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DESCRIPTIVE STUDY FOR THE ELABORATION OF STAIR LIFTING PLATFORMS

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Abstract

This article aims to describe the process of designing stairlift platforms, focusing on the Brazilian Standards (NBR): NBR 9050:2020 and NBR ISO 9386-2:2012. Such norms refer to accessibility, the right and scope, in addition to representing the social inclusion of people with some type of disability, or with reduced mobility. In this way, through a case study in a kindergarten school, we sought to develop a project for a 2D elevator platform on stairs, to improve the accessibility of children with disabilities and elderly people with reduced mobility who attend the site, in order to enable locomotion by means of a lifting platform for stairs. From the information and technical specifications presented in NBR 9050:2020 and NBR ISO 9386-2:2012, it was possible to develop the project for the school, considering the measures specified in the standards, as well as activation, speed, displacement, safety measures, among others. Thus, in addition to the search for knowledge, the elaboration of the project made it possible to develop studies on lifting platforms that guarantee safer accessibility for all, and also guarantee the full exercise of citizenship.

Keywords: Accessibility; Lifting platform; Stairs.

1. INTRODUCTION

Accessibility is one of the main issues that contribute to the quality of life and the full exercise of citizenship of people with reduced mobility and disabilities (Cercal et al., 2014). A built space, accessible to all, is capable of offering equal opportunities to its users (Cruz et al., 2020).

According to data released in 2019 by the National Health Survey (PNS), 17.3 million persons aged two years and over (8.4% of this population) had some disability and about 8.5 million (24.8%) of elderly people were in this condition). It should also be noted that the highest percentage of persons with disabilities was in the Northeast (9.9%), followed by the other regions: Southeast (8.1%), South (8.0%), North (7.7%) and Central-West (7.1%). Among children aged 0 to 9 years, 1.5% (332 thousand) had some type of disability, while among the

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elderly (60 years and over), this percentage was 24.8% (8.5 million) (Brazilian Institute of Geography and Statistics, 2021).

In this context, when considering the number of people with disabilities and reduced mobility in Brazil, it is relevant to point out specific legislation that aims to establish guidelines for the adequacy of public and private spaces, which aim to offer accessibility to this public. However, even with specific legislation, there are still numerous inadequately built stairs, non-standard elevators, among other irregularities (Cercal et al., 2014).

As highlighted by the authors Oliveira & Resende (2017), architectural barriers can be defined as obstacles built in the urban environment or in buildings, which prevent/hinder the free movement of people who suffer from some transitory or permanent disability.

One solution for promoting accessibility on stairs is the construction of electric tail lifts. The choice of platforms designed to transport the user along an inclined path that, in general, follows the inclination of the stairs, is due, in most cases, to the practicality and associated economy. In addition, projects like this require less intervention in the environment, being restricted to a small portion of the stairs. Compared to projects of greater intervention, such as in the case of elevators, in which it is almost always necessary to intervene in the entire environment, to create the necessary space for the purpose (Mota & Ribeiro, 2016).

Based on the above, in order to contribute to the process of elaboration of accessibility projects for people with reduced mobility and disabilities, this study aims to describe the process of elaboration of stair lifting platforms, focusing on the Brazilian Standards (NBR): NBR 9050:2020 and NBR ISO 9386-2:2012.

2. MOBILITY AND ACCESSIBILITY

As Maciel (2021) points out, the concepts of mobility and accessibility are often used synonymously, however mobility is related to the desire to access a certain destination and the individual's ability to move.

Mobility according to Mota & Ribeiro (2016) consists of the ability to move, as a result of physical and economic conditions, in addition to being associated with people and corresponding to the different responses given by individuals to their travel needs, when considering the dimensions of the urban space and the complexity of the actions developed in it.

Accessibility comprises the ability of individuals to reach a certain place, when considering the effort expended for such displacement. In the case of individuals with special needs, the level of accessibility of a space is increased by promoting greater ease of movement or mobility, in order to ensure less effort spent. Thus, accessibility should always be treated as a requirement of the project (Mota & Ribeiro, 2016).

The Brazilian Association of Technical Standards (ABNT), which is the body responsible for technical standardization in Brazil, through NBR 9050:2020, defines accessibility as:

> [...] the possibility and condition of reach, perception and understanding for the use, safely and autonomously, of spaces, furniture, urban equipment, buildings, transport, information and communication, including their systems and technologies, as well as other services and facilities open to the public, for public or private collective use, both in urban and rural areas, by people with disabilities or reduced mobility. (ABNT, 2020, p. 2).

In the context of accessibility, environments that offer chances of access to individuals with special needs offer stimuli to users, in addition to providing the development of physical and psychological skills, and the improvement of social relationships. On the other hand, if the built space does not allow exploration and adaptation to the existing way of social life, the person with physical disabilities will not be able to develop their skills, and thus, may become frustrated for not being able to understand spaces and socialize through a process common to all (Santos, 2018).

