16TH GOAL FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY ON THE ROLE OF INTERIOR ARCHITECTURE

16º OBJETIVO PARA O DESENVOLVIMENTO SUSTENTÁVEL: UM ESTUDO DE CASO SOBRE O PAPEL DA ARQUITETURA DE INTERIORES

16º OBJETIVO DE DESENVOLVIMENTO SUSTENTÁVEL: UN ESTUDIO DE CASO SOBRE EL PAPEL DE LA ARQUITECTURA DE INTERIORES

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ABSTRACT

The 16th goal of the 2030 Agenda for sustainable development highlights the importance of developing capacities for crime prevention. Thus, the objective of this article was to verify whether in a Brazilian college entrance hall there are physical space components that reduce surveillance, encouraging unauthorized people to enter the building. At this college, a student was stolen inside their classroom by a supposed intruder. The method uses the Crime Prevention Through Environmental Design approach for on-site observation and analysis (qualitative part), the Space Syntax Theory using the DephtMapX software to produce the visibility map (quantitative part) and the Photoshop program for image processing. The results reveal that the large number of entry and exit points, the layout (control desk and turnstiles) and the positioning of the street access door, stairs and pillars are the elements of the physical space that reduce surveillance in the entrance hall. Finally, this work shows procedures for analyzing internal spaces with a focus on crime prevention, highlighting the role of Interior Architecture in achieving the 16th goal of the 2030 Agenda for sustainable development.

KEYWORDS

Sustainability; Architecture; Crime Prevention Through Environmental Design; Space Syntax.

RESUMO

O 16º objetivo da Agenda 2030 para o desenvolvimento sustentável destaca a importância do desenvolvimento de capacidades para a prevenção de crimes. Assim, o objetivo deste artigo foi verificar se em um hall de entrada de uma faculdade brasileira existem componentes do espaço físico que reduzem a vigilância, incentivando a entrada de pessoas não autorizadas na edificação. Nessa faculdade, uma aluna foi furtada dentro de sua sala de aula por um suposto intruso. O método utiliza a abordagem Prevenção do Crime por meio do Projeto de Ambientes para observação e análise no local (parte qualitativa), a Teoria da Sintaxe Espacial utilizando o software DephtMapX para produzir o mapa de visibilidade (parte quantitativa) e o programa Photoshop para processamento das imagens. Os resultados revelam que o grande número de pontos de entrada e saída, o "layout" (balcão de controle e catracas) e o posicionamento da porta de acesso à rua, das escadas e dos pilares são os elementos do espaço físico que reduzem a vigilância no hall de entrada. Por fim, este trabalho apresenta procedimentos de análise de espaços internos com foco na prevenção de crimes, destacando o papel da Arquitetura de Interiores no alcance da 16ª meta da Agenda 2030 para o desenvolvimento sustentável.

http://dx.doi.org/10.29183/2447-3073.MIX2025.v11.n1.17-28
ISSN: 2447-0899 (IMPRESSA) | 2447-3073 (ONLINE)

PALAVRAS-CHAVE

Sustentabilidade; Arquitetura; Prevenção do Crime Através do Projeto de Ambientes; Sintaxe Espacial.

RESUMEN

El Objetivo 16 de la Agenda 2030 para el Desarrollo Sostenible destaca la importancia del desarrollo de capacidades para la prevención del delito. Así, el objetivo de este artículo fue verificar si existen componentes del espacio físico en el hall de entrada de una facultad brasileña que reducen la vigilancia, favoreciendo el ingreso de personas no autorizadas al edificio. En esta facultad, el teléfono celular de un estudiante fue robado dentro de su salón de clases por un presunto intruso. El método utiliza el enfoque de Prevención del Delito a través del Diseño Ambiental para la observación y análisis in situ (parte cualitativa), la Teoría de Sintaxis Espacial utilizando el software DephtMapX para producir el mapa de visibilidad (parte cuantitativa) y el programa Photoshop para el procesamiento de imágenes. Los resultados revelan que la gran cantidad de puntos de entrada y salida, el diseño (mesa de vigilancia y torniquetes) y la ubicación de la puerta de acceso a la calle, escaleras y pilares son los elementos del espacio físico que reducen la vigilancia en el hall de entrada. Finalmente, este trabajo presenta procedimientos para el análisis de espacios internos con enfoque en la prevención del delito, destacando el papel de la Arquitectura Interior en el logro del Objetivo 16 de la Agenda 2030 para el Desarrollo Sostenible.

