Diagnosis of accessibility in the FT/UFAM classrooms

Joseana Vinhote Melo (joseanavinhote@hotmail.com)
Dalzira de Sousa Pereira (dalzira.souza@gmail.com)
Dr. Jonas Gomes da Silva (jgsilva@ufam.edu.br)
Dr. Nilson Rodrigues Barreiros (nilbarr@gmail.com)
Msc Ely Sena de Almeida (elysenaa@ufam.edu.br)

Department of Industrial Engineering
EUREKA Laboratory
Federal University of Amazon (UFAM) - Faculty of Technology
Manaus – Amazon – Brazil

Abstract

The article analyzes the accessibility problems in the classrooms of the Faculty of Technology of the Federal University of Amazonas (FT/UFAM) based on NBR 9050:2004, to propose suggestions for improvements. The data were collected through a checklist applied in 17 classrooms chosen at random. Besides, measurements and photographic records were performed to compare the reality of the classroom environment by meeting the requirements of this standard. The analysis concluded that most of the measured variables do not satisfy the requirements of NBR 9050:2004. The most critical problems are related to a) the gap in width and height of the doors; b) the width of the corridors between the rows of chairs; c) the signs on the doors; d) the height of installation of the blackboard; e) the absence of desks adaptable and available to a Person in Wheelchair; f) the height for installing sockets; g) the height of the light and air conditioning switches. All of these items were 100% disapproved, as they did not meet the minimum requirements required by the standard. Therefore, several recommendations were suggested to the FT/UFAM managers.

Keywords: NBR 9050:2004; Classrooms; Accessibility;

1. Introduction

The Federal University of Amazonas (UFAM) completed 110 years in 2019 and has 18 units in the capital, Manaus, and 5 other units in the inland, Benjamin Constant, Coari, Humaitá, Parintins and Itacoatiara. In the capital unit, UFAM has 4 institutes, a nursing school, and 12 faculties, among them, is the Faculty of Technology (FT) that offers 10 courses in the exact sciences of which are: Architecture and Urbanism, Design, Production Engineering, Mechanics Engineering, Electrical (electronics, telecommunications, electrotechnics)Engineering, Oil and Gas Engineering, Chemical Engineering, Civil Engineering, Materials Engineering, and Computing Engineering.

In this university environment, there are 122 teachers and 47 technicians to serve around 2500 university students, who have easy and free access to the university to have a good learning experience over time.

A doctoral thesis developed by the Federal University of São Carlos (UFSCar) involving 15 public universities showed that many have not yet made adaptations to guarantee accessibility in their spaces (CASTRO, 2011).

The legislation states that public institutions, such as universities, must offer accessibility and the rules of the Brazilian Association of Technical Standards establish, for example, what the slope of a ramp should be and the required number of handrails, etc.

According to the Brazilian Association of Technical Standards (ABNT 9050), accessibility is the possibility and condition of reach, perception, and understanding for the safe and autonomous use of buildings, space, furniture, and urban equipment and elements.

Although the Federal Government has made funds available for adjustments within universities, it is still common to find several locations needing to meet accessibility standards. In the case of the Faculty of Technology, new buildings were constructed between 2007 and 2015, and some adjustments were made to buildings already built to improve accessibility. The new buildings were built by the company EBTA, each building with three floors costing R$ 6,000,000 and a building with a maximum of two floors costing approximately R$ 4,000,000 according to the college's administrative information. But are the 35 classrooms of the Faculty of Technology, built or renovated, adequate according to NBR 9050: 2004?

The interest in research arose from a project of complementary hours carried out at the Faculty of Technology, between May and December 2015, to create a Manual that obeyed NBR 9050:2004, and it was found that one of the highest rates of non-conformities in this faculty were concentrated in the classrooms.

Thus, the general objective of the research is to analyze the problems of accessibility to the FT/UFAM classrooms, to propose suggestions for improvements for the managers of this unit.

The research is relevant for the following reasons:

1) the classroom is the basis for the university to achieve its mission, which is to cultivate knowledge in all areas of knowledge through teaching, research, and extension, contributing to the formation of citizens and the development of the Amazon;

2) the Faculty of Technology, as it is an environment that uses technology and knowledge as tools, should be an example of universal design in its constructions for the other institutes and schools of UFAM and Manaus;

3) every person who attends the rooms of that Faculty must have the same conditions of use and access to the place;

4) the right to free access and mobility in any location, whether public or private, is not a favor, but a right that is protected by law;

5) NBR 9050:2004 says that every location, public or private, must meet the minimum requirements to be accessible to anyone;

6) SINAES assesses, in addition to other requirements, whether the space offered by the university to students and teachers is adequate;

7) managers must be aware of the causes of the problem of non-conformities in the classroom so that it is possible to take the necessary measures.

2. Theoretical Referential

2.1 Accessibility

2.1.1 Definitions

According to the dictionary by Aurélio Buarque de Holanda Ferreira (2010, p. 87), the word accessibility is derived from the Latin “accessibilitate”, which designates the quality of accessibility and ease in approaching, dealing with or obtaining something.

For Godinho (2010) accessibility consists of the ease of access and use of environments, products, and services by anyone and in different contexts.

The National Secretariat for Human Rights (2015) says that accessibility is the absence of barriers that guarantees equal opportunities, but Manzini et al., (2003, p. 185-192) defines accessibility as a concept that is related to citizenship, in which individuals have rights guaranteed by law that must be respected, however, many of these rights come up against architectural and social barriers.

NBR 9050 (2004) states that accessibility is the possibility and condition of reach, perception, and understanding for the use, with safety and autonomy, of buildings, space, furniture, urban equipment, and elements.

Based on the definitions above, for this research, the term accessibility means easy and free access to a building, environment, equipment, and furniture by anyone and everyone who may or may not have any physical restrictions.

2.1.2 Universal Design

Rosso (2009) states that universal design is the keyword to achieve accessibility. For NBR 9050 (2004), universal design is seen as “one that aims to meet the greatest possible range of anthropometric and sensory characteristics of the population”.

The term is used in building projects when you want to build a barrier-free environment, easy to move around and that can be used by as many people as possible.

Remião (2012) also states that the goal of universal design is to create an environment that is accessible to everyone who travels in it, regardless of whether the user is in a wheelchair, visually impaired, hearing impaired, elderly, child, a person with short stature, with temporary or permanent mobility.

