

# Universal Design Criteria in Standards and Codes About Accessibility of Built Environments in Brazil

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**Abstract.** This paper includes some criticism in analysis of the development and implementation of the national standards for accessibility of the built environment in Brazil, i.e., the NBR9050. Currently, the 2015 version of it resembles an encyclopaedia including a variety of exotic contributions gathered historically from different sources; however, that characteristic makes it work like a puzzle that keeps alive prejudices about users' needs and disabilities. Besides, there are conflicts between recommended ideas and previous requirements from older versions. The definition of Universal Design has been published since 2004, but there is still no indication of how to make the principles work in practice. Therefore, it is very hard for city officials to assess quality of environments, and professionals have serious constraints to explore their skills further while addressing users' diversified needs. Certainly, the current NBR9050 requires further editorial work. Nevertheless, an important decision is necessary: it is important to organize information so that readers may identify in each topic whether Universal Design application can be achieved or whether the proposed technical solution may lead to construction of limited spatial adaptation and reach only some poor accommodation of users with uncommon needs. Presenting some examples in context of socially inclusive environments, the newer revised version of NBR9050 is necessary to explain about pitfalls of bad design of accessibility for discriminated disabled users. Readers should be able to establish conceptual links between the best ideas so that Universal Design could be easily understood.

**Keywords.** Universal Design, accessibility features, revision, technical standards

## 1. Introduction

Universal Design practice in Brazil has been developed by enforcement of legal requirements and standards for accessibility in urban settings and building environments for public or collective use. Here is an analysis of the historical perspective in which design for accessibility has been defined. It links the slow development of knowledge in the field to the political advances that consider mainstreaming the rights of people of disabilities among other minority social groups. It reveals certain problems associated to development of standards criteria and it acknowledges the need for substantial changes in organization of data related to distinct users' experiences.

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The core message is that Universal Design concept is already embedded in the content of the technical standards, but its practice requires clear and straight forward information that shows the best examples of technical solutions for user satisfaction and full social participation within the structure of urban settings and wheelchair accessible buildings.

In fact, some features of so-called accessibility standards may be effective according to the context of environments for public use, while other features keep the old prevailing notions of prejudice about the needs and environmental competence of people with disabilities [1]. Nevertheless, some cases demonstrate that the formal requirements of standards sustain poor ideas about accessibility, and they share grounds with examples about the good practice of Universal Design in architecture.

It is necessary for architects, landscape and interior designers as well as many other professionals to address the peculiar needs and preferences of people who face problems for active social participation due to reduced mobility and poor wayfinding. That task is the first step to extend benefits of design ideas to everyone. However, the design process decisions must be driven by recognition of distinct world views that must be combined [2]. The good quality of accessibility solutions must be treated differently from the traditional approach of adapting old structures to partially grant civil rights to minority groups including people with disabilities even though the traditional framework of ideas remain untouched in every new edition.

Finally, this contribution presents some suggestion for improvement of the Brazilian Standards about accessibility to built environment. This author advocates that the innovation and advance of knowledge presented in national standards require clear statements about Universal Design practice in each of technical recommendations and requirements. At first, rather than updating and expanding the wealth of detailed knowledge about construction technology available, the Brazilian standards of accessibility must organize information and deal with successful user experiences as behaviour settings [3] [4] in contemporary wheelchair accessible environments that must also include user friendly interfaces.

## **2. The Importance of ABNT Standards for Accessibility of Built Environments**

In Brazil, accessibility for people with problems of reduced mobility is regulated by legislation that refers to technical standards about construction of urban structures, transportation and buildings. The bulk of legislation comprises of a complex net of multiple requirements at federal, state and city levels of administration. The federal legislation sets the overall conceptual directive and determines that each city administration must provide details for implementation. In all cases, the newest version of technical standards is the essential tool to set legal reference to the field of construction businesses.

