

**A Proposed methodology to Raise the Efficiency of the Design Standards for the Movement Paths within the Facilities for people with Mobility Disabilities**

**“A Care Building for People with Mobility Disabilities in Egypt (Case Study)”**

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**Abstract:**

The problem of people with special needs receives high attention as they are the category entitled to care and to provide assistance to overcome the challenges facing their needs and support them to be able to rely on themselves, especially for those who suffer from physical disabilities, which represent 10% of the total world population, "according to the statistics of the World Health Organization."

It is no secret that everyone is exposed to physical injuries, as he may be born with an injury, road accident injuries, or a pathological injury that leaves a partial or total disability, which prompted the researcher to prepare a study on places for residence and care for people with motor disabilities to find out the design defects of the internal spaces of those places. Which impedes the ability of the users to rely on themselves during the movement by using assistive technological means, whether traditional or the mechanism of movement.

This was done by conducting a questionnaire for users, supervisors, and specialists, as well as analyzing the interior designs of the spaces and movement paths, evaluating their suitability for the needs of the movement of the users, and reviewing them with the standards of buildings for people with special needs, and using previous experiences to reach the optimal design solutions for “entrances, corridors, stairs, ramps, handrails, elevators, bathrooms, toilets, and doors.” The researcher was able to identify the design modifications in order to reach the proposed methodology to raise the efficiency of the design standards.

**Keywords:** Mobility    Disabilities–Circulation–Care    building-flooring  
Materials- Architecture

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- **Methodology:**

Researcher will achieve goals by following several approaches:

**Inductive approach:** It includes the study of the foundations and design standards for movement paths within facilities for people with motor disabilities.

**Descriptive analytical approach:** It includes an analytical study of design standards for movement paths in the internal spaces of the concerned facilities and the materials used, and a questionnaire for users, supervisors, to record their vision of the best designs and materials, and to record their observations of the reasons for the difficulty of users' movement and their movements without assistance.

**The analytical approach:** It includes an applied study and includes a field visit to a care home to do a research reading on the reality of the designs, recording the advantages and disadvantages, analyzing them through the simulation program, and submitting modification proposals for the designs on the results after the modification and comparing them with the results before the modification to find out the extent of improvement and raise the efficiency of movement paths and facilitate movement.

**Deductive method:** It included devising a proposed methodology to raise the efficiency of design standards for movement paths within facilities for people with mobility disabilities, through the results reached through the theoretical and applied approach.

- **Main Goals:**

The research dealt with the study and analysis of the interior designs of the residential spaces of the current care homes for people with mobility disabilities and their conformity with the design standards of places for the care of the physically disabled and the extent to which they meet the needs of the users and provide the maximum ease for their mobility by self-reliance using modern means and prepare a base for the characteristics of the materials used and the extent to which they meet the needs of users in order to reach a proposed methodology A proposal to raise the efficiency of the design standards for movement paths for people with mobility disabilities within care centers.

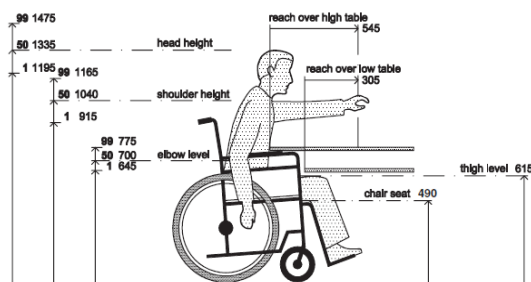
## 1. Introduction:

The Central Agency for Public Mobilization and Statistics revealed in December 2021 that the percentage of people with special needs in Egypt represents 10.5% of the total population, according to its latest census, and this means that more than 10.5 million Egyptians suffer from disability in some way, (Shaker, 2013) and the research strived to develop a methodology It aims to assist the group that suffers from motor disabilities by submitting proposals that make them able to be self-reliant in their movements within the care homes and in preparation for the generalization of these proposals to reach all places and facilities by raising the efficiency of the design standards for movement paths in the internal spaces of facilities for people with mobility disabilities.

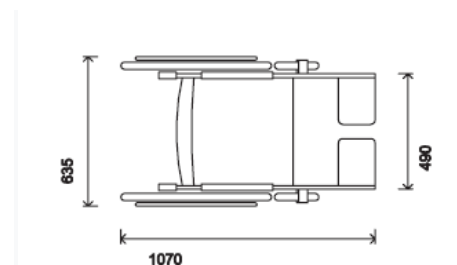
Presenting proposed models for the designs of entrances, ramps, handrails, internal passages, and external courtyards, and choosing the most appropriate materials that meet the requirements of users and provide them with maximum comfort and freedom of movement with minimal effort without obstacles. (Khalaf, 2015)

## 2. The Theoretical Part: Design standards in care buildings for people with special needs (movement disabilities)

The research deals with the study of standards and design principles for movement paths inside buildings for people with mobility disabilities, with a focus on the specifications of the wheelchair as the main means of transportation for users with mobility disabilities. Figures (1, 2) illustrate a model of a wheelchair that allows the user to rely on themselves while moving through the spaces of the building. (Aliowair, 2010)



**Fig.1** shows the dimensions of the chair the maximum height is 100 cm. Its movement allows for 360-degree rotation. Source: (Goldsmith, 2000)

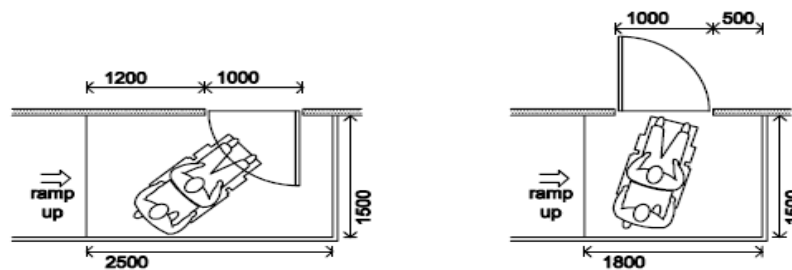


**Fig .2** shows the dimensions of the chair for adult users. The average width of the chair is 65 cm, the length is 1m Source: (Goldsmith, 2000)

## 2.1. Design principles and standards for movement paths inside buildings for people with mobility disabilities

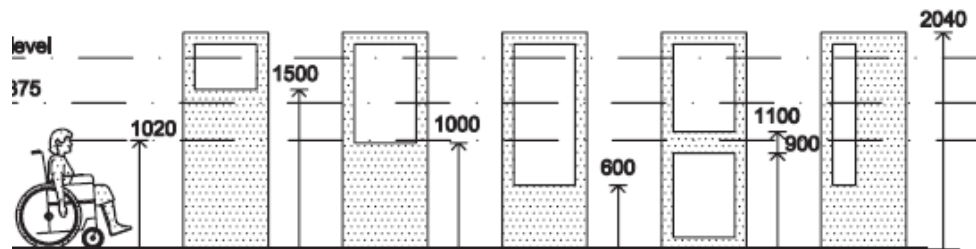
### • A- External Entrances:

