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ORIGINAL

Analysis and proposals for an inclusive classroom block

Análisis y propuestas para un bloque de aulas inclusivo

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ABSTRACT

Introduction: the study addressed universal accessibility in the San Damian University Medium (MUSD) of CESMAG University, in order to identify architectural barriers affecting people with visual, hearing and reduced mobility disabilities. The research started from the need to guarantee inclusion in educational spaces, considering the Colombian regulation NTC 6304 and the principles of universal design.
Method: a qualitative and interpretative approach was adopted through an architectural analysis of the classroom block and its adjacent routes. The process included experimental tours simulating the experience of users with disabilities, as well as the collection of information through plans, regulations, photographic records and direct observations. The hermeneutic method allowed interpreting existing deficiencies and proposing improvement strategies.
Results: the analysis revealed multiple accessibility deficiencies.Among them were the lack of tactile signs, incomplete or absent ramps, heavy doors and non-adapted furniture. In addition, it was found that the provisions projected in the plans had not been fully implemented. Although the lighting and some aspects partially complied with regulations, problems with acoustics, evacuation and Braille signage persisted. These limitations compromised user autonomy, safety and participation.
Conclusions: the study demonstrated that partial enforcement of regulations limited full inclusion on campus. However, it showed that there are technical, multisensory and low-cost solutions that could be implemented gradually. It also highlighted the importance of consolidating a design culture oriented towards inclusive design, strengthening the training of professionals committed to equity and sustainability in educational architecture.

Keywords: Accessibility; Inclusion; Universal Design; Educational Architecture; Disability.

RESUMEN

Introducción: el estudio abordó la accesibilidad universal en el Medio Universitario San Damián (MUSD) de la Universidad CESMAG, con el fin de identificar barreras arquitectónicas que afectaban a personas con discapacidad visual, auditiva y de movilidad reducida. La investigación partió de la necesidad de garantizar la inclusión en los espacios educativos, considerando la normativa colombiana NTC 6304 y los principios del diseño universal.
Método: se adoptó un enfoque cualitativo e interpretativo mediante un análisis arquitectónico del bloque de aulas y sus recorridos adyacentes. El proceso incluyó recorridos experimentales simulando la experiencia de usuarios con discapacidad, así como la recolección de información a través de planos, normativas, registros fotográficos y observaciones directas. El método hermenéutico permitió interpretar las deficiencias existentes y proponer estrategias de mejora.

Resultados: el análisis evidenció múltiples deficiencias en accesibilidad. Entre ellas se destacaron la falta de señalización podotáctil, rampas incompletas o ausentes, puertas pesadas y mobiliario no adaptado. Además, se constató que las disposiciones proyectadas en planos no se habían ejecutado en su totalidad. Aunque la iluminación y algunos aspectos cumplían parcialmente con la normativa, problemas de acústica, evacuación y señalización en braille persistían. Estas limitaciones comprometieron la autonomía, seguridad y participación de los usuarios.
Conclusiones: el estudio demostró que la aplicación parcial de la normativa limitó la inclusión plena en el campus. Sin embargo, evidenció que existen soluciones técnicas, multisensoriales y de bajo costo que podían implementarse de manera gradual. Asimismo, resaltó la importancia de consolidar una cultura proyectual orientada al diseño inclusivo, fortaleciendo la formación de profesionales comprometidos con la equidad y la sostenibilidad en la arquitectura educativa.

Palabras clave: Accesibilidad; Inclusión; Diseño Universal; Arquitectura Educativa; Discapacidad.

INTRODUCTION

Architecture has evolved as a discipline that integrates aesthetics, function, and form, allowing the user to interact with the built environment through the senses. However, when it comes to accessibility, there is a need to rethink architectural design to ensure the inclusion of all people, including in educational spaces.

Universal accessibility in educational spaces is a determining factor in ensuring the inclusion of people with disabilities. Recent studies have shown that the absence of accessible conditions creates significant barriers to equitable participation within these environments. In Colombia, Colombian Technical Standard NTC 6304 establishes accessibility requirements for higher education institutions; however, its implementation still presents numerous challenges. According to the Ministry of Health[1], in the department of Nariño, approximately 50 000 people (3,8 % of the population) have some type of disability, highlighting the need to create truly inclusive spaces.[2,3,4,5,6]

From an architectural perspective, equal opportunities must be a fundamental principle in the design of spaces. Pallasmaa[2], in his work The Eyes of the Skin, emphasizes that architecture not only defines the functionality of the environment, but also influences the way individuals perceive and experience space. Ensuring accessibility in educational spaces not only improves the quality of life of users, but also meets criteria of equity and sustainability in architectural design. The implementation of accessible solutions in university infrastructure allows for the construction of spaces that promote autonomy, safety, and comfort for the entire academic community.[7,8,9,10,11]