Architectural accessibility is an essential condition in the use of space in a safe and autonomous way. Thus, one of the fundamentals of the architectural program is to offer conditions to facilitate the mobility of all individuals with special needs. In addition, urban planning should facilitate mobility, so that each individual can choose to move as they prefer and adapt to the situation experienced (Santos, 2018).

It is also worth considering that accessibility, in addition to being related to physical-spatial factors, is also related to political, social, and cultural aspects, which influence the performance of activities (Maciel, 2021). Landim (2011) highlights accessibility in public spaces and buildings in Brazil:

> [...] Public spaces are not always designed for human diversity. Often, environments are built with great artistic and cultural potential, but without concern for the inclusion and participation of all potential users, such as those with disabilities or those with reduced mobility. Ensuring accessibility, both of space and of communication and

> information, is an important action so that everyone has the right to leisure, social coexistence and culture. (Landim, 2011, p.30).

In this way, the importance of accessibility for all is verified, both for the physically disabled and the elderly (Maciel, 2021). In this context, Federal Decree No. 5,296/2001 instituted Law No. 10,048/2000 and Law No. 10,098/2000. Law No. 10,048/2000 establishes priority for people with disabilities, the elderly aged 60 (sixty) years or older, pregnant women, breastfeeding women, people with infants and the obese in the areas of public offices, financial institutions, in addition to also including the reservation of seats for public transport companies and public transport concessionaires. This law also expands the public places and toilets of public buildings that have the duty to ensure access to people with disabilities (Maciel, 2021).

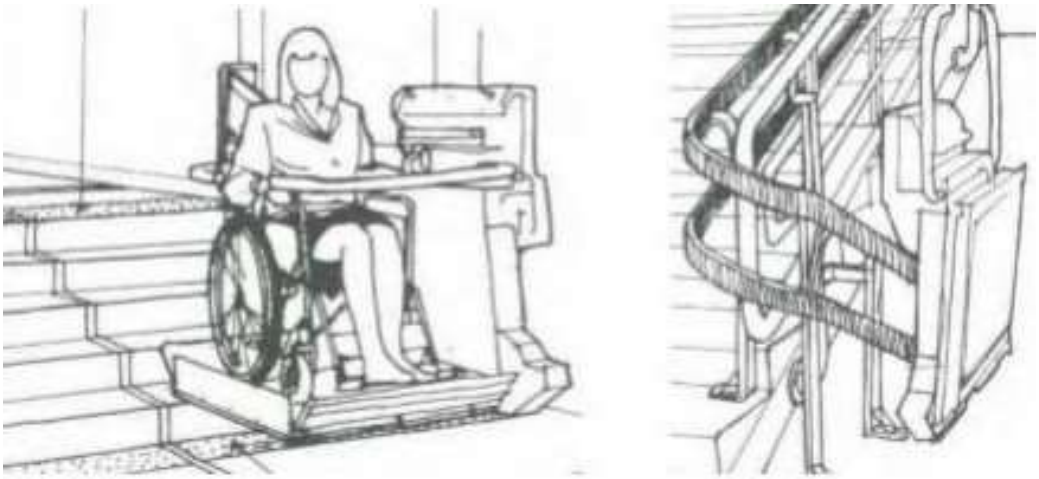
Federal Law No. 10,098/2000 expands the right of the disabled by designating general norms and basic criteria for the promotion of accessibility for people with disabilities or reduced mobility, through the elimination of barriers and obstacles on roads and public spaces, in urban furniture, in the construction and renovation of buildings and in means of communication (Maciel, 2021).

In summary, improvements and adaptations in public, private and residential environments can prevent disabilities, in addition to leading to an increase in social participation, in which such initiatives contribute to people with disabilities or reduced mobility not suffering from social exclusion (Cercal et al., 2014).

3. LIFTING PLATFORMS

According to Sebastião et al. (2017), the lifting platform is an ideal solution to assist the transport of people with reduced mobility and who need to cross stairwells and inclined unevenness. Its installation is easy and does not require major works or modifications to the existing staircase, and when the platform is not in use, it can be retracted in a vertical position, further reducing its space, as can be seen in Figure 1.

Figure 1 – Lifting platform for stairs



Source: Sebastião et al. (2017, p. 15).

It is also important to mention that the accessibility platform is fully automated, allows total autonomy and freedom to the wheelchair user, who performs movements on the platform, without the need for personal work assistance, since the platform has access ramps that lower automatically and safety handrails. In addition, the platform can be installed indoors and outdoors, as it is resistant to weather and adverse conditions (Mota & Ribeiro, 2016).