At federal level, the Brazilian Law for Social Inclusion In Spite of Disabilities [5] is also known as the Statute for People with Disabilities. That is a comprehensive collection that covers the rights of people who live at extreme of disabling conditions. In addition, the federal decree of 2004 [6] regulates two closely related laws: the first one details no prejudice procedures to be implemented in public services; the other one prescribes structural features for accessibility in public buildings. That full legislation package determines that all new blueprint projects of buildings and urban areas must include the Universal Design concept at first step of technical solutions, unless that is

proven to be financially or technically unfeasible. It entitles the ABNT (the Brazilian Association of Technical Standards) as the only non-government institution to establish the national criteria of good quality to professional outcomes in that field.

Therefore, according to the Brazilian federal legislation, the technical standards about accessibility of the built environment for people with disabilities is as strong to promote changes in the physical environment as existing legal instruments to promote social justice and equality of opportunities. That enforces professional practitioners to comply with requirements for conception of either very large spaces in architectural complexes or very small structures and special installations.

Certainly, we have come a long way to make naive people respect civil rights and invest to the well being of everyone despite high financial expenses to advance technology. Therefore, a strong set of technical standards is needed to establish the replication of good ideas everywhere and to prevent the wide spread of technical failures. However, there must be a distinction between innovation and certain ideas that indicate changes of social values historically in the same original framework that keep good principles and misconceptions alive in each version of NBR9050.

### **3. A Short Description of Distinct Versions of the NBR9050**

The first edition of NBR9050 [7] was ready in September, 1985. At that time, it was a pocket booklet with 37 half-size pages. The content included requirements for spatial functionality of wheelchair users only, even though it provided definition about seven kinds of disabilities that included minority groups of people with rheumatism sequels and aging. However, there was no emphasis in data for consideration about specific needs of varied people with disabilities. In fact, the main causes of the accessibility problems were related to characteristics of people illness or impairments rather than the misfit with environmental resources.

The main scope of technical solutions was adopted from foreign literature, since they were not based on direct research findings. There was no definition of accessibility as a concept; rather, the stated goal of standards was to provide the reduction of architectural barriers to people who had light or severe ambulatory problems. The content of 1985 version of standards focused on dimensions in space for approach and use, but it did not provide criteria for design of architectural structures that offered user wayfinding, safety, independence and autonomy.

Some human factors requirements disappeared when the next edition was published. In other topics, requirements have remained even to the current version with some changes.

Here are two examples:

- The position of side grab bar in toilets was angled in 45 degrees so that the lower end was closer to user approach and
- Certain spatial dimensions to approach and use that did not prove to be enough.

In the first example, the original intention in the NBR9050:1985 version was possibly to make it easier for users to stand up or sit down by letting the hands drift slowly on the surface of grab bars. However, the angled position was incorrect and flipped in 90 degrees. It was very hard for users to get some support during transfer from wheelchair or during stand up movements.

In the second example, the size of toilet stalls in the NBR9050:1985 washrooms were as small as 1.4m x 1.6m. The width of main run in curb ramps of sidewalks could be as narrow as 1.0m at small spaces or as large as 3.0m at pedestrian street crossings. The slope ratio of 1:12 ramps had the maximum size as 10.8m long for 0.9m high. Later versions increased stall dimensions and set the width of curb ramps to 1.2m only. Also, the next version had reduced length and height to define the maximum incline of an acceptable ramp design in new buildings.

Despite the lack of precision in narrow profile of problems as considered architectural barriers, the text of some requirements in NBR9050:1985 included short explanation for described solutions. In the appendix section, three-dimensional views of environments demonstrated the connection of accessibility elements as a system of solutions toward access and functionality to people with ambulatory disabilities. Furthermore, the views showed concerns for user safety and provision of accessibility elements that were linked to form an accessible route.