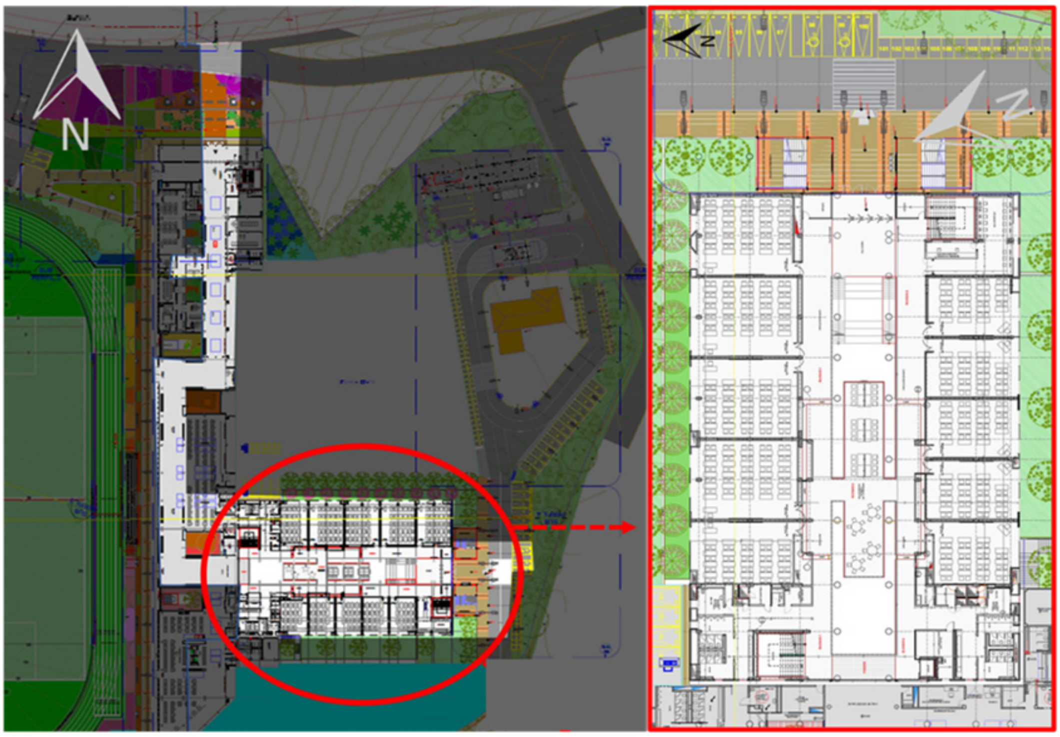

Figure 1. Subject of study: Medio Universitario San Damián classroom block and associated access routes[4]

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At the University Environment San Damián (MUSD) of CESMAG University[3], architectural barriers have been identified that affect the accessibility of people with visual, hearing, and mobility impairments. This situation limits the autonomy and participation of these users, which negatively impacts their experience and well-being and therefore limits the functionality of the environment. In this regard, this research analyzes the architectural barriers that exist at MUSD.[12,13,14,15] Considering that the building includes planned accessibility features, although not yet implemented, a comprehensive accessibility analysis was not deemed necessary. The study focused on the classroom block, which presents more stable conditions, specifically those focused on visual, hearing, and mobility impairments, in order to propose solutions that favor an inclusive educational environment and prioritize user autonomy.[16,17,18]

In order to address accessibility needs, it is essential to evaluate the measures implemented and those pending implementation within the university campus, without the risk of them becoming obsolete due to future changes in the overall campus infrastructure. The analysis also provides scalable inclusive design strategies that can serve as a model for other institutions. Some of the elements to consider include access ramps, tactile signage, adequate lighting, and adjustable furniture. These solutions not only benefit people with disabilities, but also improve the user experience for the entire university community.[19,20,21]

The research approach was developed in three phases. In the first phase, an architectural analysis of the classroom block was carried out in relation to Colombian accessibility regulations, which take into account the experience of users with functional diversity. In the second phase, a diagnosis of the existing conditions was carried out, identifying deficiencies and possible improvement strategies. The third phase consisted of proposing architectural solutions illustrated by graphics and images that reflect the modifications necessary to ensure accessibility and that were compared with architectural references.[22]

METHOD

The methodological design adopted a qualitative interpretative approach to analyze accessibility in the MUSD classroom block from a user experience perspective. The unit of analysis corresponded to the classroom block and its adjacent routes, delimiting a specific area of intervention. A hermeneutic method was applied, which facilitated the interpretation of existing architectural barriers and their impact on the mobility of people with disabilities.

The analysis was carried out through experimental tours of the campus, adopting the perspective of a user with visual, hearing, or mobility impairments. Through this methodology, accessibility deficiencies were identified and compared with current regulations such as NTC 6304 and from the perspective of an architecture student and direct experience on the tour.