Sebastião et al. (2017), cite in their study types of accessibility platforms, such as the Artira platform, Xpress II platform, and X3 platform. The Artira is an inclined platform, designed to carry passengers in a straight line or curved staircase, over flat landings or over spiral staircases. Artira is equipped with Smart-Lite technology, a feature that places it as the easiest inclined platform on the market, in addition to guiding the user through sequences of operations, as can be seen in Figure 2.

Figure 2 – Artira Platform

Source: Tecno Mobile (2020).

The Xpress II wheelchair lift platform is an ideal accessibility solution for straight stairs with two landings, which can be mounted on both sides of the stairs, depending on their design and location. The Xpress II model uses the mains power supply and is available both as backup material for full operation in the event of a power outage or in the event of an emergency. It consists of the most robust straight-tilt lifting platform available on the market, being suitable for heavy commercial applications (Sebastião et al., 2017). Figure 3 illustrates this model.

Figure 3 – Xpress II Platform

Source: Archiproducts (2022a).

The X3 inclined platform is ideal to be deployed on straight stairs inside homes or commercial premises. This model is powered by chargeable batteries, which are charged when the elevator is not in use or is parked at one of the landings. The wall controls are wireless, which provides a simpler installation compared to traditional wheelchair lifts (Sebastião et al., 2017). In this model, it is not necessary to install wires in the walls, and the X3 inclined platform can be installed with minor structural modifications. Figure 4 illustrates X3.

Figure 4 – Platform X3

Source: Archiproducts (2022b).

Inclined travel platforms have the advantage of requiring less power from the drive system. The fact that the transfer occurs within an inclined plane reduces the forces to be overcome by the components parallel to this plane. Such a reduction in power translates directly into savings in the drive system adopted in the project, in which, as an example, if this system is composed of an electric motor, the reduction in the required power requires a less robust and consequently cheaper engine (Mota & Ribeiro, 2016).

It is important to mention that further specifications on the sizing of the stair lift platform, as well as measurements of the trolley, drive, travel speed, among other information, are better detailed in the results section.

4. REGULATORY STANDARDS

According to Cercal et al. (2014), approaches aimed at people with disabilities were commonly given in a very superficial way, in addition to having little scope, not going beyond verifying the barriers that prevented the integration of these people. Also according to the authors, this is due to the fact that the main standard aimed at accessibility, NBR 9050, was only published in 1985. NBR 9050 was created with the objective of meeting the needs related to technical references related to accessibility, however there were still flaws and gaps in its formulation.

In 1993, a study group was implemented with the support of the Government of the State of São Paulo, so that it could update and expand the scope of NBR 9050. Later, this standard was published in 2004, with the aim of covering a set of specifications related to the adequacy of the physical space for the inclusion of people with special needs (Cercal et al., 2014).

In 2020, NBR 9050 was revised and began to establish technical parameters to be observed in the design of construction, installation and adaptation of urban and rural environments, and buildings to accessibility conditions. NBR 9050:2020 also considered various conditions of mobility and perception of the environment, with or without the help of specific devices, such as: prostheses, support devices, wheelchairs, tracking canes, hearing aids or any other that may complement individual needs (ABNT, 2020).

The parameters established in standards aim to make the necessary instrumentation so that anyone can adapt to the conditions of the space in question, while adding comfort and functionality, which must accommodate adjustable safety levels according to the need presented by the individual (ABNT, 2020).

As Cercal et al. (2014) clarifies, in the current scenario there are standards that can be applied in residential and commercial environments, aimed at providing an improvement in the quality of people with reduced mobility or disabilities: ABNT NBR 9050: 2020 - Accessibility to buildings, furniture, spaces and urban equipment; and ISO 9386-2:2012 – Motorized lifting platforms for people with reduced mobility - Requirements for safety, dimensions and functional operation Part 2: Stairlifts for sitting, standing and wheelchair users moving on an inclined plane.

It is important to note that before adapting an environment for a person with special needs or reduced mobility, it is first necessary to pay attention to the parameters established in NBR 9050:2020, so that later an implementation of the environment can be carried out with equipment and structures that can contribute and assist in some way in the locomotion of these people (ABNT, 2020).

In this context, NBR ISO 9386-2:2012 is the most evident, since it contains all the specifications, specific requirements, which cover the mechanical and electrical part, and parameters necessary for the preparation of a mobile lifting platform project, in addition to specifying the travel speed (ABNT, 2020).

There are also Regulatory Standards (NRs) that can also assist in the process of preparing lifting platforms in environments, such as: NR 06 – Personal Protective Equipment

(PPE); NR 10 – Safety in Electrical Installations and Services; and NR 12 – Safety at Work in Machinery and Equipment.

NR 06 addresses the responsibility of providing and ensuring the use of PPE to all workers by companies. In this NR, PPE is considered as any device or product, for individual use by the worker, intended to protect against risks that may threaten safety and health at work (Brasil, 1978a).

