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## ARCHITECTURAL DESIGN AND ITS IMPACT ON PMR ACCESSIBILITY IN HIGHER EDUCATION INSTITUTIONS

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*Abstract. This paper discusses the accessibility of people with reduced mobility (PMR) within public higher education institutions. Several researchers have approached this issue from different angles. They have identified several rights for PMRs, including the fundamental right to education, as recognized by the United Nations.*

*Accessibility is defined as the ease of movement within the environment, achieved through the removal of architectural and technological barriers in public buildings. This study aims to show the impact of the architectural spatial configuration of the university on the social behavior of PMR accessing education.*

*To achieve this goal and answer the research problem, a combination of two scientific research methods was used: a qualitative-quantitative method based on sociological surveys and observation, and a second method based on "spatial syntax," a morphological approach that reveals the close relationship between human beings and their built environment. The study was conducted at the Faculty of Architecture and Urbanism at Salah Boubnider University in Constantine.*

*The study concludes that architectural design has a direct impact on the behavior of PMRs and their appropriation of space within the faculty. Designers need to consider measures and design techniques that facilitate access for this social category to higher education institutions in the development of architectural projects.*

**Keywords:** Accessibility, PMR, Architectural barriers, Technological barriers, Spatial syntax, VGA.

**JEL Codes:** I23, O35, Z1

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## 1. Introduction

Humanity is constantly searching for an ideal of well-being and equality in rights for all. The right to education is among the fundamental rights of human beings, with the same opportunity for all citizens. It dates back to 1948 by the United Nations. They included in this convention people with reduced mobility (PRM) and guaranteed non-discriminatory access to higher education.

Also, the 2006 Convention on the Rights of Persons with Disabilities with laws that protect against discrimination in this social category (Truitari, 2014; Morinaa, Morgado, 2016). This convention has been approved by all countries worldwide to protect the rights of people with disabilities, which are both general and special (Hanga & al, 2017; Dassah & al, 2018).

Its laws can be adapted in the form of a policy reproducing an inclusive environment for PRMs, with reasonable and accessible adjustments for all (Nasution & Marwandiant, 2019). Unfortunately, PRMs have so far found difficulties in obtaining a university education (Sukirno, Premchaiporn, 2022).

Although it is a physical right associated with education, the number of disabled people in universities is reduced due to poor quality architectural design and difficulty in accessing these institutions of higher education. All these factors have a negative influence on the inclusion of PRMs in these public institutions (Barnes, 1991; Imrie, 1999).

This issue has prompted several researchers in the field to address this topic, which is a subject that affects the entire world, they have confirmed in their studies that the spatial design process is not adaptable to the real needs of people with reduced mobility. Several promoters see the issue of accessibility as an additional cost factor in the development of an architectural project.

This paper aims to present the fundamental role of the spatial architectural design of the faculty and its effect on the behavior and daily accessibility of disabled people in the university. Also, to answer the following research question:

**How does architectural design influence the accessibility of PRMs within the faculty?**

## 2. Literature review

### 2.1. The concept of " People with Disabilities"

This concept refers to individuals who experience limitations in their physical and mental abilities and are unable to perform the same tasks as others due to suffering in some way (Ergenoglu, Bayraktaroglu, 2016; Pertiwi et al., 2020).

In 2013, the International Organization defined disability and classified it into three types:

1-Impairment: Loss or anomaly of a psychological function.

2-Disability: Limitation of the ability to perform activities.

3-Handicap: Loss, impairment, or disability that hinders the ability to carry out activities normally due to factors such as age, gender, and social or cultural factors (Angeloni, 2013 in Sukirno, Premchaiporn, 2022; Ergenoglu, Bayraktaroglu, 2016).

### 2.2. The "accessibility" concept



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Is defined as the built environment being accessible to people with reduced mobility (physically disabled, elderly...etc), through the removal of architectural barriers in public purpose buildings such as universities (Ergenoglu, Bayraktaroglu, 2016).

### **2.3. Spatial Design and Accessibility for PRM**

The architectural spatial design of buildings has a direct or indirect impact on people. It aims to respond to all interactions between humans and their space. Additionally, it consists of responding to the different physical needs of individuals with an organization adapted to their wishes and appropriate for all daily activities over time (Simon, 1988).

When the criteria for space design do not meet the different functional organs of people with disabilities, there is a lack that can be addressed by architectural design (Soyupak, 2021).

In the world, especially in the field of design, laws and design standards (ergonomics) require the protection of the rights of people with disabilities and oblige architects to consider people with disabilities in their development projects.

Therefore, architects must recognize their primary role in terms of disabilities and improve their design skills to propose an adapted, inclusive, and accessible solution for all (Soyupak, 2021).

According to the work of Imrie (2000) and Nesterenko (2018), they found that there is a contradiction between theory and practice in the spatial organization of public facilities, with the majority being inaccessible to people with disabilities due to the absence of detailed design elements such as door handles, window heights, signage, and specialized sanitary facilities for people with disabilities according to universal standards. Additionally, these facilities do not consider the actual needs of this social group (Imrie, 2000; Nesterenko, 2018).

