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Investigating Circulation Spaces on Users Experience in Retail Buildings

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Abstract

circulation space studies changed our lives in many different aspects. it caused a drastic change in the 21st century and mainly in architecture. architecture design has completely evolved in what we see today, thanks to circulation technologies. understanding the importance of circulation in a building is a vital part of architecture design evaluation, as nowadays they have not been the focus as much as the exterior design of the façade of the building. this paper focuses on the reflection of circulation spaces on the experience of the user respectively with the architecture composition of retail buildings. the aim of this study is to develop circulation guidelines to enhance the user experience using the senses within circulation spaces in retail buildings. however, design succession depends on circulation and that it is not always user efficient and could affect the experience of the user. it will be achieved through several steps. first, a theoretical study is conducted, where different types of circulation spaces and user experience is studied and their relationship with each other. this review is used in the applicable studies section, where a case study is analyzed by using behavior mapping as a tool and a questionnaire survey to be able to collect the opinions of a large number of group of people and to see how they perceive circulation spaces and its relation with user experience. with the aid of technology and the better versions of circulation, the world awaits to see the unlimited creativity a human brain can do with architecture design and the different future circulation spaces. research findings show that experience of the user using circulation spaces will depend on the five senses but according to different standards that is found through the analytical study.

Keywords: Circulation; Experience; Senses; Retail Buildings; Technologies

1 Introduction

Every architecture project design requires a set of factors. One of the most important factors is the circulation process and space. Movement through space is an idea part of the architecture theme, as Le Courbusier once said, ‘experience architectural space truthfully, it is necessary to walk about and through the building (1962).’ The project can be successful if the circulation design is studied carefully to optimize the maximum flow of the users (Natapov et al., 2019). In retail and commercial buildings, the composition of the architecture space is important to deliver the best service for the users and this is achieved if the circulation aids this process (Töppig & Moital, 2020). Circulation comes into two main forms vertical and horizontal. Either form is vital to deliver the maximum efficiency of the project to the user (Portico,2020). Moreover, circulation comes in different typologies too. It could be linear, grid and curved or when considering the vertical circulation there are many different forms of elevator technology with special features to add an additional experience. In the 21st century, technology is a part of our lives and is in almost everything we use. There is no building built in this time of era that does not use technology. Innovations in technology has evolved over the years and has affected the circulation within retail and commercial buildings. Users of all age groups use different types of technology that will aid them in their daily lives, as every type of technology could be useful according to the preference of the user and their experience (Dean, 2008). Vertical and Horizontal circulation use different types of

technologies to enhance the user experience within the building. Several new technologies in circulation spaces also affect the user experience (Eby, 2017). Building efficiency is calculated by evaluating the circulation of the user within it. Users also judge retail buildings according to their experience within the building. There should be factors that could enhance the user experience and allow them to have a memorable hangout (Eby, 2017).

Looking further into how we can explore circulation spaces and how it can be designed as a means of enhancing the user experience in retail buildings. In traditional retail buildings, the design of circulation spaces has been largely shaped by accessibility requirements. In recent years, there is a growing trend for architects to explore the potential of designing the circulation spaces as a means of adding value to the user experience in a building.