The term universal design emerged in 1990 and was proposed by the American architect Ron Mace who with other architects established the seven principles of the universal design described below:

1) Equal: providing spaces, objects, and products that can be used by people with different capacities, making environments the same for everyone.

2) Adaptable: having a structure of products or spaces that meet varied skills and diverse preferences of people.

3) Obvious: being related to easy understanding so that anyone can understand, regardless of their experience, knowledge, language skills, or level of concentration. It has to do with the dimensions and spaces suitable for access, reach, handling and use.

4) Known: refers to the clear transmission of information to meet the needs of the recipient, be it a foreign person, with difficulty in vision or hearing.

5) Insurance: be related to the risks and possible consequences of the origin of accidental or unintentional actions.
6) Effortless: efficient use, with comfort and minimal effort.
7) Embracing: be related to the access to spaces and dimensions appropriate to all people.
2.1.3 Social Inclusion
Fresteiro (2010) states that social inclusion when it comes to accessibility is the elimination of barriers or constructive obstacles. Remião (2012) says that social inclusion is related to the inclusion of all types of people to participate actively in life, working in different parts of society such as recreation, work, sports activities, studies, among others.
Social inclusion is related to the search for social stability through social citizenship, that is, all citizens have the same rights in society. Social citizenship is concerned with the implementation of people's well-being as citizens (SHEPPARD, 2006).
It can be said that social inclusion is related to providing equal rights and access to all people in society, for example, in a cinema, a sports field, a shopping mall, a classroom, which is the case of the object of study of this article, etc.

2.2 Accessibility at Universities

A university said to be accessible, is one that is capable of allowing equal access to all dependencies of the environment for all users, including those who have some physical restriction. For Bittencourt et.al (2004), a built space, when accessible, is capable of offering equal opportunities to all people.
A public or private building, in this case, the university, can be considered accessible if it is designed taking into account the requirements of the technical standard of ABNT, NBR 9050 so that space provides comfort and safety to users.
A doctoral thesis carried out by the Federal University of São Carlos (UFSCar) showed that the facilities of 15 (fifteen) universities were not yet fully adaptable when it comes to the issue of accessibility (CASTRO, 2011).
A study carried out by students at the Federal University of Mato do Sul (UFRJ) in 2013, showed that the university still does not have an adequate structure when assessing accessibility at the site, for example, the classrooms have irregularities in circulation internal environment, where the place is very narrow and prevents students from easily moving, including those who have some physical restriction.
The Faculty of Science and Technology (FCT) of the Paulista State University of the Presidente Prudente campus carried out a study in which irregularities were found in the urban spaces and buildings of the university, mentioning, for example, the access to the athletics track, which had a stairway with very long steps and causing discomfort to the students and many of them preferred to go down the slope, that is, by the lateral inclination to the stairway. Another problem that was also encountered was the consultation terminal of the library, which had a very high height, where the consultation could only be performed by people standing, excluding access to a student who was in a wheelchair (DE ALMEIDA, 2011).
It can be seen in these surveys that many higher education institutions still need to improve their spaces to meet the needs of all people, however, we identified that two Faculties have stood out about the subject, namely: Faculty of Três Alagoas -AEMS and the Faculty of Medical Sciences of Santa Casa of São Paulo.

The Faculty of Três Alagoas-AEMS designed one of its buildings already with the concern to guarantee free movement of individuals, especially wheelchair users and the Faculty of Medical Sciences of Santa Casa of São Paulo has an institutional accessibility nucleus, the NAI, which aims to mobilize the various departments and segments of the Institution in promoting accessibility, which stands as a space for dialogue and collective construction of attitudinal accessibility.

The NAI has several purposes and among them are the promotion of accessibility not only to students with disabilities and/or difficulties but to the entire academic community and the population that frequents the place and that benefits in some way from its services and also has the purpose the dissemination of accessibility through actions and projects with the participation of the population to build an inclusive society.

2.2.1 Evaluation of SINAES about Accessibility

SINAES is the National Higher Education Assessment System created by Law No. 10,861, of April 14, 2004. It aims to identify the merit and value of institutions in the segments of education, research, extension, areas, courses, management, and training, also to improve the quality of higher education and promote social responsibility (INEP, 2011).

SINAES is based on three main components: institutional evaluation (internal and external), evaluation of courses and information collection.

Institutional and course evaluation are components that address, among other requirements, the term accessibility concerning physical infrastructure, physical installation and social responsibility.

Physical infrastructure and social responsibility are part of the institutional evaluation component, while the physical installation is part of the evaluation of courses, where each of these has a specific objective (MEC, 2014), such as:

• Physical infrastructure: consists of verifying whether the educational institution offers users conditions for the development of research, teaching, extension, and management in classrooms, administrative facilities, auditoriums, teachers' rooms, spaces for attending students, offices, workstations, sanitary facilities, laboratories, among others.

• Social responsibility: consists of checking if there are jobs, actions, activities, projects, and programs developed with and for the community, aiming at social inclusion, economic development, improving the quality of life, urban/local infrastructure and social innovation.

• Physical facilities: aspects such as the basic and complementary bibliographic material of the courses, informational resources, work personnel, financial resources are verified.

In this way, the information obtained with SINAES is used by higher education institutions (HEIs), to serve as a guide for their institutional and academic and social effectiveness; by government agencies to guide public policies and by everyone who wants to know the reality of courses and institutions (INEP, 2011).

2.3 Technical aspects of NBR 9050:2004

NBR 9050 (2004) is a regulatory standard that aims to provide accessibility for everyone regardless of height, age or physical or perceptual limitation, in public or private places. This standard is enforced by laws 10,048: 2000 and 10,098: 2000 to promote accessibility

The NBR 9050: 2004 establishes parameters and criteria so that when equipment, furniture or space is designed, it will meet what the standard requires so that it is considered accessible. The parameters and criteria covered in the standard refer to: 1) anthropometric parameters, 2) communication and signaling, 3) access and circulation, 4) toilets and changing rooms, 5) urban equipment and, finally, 6) furniture.

They are related to:

1) Anthropometric parameters: manual, auditory reach, dimensions of a person standing or wheelchair, transfer and circulation area and visual parameters.

2) Communication and signaling: visual, tactile, vertical, audible signaling and communication.

3) Access and circulation: floor, corridors, handrails, stairs, louvers, elevator, platform, escalator, doors, windows, etc.

4) Toilets and changing rooms: toilet, urinal, washbasin, floor, shower, bathtub, mirrors, cupboards, benches, among others.