In October, 1994, the updated [8] NBR9050 version of 56 full size pages was structurally very different from the 1985 booklet. It was the first edition that considered the emphasis on accessibility rather than the physical conditions of users, and at the introduction the concept about Universal Design was result of solutions that meet the needs of the many people as possible with respect to human mobility and perception in the population with diversity in anthropometric profile [9]. That version expanded the realm of usable environments to include general spaces for public use in addition to buildings managed by public agencies, companies and institutions. However, it did not mention that the benefits of accessibility provisions should extend to meet the needs of everyone. At that time, users could either be identified as being disabled or other people who might be part of the population at large. In fact, the NBR9050:94 considered certain people with light and severe physical conditions due to disabilities in two groups: people with ambulatory problems and people with sight and hearing related problems.

The number of pages increased and so did the number of topics as well. The ABNT Standards Committee considered new concepts such as the idea about including Braille in specific signage to identify places and services. Also, it referred to colour treatment of paving and the need of mechanical equipment such as platforms for vertical access other than elevators. The criteria included recommendation for contrasting colours and texture on floor surface to highlight important direction shifts in areas such as hallways and corridors. The NBR9050:1994 also suggested many incline ratios for ramps, according to the height of top edge and the horizontal length of run: 1:20, 1:16, 1:12, 1:10 and 1:8. There was no indication that one of them could be the most effective or the most important.

Therefore, depending on the combination of maximum length and height in addition to the maximum number of ramps between rest landings someone could design a so-called accessible ramp that was comparable to many in the same chart.

Also, the list of topics detailed recommended spatial requirements for wheelchair manoeuvring in tight spaces such as bathrooms. In fact, layout plans and three-dimensional views of those environments were extracted from the case studies of appendix in the NBR9050:1985 version; changes were made, drawings were simplified, and they were inserted directly into the content of pages with technical criteria.

In 2004, the third version of standards [10] presented in 97 full size pages an extensive collection of requirements about visual signage and tactile warnings. It had almost 50% of criteria dedicated to it. The notion of tactile paving presented in the

1994 version was expanded to include the definitions of two types of tactile surfaces, for warning and guidance of blind and visually impaired people, and the relationship between those types to form an intricate wayfinding system of landmarks. In addition to distinct aspects of shape and colour of tiles that contrasted with surroundings, the requirements for the tactile paving system had different width and position as referenced to illustrate the configuration of main circulation routes; the small model of the tactile system for each accessible building had to be on a tactile map at hand reach in the main entrance.

Compared to previous versions, that NBR9050:2004 content was broader, clearer and very detailed. The Committee changed some required criteria for anthropometrics due to revision of data and response to some failures and complaints. However, the overall list of criteria remained the same. For instance, the maximum slope of curb ramps on sidewalks was originally very steep, 12% in the earlier 1985 and 1994 versions. The NBR9050-2004 considered a reduced slope and adopted 8.33% to the main run and 30% to each one of the triangle side ramps.

Considering the problems created by design of very steep ramps, the NBR9050:2004 made it clear that the 8.33% ramp that raised 0.80m in a horizontal run of 9.30m between landings was the maximum incline accepted for new buildings that were adequately designed in compliance. Nevertheless, the same material tolerated access to the stage in auditoriums and theatres by a steep ramp up to 16.66% or 1:6 that rises up to 0.60m.

The NBR 9050:2004 presented the same earlier definition of Universal Design in the glossary even though it did not instruct ways for professionals to apply the Universal Design concept in environment settings.

Contrary to previous versions, the NBR9050:2004 did not show full layout to drawings where such elements in general were adequately located and the physical connection between them according to distinct activities. There were few images that illustrated some of those topics. Most drawings referred to the information in old versions and were related to specific fixtures instead of full size spaces such as service counters and pay areas, desks, tables, phone booth and self service shelves. In washroom facilities, the emphasis was to determine the minimum space for approach and use to toilets, shower, bathtub and dressing-room.

That version of ABNT standards dedicated the material to two large group of users other than the general population: people with disabilities and people with reduced mobility due to age, pregnancy, extremes of height, overweight, baby care giving, momentary perception and mobility restrictions or recent injuries that affected mobility or wayfinding. Besides, it indicated the need for respect to full access, autonomy, safety, connection of the elements in the accessible route besides easy wayfinding; all that matched to the conceptual advances in federal legislation.

