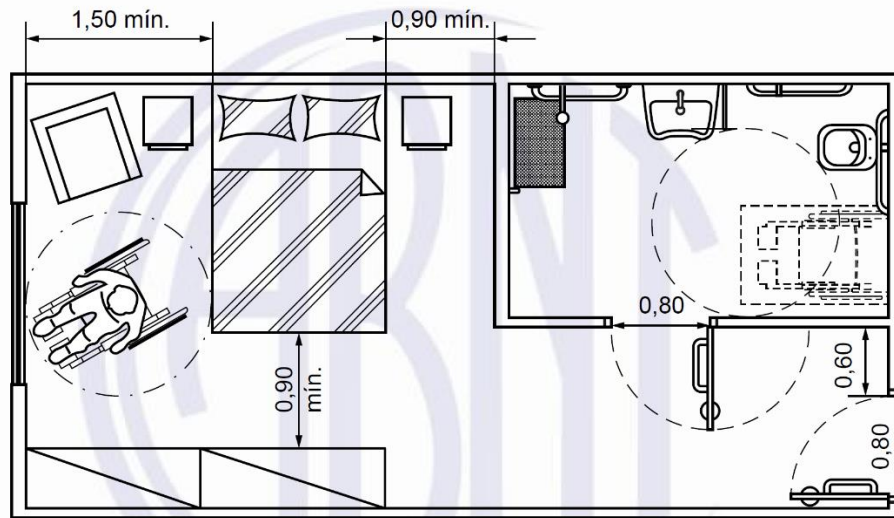


Figure 6. NBR 9050:2020 – Accessible dormitory  
Source: ABNT (2020, p.129)

Leite (2016), in his study on public bathrooms – which are obliged to follow the NBR – points out that “not only do the barriers persist, but the legislation itself is not always complied with and even faces impediments to its imposition” (p. 140). It is undeniable, according to the author, that laws and regulations helped to implement adjustments that made public places partially accessible. However, it is clear that this same accessibility, even if partial, was not found in the vast majority of residential projects in this study.

45 projects (73.77%) were found in which at least one bathroom in the residence has a door smaller than 80cm, normally being the case of bathrooms and en-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 bathroom in the residence has a door 60cm wide. Therefore, in the case of future adaptation, more extensive work will be necessary and at higher costs, however, this will still not guarantee the comfortable and safe use of the spaces.



Figure 7. 60cm wide door in a 51.18m<sup>2</sup> project  
Source: The authors (2021)

It is noteworthy that the residence used as an example in Figure 7 has only 51.18m<sup>2</sup>, with two bedrooms, living room, bathroom and kitchen, qualifying as “popular housing” according to article 177 of the Building Code, complying with different requirements in relation to the size of spaces (LINHA NOVA, 2013). These differentiations seek to enable 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 implementation site are ignored, in addition to the characteristics and needs of the residents. On the other hand, Carli (2010) highlights that it is viable to create affordable housing even in units of at least 25m<sup>2</sup>, eliminating the prejudice that accessible units are large and expensive.

Another important point highlighted by NBR 9050 (ABNT, 2020) refers to the direction in which doors open, especially in bathrooms. In 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 a vertical axis and opening into the rooms, making access and use of these difficult, since the opening space of the door overlaps with the space necessary for circulation and use of equipment. Six (5.66%) bathrooms or washrooms with sliding doors and only one (0.94%) washroom with a vertical axis door opening outside the room were also found. Analyzing the floor plans and simulating an adaptation, it can be seen that 58 of the 99 doors with a vertical axis start to open outwards in a circulation area of less than 1.20m, that is, the space adjacent to the bathroom does not allow turning of a wheelchair, likely making adaptation work even more expensive. In an ideal situation, contrary to what was mentioned previously, there are only five bathrooms. The remaining 36 doors, with the adaptation, now open to different spaces, such as bedrooms, garages, balconies, living rooms, etc., creating 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 before the real incorporation of this philosophy into everyday design. As Leite (2016) corroborates, by eliminating the conceptual barrier in relation to universal design, it will be possible to produce more inclusive and suitable environments for everyone in an unrestricted way.

## **FINAL CONSIDERATIONS**

This study sought to verify the extent to which residential projects are accessible and/or adaptable for people with reduced mobility. It is observed that the spaces analyzed have similar typologies and measurements, perhaps induced by local legislation, market and culture. Legislation defines the minimum design spaces and measures and the real estate market and culture impose construction based on economics, a situation worsened by the economic situation that induces families to resort to expensive and long financing. Although almost 50% of homes are between 101 and 200 m<sup>2</sup>, miniaturization can be seen in the area of important spaces, such as bathrooms and circulation areas that allow access to rooms. These are spaces with a smaller area compared to the whole, but they are important and frequently used in the daily life of the residence and should not be neglected.

Although many residences have reduced dimensions, it is worth adding that a good furniture design or changes in the arrangement of equipment, in addition to simple adaptations to circulation areas and doors, taking into account the specific needs of residents, can contribute to making the residence make it functional and reasonably adapted.

According to the data found, a probable or inevitable future adaptation tends to be costly and time-consuming in most homes. Even more recent projects have presented problems, mainly linked to the dictates of legislation, which induces the professional to adopt pre-established measures in search of economy, normally requested by the client looking for their dream home.

Although NBR 9050 has been in force since 1985, it is clear that its implementation, as well as the adoption of Universal Design guidelines, is far from common sense among professionals and in their 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 eliminating 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 this public the opportunity to live in an adapted and designed space, respecting their limitations, is giving these people the opportunity to develop their potential, beyond the limits imposed by the body, creating quality of life and belonging to the place in which they live.

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

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