- The design of the width of the entrances is taken into account to allow the passage of the wheelchair completely freely, with the entrances free of any obstacles, with the possibility of opening the doors from both directions to facilitate movement during entry or exit, and it is possible to use sliding doors. (Sungur, 2018)



**Fig.3** A figure showing the design dimensions that must be taken into account when implementing entrances for people with mobility disabilities, Source: (Goldsmith, 2000)

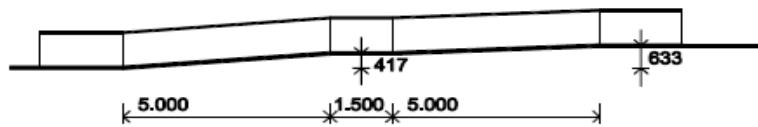
- In case of different levels at the entrances, there must be slopes with suitable slopes next to the stairs so that he does not have to use the ladder. (Dimoulias, 2014)
- It is taken into account that the glass of the doors be of a transparent type and be at suitable heights for wheelchair users to link visual communication between the inside and the outside. (Abdo, 2020)



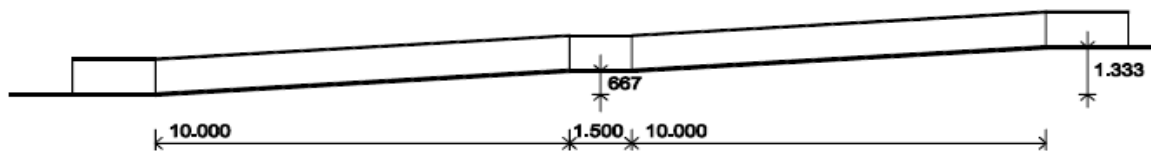
**Fig.4** A figure showing the line of sight for a wheelchair, so the glass in the doors should be at the level of the line of sight, Source: (Goldsmith, 2000)

- **B- RAMPS:**

- The design of the ramps for people with mobility disabilities is taken into account to provide them with ease of ascent or descent without exposure to stress or accidents, and the inclination ratios that allow the user "with disabilities to ascend and descend from the slopes safely and without exhaustion" depending on themselves range between 1:12 Up to 1:20, and in case the length of the ramp is more than 6 m, the slop should be made at an appropriate distance that allows the user to give part of the comfort and provide him with safety, and it is preferable that it be in the middle of the distance (Bordas, 2017)
- In the external slopes leading to the entrances of the building, it is allowed to increase their length by more than 6 m, taking into account that the slope is not more than 1:15, as shown in the figure5. (Keynes, 2007)



a Ramp in compliance with Part M, 1:12 gradient with handrail and intermediate landing

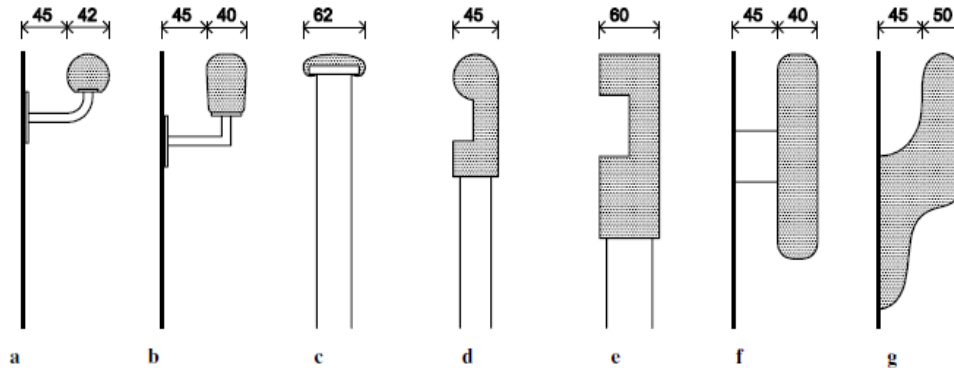


b Ramp in compliance with Part M, 1:15 gradient with handrail and intermediate landing

**Fig.5** A figure showing the ramp 1:12, 1:15 with handrail and intermediate landing, Source: (Goldsmith, 2000)

• **C- Handrails:**

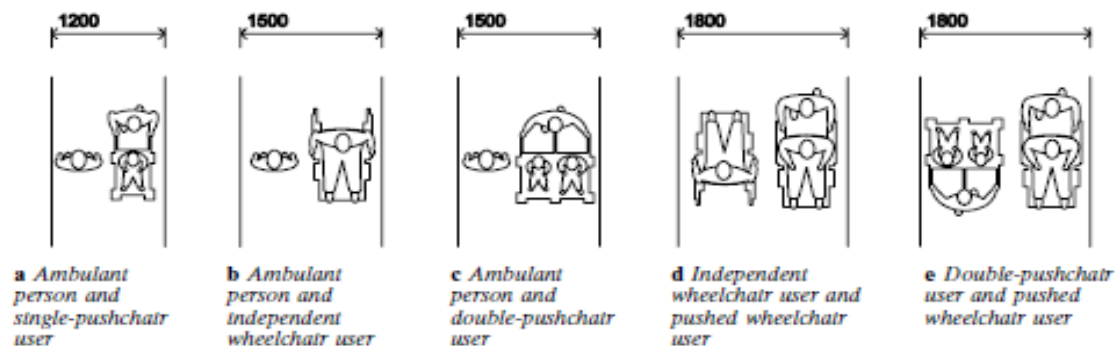
- The height of the handrail is proportional to the hand of the user of the wheelchair, so that he can rely on himself to go down or up the slope. The appropriate height of the handrail ranges between (45-60 cm), and the ends are not sharp, (License, 2021) as shown in Figure 6.



**Fig.6** A figure showing the dimensions and shapes of the different handrails, Source: (Goldsmith, 2000)

• **D- Internal Corridors:**

- it is necessary to stay away from using columns, stairs, flower beds, and any obstacles in the paths of movement of internal corridors (Standards, 2021)
- The width of the corridors ranges between 1.50 - 1.20 for the individual pass.
- It is preferable that the width of the corridors at the turning areas range between 2.70-3 m
- It is preferable to provide the sides of the corridors with handles at a suitable height to support the movement of the handicapped. (Abdo, 2020)



**Fig.7** A figure showing the sizes of the different widths of the interior corridors, Source: (Goldsmith, 2000)

- **E- External Spaces:**

- Residents with mobility disabilities spend most of their life hours inside the care homes, and for their morale and psychological conditions, it is necessary to provide outdoor spaces attached to the indoor space of the care homes, and these spaces allow them to enjoy of fresh air, direct sunlight, and social interaction with their fellow users. (Liebergesell, 2018)
- In these outdoor arenas, the availability of the necessary specifications to make them suitable for people with mobility disabilities, and the most important of these specifications, is taken into account, The presence of a supervisory staff in specific places in the yards that allow them to closely monitor the users and allow them to quickly reach any of the users. (AL-Ma'aytah, 2003)
- Availability of safe movement paths that allow users to move freely and safely. (Australian, 2014)
- The existing furniture should be made of shock-absorbing materials with circular and non-sharp edges. (Moftah, 2018)