Documentary and observational techniques were combined to collect information. Architectural plans, regulations, and theoretical background on universal accessibility were analyzed. In addition, photographic records and detailed descriptions of the routes within the campus were used, which made it possible to identify physical obstacles and propose solutions. As part of the methodological process, a systematic photographic record was made, focusing on documenting physical conditions that present inconsistencies or non-compliance with the parameters established in current accessibility regulations (NTC 6304). A technical tour was developed with an emphasis on the classroom block and the adjacent circulation spaces that allow access to that building. During this inspection, a preliminary diagnostic survey was conducted to identify both functional limitations and opportunities for improvement associated with the implementation of universal accessibility criteria.

In this way, the classroom block and adjacent routes were diagnosed, identifying existing deficiencies and proposing various options for improvement. Finally, design proposals for accessibility in the classroom block were developed, including the creation of graphics and images that visualize the design strategies.

Principles of universal design and their application

Over time, various experts have contributed to the development of strategies to improve accessibility in built environments. Among them, Guffey(5) introduced the concept of accessible ramps and promoted the elimination of architectural barriers in urban spaces. Jane Jacobs[6], in The Death and Life of Great American Cities, raised the importance of designing cities with inclusive spaces that encourage social interaction. For their part, Romedi Passini et al.[7] developed the concept of wayfinding, focused on improving orientation in architectural spaces through tactile maps, intuitive signage, and multisensory spatial references. Ronald Mace[8], creator of the concept of Universal Design, argued that spaces should be designed from the outset to be accessible, avoiding subsequent modifications.

More recently, Chris Downey[9] has emphasized the importance of designing accessible environments from a sensory perspective. His approach is based on incorporating accessible routes with tactile paving, haptic maps, and textured contrasts that allow people with visual impairments to move around independently.

Universal design, as defined by the Center for Excellence in Universal Design, states that spaces should be accessible to all people, regardless of age, size, ability, or disability. The seven principles of this approach include:

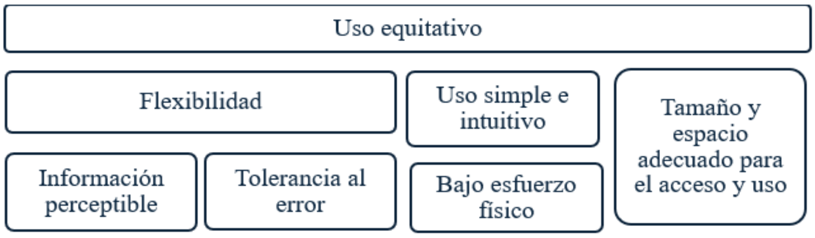

Figure 2. Seven principles for accessibility (CEUD, date of consultation 2024)

Multisensory design seeks to create accessible environments through the integration of various perceptual stimuli. These criteria have been incorporated into various international standards and are fundamental to ensuring accessible environments. Their application in architectural design improves mobility and allows people to interact with the space safely and independently.

Architectural analysis of universal accessibility according to NTC 6304

From the perspective of inclusive design, adopting the perspective of users with disabilities is key to identifying more clearly the physical and sensory barriers present in the built environment. This approach highlights obstacles such as stairs without ramps, doors with inadequate dimensions, inaccessible toilets, uneven surfaces, and poor signage, among other factors that negatively affect autonomy, safety, and comfort when moving around.

The findings derived from this analysis are fundamental for the formulation of intervention strategies that guarantee universal accessibility conditions, as well as enabling the selection of technical and design solutions that respond to the diverse abilities of users, thus contributing to the consolidation of truly inclusive, equitable, and adaptive educational spaces. This activity was part of the application of universal and inclusive design principles from the educational perspective of architecture students.

The analysis included a functional evaluation of the built environment with respect to the target user, using visual tools and direct observation techniques that facilitated the identification and characterization of architectural barriers, as well as the validation of user interaction with the elements of the space.

Figure 3. Main entrance and rear entrance to the MUSD-CESMAG classroom block

The MUSD has two main entrances: one for pedestrians and one for vehicles. The entrance to the educational establishment has deficiencies that affect its accessibility. And although the surface area designated for horizontal circulation partially complies with standards, as it is firm and non-slip, it also lacks tactile tiles or plates to facilitate the movement of people with visual impairments.

For people with reduced mobility, there is at least one accessible entrance for priority use with a minimum clear width of one meter. However, among the main problems identified are the lack of pedestrian crossings on the roads immediately adjacent to the campus, the absence of ramps or crossings on the sidewalks that allow adequate access for wheelchair users, and the location of the public transport stop on a steep slope, which makes it difficult for people with reduced mobility to use. Similarly, the parking bay is difficult for this group to access. The parking lot has only one space marked for people with disabilities.

There are routes that are interrupted by ramps that do not provide much safety for wheelchair users, such as the main access from the road to the interior of the facilities and some uneven platforms in the parking area. Although these may seem like minor obstacles at first glance, they cause discomfort and a sudden fall when descending. They also create further complications with the door installed, where it is difficult to move without assistance. For example, the glass doors connecting the administrative area to the main court are heavy and require pushing to open. In addition, they have pressure bars, which can make it difficult for people with reduced mobility to open them. This could prevent some people from moving independently to enter or exit the building.