NR 10 establishes minimum requirements and conditions aimed at the implementation of control measures and preventive systems, so as to guarantee the safety and health of workers who, directly or indirectly, interact in electrical installations and services with electricity (Brasil, 1978b).

And NR 12 provides for technical references, fundamental principles and protection measures aimed at safeguarding the health and physical integrity of workers and establishes minimum requirements for the prevention of accidents and occupational diseases in all phases of the design and use of machinery and equipment, in addition to their manufacture, importation, commercialization, exhibition and assignment in any capacity, in all economic activities (Brasil, 1978c).

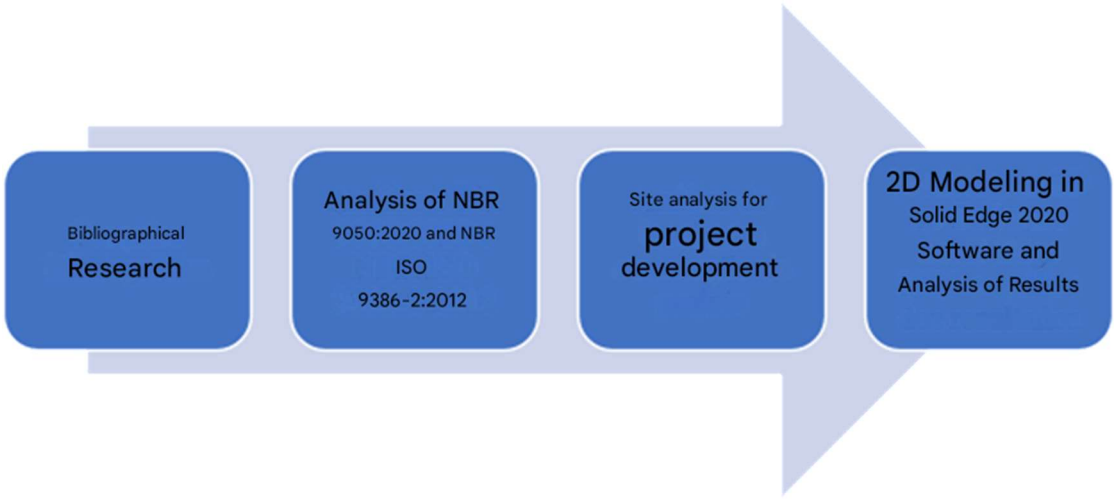
5. METHODOLOGY

It is a study with a qualitative approach, of an applied nature, descriptive as to the objectives, developed through a 2D modeling of a stair lift platform project.

The project was designed to be implemented in an early childhood education school, which receives many visits from elderly people with reduced mobility, in addition to serving children with disabilities.

In order to describe the modeling process of the stair lift platform, the study went through several stages that are illustrated in Figure 5.

Figure 5 – Methodological stages of the study



Source: The authors (2022)

To achieve the research objective proposed in this article, initially the theoretical framework was carried out so that it was possible to plan the research, in addition to contextualizing mobility and accessibility, the types of lifting platforms and the regulatory standards that are currently considered for this type of project.

Then, the Analysis of NBR 9050:2020 and NBR ISO 9386-2:2012 was carried out, along with the analysis of the project implementation site, in which the specific measurements mentioned in NBR ISO 9386-2:2012 were considered, as well as the measurements of the trolley, drive, travel speed, among other relevant information.

Subsequently, 2D modeling was done with the help of *Solid Edge software* version 2020, based on the specifications of NBR ISO 9386-2:2012. It should be noted that the data are predominantly descriptive, as it is a standard with the descriptions of essential requirements for inclined accessibility platforms.

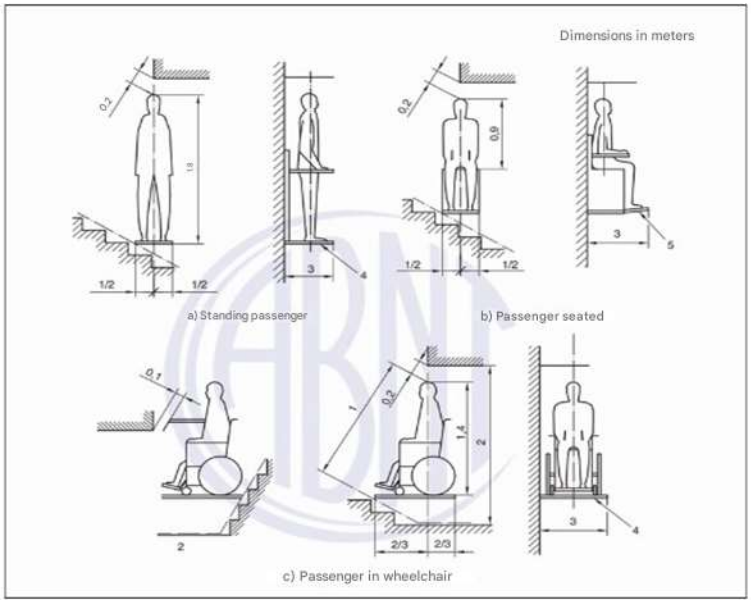
The data are predominantly descriptive. It is a material with descriptions of the company, with the activities performed in the workplaces, the characteristics of the workers and other variables relevant to the study. For this purpose, the methods of field study and case study were used.