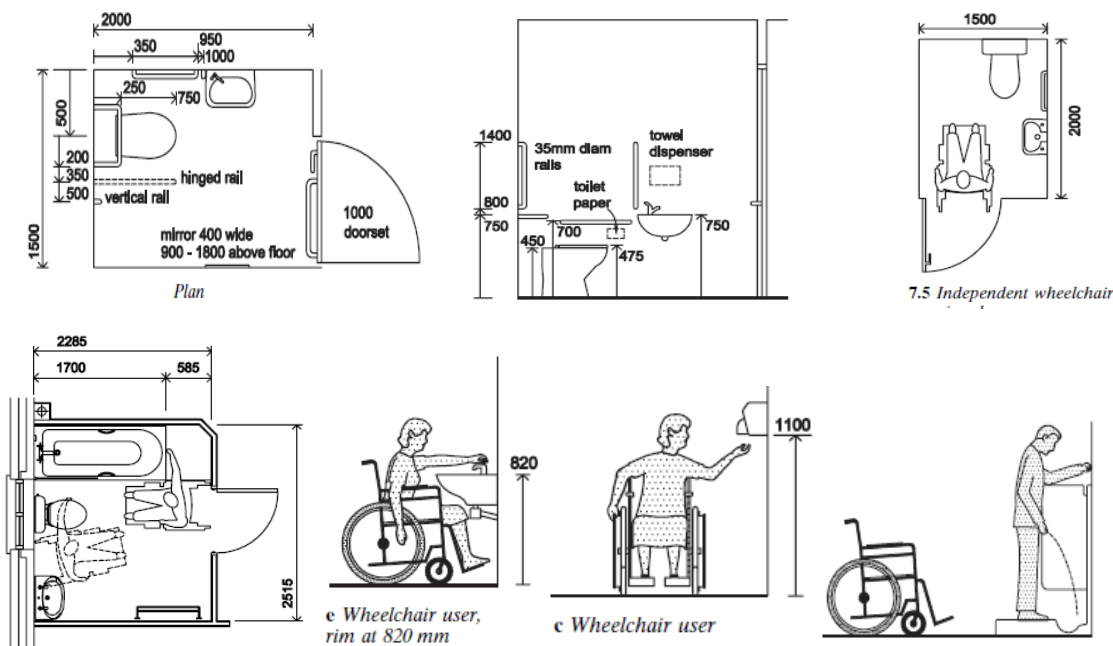


**Fig.8** A figure showing the shapes of the external spaces and the materials used in the floors, Source: Researcher & <https://www.pageindustrialcoatings.co.uk/industry-type/stadium-resin-flooring/>

- **F- Design Standards for toilets:**

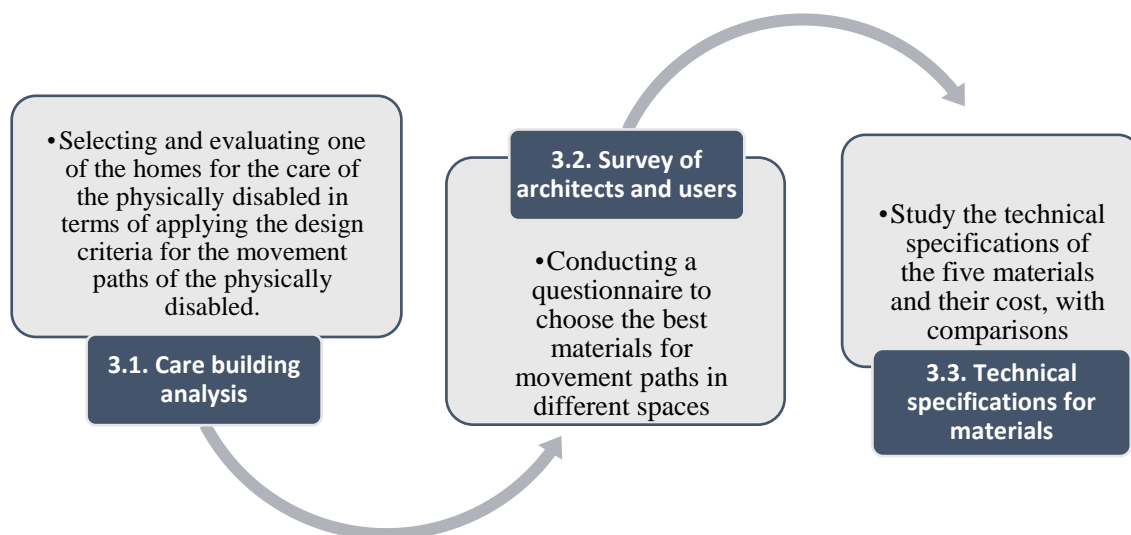
- Bathrooms must be provided with internal supports that provide the user with the possibility of self-reliance without danger.
- The suitable and preferred heights for people with motor disabilities for the cushions are 110 cm, for the basins 70-80 cm, and for the toilet 35-46 cm. (Liebergesell, 2018)
- Distributing bathroom elements to allow wheelchairs to enter completely freely and without obstacles within an area of 1.40 m, and to allow them to move in a 360-degree direction. (Willem, 2015).
- The suitable height for urinals is 36 cm from the ground, 91.5 cm long and 112 cm wide.

- Bathroom doors should open outwards and be at least 100 cm wide. (Abdo, 2020)



**Fig.8** A figure showing the distribution of bathroom elements and design standards and dimension in bathrooms, Source: (Goldsmith, 2000)

### 3. The Analytical Part: An analytical study of a care center for people with motor disabilities



**Fig.10** shows the steps of the analytical study of buildings for people with mobility disabilities, Source: Researcher



### 3.1. Analysis of a care center for people with motor disabilities for adults in Obour City

The Care Center for the for people with mobility disabilities for Adults in Obour City was chosen as a model for one of the buildings of the Care Centers for the Physically Handicapped. It can be studied analytically with the aim of evaluating movement paths and their conformity with design standards in terms of engineering measurements and the use of appropriate materials that achieve ease of movement and provide movement safety for the handicapped with the least possible effort, to rely on self in movement