### **2.4. Accessibility of PRM to higher education institutions**

The design of accessible spaces in higher education institutions, and their compliance with the needs and requirements of this social category in terms of form and functioning, is an imprint of modernization and development in the higher education sector for people with reduced mobility. The improvement of spatial design techniques must be scalable and in line with the requirements of the educational process in these institutions (Nesterenko, 2018).

The United Nations Human Rights Commission has outlined four essential characteristics for achieving education for persons with disabilities as follows:

1-Availability: Availability of accessible teaching personnel to persons with disabilities.

2-Accessibility: Emphasizes the following points: Non-discrimination in the education program; Accessibility of technological learning sites; Cost of education accessible to all individuals.

3-Acceptability: Must be accepted by everyone, namely the content, form, program, and teaching methods.

4-Adaptability: Education management must be adaptable and tailored to cultural needs and customs (Saputri, 2019 in Sukrno, 2022). (See Figure 1)



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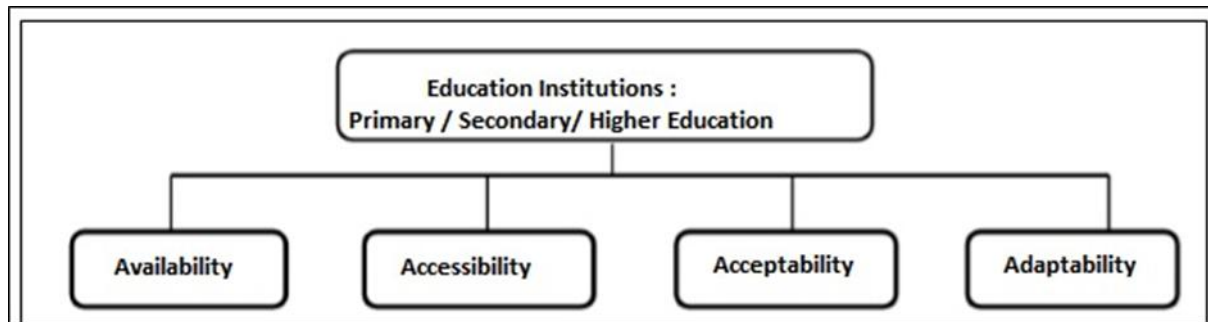


Fig. 1: Characteristics to consider when creating inclusion

(Source:Saputri, 2019)

In addition, the urban planning workshop in 2014 provided measures for better accessibility within universities as follows: General circulation on the site; Classroom equipment; Access to university libraries; Access to administrative services; Access to classrooms and workshops; Access to toilets; Reception service; Handicaps and Accessibility service; Pedagogical support.

Despite the efforts and measures taken by universities in terms of design to accommodate these handicapped individuals, they remain insufficient. Several studies show the characteristics of an inaccessible environment within the university for persons with reduced mobility.

In 2016, Morinaa and Morgado addressed the shortcomings in higher education institutions as follows:

- Lack of adequate technological assistance.
- Negative attitudes towards people with disabilities and difficulties accessing universities.
- Specialized services and teaching systems that are either non-existent or inadequate.
- Lack of necessary adjustments to study programs.
- Lack of teacher training on disabilities.
- Inaccessibility of buildings and indoor spaces.
- Inaccessibility of websites and virtual resources.
- Insufficient hearing elevators.
- Insufficient elevators.
- Lack of adapted classrooms.
- Absence of braille information posters throughout the university.

Similarly, in their study, Alsalem and Abu Doush (2018) identified three types of barriers that a person with disabilities may face: Environmental/Architectural barriers; Behavioral barriers; and Technical barriers.

1-Environmental/Architectural barriers: These are barriers that prevent people with disabilities from accessing public facilities and appropriating them.

2-Behavioral barriers: These are discriminations against a person with disabilities due to their physical or mental state.



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3-Technical barriers: When technology cannot be transformed into another format accessible by assistive devices (Whiteneck, 2000).

To address these issues, a proposal for universal design was put forth by disabled architect Ronald Mace in 1985 to improve the quality of architectural projects in educational institutions, making them adaptable and accessible for everyone. This accessible design encompasses all human conditions without distinction (age, size, personal abilities). The seven principles for ensuring that universities are accessible to people with disabilities are:

Equitable use; Flexibility of use; Simple design; Perceptible information; Tolerance for error; Low physical effort; Size and space for approach and use.

## 2.5. The Algerian policy for PMR

The inclusive education of people with disabilities is considered a fundamental human right. The national policy aims to give a respectable place to these categories of people with specific needs. Table 1 shows us the rate of students with specific needs in different national exams.

Table 1: Rate of students with special needs, in the different national exams.