PALABRAS CLAVE

Sostenibilidad; Arquitectura; Prevención del Crimen a Través del Diseño Ambiental; Sintaxis Espacial.

1. INTRODUCTION

The 16th goal of the 2030 Agenda for sustainable development, that is, Peace, Justice and Strong Institutions, includes building capacities at all levels for crime prevention, especially in developing countries (United Nations, 2024).

> 16.a Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime (United Nations, 2024, without page number).

In Brazil, the debate on crime prevention is stimulated by the Brazilian Public Security Forum (BPSF).

> The Brazilian Public Security Forum is a non-governmental, non-partisan, non-profit organization whose goal is to build a benchmark environment in the area of public security.
>
> Composed of police officers, public administrators, researchers, activists, and justice system operators, the BPSF contributes to the transparency of information on violence and the development of security policies, in addition to defending public security as a fundamental social right (Brazilian Public Security Forum, 2024a, without page number).

The BPSF promotes an annual event, named after the institution, which includes in-person and virtual meetings. In 2024, the 18th meeting took place, with the aim of bringing together different segments seeking solutions to reduce violence and insecurity. The focus was on developing prevention and qualified repression strategies to reduce homicides and other violent crimes, address violence against women, improve the prison system, weaken organized crime, and improve the financing and management conditions of public security policies. (Brazilian Public Security Forum, 2024b).

In addition, the BPSF has a journal for the dissemination of scientific works, called the Brazilian Journal of Public Security (Brazilian Public Security Forum, 2024c), and regularly publishes a report called Atlas of Violence. This document is produced in partnership with the Institute of Applied Economic Research (IAER) (Brazilian Public Security Forum, 2024d). IAER is a federal public foundation linked to the Ministry of Planning and Budget (Institute of Applied Economic Research, 2024). The Atlas of Violence aims to portray violence in Brazil, based mainly on data from the Mortality Information System (MIS) and the Information System for Notifiable Diseases (SND) of the Ministry of Health. Therefore, it provides information on homicides analyzed from the perspective of gender, race, age group, among others (Brazilian Public Security Forum, 2024d).

Then it is clear that the BPSF is a Brazilian institution designed to build solutions for crime prevention in Brazil, in line with the 16th goal of the 2030 Agenda for Sustainable Development. However, in relation to crime prevention through design, Almeida, Costa and Engler (2021) highlight that in Brazil the subject is better known and debated in the military segment than in design schools.

Nevertheless, the same is not true in English-speaking countries. Founded in Canada, the International Crime Prevention Through Environmental Design Association (ICA) aims to promote crime prevention internationally with an approach focused on architecture and urban planning. As its name suggests, the organization uses the Crime Prevention Through Environmental Design (CPTED) approach, which will be described later in this paper. According to the International Crime Prevention Through Environmental Design Association (2024, no page number), the ICA's mission is to "create safer environments and improve the quality of life through the use of CPTED principles and strategies." Similarly, in the United States, the National Institute for Crime Prevention (NICP) is focused on promoting CPTED (National Institute for Crime Prevention, 2024).

In turn, in the United Kingdom, the Design Against Crime Research Lab, a research center linked to the University of the Arts London, develops research on the use of design (focused on Product and Graphic Design) for crime prevention (Design Against Crime Research Lab, 2024).

> At the core of the Design Against Crime Research Lab's activity is research that serves the public and communities. The Lab's focus is "socially responsive design and innovation": its primary driver is social issues, its main consideration is social impact, and its main objective is social change. Overall, the team's approach embraces action research, user-centred and participatory design methods, as well as diverse ethnographic approaches (Design Against Crime Research Lab, 2024, without page number).