**- Building description:**

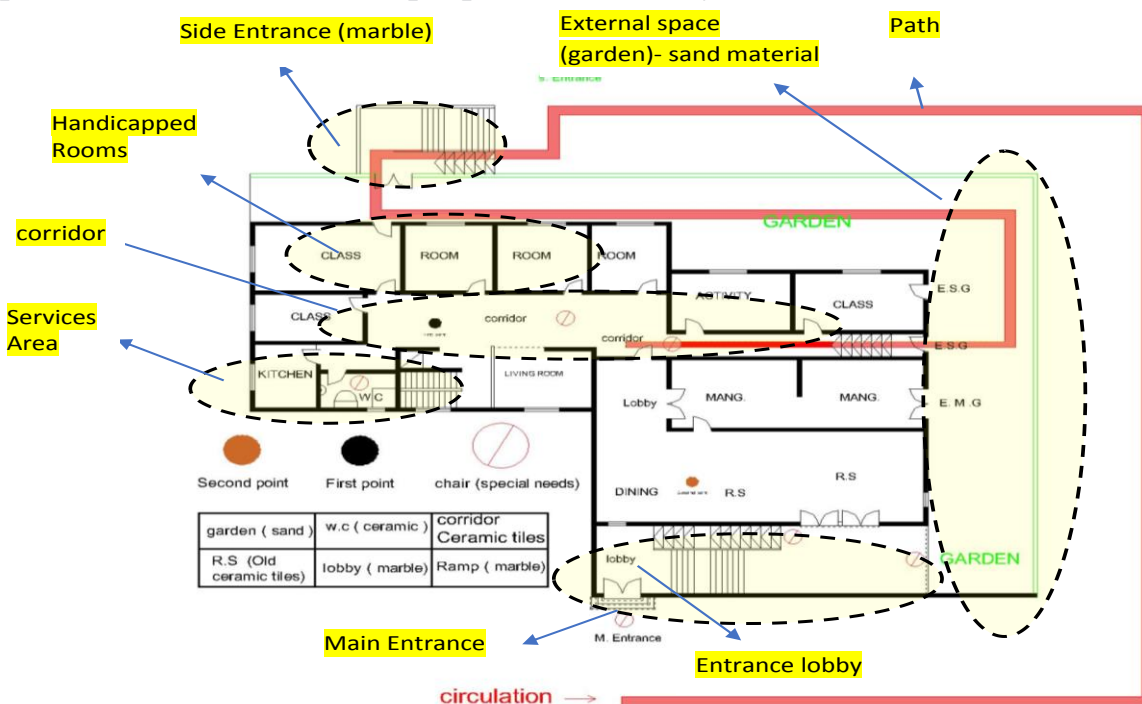
**The "horizontal plan of the ground floor" as shown in the figure11**

The building consists of two floors, the ground floor, with an area of 840 square meters

It is dedicated to the care of users with motor disabilities, "the subject of research", and includes their living quarters, in addition to lecture halls, activities, services, and dining rooms, in addition to a recreational area and outdoor yards.

The first floor, with an area of 530 square meters, is dedicated to the care of residents with intellectual disabilities, and includes their living quarters, in addition to lecture halls and appropriate activities for users.

It notes that there is a main entrance that is difficult to use for people with mobility disabilities, and a side entrance with a ramp, but it requires passage in a long traffic path that is not suitable for people with mobility disabilities.



**Fig.11** A figure showing the horizontal projection of the ground floor of the care building for people with mobility disabilities, Source: Researcher



- **The Materials Used in the Care Building:** By visiting the building, the materials used in the internal movement paths of the building were marble for the entrances, ceramic mosaic tiles in the corridors, rooms, classrooms, sand in the outer courtyards, and ceramics in the bathrooms.



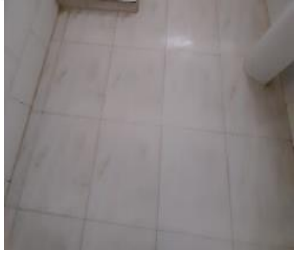


**Fig.12** shows the different materials used within the care building, especially the movement path line that is used continuously and the materials that will be evaluated, Source: Researcher

- **Table1.** Studying the extent to which the care center for people with mobility disabilities meets the design standards and requirements, Source: Researcher

Spaces	The material used inside the spaces	Design standards	photo		
			Achievable	Unattainable	
Entrances	-The floor is covered with smooth marble, which exposes residents with special needs to the risk of slipping. -The presence of stairs in front of the main entrance, which makes it difficult to use for people with special needs.	-The width of the entrance is 180 cm, which is suitable for design standards. -The size of the entrance space is 5 * 4 m, suitable for the size of a wheelchair.	√	√	
			√	√	
The opening	-The doors for the entrances are made of iron and the interiors are made of wood and metal -The lack of the possibility of visual communication through the doors.	-All doors open in one direction from the inside, and it is difficult for the users to use it without assistance.		√	

Spaces	The material used inside the spaces	Design standards	Achievable	Unattainable	photo
The Ramps	<p>-The material of the ramps is smooth marble (bocchino marble), and it causes the chair to slip during the ascent and not respond to the brakes during the descent, and leads to the user feeling insecure</p>	<p>-The slope of the ramp is 1:8 and is not suitable for a wheelchair user                      -The width of the ramps is 180 cm, and it is suitable for wheelchair users, according to the design standards</p>	√	√	
The corridors	<p>-The floors are covered with corroded mosaico tiles, which makes it difficult for wheelchair users to move around and not feel safe                      -Carpet covering the floor in the middle of the corridor and a tournament in order to improve the efficiency of the tiled floor.                      However, this procedure is prohibited, following the movement paths of people with motor disabilities.</p>	<p>-The width of the corridors is 180 cm, which is suitable as it exceeds the minimum allowable passages for movement of people with mobility disabilities                      -The presence of an obstacle (concrete column) in the middle of the corridor, in violation of the design standards</p>	√	√	

**INTERNATIONAL JOURNAL OF  
ARCHITECTURAL ENGINEERING AND URBAN RESEARCH**  
**PRINT ISSN 2785-9665**                      **ONLINE ISSN 2785-9673**  
**VOLUME 6, ISSUE 1, 2023, 122 – 147.**

Spaces	The material used inside the spaces	Design standards	Achievable	Unattainable	photo
<b>Bathrooms</b>	<p>-The floor material is made of unsafe ceramics, and there are no rubber materials placed on it to protect users with special needs</p> <p>-The material of the shower is made of ceramic and has sharp edges, which causes danger to the user</p> 	<p>-The space of the bathrooms is not sufficient for the movement of the chair 360 degrees freely, due to the poor distribution of the elements in it</p> <p>-The height of the basin is 50 cm and the height of the toilet is 45 cm, which does not conform to the standard heights of the standards for people with mobility disabilities.</p>		√  √  √  √	
<b>External spaces</b>	<p>-The floors are made of untreated sand and have pebbles, which impedes the movement of the chair and is not safe for users with disabilities</p> <p>-The material of the walls is made of bricks and is not finished and does not have layers of protection from temperatures or the risk of friction</p>	<p>-The garden area is suitable and allows access and free movement of the chair</p> <p>-The edges of the walls and columns have sharp and unsafe corner</p>	√	√  √  √	

**The results of the analytical study of the building for people with mobility disabilities:**

After a theoretical study of the criteria and requirements for the floors of movement paths for the spaces of care centers for the physically handicapped, and by comparing these criteria to evaluate the quality of the movement paths of the building for people with mobility disabilities, which was chosen as a model for the study in its current condition.

The results showed that the building's movement paths lacked many design criteria for the use and safety of people with mobility disabilities, in particular the outdoor space whose floor was covered with sand and gravel, with an uneven surface, the use of marble and smooth ceramics, and the steep slope of the slope with the absence of a slope at the main entrance, which led to an exaggeration in the length of the building, The following **table2** shows that the criteria for movement paths for people with disabilities in the building do not meet the standards by 85%.