Year	Number of persone	2010	2011	2012	2013	2014	2015	2016
<b>5<sup>th</sup> Primary</b>	The total number	<b>610952</b>	<b>598239</b>	<b>601586</b>	<b>621888</b>	<b>646965</b>	<b>648572</b>	<b>705460</b>
	specific needs	<b>131</b>	<b>149</b>	<b>270</b>	<b>203</b>	<b>216</b>	<b>183</b>	<b>131</b>
<b>BEM Middle school diploma</b>	The total number	<b>504463</b>	<b>528136</b>	<b>771284</b>	<b>603239</b>	<b>591509</b>	<b>542025</b>	<b>559929</b>
	specific needs	<b>102</b>	<b>162</b>	<b>226</b>	<b>179</b>	<b>180</b>	<b>174</b>	<b>105</b>
<b>BAC the baccalaureate</b>	The total number	<b>433814</b>	<b>496665</b>	<b>650050</b>	<b>566694</b>	<b>657026</b>	<b>853780</b>	<b>818517</b>
	specific needs	<b>162</b>	<b>148</b>	<b>170</b>	<b>238</b>	<b>280</b>	<b>374</b>	<b>487</b>

Source: ONS and Ministry of National Education years: 2010/2016 in Oumokrane et al, 2016.

The Algerian State, on its part, has developed its legislative framework in line with regional and global regulations. The objective is to establish a solid foundation for the protection of the rights of persons with reduced mobility (Oumokrane, Bouraoui, Chabi, 2016; Benamara, 2016).



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Indeed, among these national laws that guarantee the rights of persons with disabilities, as well as facilitate accessibility for this social category and improve their living conditions and well-being, we can distinguish the following:

In Algeria, a comprehensive framework has been established to protect and empower disabled individuals. The Law No. 02-09 of May 8, 2002, serves as the foundation, encompassing measures like early disability detection, access to specialized healthcare, mandatory education, job creation for social inclusion, and providing a minimum income. This law also sets accessibility standards for public buildings and transportation to enhance mobility and social participation for disabled individuals.

Additionally, Executive Decree No. 05-68, enacted on January 30, 2005, focuses on vocational training and apprenticeship centers for those with physical disabilities, expanding their educational and vocational horizons. Executive Decree No. 06-455, introduced on December 11, 2006, bolsters these efforts by specifying accessibility requirements across various aspects of life, including physical, social, economic, and cultural environments.

These initiatives are firmly entrenched in the Algerian Constitution, ensuring rights such as the right to education (Article 65), healthcare protection (Article 66), housing accessibility (Article 67), a healthy environment (Article 68), and the right to work (Article 69) for all citizens. Moreover, the Interministerial Order of March 6, 2011, furthers these efforts by establishing technical accessibility standards based on the Algerian accessibility standard NA 16227, aimed at improving access to public buildings and facilities for people with disabilities.

## **2.6. Inclusive education for PRMs in Algeria**

The integration of people with reduced mobility into higher education has been a central concern of Algerian policy since independence to the present day. Despite the efforts made through specialized ergonomic means and standards for disabled individuals, we have found, according to statistics from the National Office of Statistics (ONS), that the number of students accessing higher education is very limited (Oumokrane, Bouraoui, Chabi, 2016).

This situation is due to the absence of an adaptable environment for this category of people with reduced mobility, and the presence of architectural and technical barriers that hinder the accessibility and movement of these individuals within the university. Additionally, there is a lack of specialized education programs and assistance for them.

According to Oumokrane et al (2016) in their work written in this regard, “It is the dysfunctions and disharmonies between the political will and the real conditions as they present themselves in schools daily that generates these situations of unintended sanctions that particularly affect socially vulnerable students”.

Therefore, our study aims to establish an inventory on the subject of people with disabilities and to assess the impact of the architectural design of the faculty on the degree of accessibility for disabled individuals. This will be achieved through the application of a fundamental research method, which will enable us to address our problem statement and research question.

## **3. Research Methodology**



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For the development of this scientific research, we have relied on a combination of two complementary research methods. The first is a qualitative and quantitative method based on observation tools and sociological surveys, while the second method is "Spatial Syntax," based on the application of the "Depthmap" software. The objective is to show the degree of the effect of design on the behavior and accessibility of disabled individuals within the Faculty of Architecture at the University of Constantine 3 (UC3).

Additionally, we aim to identify the different architectural barriers and technical obstacles that prevent people with disabilities from accessing higher education.

#### 4. Case Study: The Faculty of Architecture at the University of Constantine

##### 4.1. Presentation of the Study Area

For this study, we have chosen the case of the Faculty of Architecture and Urban Planning in the Salah Boubnider Constantine 3 University campus, located precisely in the extension of neighborhood unit number 5 in the new city of Ali Mendjeli in Constantine. It was put into service in 2013.

The faculty is surrounded by several faculties of higher education, such as the Faculty of Pharmaceutical Process Engineering, the Institute of Urban Technical Management, the Faculty of Political Science, and Residence No. 4 (see Figure 2).

Moreover, it is characterized by a spatial configuration with a triangular geometric shape enclosed by courtyards in the design. It consists of several blocks, and each block contains classrooms, workshops, amphitheatres, research laboratories, a library, internet rooms, and administrative offices. The Faculty of Architecture is spread over five levels (see Figure 3).