6. RESULTS AND DISCUSSION

Lifting platforms have the same utility as elevators, but they can be coupled to stairs, in order to facilitate their use in places with reduced spaces, as in the case of an elevator that requires adequate space for its implementation. In this way, the lifting platform provides greater independence to the user.

For the 2D modeling of the project, the specifications contained in NBR ISO 9386-2:2012 were considered. According to NBR ISO 9386-2:2012, there are 3 configurations of inclined accessibility platforms, namely: a) standing passenger; b) seated passenger; and c) wheelchair passenger, in which both configurations can be better seen in Figure 6.

Figure 6 – Configurations of Tilted Accessibility Platforms



Source: ABNT (2012, p. 47).

Legends: 1 height of the passage.

2. Minimum dimensions at large tilt angles.

3. Width of the stairlift trajectory.

4. Platform.

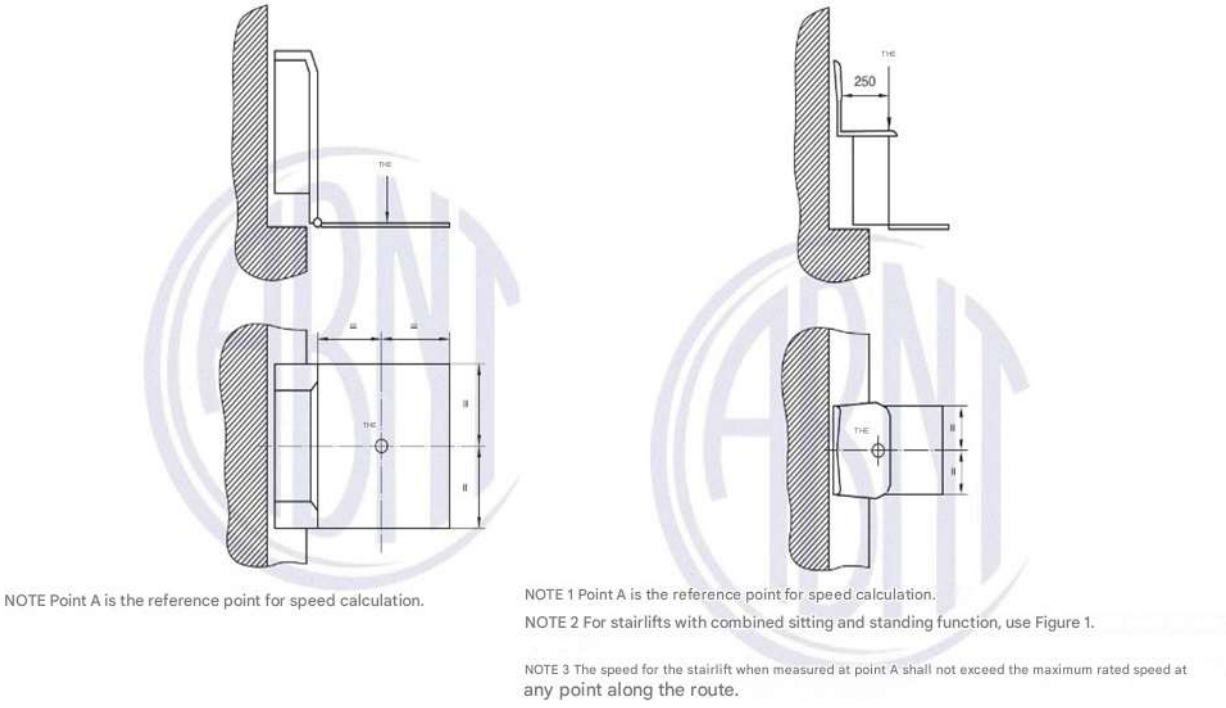
5. Footrest.

According to the specifications of NBR ISO 9386-2:2012, it is recommended that the dimensions of the headspace be obtained over the entire width of the stairlift. In addition, the aforementioned standard recommends that the components of the project must be of safe mechanical and electrical construction, using materials free of obvious defects and that are of sufficient strength and adequate quality. In addition, the specified dimensions must be ensured despite wear. It is also necessary to consider the need to protect against the effects of corrosion, minimize noise and vibration.