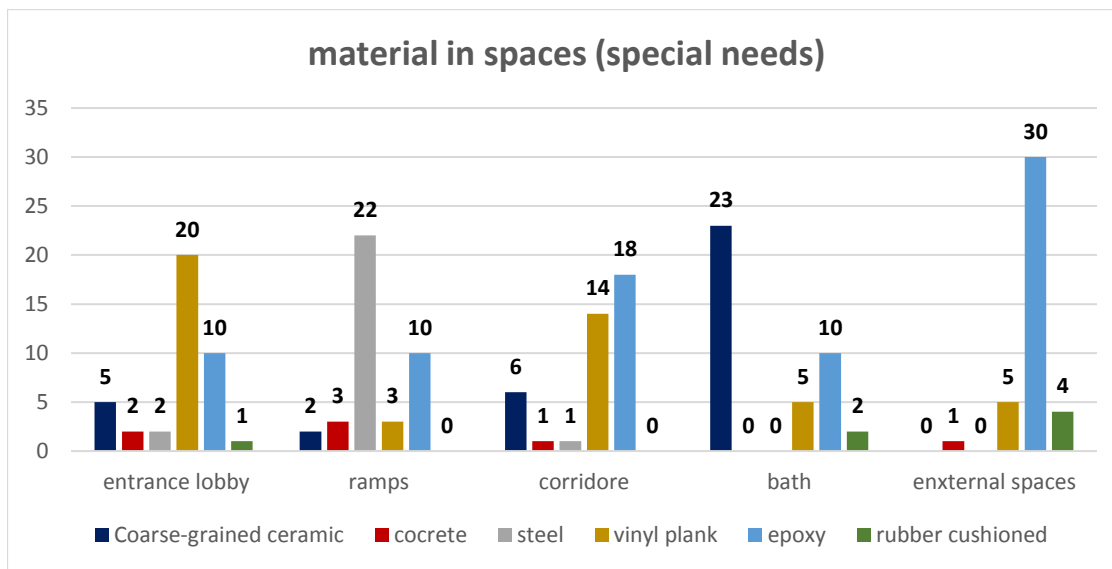
**Table 2.** The number of criteria achievable or not achievable, source: researcher

Total number of standards 22 standard	Number of criteria Achievable	5
	Number of criteria unattainable	17

**3.2. Analyzing the Results of the Questionnaire Survey (regarding the opinions of people with mobility disabilities, supervisors, and architects):**

Ten samples of materials commonly used in movement paths were reviewed to fifteen experts and specialists to nominate the best five materials that are suitable for movement paths for the disabled using their chairs, they chose (epoxy - vinyl panels - steel - rubber - grained ceramics).

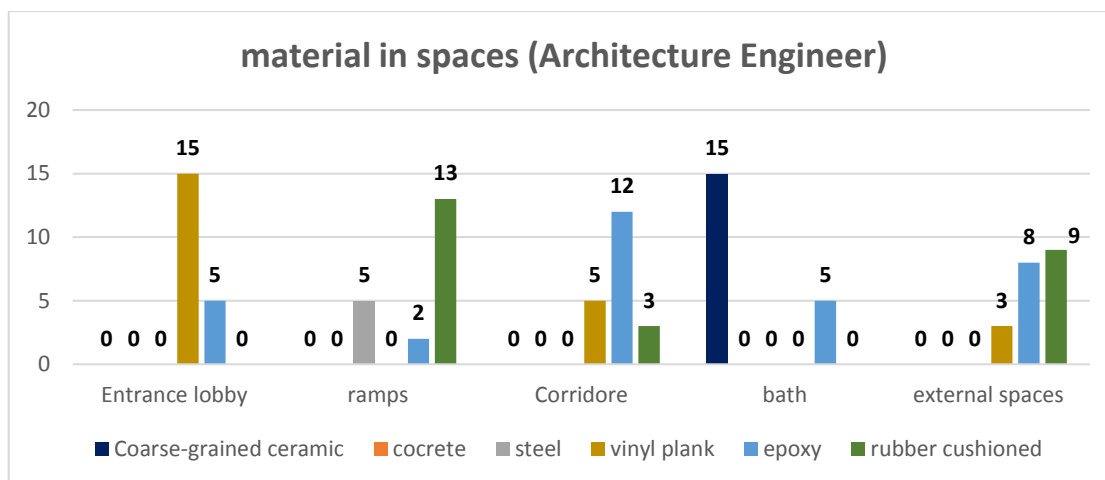
In this part of the research, the researcher directed research questions to three categories concerned with the movement paths of people with motor disabilities, and in sufficient numbers to achieve useful results for questioning the opinions of users, specialists and supervisors (30 users with disabilities - 20 experienced architects - 10 supervisors accompanying people with mobility disabilities in care homes). This is in order to determine the optimal choice of measurements and quality of the material (**Coarse-grained ceramic** - vinyl panels - epoxy - rubber -steel) that is preferred to be used for each of (entrances - ramps - corridors - bathrooms – external spaces). The results were as follows:



**Fig.13** A figure showing the results of the questionnaire, the opinions of users and supervisors, and the proportions of choosing appropriate materials for the floors of internal spaces from a practical point of view, Source: Researcher

**Table 3.** shows the percentages of users' opinions and the best floor material for the spaces, Source: Researcher

spaces	The percentage of the number of users' opinions of the vacuum floor material					
	Rubber	Steel	Coarse-grained ceramic	Concrete	Vinyl Plank	Epoxy
Entrance lobby	2%	5%	13%	5%	50%	25%
Ramps	0%	55%	10%	5%	7%	23%
Corridors	0%	2%	15%	3%	32%	48%
Bath	0%	0%	58%	0%	12%	30%
External Spaces	10%	0%	0%	2%	13%	75%



**Fig.14** shows the results of the questionnaire, the opinions of specialized architects, and the percentages of choosing materials for floors for the interior spaces that they prefer from an architectural point of view.  
 Source: Researcher

**Table 4.** shows the percentages of architects' opinions on the best suitable material for the floor of the spaces, Source: Researcher

spaces	The percentage of the number of users' opinions of the vacuum floor material					
	Rubber	Steel	Coarse-grained ceramic	Concrete	Vinyl Plank	Epoxy
Entrance lobby	0%	0%	0%	0%	80%	20%
Ramps	65%	25%	0%	0%	0%	10%
Corridors	15%	0%	0%	0%	25%	60%
Bath	0%	0%	75%	0%	0%	25%
External Spaces	45%	0%	0%	0%	15%	40%

- It notes that the opinions of users with mobility disabilities agree with the supervisors accompanying them in all cases. It also notes that there is a difference between the opinions of users and the opinions of architects in some cases, especially in the quality of materials for the floors of slopes and external squares, as shown in the results of the questionnaire, Figures 13 and 14
- The different of opinion between the users and architects: The results showed that the users suffer from the difficulty of moving on the rubber tiles in the paths of movement in general, and it requires exerting effort beyond their ability, while the architects direct their opinion towards the safety factor in the event of a fall in addition to reducing the cost, as the price of the rubber tiles is very low compared to all other materials.