5) Urban equipment: school, cinema, meeting room, auditorium, kitchen, swimming pool, parks, restaurants, cafeterias, libraries, beaches, and other places.

6) Furniture: drinking fountain, chair, seats, counters, ticket offices, desks, self-service equipment, etc.

3. Case study: Profile of FT rooms

The FT is located in the Northern sector of UFAM together with the Faculty of Law (FD), the Faculty of Education (FACED), Faculty of Social Studies (FES), Institute of Human Sciences (ICHL), Institute of Exacts Sciences (ICE) and Computing Institute (IComp) as shown in Figure 1 below:

Figure 1 – Northern sector of UFAM

The FT is composed of 2 (two) leisure areas, 2 (two) amphitheaters, 1 (one) parking lot and 16 (sixteen) pavilions represented by the blue blocks, as shown in Figure 2.

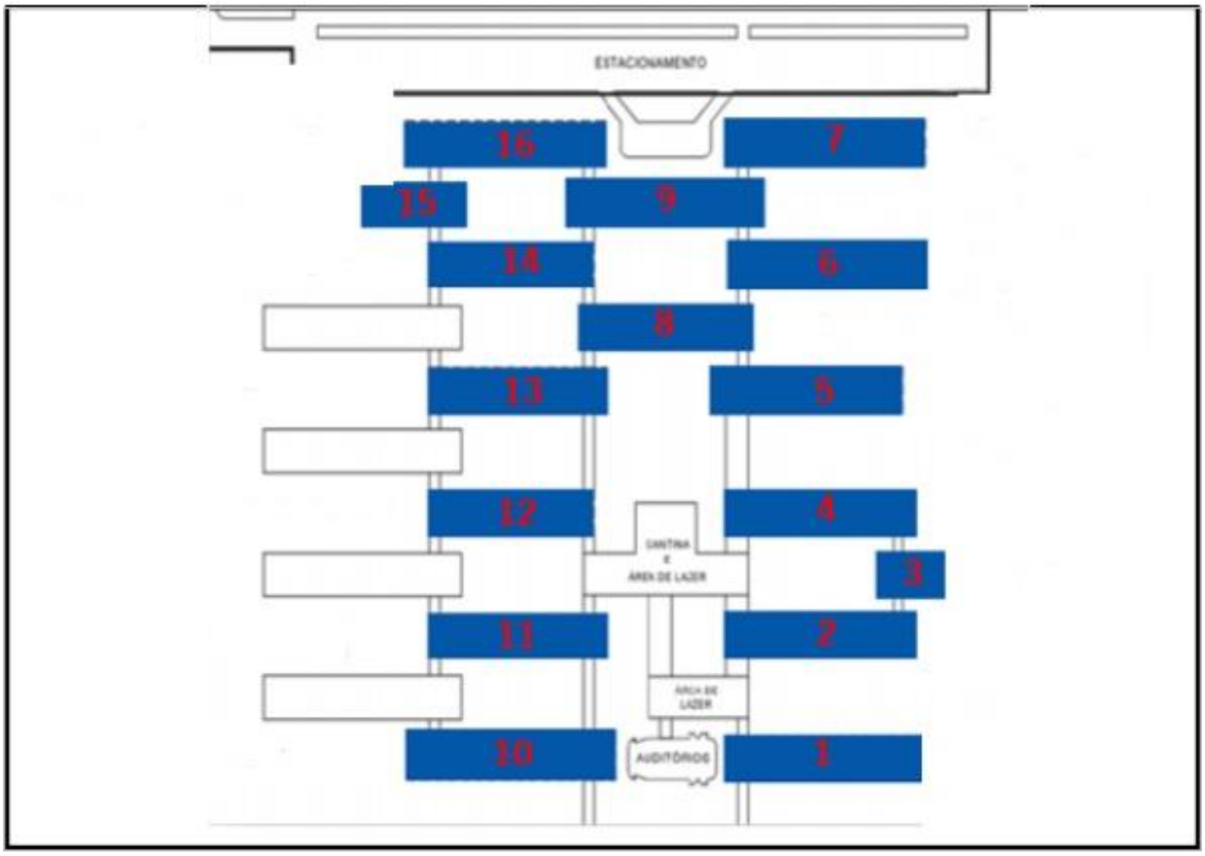


Figure 2 – Faculty of Technology Map

Source: UFAM (2016)

The 16 (sixteen) pavilions, represented in the blue blocks in Figure 2, are composed of:

1. Engineer Nelson Ribeiro: three floors with 28 classrooms, plus male and female bathrooms.
2. Rio Juruá Pavilion: allocated to the Design Department, it has a ground floor with 2 laboratories, 2 workshops, 2 centers, one of which is a research and development center and one of a product center, 1 support center for project extension and 1 room conservative.
3. Rio Tefé: belongs to the Department of Electrical Engineering (Electrical-Electronic) and has only 1 (one) ground floor which is reserved for the industrial automation and robotics laboratory.
4. Rio Purus: ground floor reserved for the Electrical Engineering Department, consisting of 1 professor room, 1 research room, 5 laboratories, 1 secretary and male and female bathrooms.
5. Rio Madeira: ground floor reserved for the Department of Electrical Engineering (Electrotechnics) with 2 laboratories, 1 room for researchers, scholars, and coordination, 1 room for vegetable oil projects, 1 center for energy development in the Amazon and male and female bathrooms.
6. Prof. Nilmar Lins Pimenta Pavillion: is reserved for the Center for Research and Development in Electronics and Information Technology (CETELI) and consists of 2 floors. It is divided between 9 laboratories, 11 teaching rooms, 1 archive room, 1 living room, 1 meeting room, 1 study room, 1 secretary, 1 directorship, 1 auditorium, male and female bathrooms.
7. Administrative Pavilion of FT and Teachers' Rooms: it is an administrative pavilion composed of 3 floors and is divided between 1 secretary, 1 directorship, 1 teacher service room, 2 multiple-use rooms, 2 meeting rooms, 79 teacher rooms, 5 academic centers, and male and female bathrooms.
8. Rio Nhamundá Pavilion: with 1 ground floor, it has 1 teacher's room, 1 project and extension room, 3

laboratories and 1 secretariat.