Thus, it is possible to see opportunities in Brazil to expand the discussion on crime prevention to the area of design and architecture, similarly to other countries. Consequently, this work aims to explore this opportunity, in order to contribute to the achievement of the 16th sustainable development goal in the country.

As a first thrust in discussing crime prevention, it is important to highlight that crime is a complex issue, so it is reasonable to assume that it requires complex solutions. However, society often claims prompt and simplistic solutions and some people view this issue as just a matter of policing. According to Bondaruk (2007) in 2006, the criminal organization called First Capital Command (in portuguese, Primeiro Comando da Capital (PCC)) carried out a series of attacks in the São Paulo city, a Brazilian metropolis, causing panic among the population.

> In times of crisis, society demands fast solutions (...). The problem is that such quick and ready-made solutions do not exist.(...) The combination of an active community, a government focused on meeting public demands, an efficient and effective police force and, above all, a social environment better adapted to prevent the occurrence of crime and the fear of crime, might provide the solution we all desire for public safety (Bondaruk, 2007, p.53).

Unfortunately, attacks like this keep happening in the country. Trindade and Jácome (2023) reported that the government confirmed at least 259 attacks by criminal organizations on shops, vehicles and public buildings in a Brazilian state called Rio Grande do Norte, that occurred during 5 days in March 2023. Coincidence or organization?

Therefore, it is urgent to develop research to face and prevent crimes in Brazil. As Bondaruk (2007, p.53) said, one of the possible approaches is the creation of "a social environment better adapted to prevent the occurrence of crime and the fear of crime". However, how could this be done?

Although they are rarely known in Brazil, the Design Against Crime (DAC) and the Crime Prevention Through Environmental Design (CPTED) approaches can show a direction.

DAC approach develops products, environments and services to modify the potential offender's perception of the crime benefits (Silva *et al.*, 2018). The Design Against Crime Research Lab (2024) uses responsive design for:

> Reduce the negative consequences of criminogenic (i.e., likely to cause criminal behavior or serving criminal goals) affordances of products, services, environments, and communications and instead designing affordances that discourage the crime, but are "fit for purpose" "and contextually appropriate" (Design Against Crime Research Lab, 2024, without page number).

In addition, DAC modifies the opportunities network that makes the criminal practice easier.

> Most crimes are committed because the offender sees an opportunity (...). The more insecure and vulnerable the offender feels to act, the less likely they are to commit a crime (Bondaruk, 2007, p. 56)
>
> Opportunities for crime are highly specific - the theft of vehicles to use in races on public roads ("rachas") has a completely different pattern of opportunities than the theft of cars for disassembly and trafficking of their components ("desmanche") (Bondaruk, 2007, p.57)

According to Clarke (1997), Situational Crime Prevention (SCP) proceeds from an analysis of the circumstances that generate specific types of crimes, in order to introduce discrete management and environmental changes to reduce the opportunities for these offenses. Similarly, Clarke (2018) declares that most of us can recognize the role opportunities have played in our lives, although many people are unaware of this influence. Hence, for anyone engaged in explaining human behavior, which includes crime, it is important to consider the effects of opportunities.

In the same way, Crime Prevention Through Environmental Design (CPTED) establishes that the physical environment can be subtly manipulated to induce behavioral effects capable of reducing the occurrence of crimes and making criminal action less attractive to offenders (Crowe, 2013). Moreover, Hushen and Hushen (2020) state that CPTED is defined as the appropriate design and effective use of the built environment to reduce the fear and the crime occurrences, as well as to improve people's quality of life.

However, DAC, SCP and CPTED should not be confused with hostile architecture. According to Rosenberger (2020), hostile architecture is designing objects for public spaces to discourage specific uses and, consequently, discourage the presence of specific people (e.g., homeless people and skateboarders). Therefore, the idea of kicking out specific groups is incompatible with DAC, SCP and CPTED as they aim to dissuade potential offenders from

committing crimes (by reducing opportunities) rather than excluding them from using the space.

> In contrast to common view, CPTED principles show that living in safer environments does not require oppression, hostility or social withdrawal. On the contrary, crime prevention suggests strengthening citizenship, appropriating spaces, promoting a sense of belonging between individuals and environments, as well as people's care and responsibility for the public spaces they use (Almeida, Costa and Engler, 2021, p.19).