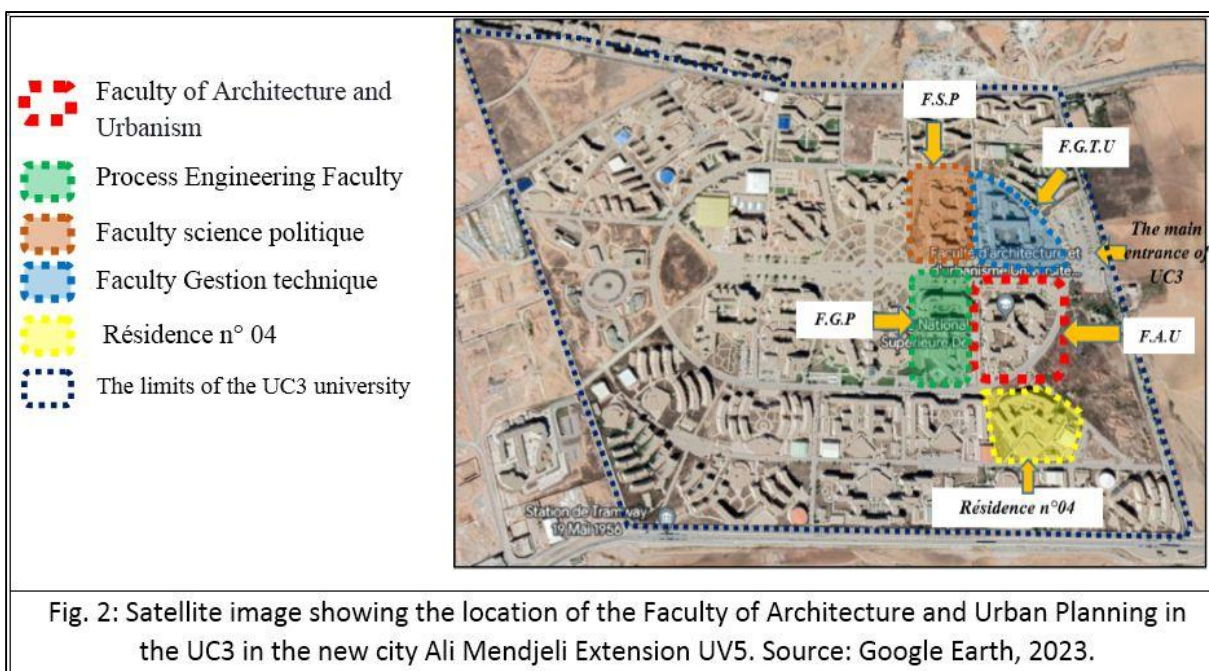


Fig. 2: Satellite image showing the location of the Faculty of Architecture and Urban Planning in the UC3 in the new city Ali Mendjeli Extension UV5. Source: Google Earth, 2023.



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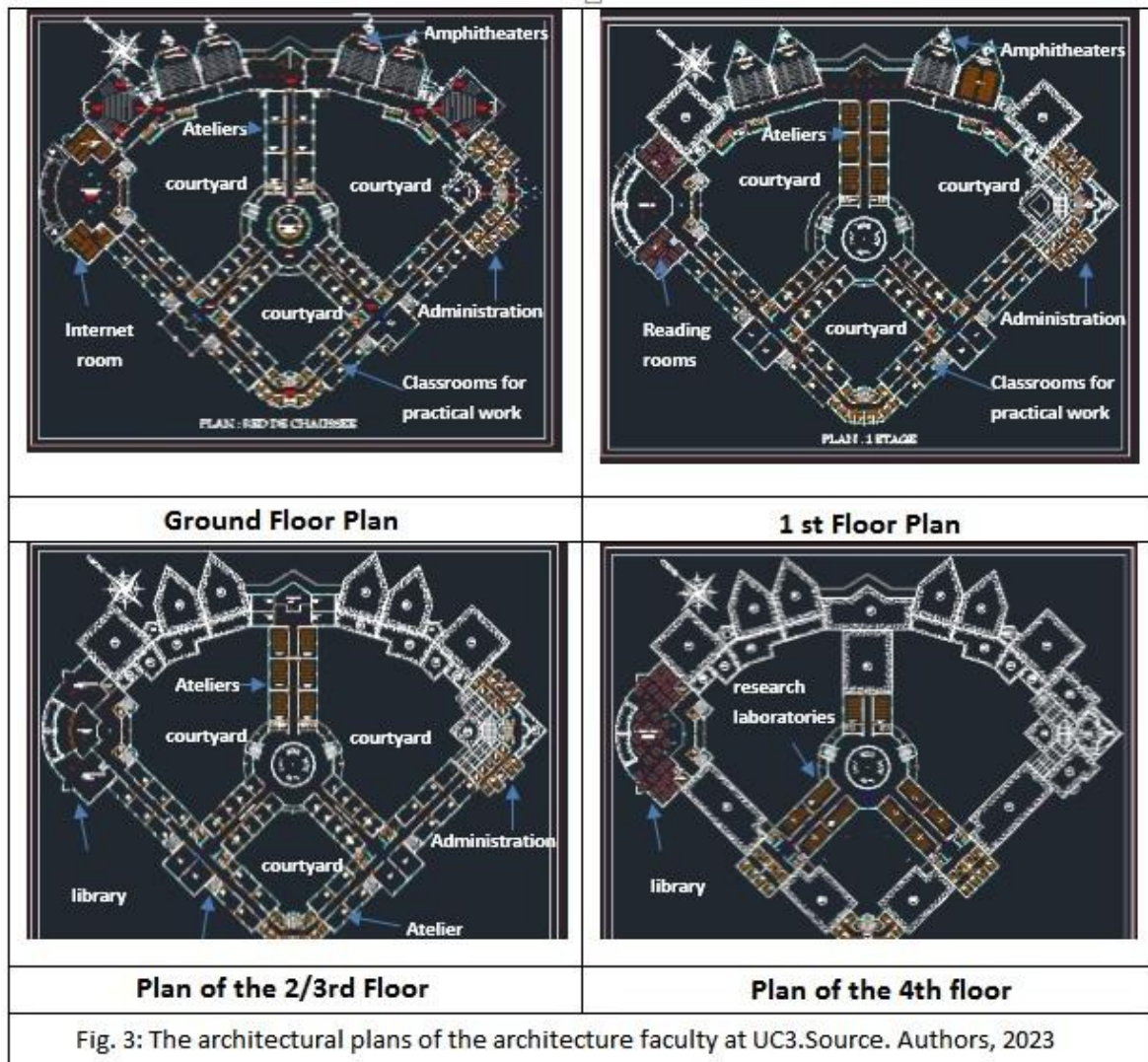
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## 5. Analysis of results