9. Rio Trombeta Pavilion: reserved for the Materials Engineering Department, divided between 3 laboratories, 1 researcher room, and 1 reception.
10. Rio Aripuanã Pavilion: it has 2 floors and consists of 1 library, 3 studios, 1 laboratory, 8 teacher's rooms, and 1 building maintenance coordination.
11. Rio Tapauá Pavilion: it has only the ground floor and consists of 4 rooms, 3 laboratories, and male and female bathrooms;
12. Rio Juruá Pavilion: reserved for the Mechanical Engineering Department and has only 1 floor. It consists of 7 laboratories.
13. Rio Canumã: it has a ground floor and is composed of 3 laboratories, 1 coordination, and 1 classroom.
14. Rio Xingu Pavilion: it has 1 ground floor and is composed of 1 management room for fluid mechanics laboratories, 4 laboratories, 1 equipment room, and 1 professor room.
15. Prof. Emani Vilar Parente da Câmara Pavilion: has only 2 floors and consists of 3 laboratories, 2 meeting rooms, 6 group member rooms, 1 secretariat, and 1 coordination.
16. Prof. Vilar Fiuza da Câmara Pavilion has two floors and the basement. It is divided into 3 laboratories, 1 master's room, 3 secretariats, one of which is for post-graduate studies, one for research and extension and one for the master's degree, 4 centers, 8 rooms reserved for various programs of the Faculty of Technology.

It can be seen that only the Engineer Nelson Ribeiro pavilions (28 rooms), Rio Tapauá (7 rooms) and Rio Canumã (1 room) are the ones with classrooms, totaling 36 identified rooms.

The rooms of the Rio Tapauá and Canumã pavilion are the oldest buildings in the college and all have the capacity for up to 60 students to carry out their activities with the teacher.

Meanwhile, the Engineer Nelson Ribeiro pavilion was opened in June 2015, containing small rooms with a capacity for 25 students and large rooms for 60 students, with chairs, desks, and blackboard differing from the other two pavilions.

3. Methodology

The data collection and analysis took place in the second half of 2015, divided into 10 (ten) stages:

Step 1) Bibliographic research: in the first half of June 2015, a search for books and related articles were carried out to support the research;

Step 2) Study of rules and legislation: in the second half of June 2015, the rule NBR 9050: 2004 and law decree 5296: 2004 were studied, to have technical and legal knowledge on the issue of accessibility;

Step 3) Sample definition: in the first week of August 2015, classrooms, pavilions and their quantities were defined to serve as a basis for the study of this article.

The definition of the sample counted with the help of the FT hours accessibility manual project, which aimed to assemble an accessibility manual, according to NBR 9050: 2004, based on the conformities and non-conformities found in the premises of the Faculty of Technology. In the development of this project, a data survey was carried out in which it was found that the classrooms were one of the places that most presented non-conformities concerning accessibility. With that, it was defined that the classroom would be the object of study and that the pavilions that had some classroom would be part of the research.

The Engineer Nelson Ribeiro, Rio Canumã and Rio Tapauá pavilions are the only ones that have classrooms and are available to the academic community, as the remaining pavilions are divided between laboratories, workshops, studios, study and research rooms, among others.

The classrooms of the 3 pavilions, Engineer Nelson Ribeiro, Rio Tapauá and Rio Canumã, total 36 classrooms of which 17 were randomly chosen, representing approximately 47% of the total classrooms at the Faculty of Technology.

Step 4) Initial visit to the rooms: in the first week of August 2015, an initial visit to the rooms was made to see what could be analyzed considering NBR 9050/2004;

Step 5) Definition of parameters and criteria for analysis: in the second week of August 2015, the following parameters and criteria were defined: anthropometric parameters, access and circulation, signaling, furniture, and urban equipment. The parameters are related to the manual reach of sockets, light switches, and air conditioning and the criteria are related to the measurements and specifications of the gap in the door, advancement and lower height for desk, installation of a handle, blackboard, spacing between corridors, signs on the doors and at the walls.

Chart 1 shows what will be analyzed as a parameter and as a criterion and what is related to them:

Criterion				**Parameter**
Access and Circulation	**Signaling**	**Urban equipment**	**Furniture**	**Anthropometric parameters**
Door	Visual signage at the door entrance	Blackboard	Desk	Light switch
Corridor between the row of chairs	Signaling at the wall	-	-	Air conditioning switch
Corridor between the chairs and wall	-	-	-	Socket

Chart 1 – Criterion and NBR 9050:2004 Parameters.
Source: Author (2016).

In each parameter and criterion, the following was analyzed:

1. Doors: the gap of the width, the gap of the height of the door, the height of the handle installation and the type of handle were verified. In the signage criterion, the signage on the fence (wall, panel or partition), visual signage about the information and the installation heights were analyzed.

2. The corridor between the rows of chairs: the free space between the rows of chairs in the classroom was analyzed;

3. The corridor between the chairs and the wall: the free space between the first chairs and the wall where the blackboard is installed was verified;

4. Light, air conditioning and socket switches: the anthropometric parameter analyzed in these items refer to the installation height, that is, lower height;

5. Desk: it is a standard furniture criterion, where there were a lower height and the advance that can be

made on the desk and if there is an adaptable desk available to a person in a wheelchair;

6. Blackboard: this last item of the furniture criterion, the lower height of installation of the slate was verified.

Step 6) Creation of the data collection instrument: in the third and fourth weeks of August 2015, a checklist was developed (Appendix A) to assess the physical space of the rooms based on the definitions in step 5;

Step 7) Data collection: the checklist was applied in 17 rooms during September 2015 with measurements and record of activities through photographs;

Step 9) Data analysis: between October and November 2015, during the collection, the data were collected and then digitalized and built charts, desks, and graphs to discuss the results and build the article;

Step 10) Construction and defense of the article: between January and April 2016, the article was written for defense in early May 2016.

4. Discussion

The results of the data collection, in general, were not positive, the numbers in red color mean that they do not meet the requirements of the standard, as discussed below.

4.1 Access and Circulation

4.1.2 Access and Circulation at the classroom door.

Item 6.9.2.1 of NBR 9050: 2004 states that the door of a location must have a minimum width and height of 0.80m and 2.10m, respectively. The handles must be installed at a height between 0.90m and 1.10m high and be of the lever type according to item 6.9.2.3.