Almeida, Costa and Engler (2021) say that CPTED has been studied in English-speaking countries for approximately half a century. However, according to these authors, in Brazil, publications on the topic appeared more consistently only at the beginning of the 21st century.

Stimulating knowledge of the design and architecture for crime prevention in Brazil is crucial to providing society with the scientific basis necessary to make more assertive decisions for preventing crime considering Brazilian specific contexts. Furthermore, research on crime prevention could help other countries to find similar solutions. So, how could architects contribute to crime prevention in a specific situation?

As each type of crime has a specific network of opportunities, it requires analyzes and solutions targeted to each case. Thus, the authors of this article realized that the case study was the most appropriate approach to address the issue. Consequently, the first step of this research was to find a building where a crime occurred.

Thus, a Brazilian college was chosen, because there a student was stolen by an alleged intruder inside their classroom in 2022. According to the faculty deans, after the theft, students said they had seen an unrecognized man inside the classroom. Although the college deans said they immediately notified police about the theft (in 2022), so far (in 2024) the college managers have not been getting answers and the perpetrator has not even been identified. It is important to say that, for preventing crimes according to the CPTED approach, it is not necessary to identify the aggressor. As the focus is on prevention, the main strategy is to reduce opportunities that stimulate crime. Investigating, prosecuting and catching the perpetrator is the duty of the police and justice. However, Architecture can make new occurrences difficult.

After that, the object of study was chosen: the first room that the alleged attacker managed to cross without being identified, that is, the building's entrance hall. Hence, the problem of this research was elaborated: Is there any physical space component in the entrance hall that facilitates the entry of unauthorized people into the college? Then, the hypothesis emerged: In the entrance hall there are physical space components that reduce surveillance, encouraging unauthorized people to enter the college. Finally, the objective was created: to analyze the spatial configuration of the college's entrance hall.

Moreover, the research was defined as a mixed method, as it has qualitative analyzes (based on on-site observation) as well as quantitative analyzes (obtained through DephtMapX computer program).

This research can stimulate architects (in Brazil and other countries) to consider reducing crime opportunities in Interior Architecture design, not only making them aware of the importance of the topic, but also presenting alternatives for practical application. Consequently, Interior Architecture will be able to contribute to the achievement of the 16th goal of sustainable development, Peace, Justice and Strong Institutions.

2. ARCHITECTURE FOR CRIME PREVENTION

Crowe (2013) states that CPTED has three overlapping strategies: natural surveillance, natural access control and territorial reinforcement. Surveillance includes facilitating space observation by individuals, so that a potential offender realizes that it is risky to commit crimes there. Surveillance could be organized (police patrol), mechanical (lighting) or natural (windows). Natural surveillance can be defined as a by-product of the routine use of an environment. Hushen and Hushen (2020) suggest using lighting and transparent building materials to stimulate natural surveillance.

Access control means creating barriers between the potential aggressor and the crime target, as well as creating a perception of risk in potential perpetrators. Access control could be organized (guards), mechanical (locks) or natural (spatial definition). Restricting access to the target should preferably be done in a natural way, that is, a control that is a by-product of the routine use of the environments (Crowe, 2013). For Hushen and Hushen (2020), natural access control includes guiding people through spaces via a strategic design of streets, sidewalks, building entrances and landscaping. According to the authors, it is necessary to ensure that building entrances are easily identified, well lit and visible from windows.

Based on Hushen and Hushen (2020), it is possible to infer that people should not become lost or confused when moving around the space, as they would then be less susceptible to perpetrators' attacks.

Hushen and Hushen (2020) say territorial reinforcement is the creation of places that stimulate a deep sense of belonging in their users. Similarly, Crowe (2013) says that the concept of territoriality suggests that design can create or extend a sphere of influence so that users develop a sense of proprietorship, i.e., a sense of territorial influence, which is perceived by potential offenders. Hushen and Hushen (2020) exemplify a territorial reinforcement strategy. On a gate at South Florida University, there is a symbol of its football team. The design strategy, that is, this image in that place, is an attempt to strengthen the bonds of belonging between students and the university campus.