Stair lifts should be designed, built and installed should provide greater ease of access for periodic maintenance and repairs. The materials used in the construction of the stairlift must not favor combustion, do not pose a danger through their toxic nature and the amount of gas and smoke that can be generated in the event of a fire.

As for the nominal speed in the direction of travel, it must be less than or equal to 0.15m/s when measured at the reference points shown in Figure 7.

Figure 7 – Reference point for the wheelchair user standing and sitting



Source: ABNT (2012, p. 42-43).

Regarding the nominal load, NBR ISO 9386-2:2012 emphasizes that stairlifts must be designed for one person, in which the nominal load must not be less than 115 kg, or for a person in a wheelchair, with a minimum nominal load of 150 kg. In case the load to be carried is not known, it is recommended that the rated load of the wheelchair stairlift is not less than 225 kg.

The safety coefficient for all parts of the equipment shall be greater than or equal to 1,6, based on the creep resistance and maximum dynamic load. This safety coefficient is based on steel and equivalent ductile materials. "Higher safety coefficients should be considered for other materials" (ABNT, 2012, p. 8).

The complete installation of the stairlift must resist, without permanent deformation, the forces imposed during normal operation, during the application of the safety devices and under impact on the jambs when traveling at rated speed. The guide components, their fittings and joints must withstand deflections due to uneven loads without affecting normal operation.

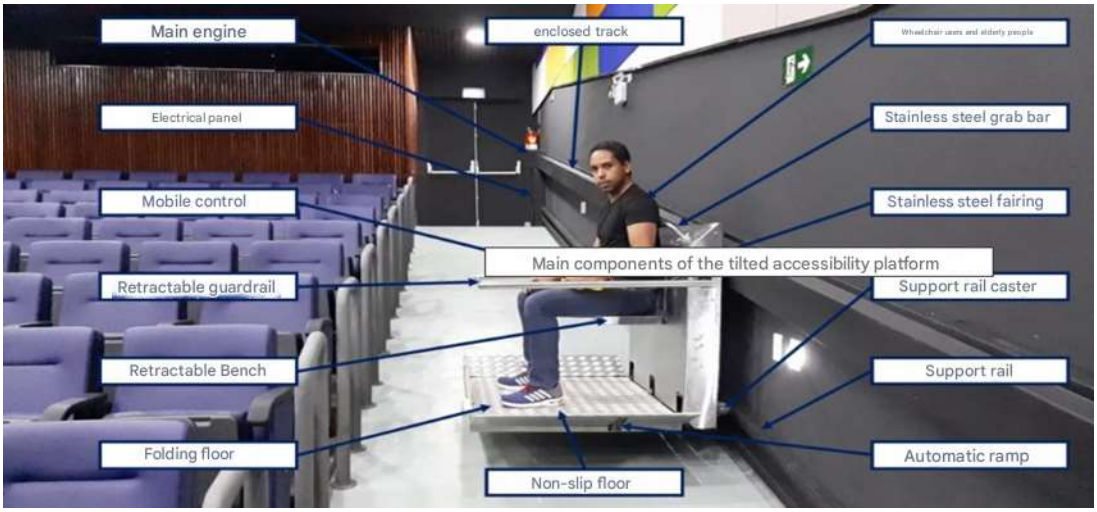
Electrical and mechanical components must be protected against harmful or dangerous effects of external influences encountered in the intended installation area, such as: ingress of water and solid bodies; effects of humidity, temperature, corrosion, air pollution, solar

radiation; and action of flora, fauna, among others. The guard must be designed and constructed and the stairlift must be installed in such a way that influences do not impede its safe and reliable operation.

According to NBR ISO 9386-2:2012, there must be an emergency command device, which when activated, the platform must be inoperative, even if the operating buttons are activated and the platform is energized. It should be noted that the emergency instructions/manual must be displayed prominently, in addition to emphasizing that the stairlift must be turned off and kept under constant surveillance when in emergency operation.

NBR ISO 9386-2:2012 has several safety requirements for accessibility platform projects, such as: non-slip flooring; need for a retractable seat; automatic opening and closing; automatic ramp handling, automatic gate handling; Ramps must have a maximum slope of 8%. Figure 8 illustrates the key components of the tilted accessibility platform.

Figure 8 – Key components of the tilted accessibility platform



Source: IESAB (2021, n.p.).