Since it had expanded the profile of users, it dedicated the scope of adaptability to accommodate varied demands of large spaces as compared to traditional ones. For instance, it focused on increasing the minimum number of spaces and fixtures for adapted and adaptable environments, such as reserved toilets in washrooms, reserved seats in a theatre or reserved suite units in hotel guestrooms. Thus, while 5% of hotel rooms, for example, should be adapted to meet requirements of accessibility standards, 10% of additional rooms should have structural characteristics to accommodate changes and become accessible if demand of accessible units by hotel customers increases. The NBR9050:2004 did not specify the type of flexibility in adjustments that could be made to conventional units in order to make them adaptable. It depicted an

accessible hotel room as a very small bedroom with full size bed, one nightstand, wardrobe and a manoeuvring circle of 1.5m inscribed in the door area, and it also specified the need for required provision of special communication devices and lighting fixtures for adapted suites.

Further innovation of the NBR9050:2004 from its predecessors included a brief description of peculiar characteristics for accessibility features in a list of many distinct environments, such as: kitchens, lodging facilities, schools, pool areas, restaurants, sport facilities, health clinics, libraries, auditorium and movie theatres, parks, recreational clubs, banks, police departments as well as penitentiaries, historical sites, and related urban settings. In addition, the issue of emergency egress in multiple story buildings was considered. The NBR9050:2004 presented description and illustrations about the rescue area at stair landing or smoke free hallway. The required minimum size of rescue area was related to the number of spaces for wheelchair accommodation.

Contrary to the notion of autonomy and independence, the NBR9050:2004 considered valid the availability of technical staff specially trained to provide assistance as required. In fact, the ABNT experts introduced signage about special devices in escalators that could make them link movable steps and make them work as an inclined platform. Also, the ABNT committee imposed users the need to call for help to operate the machinery. At that time, information about such technology was very restrictedly available. Even to date, there is not a single unit of that special kind of escalators in the country. However, the notion of specially trained staff to complement the operation of accessibility equipment introduced the concept of users submissive to "assistive accessibility" and counteracted all efforts for dissemination of Universal Design.

The most recent version of the NBR9050 is the 2015 version [11] with 148 full size pages. After eleven years since the last publication, the ABNT Committee have gathered enough information to compile a much larger variety of requirements. It seems, ABNT experts had decided to publish an official statement about making a fair and even distribution of technical solutions for social inclusion of all people with disabilities and people with reduced mobility and perception in built environment.

In addition to all previous topics, the list of content includes the following criteria and much more:

- indexing colour contrasts in a chromatic rating scale;
- glare, lighting and legibility according to reflected light values;
- types of side protection in accessible routes that are above floor level;
- varied types of door handles;
- characteristics of tactile warnings in visual signs;
- sound parameters for hearing;
- international symbols of three distinct types of disability;
- size and location of emergency alarms in washrooms;
- handrails in poorly adapted areas, where ramp and single step are combined;
- curved steps in stairways;
- characteristics of glazed walls and transparent doors;
- multiple types of fixed and movable grab bars around toilet seats and lavatories inside washrooms;
- vertical grab bars near toilet seats and lavatories.

The new set of standards is the most complex version, and expectations are the future versions will keep the pace of conflicting concepts, confusion and complexity.

The large variety of alternatives for grab bars in washrooms, for example, neither promotes attractive nor safe environments. The list of unusual requirements and recommendation is a long one, and it raises discussions about feasibility.

Then, design professionals and entrepreneurs are concerned. Since the NBR9050:2004, industry was slow to catch up and develop products that responded to ABNT requirements. To date, the construction market does not offer the needed variety of quality products at reasonable prices. There is no research about efficacy associated to ABNT requirements, and knowledge arises from little success and continuous failures. Construction actors feel the burden of paying a high price alone for accommodation of ABNT criteria according to the law in court suits. Nevertheless, the complex web of power in decision making processes splits the control and supervision to many actors who are not prepared to express Universal Design in full terms. There is not an effective policy to encourage a cultural shift towards economical sustainability of accessibility products and to prevent failure of social programs.