Crowe (2013) also highlights the importance of maintaining spaces for crime prevention. According to Crowe (2013, p.28), "Deterioration and blight indicate less concern and control by intended users of a site and indicate a greater tolerance of disorder.". In turn, Hushen and Hushen (2020) consider maintenance as a fourth strategy of CPTED and exemplify that trees without correct pruning can obstruct visibility, hindering natural surveillance. Similarly, Almeida, Costa and Engler (2021) highlight that the lack of tree pruning can also obstruct artificial lighting in public spaces.

According to Lamoreaux and Sulkowski (2020), recent research has shown that, in schools, the balance between meeting physical security needs and ensuring students' psychological comfort can be achieved through CPTED strategies.

The use of CPTED as a crime prevention approach can not avoid spatial analysis. Among various theories, Space Syntax is one of the possibilities for carrying out this type of analysis. Netto (2016) states that Space Syntax is a socio-spatial theory which emerged in the 1970s. The theory is a strong reaffirmation of space as a living dimension based on its inherent relationality (Netto, 2016). In turn, Alitajer and Nojoumi (2016, p. 341) declare that "Space syntax seeks to explain how spatial configurations express social or cultural meanings". According to Hillier (2007), a specific spatial configuration can define social patterns, such as land use models, movement, urban crimes and location of immigrants.

Based on Space Syntax Theory Turner and Varoudis (2024) created the DepthMapX software.

> DepthmapX is a multi-platform software to perform a set of spatial network analyses designed to understand social processes within the built environment. It works at a variety of scales from building through small urban to whole cities or states. (Turner; Varoudis, 2024, without page number).

Alitajer and Nojoumi (2016) highlight Depthmap was created by Alasdair Turner at University College London (UCL) and it is used to perform visibility analysis in architecture and urban planning. They used UCL DepthMap software to analyze behavioral patterns in the spatial configurations of traditional and modern houses in Hamedan, Iran. Similarly, Yaseen and Mustafa (2023) used Depthmap to try to find out the existence of biophilic design parameters and the proportion of naturalness of view from permeable openings in schools by assessing their spatial layouts and configurations.

3. METHODS

The authors of this paper are interested in developing crime prevention strategies in Brazil using the CPTED approach, mainly in preventing theft in public schools.

Consequently, the first author was looking for a school where thefts had occurred. Then, she heard from a friend about a theft at a public college. In fact, thefts at schools are common in Brazil and it is not difficult to find this type of situation. In this country, public elementary and high schools have similar architecture, however, public college buildings are usually different. Therefore, she saw, there, a chance to investigate the influence of physical elements on the opportunities network for this type of crime, due to the greater variability of the spatial definition. So, she quickly contacted the faculty deans, who authorized the research to be carried out there. Thus, the research began a few weeks after the theft had occurred.

Then, she was to talk to the college deans to understand the circumstances under which the theft had occurred. They said a student declared someone stole their cell phone inside their classroom. And, after the theft, students said they had seen an unrecognized man inside the classroom. The leaders said they immediately notified police about the crime, however, the police had not yet given answers.

Hence, the authors decided to investigate whether in the entrance hall, the faculty's first access control place, there were physical elements that facilitated the entry of strangers into the building. Thus, the problem, hypothesis

and objective were defined, as shown in the Introduction section of this article.

The authors chose not to publicize either the name or the address of the college, as this research will reveal security vulnerabilities in the building, which can facilitate other crimes. For the same reason, they chose to use images that show only the essential elements for this research.

The first author obtained the architectural plan in editable format (with .dwg extension) and, considering CPTED strategies, she produced a simplified architectural plan in AutoCAD software to show only the essential information for this research.

In July 2022, she was in the entrance hall to observe and analyze spatial conditions according to CPTED's overlapping strategies, that is, surveillance, access control, territorial reinforcement and maintenance. The authors consider uses, access, flows, layout, lighting, materials and the existence (or non-existence) of electronic devices as the physical aspects of the space that can influence surveillance. Using her on-site observation notes and the simplified architectural plan, she produced an image using the computer program Photoshop, adding arrows and legend to the original drawing. It was the qualitative part of this mixed research.