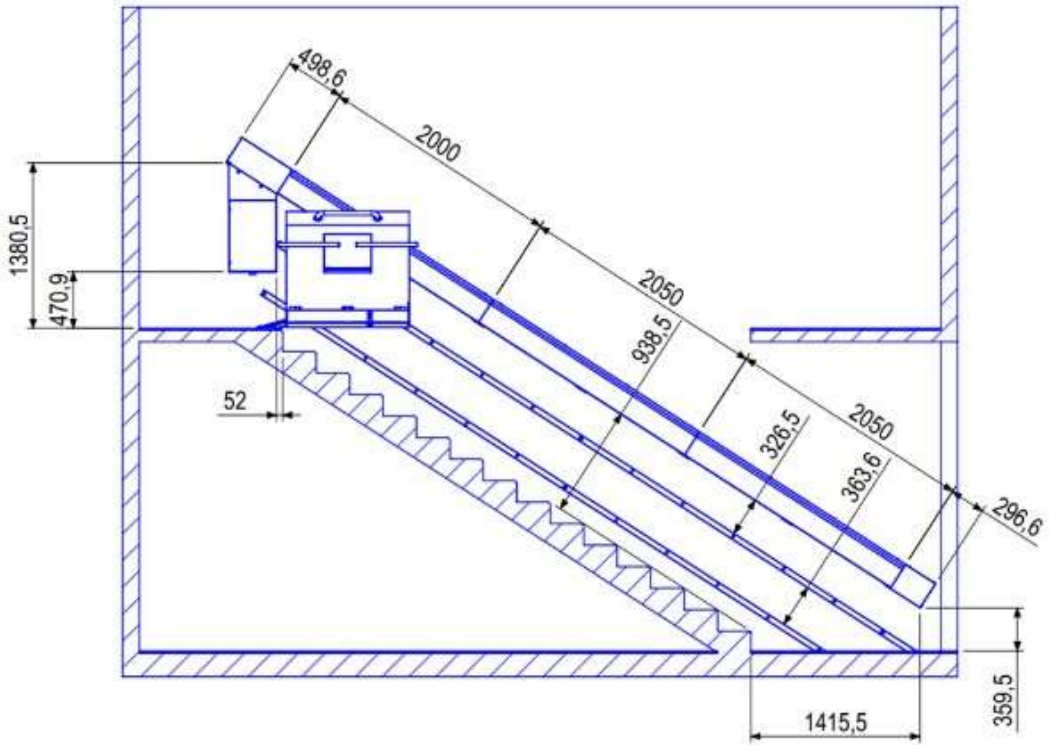
In addition to the necessary components of the platform, it is relevant to mention that the project must be in full compliance with current legislation. These are essential items, both for the safety of users and for the legal support of the owner in the face of any inspection, unforeseen event or accident, and must meet the specifications of NBR ISO 9386-2:2012, NBR ISO 9386-2, NR 10 and meet the standardization required by the municipalities, according to the specifications of each municipality.

When it comes to the minimum dimensions of the project, the standard presents some minimum dimensions that must be respected for the construction of inclined accessibility platforms, namely: "the maximum recommended dimensions for the platform are 900 mm wide

by 1250 mm long. In buildings with public access, the minimum dimensions of the platform must be 750 mm wide by 900 mm long.

Figure 9 presents an example with dimensions of a tilted accessibility platform model. It is important to note that, as the projects are made according to the specifications of each location, there is no standard dimension.

Figure 9 – Dimensions of a Tilted Accessibility Platform Model



Source: IESAB (2022, n.p.).

After following the specifications and guidelines of NBR ISO 9386-2:2012, the project of stair lifting platforms was prepared to be implemented in an early childhood education school that receives many visits from elderly people with reduced mobility, in addition to serving children with disabilities.

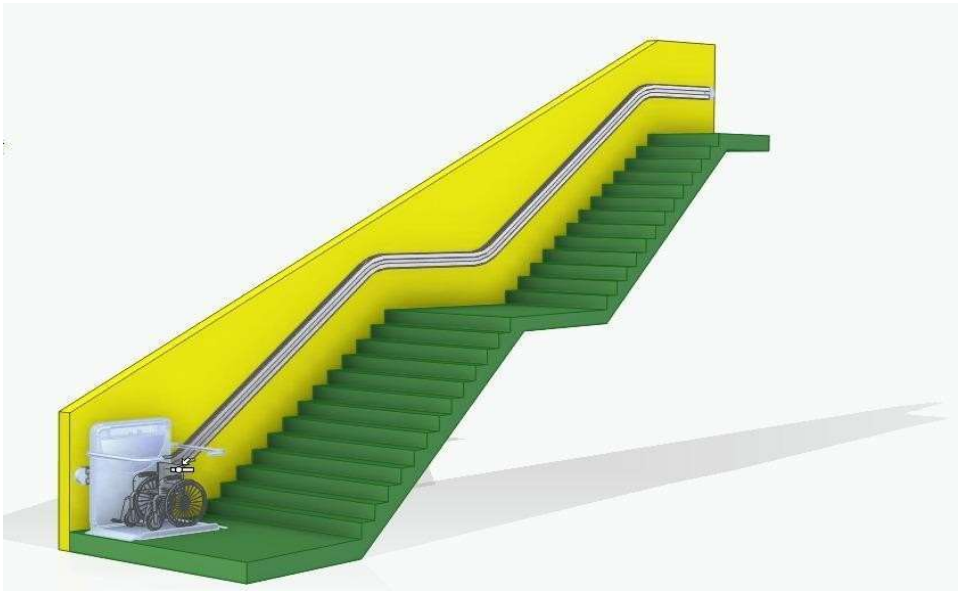
Thus, when considering the dimensions specified in NBR ISO 9386-2:2012, it used the *Solid Edge* 2020 Software to prepare the 2D modeling of the project, as shown in Figures 10, 11 and 12. Figure 10 shows the path that will be taken by the cart, as well as where it will be parked.