Figure 4. Movement towards the doors of the MUSD-CESMAG administrative headquarters

On the other hand, the architectural project plans include the incorporation of a ramp connecting the academic building with the parking area, in order to guarantee accessibility for people with reduced mobility. A bridge is also planned as a connecting element between functional areas. However, a review of the constructed state revealed the absence of this ramp, suggesting a possible modification of the original design during the execution phase. There is a frequent gap between project planning and the actual construction, which may be due to factors such as phased execution, budget constraints, technical adjustments in the field, or the redefinition of functional priorities during the development of the project. These variations underscore the importance of comprehensive design management that considers the permanence of accessibility criteria at all stages of the construction process.

However, the lighting on campus is adequate and complies with current regulations. It is distributed evenly, enhancing the colors, tones, and textures of the interior spaces. This lighting not only facilitates orientation but also synchronizes harmoniously with natural light and considers the selection of surfaces and colors to create a coherent visual environment. The system also includes motion sensors to control lighting in different areas. However, there is some glare in the classrooms.

Figure 5. Lighting in the MUSD-CESMAG facilities

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With regard to signage, the MUSD complies with the regulations established in current legislation; however, the implementation of protectors for Braille signage is recommended, especially on the plates located on the walls before accessing the elevator. It has been noted that on some floors these signs are significantly damaged, with some or all of the raised dots missing, which can cause confusion for students who rely on this information for orientation. The addition of appropriate protectors ensures the durability of the signage and ensures that it can be read correctly over time.

The design of the corridors takes into account not only the normal flow of people, but also the maneuvering, turning, and direction-changing needs of people in wheelchairs. The corridors are free of obstacles, ensuring accessibility along the route. There are no protruding elements, and it complies with the requirements established to guarantee mobility without difficulties. The floor has a 5 cm concrete finish, hardened, polished, and glazed in white. The floor coverings are firm and non-slip in both dry and wet conditions, ensuring safe transit in the space. In addition, both the floor and wall surfaces are designed to prevent slipping.

Figure 6. Facilities inside the MUSD-CESMAG classroom block

The classroom block has two fixed staircases and an elevator, which is the only means of access for people with reduced mobility. In case of emergency, there is no adequate evacuation route for people with disabilities. If the elevator stops working, there are no safe spaces for these individuals to evacuate. According to regulations, there must be at least one alternative means of vertical circulation that allows both transit and evacuation of individuals with disabilities, whether permanent or temporary. The classroom block terrace does not have any means of circulation other than the stairs located inside and outside the space.

Specifically, according to the original floor plan, the classrooms include spaces designated for people with reduced mobility. None of these provisions have been implemented in the execution, as none of the classrooms have adequate furniture for people with functional diversity. In addition, the Braille signage that should indicate the classroom number is absent, making it difficult for them to find their way around the building independently. This lack of accessibility creates a significant barrier to the inclusion of people with disabilities.

Figure 7. Classrooms at San Damián University Center - CESMAG

The classrooms, especially the larger ones, have an echo problem that affects the acoustics of the space, which is a challenge for people with hearing disabilities. To solve this problem, the installation of sound amplification systems, such as microphones or speakers, should be considered. Additionally, the incorporation of visual support technology, such as electronic devices or home automation systems, could be of great help in improving class comprehension. These technological solutions would offer an alternative for students with hearing difficulties, allowing them a more inclusive and accessible educational experience. It is essential that classroom design and support systems comply with regulatory requirements and effectively respond to the needs of all students, ensuring their autonomy and full participation in the educational process.

Finally, the classroom block has a bathroom and an accessible toilet on each floor. The bathrooms are designed in accordance with accessibility regulations, providing sufficient space for wheelchair maneuvering, grab bars, and accessible sinks. Although they comply with most of the standards, it is necessary to install a panic button in case of emergency for a person who needs help. It should be noted that another problem is that the accessible bathroom is often locked on some floors.

Beyond being a regulatory issue, accessibility becomes a tangible manifestation of the ethical and professional commitment of architects and designers. Applying technical standards not only breaks down physical, sensory, and cognitive barriers, but also establishes a spatial strategy that contributes to human diversity and opens the door to interaction and participation. The review and application of accessibility standards is an essential factor in the creation or adaptability of spaces that transcend physical limitations and, at the same time, promote the inclusion and participation of all people. In order to evaluate compliance with universal accessibility criteria in MUSD facilities, a diagnostic matrix was applied based on the requirements established by Colombian Technical Standard NTC 6304, which are shown in the following table.