Pavilion	**Gap - Height (2,10m)**			**Gap - Width (0,80m)**			**Handle installation height (0,90 à 1,10m)**			**Handle**
Engineer Nelson	**Lowest Value**	**Medium Value**	**Highest Value**	**Lowest Value**	**Medium Value**	**Highest Value**	**Lowest Value**	**Medium Value**	**Highest Value**	**Lever type**
Ribeiro	2,06m	2,07m	2,08m	0,76m	0,77m	0,78m	1,04m	1,05m	1,08m	Yes
Rio Tapauá	2,08m	2,10m	2,13m	0,76m	0,77m	0,78m	1,05m	1,07m	1,08m	No
Rio Canumã	2,13m			0,78m			1,05m			No

Chart 2 – Values of items for access and circulation in the doors

Source: UFAM (2016).

Analyzing the results of Chart 2 above, it was found that 100% of the doors were disapproved concerning item 6.9.2.1, as they do not simultaneously meet the minimum values of width and height. However, about the installation height and the handle type, it was considered that 70% complies with what item 6.9.2.3 of NBR9050: 2004 asks for.

It is worth mentioning that the non-conformity related to the dimensions above (values in red color) can compromise the access of a student, teacher or even visitor who has a temporary or permanent physical restriction in a wheelchair, walker or even a crutch in the classroom.

In the Rio Tapauá and Rio Canumã pavilions, although the height of the door handles was considered to be within the standard, the door handles are not a lever type, which causes a person to enter the classroom to exert a force more than 36N.

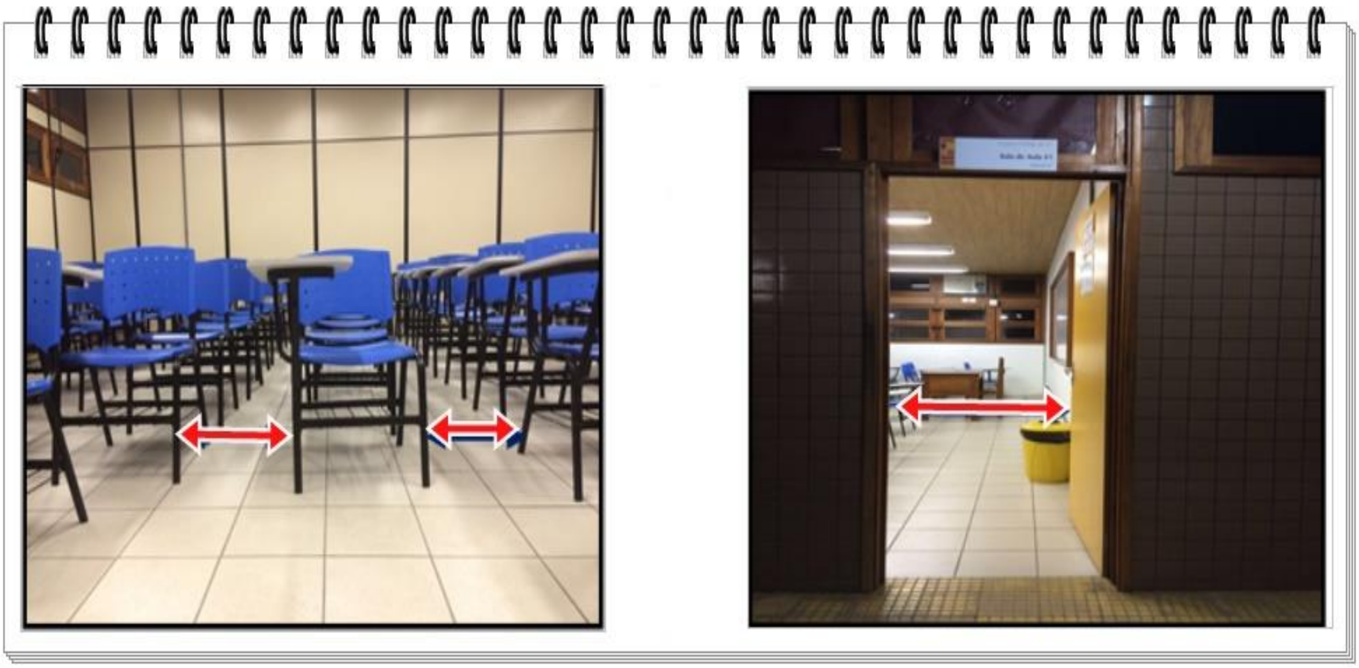
4.1.2 Access and Circulation involving chairs and wall

Item 6.9.1.1 of NBR 9050: 2004 states that the space in the corridors must be 1.20 m for corridors in common use with an extension up to 10.00 m; and 1.50 m for corridors longer than 10.00 m.

To define the free space, both for the main corridor formed by the distance from the first chairs to the wall where the blackboard was installed, and for the free space between the rows of chairs, it was necessary to know the length of the corridors.

The corridor between the rows of chairs is approximately 5.0 m long and the main corridor is approximately 9.0 m long, so the analysis took into account that the two corridors had to have a free space of at least 1.20 m width.

Figures 3 and 4 below represent the corridors existing in the classrooms and the arrows represent where measurements were taken for comparison with the standard.



Figures 3 and 4 - Corridor between the rows of chairs (left) and classroom main corridor

Source: Author (2016)

The values found for the corridors between the rows of chairs and the main corridor are shown in Charts 3 and 4:

Pavilion	Corridors between the rows of chairs /desk (1,20 m)		
Engenheiro Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,40m	0,73m	0,90m
Rio Tapauá	0,68m	0,72m	0,80m
Rio Canumã	0,78m		

Chart 3 –Access and Circulation between the rows of chairs.
Source: Author (2016)

Pavilion	Main corridor (1,20 m)		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	1,38m	1,52m	1,62m
Rio Tapauá	1,59m	1,62m	1,69m
Rio Canumã	1,75m		

Chart 4 – Access and Circulation in the classroom main corridor
Source: Author (2016)

It can be seen (Chart 3) that the corridors between the rows of chairs in the Engineer Nelson Ribeiro, Rio Tapauá and Rio Canumã pavilions do not meet item 6.9.1.1, which defines the width for corridors up to 10m must be 1.20 m, so they fail 100%.

On the other hand, the values raised in (Chart 4) the main corridor of the 3 pavilions meet the minimum requirement required by the standard and are 100% compliant since the lowest value found in the corridors was 1.38 m which shows that any person independent of his physical condition can move about him without any problem.

It is important to note that the non-conformity related to the free space between chairs implies poor circulation of students in the room, because, often, so that they have access to the desired place to sit and watch the class, they enter the corridor of the rows of chairs due to lack of space. This situation is even worse for a student with physical restraint, such as a wheelchair or on a crutch, for example, to have access to the chairs, at least, the student will have to ask someone a place or ask for help from people in the room to move their chairs away.