Afterwards, the researchers began the quantitative part. The authors modeled the room plan in the DephtMapX software to generate the visibility map. This computer program calculates the visibility from all internal points of a polygon based on all other points within the same polygon. They downloaded DephtMapX, produced by Turner and Varoudis (2024), for free from a specific website, whose access link can be found in the References section of this article.

Subsequently, the first author added the graphical representation of the control desk, texts and legend to the image generated in DephtMapX using Photoshop software. She did this treatment to facilitate the understanding of the spatial elements and the results generated by DephtMapX. Then, she observed the regions of space that had less visibility and crossed this information with that she obtained qualitatively, in order to identify possible elements of the physical space that hindered surveillance on site. After that, she discussed the results with other authors, to improve them. Such procedures allowed answering the problem-question and testing the hypothesis.

4. RESULTS

As shown in Figure 1, the entrance hall has approximately 361.7 m², a control point, where there are two guards (control desk), two restrooms for the guards (W.C.), five entry points (three doors for access from the street and two doors for parking access) and several points for access to other parts of the building. Furthermore, there are pillars and some turnstiles in the room. Next to the turnstiles, there are small doors that allow access for people in wheelchairs. However, when the first author was at the site, she observed that all the turnstiles were inoperative, there were no cameras as well as she did not find other electronic devices for surveillance. There is also a projection of the second floor, as well as a concrete awning, with the other parts of the room having a double ceiling height. The majority of the facade is a large wall of aluminum and transparent glass, on which are sliding doors made with the same materials that allow entry into the hall from the sidewalk. This pavement is used by a large number of people of different ages, nationalities and social levels. The room is adequately lit, both during the day and at night, as well as clean and orderly. As expected, the entrance hall is mainly used as a transit area.

Figure 1: Simplified architectural floor plan of the entrance hall.
Source: Made by the authors.

As shown in Figure 1, the college's entrance hall communicates with other spaces through several points. It is possible to enter the room from the public street, through one of the three doors. The second path is from the parking lot, crossing one of the two doors. However, the parking is only for professors and before entering in it, the person must identify themselves to a guard (organized access control).

The main entrance is from the street, where students and visitors enter. As Figure 1 shows, there is a door far from the control desk which allows a person from the sidewalk to reach elevators and a staircase without any access control (bottom right corner of the image). However, this door was locked when the first author was there as well as the door on its left side. Hence, it was only possible to leave the street and enter the hall by going through the door directly in front of the control desk.

Moreover, a person in the hall can access other parts of the building through doors, stairs and elevators (Figure 1). A part of this flow could be controlled by the turnstiles (mechanical access control), but they did not work. Consequently, the small doors close to the turnstiles were not locked. In addition, the guards' desk (control desk) is very far from the main entrance (access from the street), so it is hard to control the flow, especially during busy times. When the first author was there, she noticed that several people quickly crossed the room, went through one of the small doors and took the elevators, ignoring the guards.

Classes take place in the morning, afternoon and evening, and crowds may occur at student arrival times. At these times, the path taken by most students is as shown in Figure 2, that is, they go through the small door next to the turnstiles. Due to the intense student flow at this time, the guards keep the small door permanently open. Consequently, in this situation, there is no mechanical access control on the path between the entrance door (street access) and the elevators and stairs (Figure 2).

Figure 2: Path taken by most students before classes start.
Source: Made by the authors.

So, when analyzing access control, it was possible to identify three main elements of the physical space that make agents' work difficult. The first is a large number of entrances and exits, which requires guards to be aware of several locations simultaneously. This may be one of the reasons why some doors were locked. The second is the layout, which placed the control desk far from the main entrance, as well as put the turnstiles in an inappropriate location (it is possible to access other college areas without going through them). And the third is the fact that the turnstiles were inoperative, therefore, an opportunity to carry out mechanical access control was lost. The authors realized that if the turnstiles work and they are next to the entrance door (street access), access control will be much easier.