2 Circulation Spaces

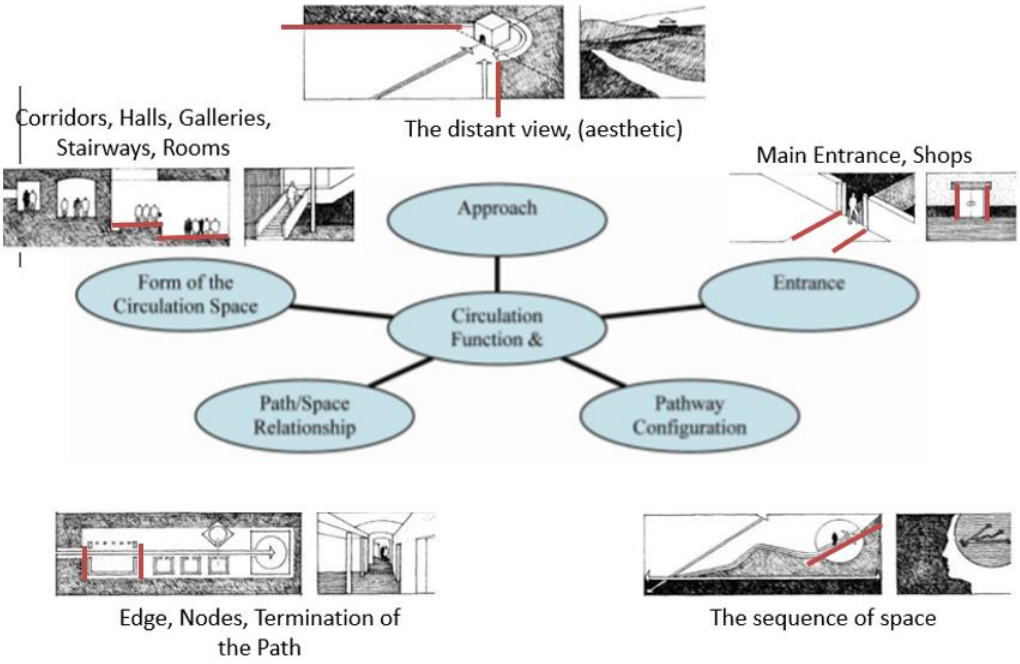


Figure 1. *Types of Circulation Spaces (Author, 2023)*

The arteries of a heart is exactly equivalent to the Circulation Spaces. Circulation Spaces are the core of any building design and it is the reason behind a projects success (Frederick, 2007). Circulation in architecture refers to the paths that run through the floor plans. These routes are how we experience architecture, and their design has a significant impact on a plan's success or failure. Circulation Spaces should be just as interesting as any other aspect of a structure. There are always new methods to make circulation more fascinating. (Yang, 2017)

Circulation Spaces within retail buildings is a set of different components. It consists of the entrance whether the shop itself or the retail building, form of the circulation space could come in many different types, approach of the function, entrance, form of the circulation space the path, space relationship, and pathway configuration. (Elottol & Bahauddin, 2011).

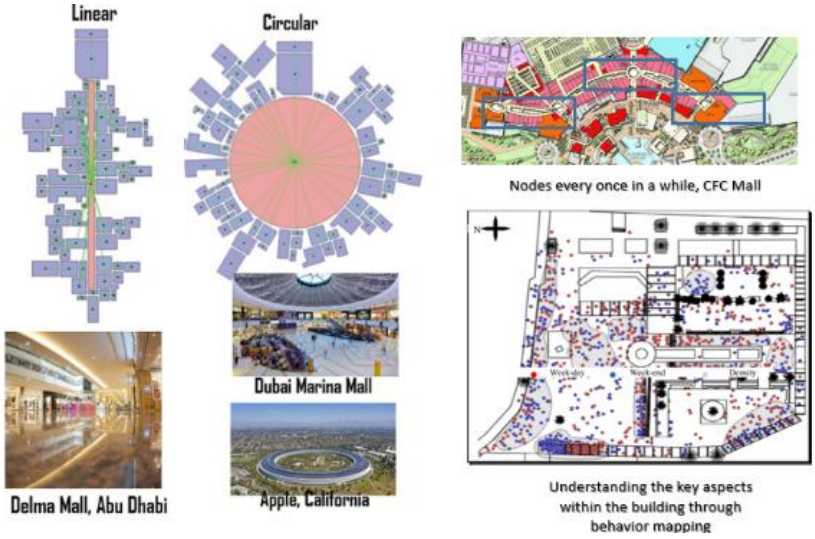
2. 1 Verticality and Horizontality

People use circulation spaces to get through and around the building. Circulation is commonly thought of as the space between locations that serves as a link, but it may be much more. It is a concept that encapsulates the sensation of moving our bodies around a structure in three dimensions and over time (Yang, 2017).

There are two main types to be able to circulate around spaces. Circulation can flow in either a horizontal or a vertical direction. If circulation is characterized as horizontal, it relates to how people move in and about on a certain floor or level; whereas, if it is described as vertical, it refers to the interaction between the levels, or how people travel between the different floors. Moving walkways and corridors are examples of horizontal circulation, while a lift, stairs, escalators, and ramps are instances of vertical circulation (Zhao et al., 2015).