Table 1. Accessibility Assessment at the MUSD according to NTC 6304

Aspect Evaluated	NTC 6304 Requirement	Complies	Observations
Parking	Have accessible parking spaces with adequate signage and close to the main entrance.	Partially	Insufficient signage and lack of specific markings for users with disabilities.
Pedestrian ramps	Slope no greater than 5 %, non-slip surface, and handrails at two heights.	Partially	Although the slope is not very steep, greater control may be required when moving around to ensure user safety.
Doors	Minimum width of 900 mm, easy opening, lever-type handles, and Braille signage where necessary.	Partially	Some doors are heavy, do not open easily, and most handles are not lever-type.
Horizontal circulation	Wide corridors (minimum 1800 mm), free of obstacles and with tactile signage.	Partially	No tactile signage and some corridors with minor obstacles.
Vertical circulation	Accessible elevators with Braille buttons, adequate mirrors, and handrails on stairs.	Partially	Sometimes the mirror and bar are covered with tarpaulins, limiting their usefulness.
Accessible restrooms	Spaces with a turning radius of 1800 mm, grab bars, and emergency alarms.	Partially	They do not have assistance alarms and the bars are not in all bathroom stalls.
Lighting	Adequate to avoid shadows, with well-distributed lighting.	Partially	May cause glare in classrooms due to the acrylic board.
Signage	Braille indicators, high relief and color contrast; tactile signage on routes.	Partially	Tactile and visual indicators are missing in some important areas. Others are damaged
Teaching environments	Classrooms with accessible furniture (adjustable tables, movable boards) and sufficient space for maneuvering.	Partially	Few classrooms have accessible furniture, and the boards could cause glare due to light reflection.
Recreational areas	Sports facilities with accessibility for spectators and participants with disabilities.	No	There are no designated areas for spectators with disabilities or aids for sports accessibility.

Although the infrastructure evaluated shows progress in terms of accessibility, there are still significant deficiencies that limit the full inclusion of people with disabilities. Most of the aspects evaluated partially comply with the requirements established in NTC 6304, especially in key elements such as signage, ramps, circulation, and accessible furniture. Notable failures include the lack of adequate demarcation in parking lots, the absence of tactile signage, non-adapted furniture, and poor accessibility in recreational areas.

Critical issues associated with pedestrian congestion were identified, especially during peak hours (between 11:30 a.m. and 12:30 p.m.), a situation that represents a potential risk for users with reduced mobility, as it hinders their safe and autonomous movement within the campus. Additionally, deficiencies were detected in the artificial lighting conditions as the day progresses, which significantly affects the legibility of existing signage, as it lacks radioluminescent or reflective properties. This limitation poses a considerable risk in potential emergency situations, such as fire evacuations, where the visibility of escape routes and safe areas would be compromised by the lack of signage systems adapted to low-light conditions.

While current signage performs adequately under standard daytime conditions, the findings underscore the need to implement substantial improvements that address high-traffic scenarios and low-visibility conditions. Signage and accessibility systems in the MUSD need to be strengthened as an integral part of an inclusive, safe, and efficient infrastructure that ensures equitable travel conditions for all users. Critical evaluation of these aspects allows for the identification of priority areas for improvement that must be addressed in order to consolidate a truly inclusive environment.

Potential solutions or improvements in terms of universal accessibility for the MUSD-CESMAG.

As evidenced in the diagnosis, there is currently only one accessible parking space in front of the classroom block entrance. This space complies with the dimensions and specifications established in NTC 6304, but it is insufficient to meet the demand of the student population with disabilities. Although there are no exact data on the number of users with reduced mobility who require this service, it has been identified that, at times of high traffic, such as final deliveries, conferences, academic events, or exhibitions, the number of vehicles on campus increases significantly, leading to greater competition for parking spaces. This situation is exacerbated by the fact that the university is still in the process of developing and maintaining its facilities, which has left some regular parking spaces without adequate markings.

Given this situation, we propose the creation of at least two additional accessible parking spaces, strategically located to facilitate access to the main buildings. We also recommend the implementation of a parking reservation system that prioritizes access for people with functional diversity and guarantees the availability of these spaces at times of peak traffic congestion.

Another practical solution to improve accessibility in the classroom block and its adjacent routes is the implementation of tactile paving tiles, which can be either guide or warning tiles, designed specifically for people with visual impairments. Integrated tactile paving tiles are designed as complete tiles that incorporate specific patterns: guidance (with stripes) and warning (with dots). They include four stripes or 36 raised dots, which optimize installation and ensure clear, tactile orientation.

Their polycarbonate or stainless steel material ensures greater wear resistance and an aesthetic appearance that blends in with the design of the environment. The tiles can be adhered to the floor using specialized glue or installed with pin embedding systems, which simplifies their implementation and guarantees a long service life with low maintenance.

Figure 8. Accessible imagery at the entrance to the MUSD-CESMAG administrative block

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The installation of tactile paving tiles is an efficient and normatively supported measure to transform the block into a more accessible environment. Its implementation not only responds to the orientation and safety needs of people with visual impairments, but also reinforces the institutional commitment to inclusive and universal design. This intervention, although simple, has a significant impact on the quality of life and autonomy of users.