Although the glass facade allows agents to see who is coming in advance, when analyzing the surveillance, the researchers realized that the pillars and staircase next to the control desk can reduce visibility inside the hall. The DephtMapX visibility map will help them to verify it.

Figure 3 shows the visibility map of the college entrance hall generated using DepthMapX software, with image editing using Photoshop App. Areas with colors close to red (warm colors) are regions with high visibility, from all points located in the entrance hall. Conversely, areas with colors close to blue (cold colors) are those with low visibility from all points located in the internal space.

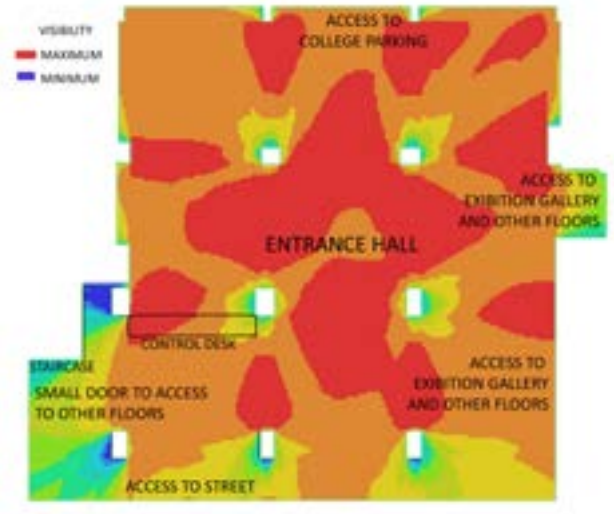
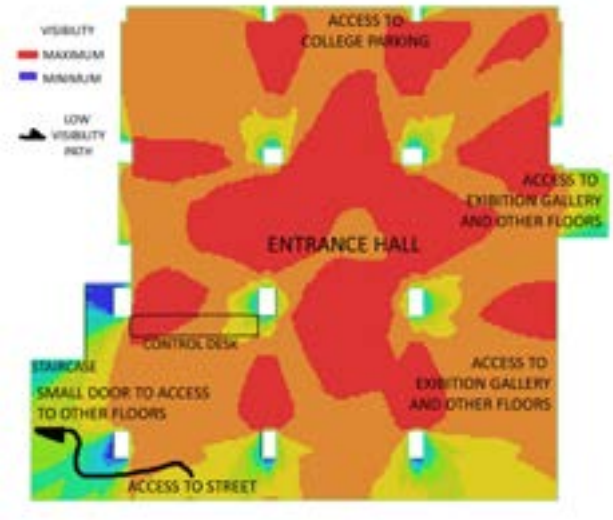


Figure 3: Entrance hall visibility map.
Source: Made by the authors.

In Figure 3, most areas are red or orange, so visibility is high or medium in most of the room. However, the pillars (white rectangles in Figure 3) and the staircase near the control desk reduce visibility in their surroundings, as they are partially surrounded by cyan and blue spots in Figure 3. Thus, the visibility map generated in DephtMapX (quantitative data) confirmed the question the authors did from qualitative data: the staircase and pillars generate a low visibility area on the left side of the

control desk (Figure 3). In addition, they noticed that a person can cross the entrance hall through a low-visibility path, as shown in Figure 4b.

(4a)



(4b)

Figure 4: Path taken by most students before classes start (4a) and path from the main entrance to access to the other floors through low visibility areas (4b).
Source: Made by the authors.

When comparing Figures 4a and 4b, the researchers realized that the low visibility path is close to the track taken by most students before classes start. Therefore, low visibility, crowding and the absence of mechanical access control at this time create opportunities for an offender to enter the building without being identified. So, DephtMapX visibility map helped them to identify the space surveillance vulnerabilities.

When analyzing territorial reinforcement, the authors did not find strong evidence of this process, as expected. The room is a transit place located in a building used by many people, including visitors. Therefore, the characteristics of the room are not very coherent with this type of strategy. The authors also note that the room is properly maintained, clean and orderly. Thus, there are no problems related to maintenance. So, access control and surveillance are the main security strategies in this case.