### **3.3. An analytical study and comparisons of the technical specifications and cost of materials for floors of care building for people motor disabilities**

From the results of the questionnaire and through the studying previous research on movement paths in care homes for people with motor disabilities, the most important types of materials used for this purpose were identified (epoxy - steel - rubber - grained ceramic - vinyl panels) and by studying the technical properties affecting the ease of movement of the disabled and their degree of safety to determine the best of these raw materials for the floors of the different spaces of the care homes, the results were as follows:

#### **1- Epoxy Materials:**

**Description:** It is a material that is liquid when used, spread on flat floor surfaces and allow to dry slowly over several days. (Liquid epoxy, 2023)

The epoxy material is characterized by strength, durability, scratch resistance, and its rough, anti-slip surface, which provides safety when falling on it. It is resistant to moisture, oily materials, and chemicals. It is also very sticky to the floor. There are several types of epoxy for different purposes.

**Heat Resistance:** The average resistance of epoxy “used in the floors of service buildings” ranges between 20-90 degrees Celsius without affecting the properties, texture or surface hardness that resembles glass. (High temperature, 2022)

**Life Span:** With regard to the good types used in flooring the floors of residential and service places, the average life span of epoxy ranges between 10-20 years. (Epoxy, flooring, 2020)

**Compression Resistance:** Epoxy has a high compressive strength three times that of concrete, with an epoxy tensile strength of approximately 10,000 psi. (Strength epoxy, 2022)

**Slip Resistance:** (0.60 COF) Rated coefficient of friction (COF)

The slip coefficient of epoxy is more than 0.6 according to the main standard of anti-slip "NFSI / B / 01.0", and this value reduces the slip probability by "50-90% ". (Slip Resistance, 2020)

#### **2- Steel Marterials:**

**Description:** Steel is iron metal added to its components with some other materials such as "carbon - nickel - chromium - tungsten" to obtain steel with different specifications according to the additions that suit the desired purpose. (EFC ramp, 2022)



Whether iron or steel, it has good qualities, including strength, durability, formability, corrosion resistance, and pressure tolerance, and the most important defect is that it is exposed to rust, but there are types of stainless steel that are suitable for all uses.

**Heat Resistance:** Iron or steel can withstand heat at high temperatures up to (400-600 degrees Celsius) without affecting the specifications or shape, but the degree of hardness HR or HV is affected. However, there are types whose hardness degree is not affected even at temperatures exceeding 1000 degrees, such as “Steel high speed steel” (H.S.S).

**Life span:** In the case of use in service areas, its life span extends to infinity, provided that maintenance and paint are adhered to in order not to cause “oxidation” rust.

**Compression Resistance:** The value of compression Resistance depends on the type of iron or steel used, its chemical composition, and most importantly, the method of its thermal treatment.

**slip Resistance:** The slip coefficient of steel is inversely proportional to the surface hardness, the higher the hardness, the lower the slip resistance and the lower the corrosion rate.

The ramps use steel sheets formed with grainy projections that reduce slippage by a very high rate.



**Fig. 15** A figure showing the Epoxy & Steel materials for floors & ramps, can be used in external spaces & corridors, Source: <https://www.pcp-corp.com/global/products/plank-grating-o2-f960004100>

### **3-Vinyl Planks:**

**Description:** Vinyl planks that look like wood chips are glued to flat floors and cover a shiny, parquet-like surface. Small spaces are spread out.

**Heat Resistance:** The optimum temperature for vinyl floors ranges from -3-18 degrees Celsius, and in some types, it reaches 37 degrees Celsius, meaning that it cannot withstand high temperatures. (vinyl temperature, 2022)

**Life span:** With regard to the good types used in flooring the floors of residential and service places, the average life span of vinyl ranges between 10-20 years. (Vinyl flooring, 2017)

**Compression Resistance:** The life span of vinyl Plank can extend to 2-10 years with good use and necessary maintenance.

**slip Resistance:** (0.40 COF) Coefficient of Friction (COF) rating Some companies produce special types of non-slip vinyl, as it has a network of glass fibers that raise the degree of slip from R10-R12 and increase the degree of corrosion resistance. (slip resistance flooring, 2022)

### **4- Rubber Tiles:**

**Description:** Rubber is characterized as a material that absorbs shocks and protects those who fall on it from serious injuries. It is also a material with high resistance to slip. Therefore, in theory, it is ideal for floors, voids of homes for people with mobility disabilities, but it is considered unsuitable for the movement of wheelchairs used by people with mobility disabilities, as it requires more effort. Especially if the user relies on himself.

**Heat resistance:** High-quality rubber withstands temperatures from 13-40 degrees Celsius without affecting its properties and cohesion. (High temperature, 2020)

**Life span:** Rubber can withstand work under normal conditions for long periods ranging between 10-15 years. (playground, surfaces, 2022)

**Compression Resistance:** Rubber can withstand high levels of pressure without changing its specifications or consistency, but its hardness is low. (Rubber sheet, 2020)

**Slip Resistance:** (0.40-0.50 COF) Coefficient of Friction (COF) rating

Slip resistance is one of the natural properties of rubber. When choosing rubber to cover the ramps, the slip coefficient should not be less than R10-R12. (yosry, 2012)

**5- Coarse-Grained Ceramic:**

**Description:** Ceramic tiles of different sizes and colors are suitable for furnishing all voids of residential and service buildings, but when furnishing spaces for people with mobility disabilities, the advantages and disadvantages must be measured from the point of view of users with motor disabilities, Grained Ceramic tiles are resistant to corrosion and scratching and bear heat and heavy loads.

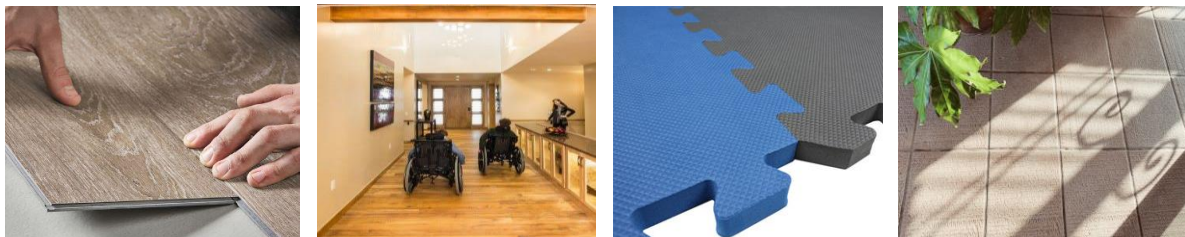
**Heat resistance:** Ceramic can withstand high temperatures up to 1000 degrees Celsius without affecting its cohesive properties. (Ceramic,heat resistance, 2022)

**Life span:** Ceramics can withstand the normal use of residential and service buildings for years of up to 50 years or more, and they are in good condition. (lifespans, 2021)

**Compression Resistance:** Grained Ceramic can bear compression under high loads, with a compression coefficient of up to 3300 psi.