4.2 Signaling

4.2.1 Signaling at the doors.

Item 5.10 of NBR 9050: 2004 says that there must be visual information on the door (room number, function, etc.), installed at a distance of 1.40 m from the floor. The tactile signs (in Braille or embossed text) must be installed on the door casing or in the fence (wall, partition or panel), on the side where the handle is, at a height between 0.90 m and 1.10 m.

The circles and arrows in Figure 5 shows where the information for the data collection in Chart 5 was taken from.

The survey (Chart 5) showed that there are signs on the doors, but they do not meet item 5.10 of NBR 9050: 2004, which states that there must be signs not only on the door but also on the adjacent fence and these signs must meet the heights suggested by the standard. For this reason, the signs on the doors are 100% disapproved.

All visual signs on the doors of the pavilions are installed above 2.10 m in height. To reverse this situation, the college placed an improvised A4 sheet on the doors with information about the names of the subjects and the times. Also, a student or teacher who has a visual impairment will have more difficulties in accessing the information in the classrooms, as in no pavilion there is tactile signage in Braille or embossed on the doors.

Figure 5 – Signaling at the doors
Source: UFAM (2016)

Pavilion	Visual signaling at the door	Signaling at a distance of 1.40 m from the floor	Signaling in the wall	Fence signage at a height between 0.9m and 1.1m from the floor
Engineer Nelson Ribeiro	Yes	No	No	No
Rio Tapauá	Yes	No	No	No
Rio Canumã	Yes	No	No	No

Chart 5 – Information about signage in the FT/UFAM classrooms
Source: UFAM (2016)

4.3 Urban Equipment

4.3.1 Blackboard

NBR 9050: 2004 in item 8.6.8 says that the slates must be accessible and installed at a maximum height of less than 0.90 m from the floor. Chart 6 and Figure 6 show the results of the measurements and the photo taken during data collection, respectively.

In this regard, 100% of the measurements (Chart 6) of the height of the installation of the blackboards in the classrooms of the 3 (three) pavilions are out of the standard.

Failure to comply with the height of installation of the blackboards can cause problems in the manual reach of teachers and students when they are going to use them, as a person to write will have to make a greater effort to reach the top and also people with short stature or wheelchair users can reach only the center or bottom of the board, leaving little space for writing.

Pavilion	Height of Installation (0.90m)		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,95 m	1 m	1,22 m
Rio Tapauá	0,92 m	0,93 m	0,95 m
Rio Canumã	0,92 m		

Chart 6 – Height of blackboards.
Source: Author (2016).

Figure 6 – One of the blackboards measured
Source: Author (2016)

4.4.1 Desk

Items 9.3.3.1 and 9.3.3.3 of NBR 9050: 2004 inform that the work desks must have a minimum lower height of 0.73 m and the progress must be 0.50 m. Besides, in item 9.3.1 of the standard, it says that there must be adaptable desks at accessible places and have desks available to the person in a wheelchair.

The desks analyzed concerning the lower height and advance are those used by teachers, as well as the adaptable desks available for a person in a wheelchair was, not only for teachers but also for students. Thus, it was observed that in each classroom there was only one desk for the teacher and depending on the size of the room, there could be 25 to 60 desks with attached arms for students.

The data collected were summarized in Chart 7, whose results indicate that:

a) only one (5.88%) desk for teachers met the minimum lower height of 0.73 m, required by item 9.3.3.1. The majority (15 of them = 88.24%) of them meet the minimum 0.50 m advance required by the standard in item 9.3.3.3.

b) in 100% of the rooms there are no adaptable or available desks for a person in a wheelchair.

Pavilion	Bottom Height (0,73m)			Progress (0,50m)			Adaptable desk	Available desk for person in a wheelchair
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value	Lowest Value	Medium Value	Highest Value	Não	Não
	0,66m	0,70m	0,73m	0,42m	0,53m	0,57m		
Rio Tapauá	0,65m	0,67m	0,69m	0,50m	0,52m	0,53m	Não	Não
Rio Canumã	0,67m			0,53m			Não	Não

Chart 7 - Measurements on desks in 17 classrooms.
Source: Author (2016).

Non-compliance related to the lower height of the teachers' desks can cause a relaxed posture and also possible back pain. These problems arise from the inclination of the trunk that the teacher will have to do so that his body is closer to the desk. Another problem is the absence of adaptable or available desks for a person in a wheelchair, where this implies that if perhaps, there is a student or teacher in a wheelchair, they will have difficulties in carrying out their activities in the classroom, as there is no way for a student or teacher to support their material or equipment appropriate to carry out your activities.

4.4 Anthropometric parameters

4.4.1 Socket height.

Item 4.6.7 of NBR 9050: 2004 defines installation height for controls and controls that can be socket, doorbell, light board, heater, intercom, among others. In this case, only sockets and switches in the classroom were analyzed.

For sockets, item 4.6.7 states that the recommended installation height is at least 0.40 and at most 1 m. Figures 7 and 8 represent the sockets found and their positions.

The results in Charts 8 and 9 show that the analyzed sockets failed 100% in both vertical and horizontal measurements. It is important to note that in the Rio Canumã and Tapauá pavilions there are no sockets in the horizontal position, which is why there are no values in Chart 8 for them.

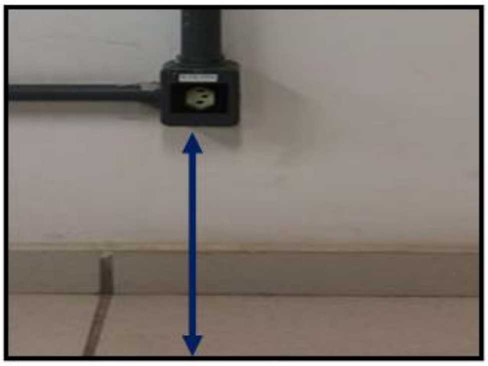


Figure 7 – Vertical socket.
Source: Author (2016).

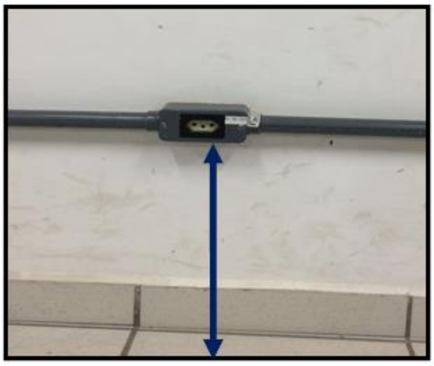


Figure 8 – Horizontal socket.
Source: Author (2016).