So, in the entrance hall there are physical space components that facilitate the entry of unauthorized people, they are: the large number of entry and exit points; the layout (control desk and turnstiles positions); the positioning of the street access door, the staircase and the pillars. The researchers confirmed the hypothesis by proving that these components in those places reduce surveillance. First, the large number of entrances and exits, as well as the absence of working cameras and turnstiles, which requires guards to be aware of several locations simultaneously. Second, the control desk is far from the main entrance and the turnstiles are in inappropriate places making surveillance and access control difficult at busy times. Third, the positioning of the street access door, staircase and pillars creates a path through low visibility areas that is close to the student entrance path where crowding occurs and there is no access control. Consequently, the activation of turnstiles and the installation of surveillance cameras aimed at low-visibility areas would help minimize surveillance weaknesses.

Hence, the results show how Interior Architecture can contribute to achieving the 16th goal of the 2030 Agenda for sustainable development, building capacities for crime prevention. Through spatial analysis procedures, the authors demonstrate how architectural elements (such as layout) can help prevent crimes, reducing opportunities for crimes to occur, in line with CPTED principles.

However, they also highlight the limits imposed on solutions in a constructed building. It will be extremely difficult to move the staircase or pillars, and it will be hard to move the control desk and turnstiles, as they are fixed on the floor. Consequently, what remains are mechanical strategies for access control (operational turnstiles) and surveillance (cameras), which are not ideal CPTED strategies, as the approach suggests natural and subtle strategies. Therefore, it is possible to note that if crime prevention is considered at the design stage, it can generate subtle solutions capable of producing more aesthetically pleasing spaces.

Moreover, it is clear that crime prevention does not always require the use of expensive devices. Consequently, the use of CPTED principles in design contributes to ensuring the safety of everyone, regardless of social level. In addition to the benefit to students and professors, the researchers realized how a more suitable space for crime

prevention can help guards in their work, reducing stress levels and improving their quality of life.

Similarly, designing considering crime prevention in internal spaces does not always require high-end tools. DephtMapX is a free and user-friendly software, as well as it does not require high-end computers for data processing. However, their visibility map has limitations: the analysis carried out by DephtMapX only considers two dimensions, disregards points outside the perimeter of the space and disregards the properties of construction materials, such as the transparency of glass, for example. Nevertheless, it can be used in research and low-budget projects, boosting studies on the relationships between crime prevention and Interior Architecture.

5. CONCLUSION

The 16th goal of the 2030 Agenda for sustainable development encourages the creation of capacities for crime prevention. By applying spatial analysis procedures to prevent crimes in an internal space, this work showed how Interior Architecture can contribute to achieving the aforementioned target. Therefore, this article aims to encourage further research on the topic, thus contributing to improving people's quality of life through Architecture. Although they had already achieved the research objective, the researchers must provide an answer to university managers. In August 2022, the first author invited the college's dean and vice-dean for a meeting to show the spatial analyses. After the debate, the leaders chose the options they considered feasible and initiated actions.

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ACKNOWLEDGEMENTS

We thank the faculty deans for their support and assistance in this study, as well as Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for the financial support.

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HOW TO CITE THIS ARTICLE:

COSTA, S. M. M.; SOUZA, R. C. F.; ENGLER, R. C. 16th Goal for sustainable development: A case study on the role of interior architecture. **MIX Sustentável**, v.11, n.1, p.17-28. ISSN 2447-3073. Disponível em: <http://www.nexos.ufsc.br/index.php/mixsustentavel>. Acesso em: _/_/_.

SUBMITTED ON: 13/06/2024
ACCEPTED ON: 09/01/2025
PUBLISHED ON: 18/02/2025
RESPONSIBLE EDITORS: Lisiane Ilha Librelotto e Paulo Cesar Machado Ferroli

Record of authorship contribution:
CRediT Taxonomy (http://credit.niso.org/)

SMMC: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, visualization, writing - original draft and writing - review & editing.

RCFS: conceptualization, formal analysis, methodology, project administration, supervision, validation and writing - review & editing.

RCE: project administration, upervision, validation and writing - review & editing.

Conflict declaration: nothing to declare.