To ensure the safety of all users in the event of an emergency, the implementation of a multisensory alert system is proposed at CESMAG University. This system would integrate different communication channels to ensure that information reaches everyone, regardless of their sensory abilities. Strobe lights with a low flash rate would be installed to prevent epileptic seizures, combined with an adequate number of low-output sound resonators to avoid confusion and disorientation. In addition, clear and concise voice messages will be used, and it is proposed to implement tactile vibration systems for people with hearing disabilities.

A standard information point equipped with a tactile map is required, accompanied by information written in Braille to facilitate spatial understanding and the location of different areas of the campus through touch. Advanced technology can be incorporated, such as an interactive screen offering access to institutional information, complemented by headphones that provide audible instructions, allowing people with visual impairments to hear relevant information. This option could include additional features such as itinerary notices and interactive elements for consulting schedules and specific locations. Proposals must comply with ergonomic measures that are inclusive, i.e., if a person with reduced mobility approaches, they must be able to access it as easily as any other user.

Figure 9. Proposed itinerary location and haptic map

On the other hand, for emergency exits and evacuation routes to be truly effective, doors must be accessible to all types of users and must be able to be opened with minimal effort. Automatic sliding doors or servo-operated swing doors may be used for this purpose. These doors have a detection device that prevents people from coming into contact with them during opening and closing, and a delayed return mechanism that allows safe passage and detects the presence of people in the closing area. In the event of a power failure, they can be operated manually.

Figure 10. Existing doors and proposed accessible door at MUSD-CESMAG

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One of the problems identified in the MUSD classroom block is related to the functional conditions of the elevator. Although the equipment has elements required by accessibility regulations, such as the installation of a mirror to facilitate the visibility of obstacles when reversing out of the cabin, and a side support bar to ensure stability during movement, it was evident that these elements are sometimes covered by tarpaulins or other materials, which limits their effective functionality and contravenes the principles of universal accessibility.

In terms of the sensory communication system, the elevator provides adequate and understandable audio responses for people with visual impairments. However, it is suggested that the waiting time for the automatic closing of doors be optimized in order to facilitate safe and unhurried entry for people with reduced mobility.

Regarding the elevator's capacity to absorb pedestrian traffic demand at times of high traffic, it was determined that the exclusivity of a single functional elevator represents an operational risk, since, in the event of a failure, people with reduced mobility would be left without a viable alternative for vertical circulation. This situation highlights the need to implement complementary measures for assisted horizontal or vertical transportation, as well as to establish priority protocols for elevator use by persons with disabilities. The installation of evacuation chairs at visible and strategic points within the University is recommended. These chairs should be easily operable and allow for the safe transport of persons with reduced mobility via stairs and other evacuation routes.

Figure 11. Classroom block elevator

The accessible bathrooms at the university do not have assistance alarms or panic buttons, which represents a barrier to the safety and autonomy of people with reduced mobility or disabilities. As a solution, we propose the installation of an accessible alarm system that can be activated from different key points, such as the seats in the changing rooms, the shower, and the toilet, as well as from the floor in the event of a fall. This system should include an easy-to-operate mechanism, such as a red pull cord with highly visible rings, located at different heights to ensure it can be reached from a wheelchair or in an emergency position. In addition, it is recommended that visual and audible feedback be integrated to confirm that the alert has been received and that assistance personnel are on their way, thus ensuring a rapid and effective response to any eventuality.

The University has identified that some accessible bathroom doors present operational difficulties, especially for people with reduced mobility, due to the use of straight handles in a vertical position. Although these are endorsed by the standard, the space required to enter causes wheelchairs to collide with the side walls when pulling the door open. As a recommendation, we propose the installation of more efficient lever-type or 45-degree bar handles that allow for easier opening and will facilitate the use of the sanitary facilities for all users.

In the study room areas, where power outlets are currently located on the floor, it is essential to improve accessibility by installing outlets at desk height. This will allow people with reduced mobility or visual impairments to access them more easily and independently. In addition, it is recommended to ensure that at least one workstation has accessible ergonomic furniture, which ensures sufficient space for wheelchair maneuverability and the integration of tactile or Braille signage for easy identification.

To improve orientation for people with visual impairments in the classroom block, we propose the implementation of Braille signage on stair handrails. This signage, located at the beginning or end of the handrail, would indicate the floor number in Braille. Other relevant information could also be included in the signage, such as the location of classrooms or services on that floor, to facilitate orientation and independent mobility.

Figure 12. Imaginary images in the study areas of the San Damián University Center

The current classroom markings consist of a sign with the classroom number in fairly small print and without any kind of relief. It is proposed that the classroom number be marked in Braille below the conventional number. This tactile signage would allow people with visual impairments to easily identify the classroom number and access it independently.