**Slip Resistance:** (0.30 COF) Coefficient of Friction (COF) rating

The slip resistance of ceramics is relatively low, as the slip coefficient reaches the lowest allowable limit, which is 0.3 COF (floor tiles, 2021)

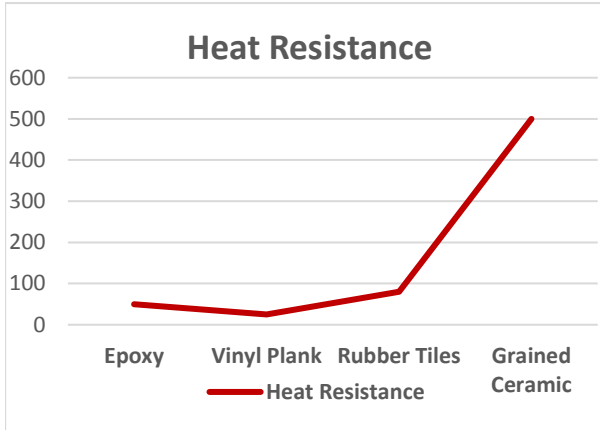


**Fig. 16** A figure showing the vinyl plank & Rubber tiles & Coarse-Grained Ceramic materials for floors, can be used in external spaces & corridors (materials commonly used in circulation), Source: <https://gharpedia.com/blog/types-of-flooring-materials>.

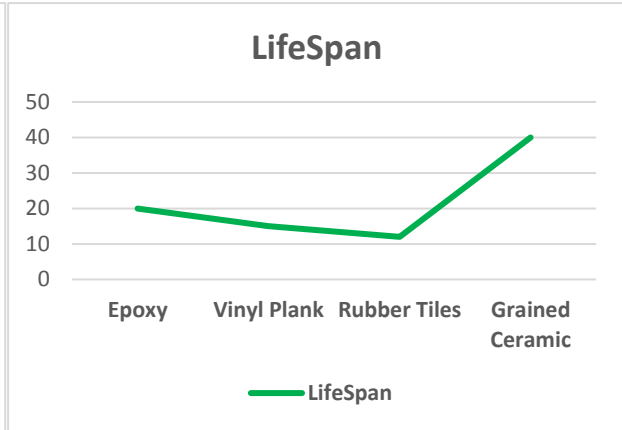
**Table 5:** Comparison of results of technical properties of commonly used materials for flooring:

Materials	Heat Resistance	Lifespan	Compression	Slip Resistance
Epoxy	20-90 °c	20Y	10000PSI	0.6 COF
Steel	400-600 °c	&	&	&
Vinyl Plank	18-37 °c	10-20Y	1300PSI	0.40 COF
Rubber Tiles	30-130 °c	10-15Y	400PSI	0.40- 0.50 COF
Grained Ceramic	Up to1000 °c	30-50Y	3300PSI	0.30 OF

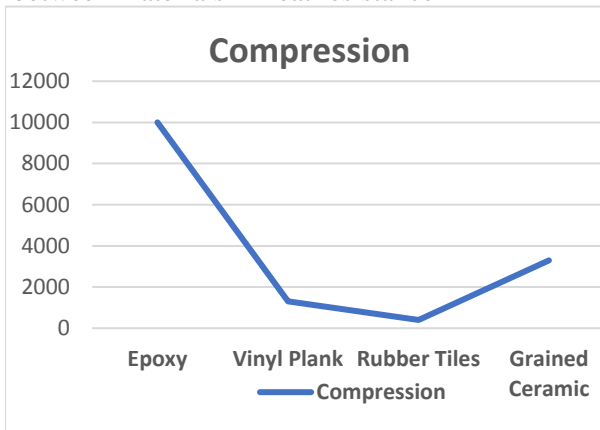
- Results of comparisons of materials proposed to be used, **The higher the value, the better the results**



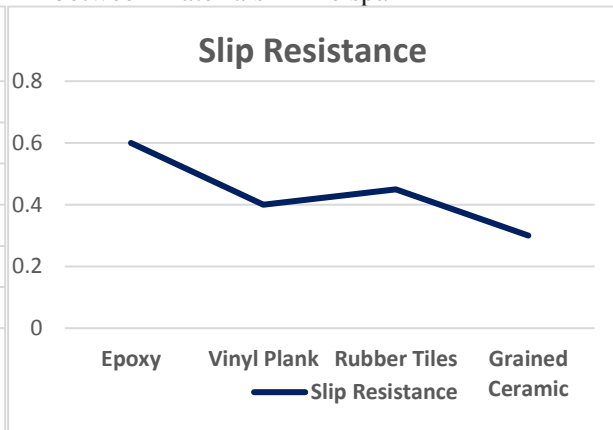
**Fig. 17** The curve shows a comparison between materials in heat resistance



**Fig. 18** The curve shows a comparison between materials in life span

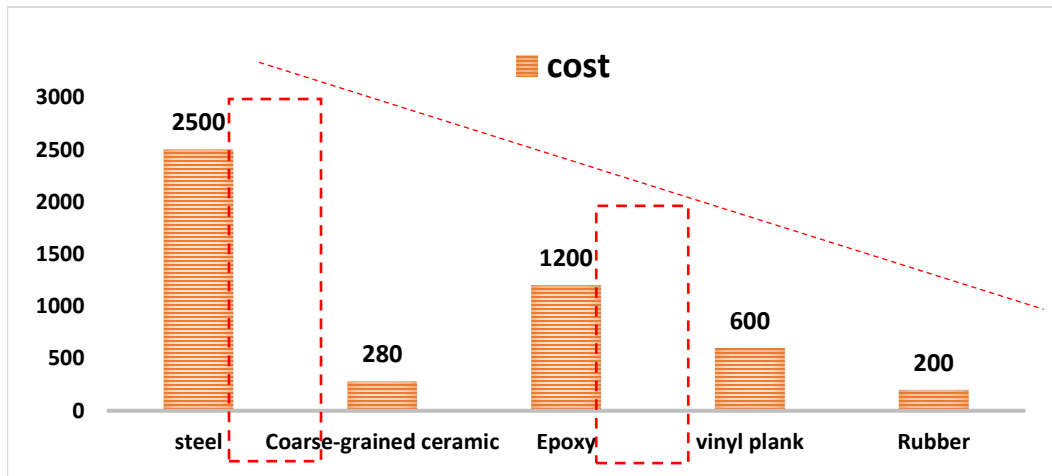


**Fig. 19** The curve shows a comparison between materials in compression resistance



**Fig. 20** The curve shows a comparison between materials in slip resistance

- **The different cost of the materials:** The figure21 shows a comparison of the cost of different materials for floors that were selected by experts to be taken into account when choosing the appropriate material for each space, "with a focus on choosing the best of them for the convenience of users".
- The results showed that the lowest cost is rubber, however it was excluded from the users, steel is the most expensive, and epoxy is considered the average cost for the different materials.