Figure 10 – Path to be taken by affection

Source: The authors (2022).

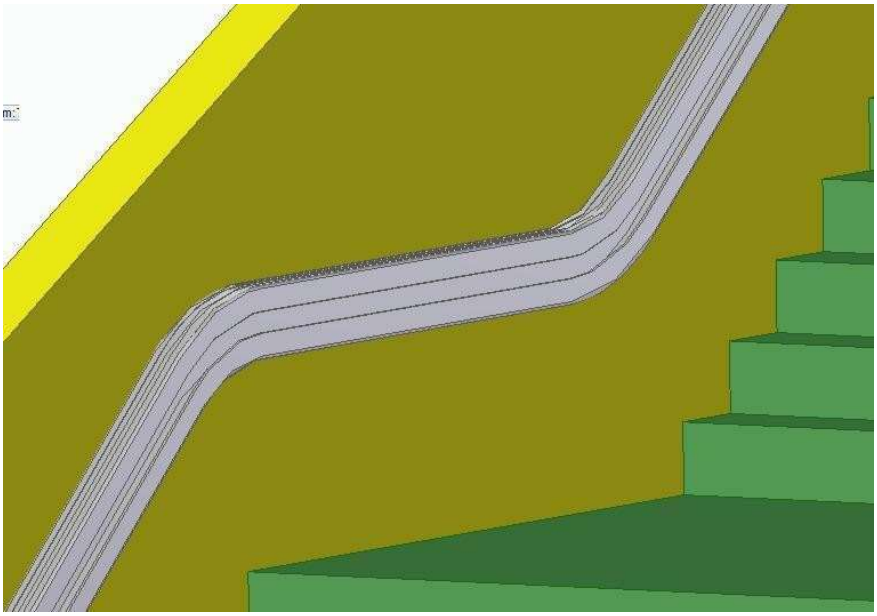
Figures 11 and 12 illustrate the place where the cart support will pass, where it will be guided when making the curves of the stairs and stops.

Figure 11 – Cart guide



Source: The authors (2022).

Figure 12 – Detail of the tab



Source: The authors (2022).

According to NBR ISO 9386-2:2012, mechanical guides and stops must be provided to maintain and guide the car throughout its route, and be made of metal. Hinged rails may not obstruct the staircase or floor when held in the folded position. In addition, manually hinged sections must be counterbalanced, and a safety switch must be installed to prevent the stairlift from reaching the hinged section of the guide, except when the hinged section is correctly positioned for elevator operation. The control system of motorized articulated guides must operate at constant pressure, that is, tighten to work.

The project will feature different types of materials, such as: stainless steel, 1020 steel and 1045 steel. Such materials. They were chosen according to the technical needs of the project, but always seeking to please the owner of the school and its users in an aesthetic and visual way. The platform will also have guides for the visually impaired, and a side support to hold on. The railing will be retractable to minimize the space occupied when the system is not used, in order to generate greater comfort.

The material used in the platform will be in accordance with the specifications of NBR ISO 9386-2:2012, to meet the load capacity of the equipment. It will also have a differentiated *design* and non-slip floor, the panel will have necessary functions so that people with special needs can enjoy it easily and quickly, in addition to having buttons for up/down and emergency.

7. FINAL CONSIDERATIONS

When preparing the design of the lifting platform for accessibility on stairs, theories and guidelines of NBR 9050:2020 and NBR ISO 9386-2:2012 were applied, such as specific measures, drive, speed, displacement, safety measures, among others; with the objective of obtaining a well-specified project, with clear objectives, and in accordance with current legislation and regulatory standards.

The requirements that stood out in the development of the project are low cost, safety in its operation and promotion of the full exercise of citizenship. In addition, it is worth mentioning that for the preparation of the lifting platform project for accessibility on stairs, NRs 06, 10 and 12 can also assist in the project preparation process, along with NBR 9050:2020 and NBR ISO 9386-2:2012

As suggestions for future research, it is recommended the automation of the system's lifting, by means of an electric motor, mechanical, hydraulic and pneumatic systems, in order to improve the project in future studies.

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