### 5.1. Physical accessibility of people with reduced mobility within the Faculty of Architecture of Constantine (Environmental/technological barriers)

According to the field survey and data collected from the rectorate of Constantine 3 University, there are only 11 persons with disabilities (PWDs) in total. They are enrolled in the following faculties: Information and Communication Faculty, Process Engineering Faculty, Political Science Faculty, Urban Technical Management Faculty, and Pharmacy Faculty.





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However, there is no enrollment of PWDs in the Faculty of Architecture.

Based on statistics from the relevant services, we have observed the following results:

The number of PWDs in Constantine 3 University is distributed as follows:

Table 2. The assignment of PRM in UC3.

Number of students	N° Students in Bachelor	N° Students in Master	N° Students in PhD	N° Students in Pharmacy
11	6	3	1	1

Source. Service pédagogie UC3 + Authors, 2023.

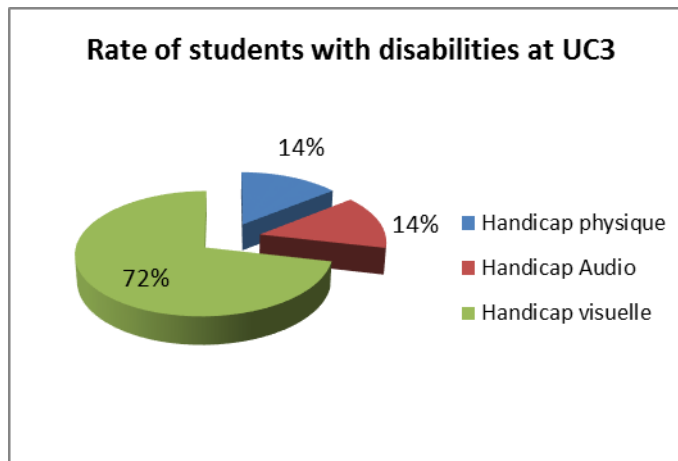


Fig. 4: The rate of RMC students at UC3. Source: Authors, 2023.

Table. 3: The different types of disabilities at UC3.

Type of disability	N° students at UC3
Visual impairment	5
Hearing impairment	1
Physical disability	5
Total number of students	11

Source. UC3 Pedagogy Service + Authors, 2023

Our analysis will focus on the environmental (architectural) and technological barriers addressed in the theoretical approach that prevent accessibility for people with disabilities within the university, using the research tool "Observation." Based on the work of ATELIER PARISIEN D'Urbanisme, 2004, and Alsalem and Abu Doush, 2018, we will attempt to determine their presence or absence in our study area.

### 1. General access on site

Based on our observation at the study site, we have noticed that the interior space of the faculty is designed in a normal way at the expense of this social category. There is only one ramp present in the main access to the facility. Furthermore, there are no sound alert signals and safety measures specifically designed for people with disabilities (PWDs).



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## **2. Equipment in classrooms**

There is a total absence of specific equipment for PWDs in classrooms. The controls of the pieces such as lighting, heating, air conditioning, windows, and blinds are not installed within the reach of a person with a disability. There is also a lack of assistive technologies such as screen readers (JAWS and NVDA), screen magnification software (Zoom Text), and speech recognition software (Dragon Naturally Speaking).

## **3. Access to university libraries**

According to the architectural plan of the faculty, the library is inaccessible to PWDs due to its location on the first floor: the reading room for students is located on the first floor, the book lending room is on the second floor, and the thesis and dissertation lending room is on the third floor. Additionally, there is a total absence of elevators. The library and internet room equipment are equipped with printers and computers, but there is a lack of large print or braille labels on keyboards. We have also noticed a lack of high-contrast signs.