On the other hand, building officials are also concerned. Actually, it is very difficult for building inspect officials to assess and confirm that the technical solutions fit into the Universal Design concept. They do not have the means to assess quality of solutions. Considering the context of construction processes in Brazil, it is very difficult for building inspect officials to deny approval of wheelchair accessible architectural products for their potential lack of compliance to details of the new version of the NBR9050 standards. Whether the content of technical standards refers to conceptual conflicts that are not stated as so, then city officials may prosecute building entrepreneurs and construction firms that may be acting against the law even when they may be heading towards an idea that is truly Universal Design application.

#### **4. Pitfalls and Suggestions for Information Structure Within the Content of NBR9050 Standards**

The current version of NBR9050 is poorly edited and organized. Seriously, the ABNT Committee should call off the current version of NBR9050 standards and should try to improve its layout presentation urgently. Besides grammar mistakes and confusing deviations of dimensions in text and drawings, the set of standards repeats information in distinct sections and asks readers to follow citations that simply are not available. However, the main flaw is related to content instead of format.

To date, the ABNT Committee's best strategy to organize information has been to distinguish between adapted and adequate accessibility conditions inside topics while presenting updated requirements along with old data selected from previous versions of standards. Adapted accessibility is possible when physical changes are introduced in existing buildings that were not originally designed to address current NBR9050 requirements. Adequate accessibility is result of design projects that followed both NBR9050 recommendations beyond technical requirements.

In new buildings, expectations are that design criteria in ABNT standards may provide clues for application of Universal Design principles. In other cases, as readers identify topics that are for adapted buildings only, then full compliance of requirements will not be needed and that way may not lead to the best practice. In such conditions, understanding Universal Design may not be within reach at all.

Indeed, consideration about case studies reveals that the distinction between adapted and adequate solutions is not enough for someone to develop Universal Design

ideas. There must be very few case studies out somewhere that included all NBR9050 technical recommendations for adequate environments. In fact, they are not a warranty that good design for all is the end result. That occurs because Universal Design is not within a collection of design recommendations only.

Nevertheless, it would be great if current version of ABNT standards had clearly identified the criteria for adapted buildings from the criteria of adequate buildings as separated parts or chapters. At least, readers could interpret better the types of solutions cannot be suitable to design of new buildings. Moreover, certain topics that generate Universal Design application for sure should be identified and highlighted into the foreground of design considerations that are related to successful case studies.

Setting an expiration date to old accessibility solutions that were originally based on outdated technical standards is a difficult challenge. It means that more resources are necessary to fix mistakes where technical solutions were accepted as the state of art in the field. Furthermore, it gives a sense of failure and insecurity. However, that happens each time a new version of technical standards is published. The question is whether the NBR9050 could be originally made to foster knowledge about Universal Design applications and to prevent premature obsolescence.

It is necessary that ABNT adopts a revised edition of standards with checklists and multiple sections that describe in detail of fewer pages what, when and how to achieve best practice. The inclusion of editors' remarks to revised editions would provide enough information for blueprint and building evaluation about quality of users' experiences. The editors should be members of ABNT accessibility boards [12] [13] comprised of educated stakeholders and official representatives that control construction activity in distinct cities around in the country. By selecting the best examples of Universal Design practice according to varied problems, they might promote successful case studies that address mobility or wayfinding issues at the basis of reaching other needs like users' satisfaction and preferences.

The idealistic content for a future edition of technical standards that considers Universal Design should separate information in sections or distinct handbooks. The first priority of considerations should be reduction of pages to create a concise list of topics that could be easily found and verified during design production or formal expert inspection. Then, all the other technical details and theoretical concepts behind specifications that justify design ideas could be assembled further in the text or the appendix.

Therefore, the future NBR9050 versions seems be more effective if they would be bound to a collection of many thin and portable handbooks [14]. That way, perhaps, the set of criteria in technical standards could be more useful and easier to understand.