2. 2 Layout

There are three separate circulation types: linear, curved, and grid-based, which differ in geometrical form but are functionally and topologically comparable (Natapov et al., 2019). Circulation paths do not have to be unsightly or concealed when designing them; they can be a stunning architectural feature (Ward, 2021).
A linear layout is the most basic circulation type because it allows for the most straight views (Hillier 1996). The term



"linearity" refers to the ability to move from an ordered linear path to a random or axial layout. This circulation, like any other, can have a variety of spatial properties, such as being wide or narrow, short or long, and so forth. The linear system can have one or more circulation channels, as well as symmetry in its functional unit organization.
A curved system, which is structured by central symmetry or rotation, is the next form of circulation. It comes in a variety of shapes and sizes, including focal, concentric, and spiral patterns. A center space around which functional units are organized distinguishes this curving circulation. The core space is linked to the circulation in these buildings. The curved system creates a sense of direction along a path a rotational movement. The movement in a curved spatial structure is the outcome of rotation with a specific angle. For instance, the, visual contact with a central, focal point like the apple headquarter building in California.

A grid-based or network system is the final type of the circulation kinds. This system arose through the recurrence of a prominent pattern at various scales. It can be grid-based, scatter-point-based, or hierarchical network-based. In this system, spatial units follow a specific coordination structure. A nested space system, which is characterized by a sequence of units going from the largest to the smallest, can be used in addition to the coordinated grid (Elif, 2015). The level of utilization (how busy it is) and the aesthetic of these types of circulation zones will differ functionally. Private circulation routes will be optimized for productivity and efficiency, whilst public circulation routes will be more appealing and aesthetically acceptable. When examining different circulation paths, walkway should be clear and well lit. Also, circulation paths are used as a fire escape route,to make sure it is the quickest and safest way out of the building. The circulation flow

Figure 2*. Layout Typologies (Author, 2023)*

is one of the first areas explored in design procedures; the circulation will often inform the rest of the interior idea. (Natapov, 2015).

2. 3 User Experience.

User experience is significant since it aims to meet the needs of the user. Its goal is to provide good experiences that encourage users to stick with a product or brand. Furthermore, defining customer journeys on your product that are most conducive to commercial success is possible with a meaningful user experience (Lemon & Verhoef, 2016).

The mood of the user could affect the experience accordingly. Consumer mood, participation level, and the effectiveness of the user experience, all have a major impact on retail circulation. Results from a scientific test expose that mood interferes with the retail experience (Swinyard, 1993). The different types of mood could occur briefly and is just an emotional state mentally towards the surrounding and environment the user is in (Baken, 2016). There are different types of feelings within the mood of a user. Such as, calmness, relaxation, welcoming, tranquil, spiritual. Also, there could be the feeling of displeasure, dramatic, sad, fearful, angry, frustrated and depressed. There could be the feeling of mysterious; wander and exciting which all could end up with an affective engagement by the user (Harappa, 2021).
For instance, the world trade center mall in Abu Dhabi, UAE is one of the most retail stores with a significant location within the downtown. The world trade centre in Abu Dhabi is entirely made from wood in the interiors and is on the darker side. The wood pattern reflects the heritage of the city but too much of it caused the mall to feel super compacted which made feel people depressed as they enter the mall as it is dull. However, light opposes darkness so as cheerfulness opposes dullness. Yas Mall, Abu Dhabi took light as the main theme, which is very inviting (Quartier, 2018).
All the corridor spaces within yas mall have skylights with different designs that guide the user while walking. Nodes are identified with focal point that is shined by natural light and zigzag lines throughout all horizontal circulation spaces (Wright et al., 2019).
Moreover, the heights and open spaces within retail buildings play a major role in the user mood; the mood of the user is affected as the user enters a space. Double Heights are known for its welcoming effect on the user. Usually when the heights are small the user feels suffocated and compacted within the space circulated (Minnesota,2007).