Pavilion	Bottom height of the vertical socket (0,40 à 1m).		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,29 m	0,30 m	0,31 m
Rio Tapauá	0,22 m	0,23 m	025 m
Rio Canumã	0,22 m		

Chart 8 – Bottom height of the vertical socket
Source: Author (2016).

Pavilion	Bottom height of the horizontal socket (0,40 à 1m).		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,27 m	0,30 m	0,31 m
Rio Tapauá	-	-	-
Rio Canumã	-		

Chart 9 – Bottom height of the horizontal socket.
Source: Author (2016).

The problem caused by the non-conformity of the sockets is concerning the manual reach and effort required to reach them, as students and teachers need to bend down out of the ordinary to be able to use a simple socket.

4.4.2 Height for switches

About the item 4.6.7, the standard says that the height for installing switches is at least 0.60 and at most 1 m. Figures 9 and 10 show the height of the light and air conditioning switches.

Figure 9 – Height of the light switch.
Source: Author (2016)

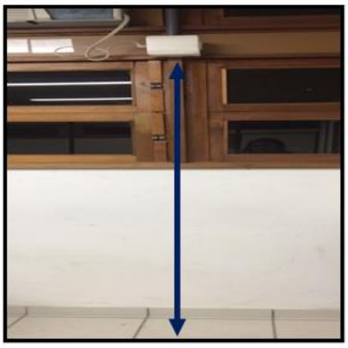


Figure 10 – Height of the air conditioning switch.
Source: Author (2016)

The values found in the data collection for the height of installation of the light and air conditioning switches are shown in Charts 10 and 11.

Pavilion	**Bottom height of the light switch (0,60 à 1m)**		
Engineer Nelson Ribeiro	**Lowest Value**	**Medium Value**	**Highest Value**
	1,06m	1,10m	1,12m
Rio Tapauá	1,08m	1,10m	1,12m
Rio Canumã	1,11m		

Chart 10 - Measurement of the light switch heights
Source: Author (2016)

Pavilion	**Bottom height of the air conditioning switch (0,60 à 1m)**		
Engineer Nelson Ribeiro	**Lowest Value**	**Medium Value**	**Highest Value**
	1,17m	1,95m	2,2m
Rio Tapauá	-	-	-
Rio Canumã	-		

Chart 11 - Height of the air conditioning switch.
Source: Author (2016)

Looking at the measurements in Charts 10 and 11, it is clear that 100% of the measurements are outside the standard required. Regarding the lower height of the light switch, it was found that the values are above the maximum limit allowed by the standard by up to 0.12 m, but the biggest difference identified was in the height of the air conditioning switch, where a value was found up to 1.2 m above the permitted limit. The problem with the switches concerning their height is the manual reach. In the classroom of the Engineer Nelson Ribeiro pavilion, for example, some students get on their chairs to turn the air conditioning on or off at the serious risk of having an accident.

The Rio Tapauá and Canumã pavilions do not have switches because they are split-model air conditioning and for this reason, no measures were taken.

5. Conclusions and recommendations

The article analyzed the problems of accessibility to the FT/UFAM classrooms based on NBR 9050: 2004, to propose suggestions for improvements for the University's managers.

The analysis consisted of verifying what was and did not comply with the requirements of the Standard, through a checklist applied in 17 rooms of the Engenheiro Nelson Ribeiro, Rio Tapauá and Rio Canumã pavilions.

The analysis concluded that most of the measured variables do not meet the requirements of NBR 9050: 2004. The most critical problems are related to a) the gap in width and height of the doors; b) the width of the corridors between the rows of chairs; c) the signs on the doors; d) the height of installation of the blackboards; e) the absence of desks adaptable and available to a person in a wheelchair; f) the height for installing sockets; g) the height of the light and air conditioning switches. All of these items were 100% disapproved, as they did not meet the minimum requirements required by the standard.

Therefore, it is recommended that:

a) to overcome non-conformities about the width and height of the doors, it is necessary that, when there are renovations in the pavilions, the FT/UFAM managers, in partnership with the construction company responsible for the work, take into account what the NBR 9050: 2004 suggests concerning the measures for the classroom doors so that all students have equal access to the place;

b) One of the alternatives to overcome the problem to the corridors between the rows of chairs is to reduce the number of students in the classrooms, redistributing classes with more students to larger rooms. This alternative will help to improve access, circulation and learning in the classroom as the students at the back are very far from the blackboard and consequently from the teacher. It is recommended that a study be made on the demand for classrooms for each course, to better dimension the size of the FT UFAM classrooms;

c) Plates installed above 2.10 m in height can be moved and installed in the center of the door at the height suggested by the standard and the improvised A4 sheet can be placed on the pavilion's corridor mural for students and teachers if they want to have more information of the rooms can consult. With the signage on the fence near the door handle, the Faculty may request the purchase of material to install the signage in Braille or embossed;

d) The non-conformity about the installation height of the blackboards can be overcome with its movement. The blackboard of Engineer Nelson Ribeiro Pavilion to reach the height required by the standard can be moved without any problem, as they are only screwed into the walls. However, the blackboards of Rio Canumã and Rio Tapauá, to be moved, need to remove the beams below them that serve as support for brushes and erasers;

e) The absence of desks adaptable and accessible to a person in a wheelchair in the rooms can be overcome with the purchase of desks for people with needs;

d) Sockets and switches to reach the minimum height required by the standard must be moved when there is a possible renovation in the Faculty, where those responsible for the work in partnership with the building maintenance coordination take into account the minimum installation height required by the standard.