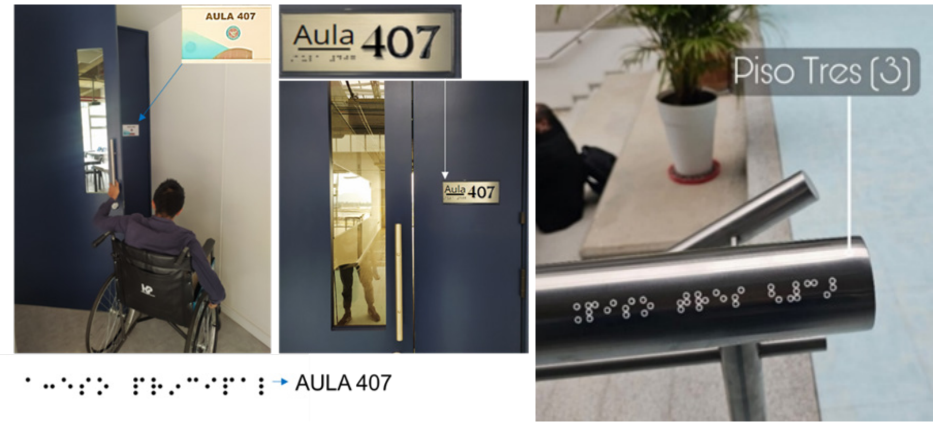

Figure 13. Imaginary and Braille demarcation in classrooms and corridors

Noise measurements taken in the classroom block recorded a minimum noise level of 37 dB with an average voice tone, which exceeds the recommended limit of 20 to 30 dB for classrooms, where optimal acoustic comfort is sought. To improve the acoustics of the space and create a more comfortable and functional environment for users, we propose installing an acoustic ceiling that absorbs sound waves and reduces reverberation. We also suggest incorporating other acoustic design strategies, such as the use of absorbent panels on the walls. Even with a good acoustic environment, people with hearing impairments may have difficulty hearing at a certain distance from the sound source. Therefore, communication systems that improve sound reception, such as magnetic induction loops, should be included. These systems allow the audio signal to be transmitted directly to hearing aids or cochlear implants, improving sound clarity and intelligibility.

It is important to note that, for people with hearing impairments, sound quality is not limited to noise level alone. The level, frequency, and clarity of sounds are also crucial for a good listening experience. If echoes interrupt sounds, words or lectures may be unintelligible to them. Likewise, if frequencies are too high, they can cause discomfort or even pain. Considering these aspects is key to the inclusive design and functionality of the building.

To optimize lighting in classrooms and avoid glare or the formation of pronounced shadows, we propose the implementation of strategies that control the intensity and direction of light. Blinds or curtains could be used to regulate the entry of natural light and avoid glare on classroom boards. Another option is to use matte acrylic boards, which do not reflect light and allow for better viewing of video projections or presentations. These measures create a more comfortable learning environment for all students, especially those who are sensitive to light or have low vision. Glare can also affect the ability of people with hearing impairments or those who use lip reading as a method of communication.

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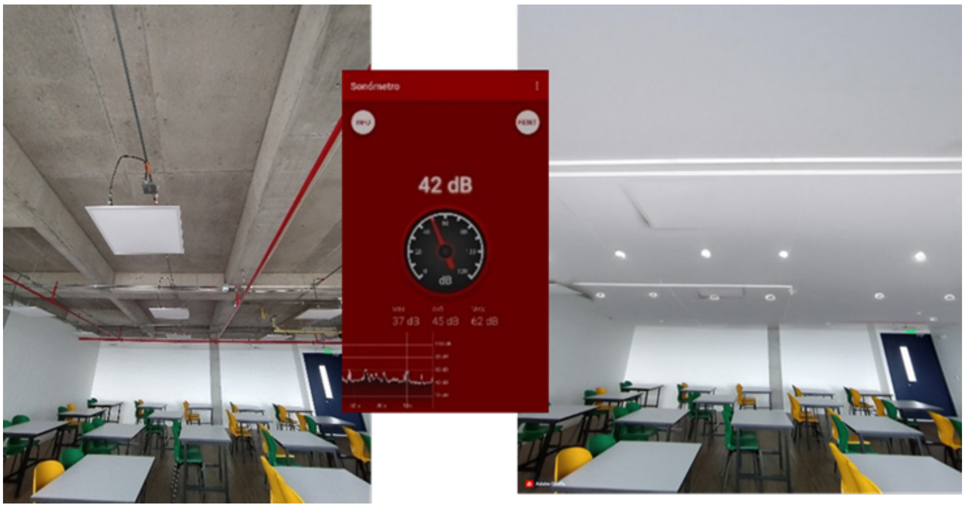

Figure 14. Concept for classroom sound systems

Finally, at the university, the educational media window is not functional for people with reduced mobility who need to request materials from this module. To ensure accessible and inclusive service, it is proposed to relocate it to a maximum height of 1100 mm from the floor, allowing for comfortable and efficient access. This improvement will not only benefit students, but also teachers who may require materials and have a disability.