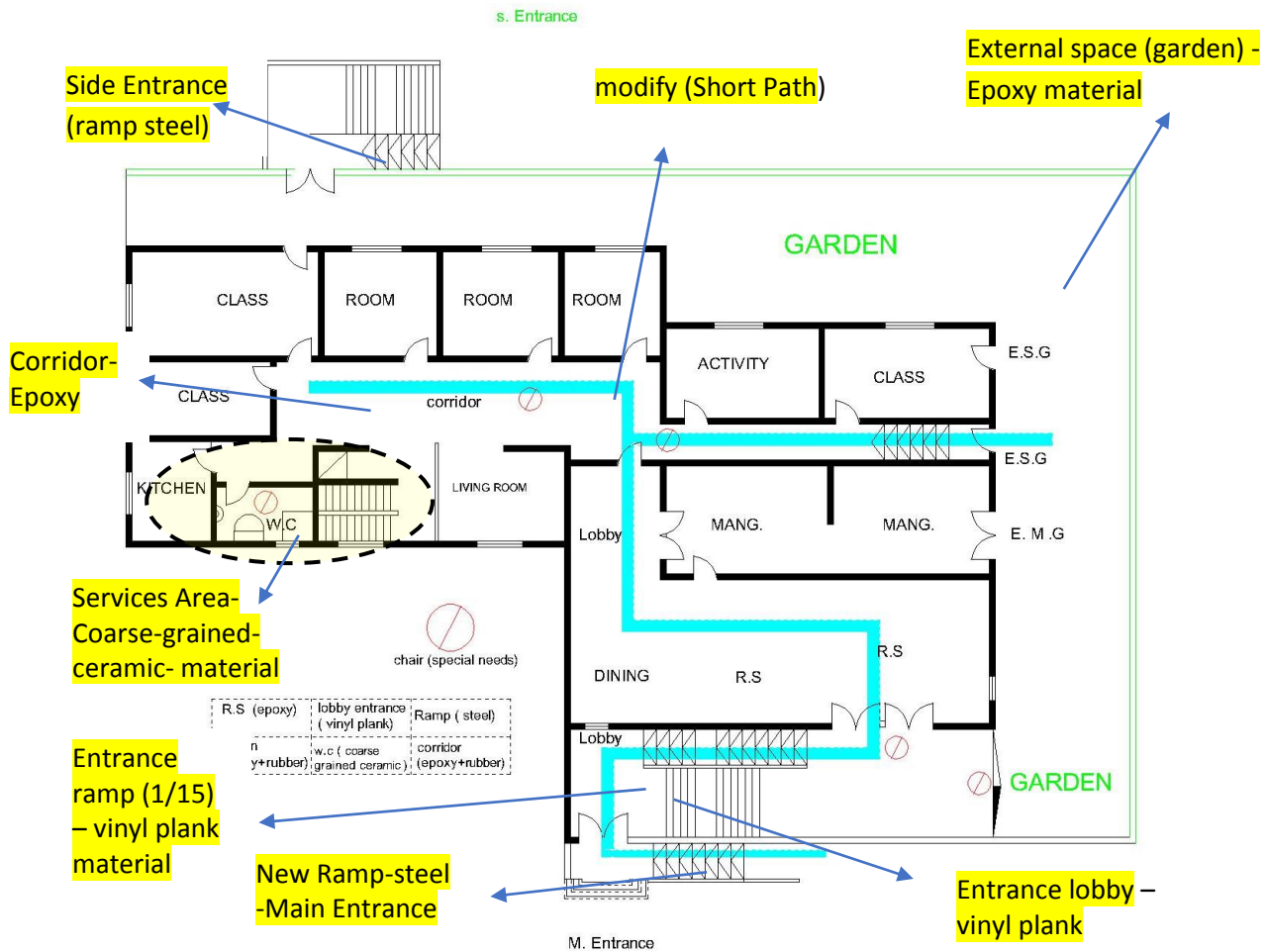
**Fig.21** shows a comparison between the cost of the different materials proposed to be used, Source: <https://www.forbes.com/home-improvement/flooring/flooring-cost/>

#### 4. Treatment Suggestions in Care Center:

Through visits to a care center for people with motor disabilities in Obour City, personal interviews with users and supervisors, and collecting a database that the research dealt with in an analytical study, the research came up with proposed alternatives in order to develop the movement paths of the care center as follows:

- Creating a ramp with an inclination of 1:15 next to the stairs of the main entrance to shorten the path of movement for wheelchair users with disabilities, it slopes at the entrance of the main door, adjusting the slope to be 1:15 instead of 1:8.
- Replacing all floor materials for the spaces of the internal movement paths and the external spaces, to be according to the results of the questionnaire and the analytical study.
- Making all doors open in both directions "inside and out" to facilitate entry and exit for wheelchair users.
- Replacing bathroom floors with standard materials

- Redistribute the elements inside the bathrooms to create spaces that allow the wheelchair to enter easily and the possibility of 360-degree rotation in a clean space
- Replacing bathroom elements with elements whose sizes and heights are suitable for the use of people with mobility disabilities, according to standards.
- Adjusting the openings of the doors and covering them with transparent glass at heights that allow “people with mobility disabilities while on a chair” to see who is inside or outside the rooms, according to their location.



**Fig 22.** shows the proposal to address the path of movement, with the use of a ramp instead of stairs, Source: Researchers

## 5. Conclusion

Through the research, the following results were reached:

- The importance of applying the design standards for "paths of movement of people with mobility disabilities", which works to meet their needs and facilitate their safe movement within the internal movement paths and the external squares.
- The importance of choosing the appropriate materials for the wheelchair movement paths, which provide the user with ease of movement with minimal effort and maximum safety.
- Epoxy material is suitable in all spaces to enjoy high mechanical and aesthetic properties, in addition to its average cost.
- The exclusion of rubber materials, despite their low cost, in addition to the element of safety, which is very important for people with motor disabilities, but the opinions and demands of the user are higher than the opinions of experts in some cases.

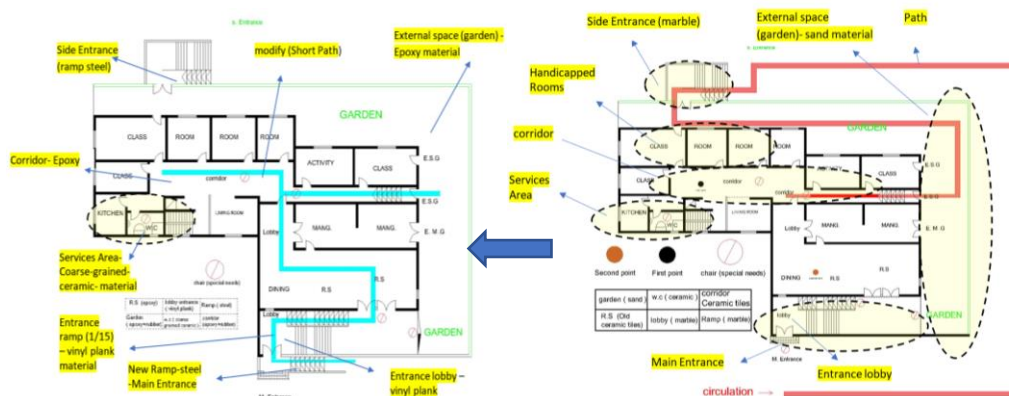


Fig.23 shows a Comparison of the care center before and after treatment proposals

## 6. Recommendations

- The importance of coordination between architects and users with disabilities in particular, and users in general, to be able to provide realistic designs that meet the needs and requirements of users and work for their comfort.
- A recommendation to continue research and study the impact of the five raw materials "selected by specialists" on the thermal comfort of the interior spaces in care centers for people with special needs.

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