## **4. Access to administrative services**

Located on the floor are inaccessible to the PRM because the majority of the offices are located on the floor and in the absence of elevators, it is always necessary for the presence of human help to access these offices.

## **5. Access to classrooms and workshops**

The majority of the offices are located on the upper floors, which are inaccessible to PWDs due to the absence of elevators. Assistance from a human aide is necessary to access these offices.

## **6. Access to restrooms**

The majority of the restrooms in the faculty are not suitable for disabled persons. Except for the toilets on the ground floor located next to the conference room and the renovated amphitheaters.

## **7. Reception service - "Handicaps and Accessibility" Service**

There is a complete absence of a specialized service for the guidance, advice, and assistance of disabled persons within the Faculty of Architecture.

## **8. Pedagogical support**

-Inadequate equipment for disabled students, where we have noticed a complete lack of a computer room adapted for motor and visual impairments in the faculty library and the internet room.

-Human assistance: According to the accessibility standards for persons with reduced mobility within a public facility, disabled students can benefit from a reader, specific pedagogical support, and assistance with administrative procedures upon request. We have noticed an absence of this human assistance.

## **5.2. Syntactic analysis of the architectural spatial configuration of the faculty**

The method of spatial syntax is an analytical approach developed in Anglo-Saxon countries based on spatial configuration. It appeared in the 1980s and was developed by Bill Hillier. This scientific research method explains the close relationship between humans and their physical space through the study of their social behavior (Hillier, Hanson, 1984; Hillier, 2007; Sharmin, Kamruzzaman, 2017).



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Similarly, Dursun (2007) and Benkechkache & Nait Amar (2022) emphasize that spatial syntax is based on the configurational theory of space and attempts to decode the spatial organization, decipher, and approach the reality of architectural space. This method appears as a tool for architects to explore their design ideas and understand how space functions.

Moreover, it is a method of quantifying, analyzing, and measuring spatial relationships in buildings. It is an objective method for evaluating and studying the spatial relationships between the morphological structure of architectural spaces and social events (Jiang and Claramunt, 2002; Shahbazi et al., 2018).

#### **5.2.1. The measure of connectivity**

A global measure defines the local integration of space (Bouarrourdj, 2019). According to the analysis of all the visual graph analysis (VGA) of the Faculty of Architecture, we have found that the degree of connectivity of spaces is higher, especially in the halls of the two main and secondary entrances of the main and ground floors, and the library on the 4th floor. All these spaces are represented in the VGA with a red color, and the degree is lower in the corridors that lead to classrooms marked in the VGA with a gradient color from orange to yellow. The rest of the spaces are not connected to the overall spatial configuration and are distinguished by a blue color (classrooms, workshops, research laboratories).

Accessibility in non-connected areas is very low for people with disabilities.

#### **5.2.2. The measure of integration**

A static global measure that allows us to know if the space is integrated or segregated, locate the most frequented space, measure the intensity of movement, and measure accessibility through this syntactic measure (Bouarrourdj, 2019).

According to the analysis of our VGA, we found that the integration of spaces is higher, especially in the two halls of the two main and secondary entrances and a part of the corridor next to the conference room and the amphitheater. In addition, the roundabout at the intersection of the three blocks, and finally, the library on the 4th floor is represented by a red color in the graph. Students' visitation and use of these areas in the Faculty of Architecture are very important, and they are more accessible to students during their appropriations. These are excellent places for social gatherings.

**5.2.3.** In contrast, the rest of the spaces are segregated in the spatial organization of the faculty, with very low student visitation and accessibility. These spaces are only used for taking classes, and they are represented by a blue color in the graph. Accessibility is very low, especially for people with reduced mobility, due to the absence of signs and audio-visual elevators for people with special needs. **Control measurement**

Is a local measurement. This analysis, allows us to demonstrate the possibility of having control over the entire space or not (Bouarrourdj, 2019).

Based on the analysis of the visibility graph assembly (VGA), we noticed that the control of the spaces that make up the faculty is only acceptable when represented in the graphs with a yellow color in the set of levels of the Faculty of Architecture.