Figure 15. Conceptual image for requesting teaching materials at Educational Media

CONCLUSIONS

This study proposed a strategic framework for the progressive implementation of universal accessibility criteria on the CESMAG University campus, with a special emphasis on the classroom block as a pilot space. This choice is based on the level of physical consolidation of the building, which allows standardized solutions to be applied without interfering with the project development of other areas still under construction.

Data digitization and the systematic collection of spatial information have proven to be key tools for understanding the dynamics of space use and guiding interventions from a functional and inclusive approach. Although the main focus of the study is on people with visual, hearing, and mobility impairments, the proposed strategies extend their benefits to other groups such as the elderly, pregnant women, children, and users with temporary limitations, especially at high-attendance events such as fairs or academic conferences. These strategies reinforce accessibility as a cross-cutting principle that increases the quality of space for the entire university community.

The study shows that a minimal, instrumental application of standards—such as NTC 6304—provides accessibility as a tool for institutional transformation that strengthens equity, student retention, and a sense of belonging. Gaps were identified between the design projected in plans and its execution on site, attributable to unforeseen events, budget constraints, and omissions in the technical supervision processes. This situation highlights the need to strengthen control mechanisms to avoid barriers to exclusion that directly impact the functionality of the space.

Contrary to the belief that accessibility implies extra costs, it has been demonstrated that there are technical and multisensory solutions with low economic impact that can be implemented gradually and consistently with the growth of the campus. Finally, the need to strengthen the training of architects and professionals in the built environment in a design culture oriented towards inclusion is emphasized, promoting academic spaces that integrate this knowledge as structural axes of contemporary design.

BIBLIOGRAPHIC REFERENCES

1. Ministerio de Salud. Boletines poblacionales para personas con discapacidad. 2020. https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/DE/PS/boletines-poblacionales-personas-discapacidadI-2020.pdf

2. Pallasmaa J. Los ojos de la piel: La arquitectura y los sentidos. 2nd ed. Barcelona: Editorial GG; 1996.

3. Universidad CESMAG. Manual señalético San Damián. https://fliphtml5.com/wfqva/fjws

4. Yepes C. Planimetría: Diseño arquitectónico medio universitario San Damián U. CESMAG. Universidad CESMAG; 2021.

5. Guffey E. Selwyn Goldsmith's Designing for the Disabled. 2nd ed. 1967. ISSN 2405-8726. https://www.sciencedirect.com/science/article/pii/S2405872620300678

6. Jacobs J. The death and life of great American cities. New York: Vintage Books; 1961.

7. Paul A, Passini R. Wayfinding: People, signs, and architecture. 1992. https://trid.trb.org/View/367500

8. Mace RL, Hardie GJ, Place JP. Accessible Environments: Toward Universal Design. Raleigh, NC: Center for Universal Design, North Carolina State University; 1991.

9. Downey C. Blind architect. Perkins School for the Blind. https://www.perkins.org/resource/chris-downey-blind-architect/

10. Alba Pastor C. Diseño universal pautas. https://d1wqtxts1xzle7.cloudfront.net/56229831

11. Beltrán Chamorro E. Accesibilidad del espacio físico y señalización podotáctil: Importancia para las personas con discapacidad. Instituto Nacional para Ciegos (INCI). 2023. https://www.inci.gov.co/blog/accesibilidad-del-espacio-fisico-y-senalizacion-podotactil-importancia-para-las-personas-con

12. Centre for Excellence in Universal Design. Definition and Overview of Universal Design (UD). Universal Design. https://universaldesign.ie/about-universal-design/definition-and-overview

13. García C, García T. La construcción del desarrollo espacial y su representación mental en personas ciegas y disminuidas visuales graves. Proyecto de Investigación y Desarrollo 2014-2015. 2013.

14. ICONTEC. Norma Técnica Colombiana NTC 6047: Accesibilidad al medio físico. Espacios de servicio al ciudadano. 2013.

15. ICONTEC. Norma Técnica Colombiana NTC 6304: Accesibilidad de las personas al medio físico. Instituciones de educación superior (IES). Requisitos. 2018.

16. ICONTEC. Norma Técnica Colombiana NTC 5610: Accesibilidad al medio físico. Señalización táctil.

17. ISO. ISO 9386-1: Power operated lifting platforms for persons with impaired mobility. Rules for safety, dimensions and vertical operation, Part 1. Vertical lifting platforms.

18. ISO. ISO/TR 22411: Ergonomic data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities.

19. Márquez A. Introduction to multi-sensory design. Curiosity Archives. 2017. http://www.aknamarquez.com/blog/2017/7/23/what-is-multi-sensory-design

20. Scott KP. Sight without vision. 2020. https://kevinpaulscott.com/sight-without-vision/

21. Spence C. Senses of place: Architectural design for the multisensory mind. Cognitive Research: Principles and Implications. 2020;5(1). https://doi.org/10.1186

22. UNESCO. División de planeamiento y políticas educativas y estándares para las construcciones escolares. 1986.

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None.

CONFLICT OF INTEREST
The authors declare that there is no conflict of interest.

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