6. Appendix A – Checklist

Auditoria Sala de aula. Data: __/__/____

Bloco:______________________________ Andar: ___________________

	Portas	
Vão Livre largura da porta	Largura:	Min. 0,80 m
Vão Livre altura da porta	Altura:	Min. 2,10m
Tipo de Maçaneta	Alavanca ( ) Sim ( )Não Que tipo?	Devem ser do tipo de alavancas
Altura da Maçaneta		Altura entre 0,90m e 1,10 m
	Sinalização nas portas	
Sinalização Tátil na entrada da sala	( ) Possui ( ) Não Possui	Tem que ter sinalização tátil na entrada das salas
Altura de instalação da sinalização Tátil na entrada da sala.	Altura Inferior:	A altura inferior da sinalização deve ser instalada a 1,40m do chão.
Sinalização no vedo	( ) Possui ( ) Não Possui	Sinalização tátil em braile ou relevo.
Altura de instalação da sinalização no vedo.	Altura Inferior:	A altura inferior deve ser instalada a 0,90 e 1,10m do chão
	Corredores	
Espaço livre entre as fileiras das cadeiras	Largura:	O corredores com exten~soa até 10m devem ter um espaço de 1,20m.
Espaço livre entre as primeiras cadeiras e a lousa	Largura:	
	Tomadas e Interruptores	
Interruptor	Face Inferior: Face Superior:	Entre 0,60 m e 1,0m
Tomada	Face Inferior: Face Superior:	Entre 0,40m e 1,0m
Quadro de luz	Face Inferior: Face Superior:	Entre 0,80m e 1,20m
	Equipamento	
Lousa	Face Inferior: Face Superior:	Altura Inferior Máxima 0,90 m do piso
	Mobiliário	
Mesas individuais acessiveis e disponivel a P.C.R	( ) Possui ( ) Não Possui	Pelo menos 1% do total deve ser acessível a P. C.R Min 1 para cada 2 salas
Mesas	Altura Avanço	As mesas ou superficies devem possuir altura livre inferior de no mínimo 0,73 m do piso. Deve ter um avanço de 0,50m.

Observações:

7. References

[1] ALCADE, E. A. et.al. **Acessibilidade nas faculdades integradas de três lagoas: indivíduos com dificuldade de locomoção, temporária ou permanente**. Disponível em: http://www.aems.edu.br/conexao/edicaoanterior/Sumario/2012/downloads/2012/humanas/ACESSIBILIDADE%20NAS%20FACULDADES%20INTEGRADAS%20DE%20TR%C3%8AS%20LAGOAS.pdf. Acesso em: Abril de 2016.

[2] ALMEIDA, P. A. S.; BUENO, C. L.. **Acessibilidade de "cadeirantes" no espaço de ensino público: unesp, campus de presidente prudente – sp**, 2011. Disponível em: http://revista.fct.unesp.br/index.php/topos/article/viewFile/2283/2088. Acesso em: abril de 2016.

[3] ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **NBR 9050:2004 - acessibilidade a edificações, mobiliário, espaços e equipamentos urbanos**. Rio de Janeiro, 2004.

[4] BITTENCOURT, L. S. et al. **Acessibilidade e Cidadania: barreiras arquitetônicas e exclusão social dos portadores de deficiência física**. Anais do 2º Congresso Brasileiro de Extensão Universitária, 2, Belo Horizonte, 2004. Anais... Belo Horizonte, 2004.

[5] CASTRO, S. F.. **Ingresso e permanência de alunos com deficiência em universidades públicas brasileiras**, 2011. Tese (Doutorado em Educação Especial) – Programa de Pós-Graduação em Educação Especial. Disponível em: **http://www.bdtd.ufscar.br/htdocs/tedeSimplificado//tde_busca/arquivo.php?codArquivo=4149**. Acesso em: Abril de 2016.

[6] FERREIRA, A. B. de H. **Novo Dicionário Aurélio da Língua Portuguesa**. Rio de Janeiro: Nova Fronteira, 2010.

[7] FRESTEIRO, R. H. **A influência da iluminação: identificando barreiras**. In PRADO, A.R. de A.;

[8] GODINHO, F. **Conceito de Acessibilidade**. Disponível em http://www.crea-go.org.br/site/acessibilidade. Acesso em: abril de 2015.

[9] INSTITUTO NACIONAL DE ESTUDOS E PESQUISAS. **Sistema Nacional de Educação Superior**, 2011. Disponível em: http://portal.inep.gov.br/superior-sinaes. Acesso em: Abril de 2016

[10] MANZINI, E. J. et al. **Acessibilidade em ambiente Universitário: identificação e quantificação de barreiras arquitetônicas**. In: MARQUEZINI, M. C. et al. (Org.). Educação física, atividades lúdicas e acessibilidade de pessoas com necessidades especiais. Londrina: Uel, 2003. p.185-192 (Coleção Perspectivas Multidisciplinares em Educação Especial, v. 9).

[11] LOPES, M. E. ; ORSTEIN, S.W (Org). **Desenho universal: caminhos da acessibilidade no Brasil**. 1 ed. São Paulo: Annablume, 2010.p. 117-127.

[12] MINISTÉRIO DA EDUCAÇÃO. **Sistema Nacional de Educação Superior**, 2016. Disponível em: http://portal.mec.gov.br/component/content/article?id=12303:sistema-nacional-de-avaliacao-da-educacao-superior-sinaes. Acesso em: Abril de 2016.

[13] MOREIRA, S. G. et. al. **Estudo ergonômico de instalações de uma instituição de ensino superior pública**, outubro de 2013. Disponível em: http://www.abepro.org.br/biblioteca/enegep2013_tn_stp_180_028_22747.pdf.Acessoem. Acesso em: Abril de 2016.

[14] NÚCLEO DE ACESSIBILIDADE DA FCMSCSP. **Acessibilidade institucional**. Disponível em: file:///C:/Users/Edileu/Desktop/Projeto%20Fina%20lde%20Curso/Artigos%20Acessibilidade/Acessibilidade%20Institucional%20santa%20casa.html. Acesso em: Abril, 2016

[15] REMIÃO, J. L. **Acessibilidade em Ambientes escolares: dificuldades dos cadeirantes**. Trabalho de Diplomação (Graduação de Engenharia Civil) – Departamento de Engenharia Civil, Universidade Federal do Rio Grande do Sul.

[16] ROSSO, M. S. **Desenho Universal: arquitetura inclusiva**. Disponível em: http://au.pini.com.br/arquitetura-urbanismo/180/arquitetura-inclusiva-acessibilidade-128101-1.aspx. Acesso em: abril de 2016.

[17] SECRETARIA NACIONAL DE DIREITOS HUMANOS. **Direitos das Pessoas com Deficiência: Conceitos, Tendências e Desafios**, março, 2015. Disponível em: http://www.cnpd.gov.br/wp-content/uploads/Apresentacao-SDH.pdf. Acesso em: 18 abril 2016.

[18] SHEPPARD, M. **Social work and social exclusion: the idea of practice**. Aldershot: Ashgate, 2006. Acesso em: abril de 2016.