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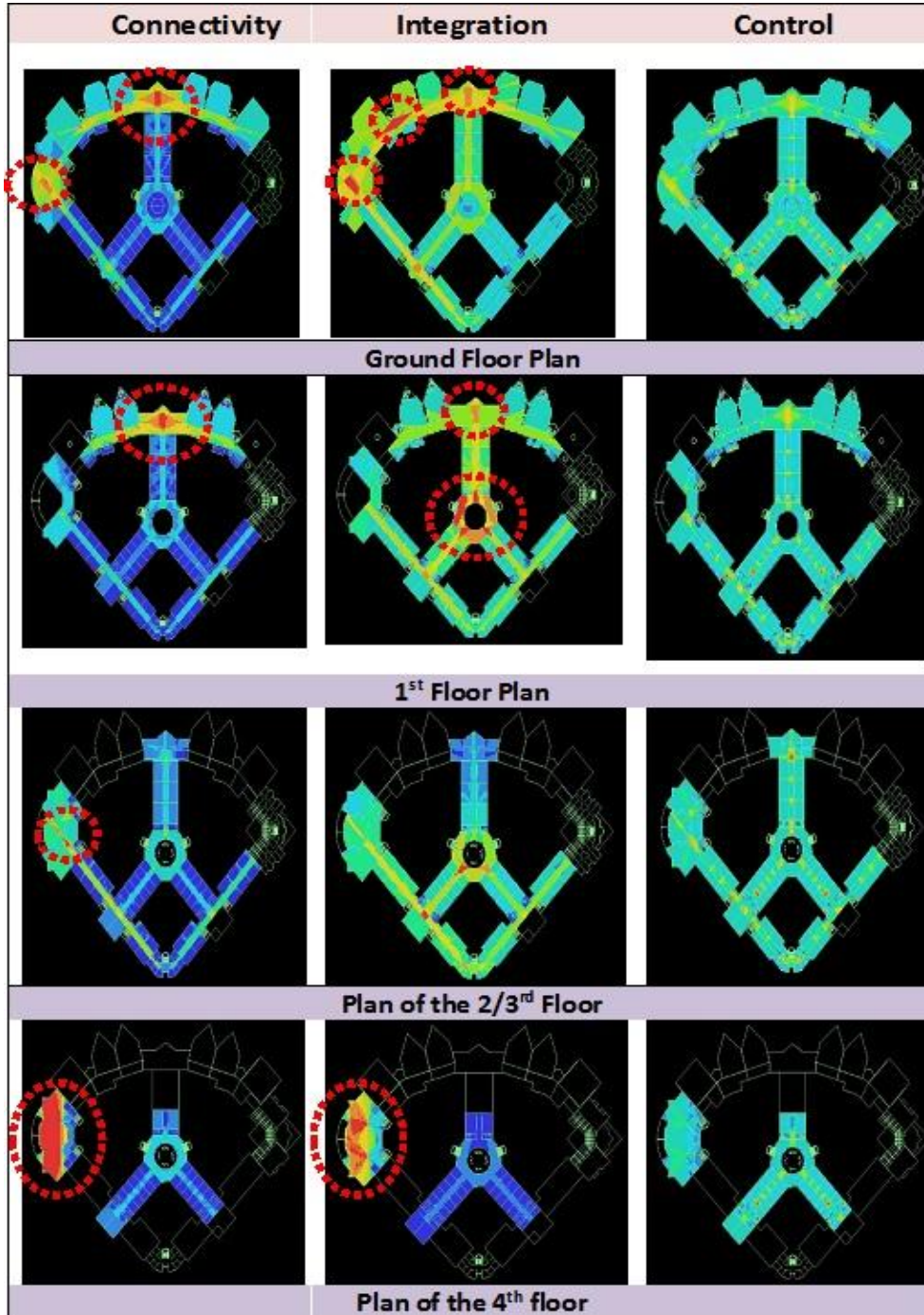
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Table. 4: The different syntactic measures of each level in the faculty of architecture.



Source : Authors contribution, 2023



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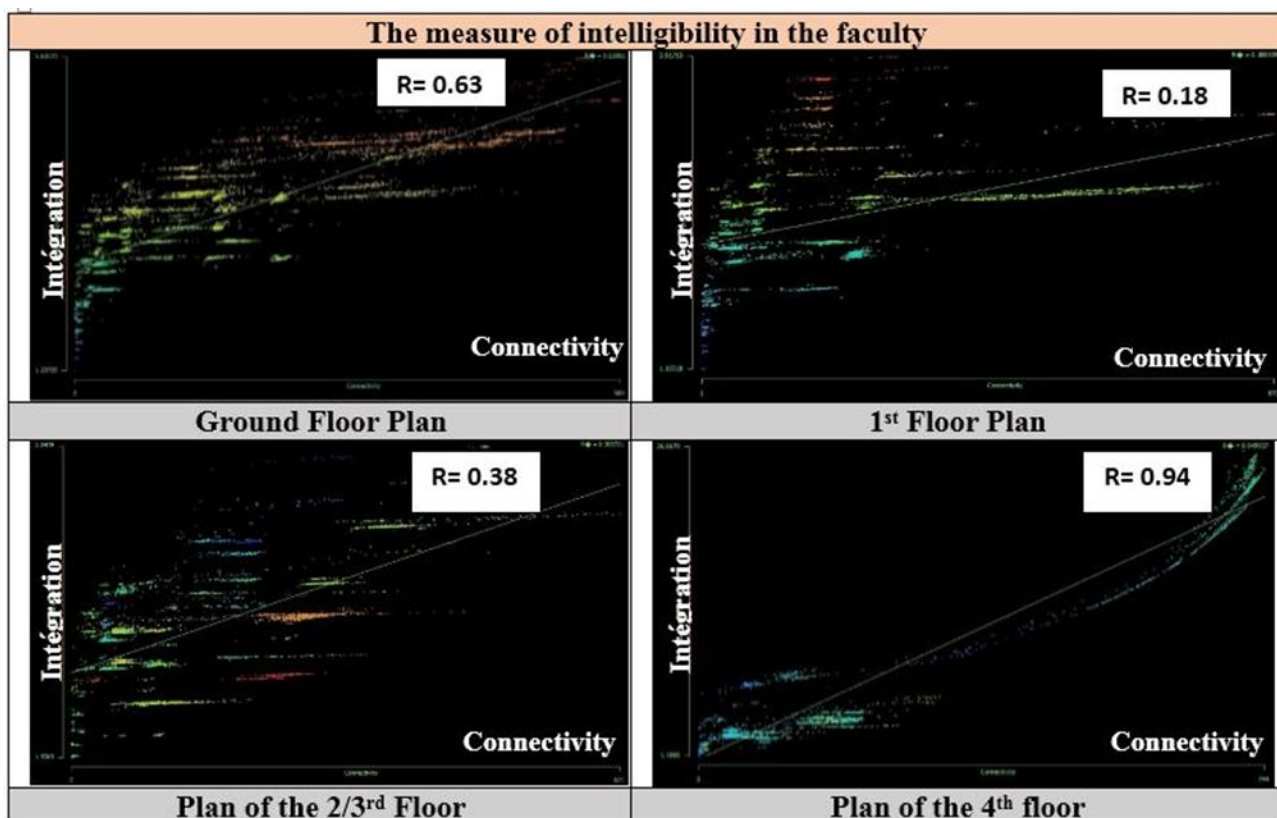
#### 5.2.4. The measure of intelligibility