The list of content should be presented with innovation. The first handbook in the set should offer readers several contexts both indoors and outdoors in which full participation to social interaction through Universal Design practice occurs in meaningful, productive, social, cultural and related activities. Users' decisions at varied choices would make the scheme of environmental exploration. The emphasis of structure would be related to the core concept of accessibility route as a circuitry of multiple passages, landmarks and interfaces.

The following handbooks in the set would present information progressively. The main part of the standards should be dedicated to descriptions about urban settings and the multiple connections between buildings, open spaces, and transportation systems. After the open aired external areas of streets, parks and natural settings could be explored, then, readers would be invited to consider user-friendly entrances at flat



landings and move into internal areas of buildings. Each handbook could be related to specific areas or domains, such as: accessible urban settings and transportation hubs, mobility related spaces including connections between floor levels and circulation, wayfinding cues and legibility, building management for socially inclusive procedures services and flexible exception to the rules, web representation of user experiences and expectations, auditory and tactile signage as challenges for total communication, usability of accessibility design of furniture, reaching and handling equipment and installations, combining visual, accessibility maintenance, historic sites and preservation issues, and finally, the appendix. The special configuration of old adapted structures as well as technical descriptions of fixtures, and signage would be considered in some of the last sections. Adaptation requirements of existing buildings of historic value and urban settings that do not accommodate structural changes without comprehensive intervention should be considered maybe as a separate set of standards that regards special attention and concern.

At the end of each handbook of NBR9050, checklists with straightforward information about the content could inform building inspectors the most relevant topics for assessment to similar cases. The appendix would include additional information that helps readers understand the content, although it would not affect results.

One of the advantages of keeping separated handbooks is to let the development of knowledge about design criteria expand according to research and technological investments in each field without compromising the other sets of requirements.

## **5. Conclusions**

According to the historical development of NBR9050, the meaning of some technical solutions date back to the time building for accessibility was making adaptations to accommodate disabled people in separate means of access through back doors. That mind frame still remains in current versions, and it does not seem to be the best strategy for promotion of Universal Design. It casts doubts to technical standards as source of knowledge and to the concept of Universal Design that is beyond users experiencing frustration and low self-esteem in partial adaptations to inaccessible structures.

As long as architects and design professionals follow the content of technical standards, legislators assume they do not need to worry about providing improvements or additional quality to environments that are designed for accessibility. Therefore, readers of current technical standards may understand in a wrong way that prevalence of prejudice to disability conditions is still possible.

Despite technological advances, the proliferation of inaccessible structures is a fact. Then, the confidence about the effectiveness of NBR9050 is lower at publishing of each new edition. Building professionals and their clients are not motivated to improve the quality of products and they adopt poor solutions that require the least financial investment. City officials also do not demonstrate enough knowledge to understand ideas that favour Universal Design practice as opposed to the traditional approach of creating segregated environments. Even when they do recognize the Universal Design aspects of good quality solutions, they do not have legal instruments to praise good professionals and help disseminate innovative design concepts.

Clearly, technical standards should serve in general as a ruler to provide references of best practice, even though it may change and improve overtime just to keep up with current technology, to avoid inefficiency and to accommodate innovative conceptual

landmarks. However, the content of ABNT standards for accessibility includes outdated concepts and incomplete or misleading information. No matter how much the content of legislation and standards has progressed up to consider the need for Universal Design at the basis of any new design project, a revision of the NBR9050 is necessary to show about what, how and when Universal Design is possible within the material already available.

The way out of such entangled mesh of poor quality environments and inaccessibility seems to be the recognition of available framework of ABNT technical standards as ineffective to regulate construction activity. Binding together small handbooks of complementary sets of technical standards seems to be the key to accommodate constant improvements while freeing the framework from old mindsets.

Since this paper presented suggestions that are not clearly illustrated, one might consider it to be utopia or simply too superficial. However, interesting handbooks about Universal Design experiences are already somewhere in press or into online production. The challenge is to make such initiative as one of ABNT resources that connect ideas, links and user experiences and make them available without embedded prejudices and distortions.

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