Is a measure that defines the readability of spaces through the ratio between connectivity and integration (Bouarrourdj, 2019). It allows us to determine if the space is homogeneous or not.

According to Table 02, we observed from the VGA graphs of the intelligibility measurement that the ground floor and the 4th floor have homogeneous intelligible spaces because the regression coefficient is greater than 0.5, with values of  $R = 0.63$  and  $R = 0.94$ , respectively.

On the other hand, when compared to the spaces that make up the three-level configuration of the faculty, the 1st, 2nd, and 3rd levels are non-homogeneous and unintelligible, as the regression coefficient is less than 0.5, with values of  $R = 0.18$  and  $R = 0.38$ , respectively. (See Table. 5)

Table. 05: The VGA of the intelligibility measure.



Source : Authors contribution, 2023

## 6. Discussion of the results

Based on the analysis and sociological survey conducted in the field, we have found that accessibility within the Faculty of Architecture and Urbanism is limited. All the spaces are designed in a way that is inaccessible



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to people with reduced mobility, due to the total absence of the different criteria mentioned in the theoretical approach to environmental and technological barriers that facilitate the accessibility of these individuals. These spaces are unsuitable for the real needs of people with disabilities of any type, due to the lack of norms and measures for a space adapted to PRM in terms of surface area, teacher training for their supervision, absence of signage, lack of hearing lifts, absence of technology-related equipment adapted to PRM, all of which prevent the accessibility of this category within the university in general and the faculty in particular.

For the second method of scientific research, "spatial syntax", we observed from the analysis of the visibility graphs of two syntactic measures, connectivity and integration of the different levels of the Faculty of Architecture and Urbanism, that the degree is high mainly in the following spaces:

The main and secondary entrance halls located on the ground floor as well as the library located on the 4th floor presented in the VGA by a red color, these are spaces that are highly frequented daily by students. Conversely, if we compare them to the spaces reserved for classrooms and workshops, these spaces are marked by low connectivity and integration presented in the VGA of the two measures with a blue color, the appropriation of these spaces is very low and marked by calmness, making it an excellent study space.

Based on the survey and observation in the field as part of our study, we found that vertical connectivity between the different levels of the faculty is limited only by the staircase, which is difficult for people with reduced mobility due to the absence of ramps and hearing lifts to access classrooms, workshops, and the library.

We also noticed through the study of VGA that the control measure is very limited, which directly affects the accessibility of people with special needs, and this situation is amplified by the absence of a "Handicap and Accessibility" reception service and human assistance.\*

## 7. Conclusion

From this study, we have concluded that the Algerian university, specifically the faculty of architecture and urbanism of Constantine, is marked by a complete absence of standards in terms of space and technological means that facilitate accessibility for people with reduced mobility to have a place that meets their real needs within the faculty. Additionally, we have found through the research method of the spatial syntax that there is a direct impact between architectural design and the social behavior of disabled individuals for a better appropriation of space within the faculty.

Despite legislative prerogatives regarding accessibility and the right to education through "inclusive education" for disabled individuals, there is a striking contradiction between theory and practice. There are several environmental and technological barriers and obstacles that prevent the easy mobility of these individuals within the faculty.

Ultimately, all of these factors have a negative impact on the integration of individuals with reduced mobility in this faculty. Therefore, architects and decision-makers in the field must improve the architectural quality of these spaces in their spatial organization through specialized design techniques and technological means to facilitate education. This is to have a space that is adapted to the specific needs of disabled individuals and a better quality of educational life.



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