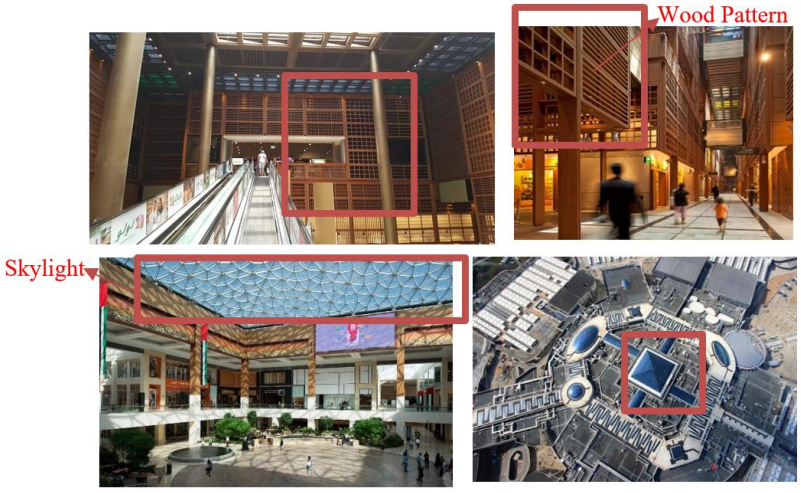


Figure 3*. WTC and Yas Mall Abu Dhabi (Author, 2023)*

3 User Needs

'User needs' are the aims, values, and aspirations of people. They are the features that a product or service must have in order for it to be useful. User requirements assist in expressing and comprehending who are the customers and the situations that lead them to use a product or service. They assist in ensuring that the things-built assist individuals in locating or completing tasks. The circulation spaces in retail buildings, which are usually divided into zones corresponding to specific functions, such as movement or use of different retail items. Focusing on how each zone influences shopper's experience and analyse what kind of technologies should be deployed in these zones to improve shoppers' experience (Gray et al., 2009). Users as they circulate in retail buildings show different routes according to the behavioural mapping showing the different routes taken. Understanding user goals is just as important as understanding user needs. Understanding user goals is just as important as understanding user needs. The circulation space should aid in achieving the users goal easily without having the user go through a hard time to reach the goal thus fulfilling the need. For instance, a user is going to a fragrance shop to get a perfume this is the user need and goal from the retail store. The smell and the way they display their items could lead the user through the circulation spaces and through the sequence of space to reach and fulfil the user need easily with a good experience throughout his journey through the store.

4 Measurement of Experience

After grasping the ideas of circulation and user experience, it is time to consider how they interact and how it might be used them to customize spatial experiences and increase efficiency. To measure the experience and investigate the impact of circulation spaces on user experience depends on the five sense and mobility based on the research. Thus, being able to guide the designer and reach the aim of this study through the summary in Table matrix below.
The table matrix summarizes the conclusion of the theoretical study of the literature review and shows the relation between factors that affect the experience and the elements of experience within circulation space.

Table 1. *Measurement of Experience (Author, 2023)*

Factors affecting the experience / Elements of Experience within circulation space			Hear			Touch		Smell			Taste	Eyesight						
			Sound			Textures						Colors		Height			Scale	
			Relaxing Music	Depressing Music	Noise around different spaces	Smooth	Rough	Dominant Smell	Normal Smell	Stinky Smell		Bright	Dark	High	Moderate	Low	Spacious	Compacted
User Moods	Relax	Dramatic																
		Calm																
		Relaxation	✓			✓						✓						
		Welcoming																
		Tranquil																
		Spiritual																
	Displeased	Dramatic																
		Sad		✓			✓						✓					
		Fearful																
		Angry																
		Frustrated																
		Depressed																
	Affective Engagement	Dramatic																
		Mysterious	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓
		Wonder																
		Exciting																
User Needs		• Services • Products • Destinations	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓		✓	
Comfort and Activities		• Aesthetic • Innovative Technologies	✓			✓		✓	✓			✓		✓	✓		✓	
Mobility		Fast	✓		✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
		Slow		✓	✓	✓	✓		✓		✓	✓		✓	✓		✓	

5 Methodology.

A case study is taken and observed to see and support the research to see if elements of circulation spaces affect the user experience in any way and whether user needs are achieve to have a successful project and building. City Centre Almaza is one of the most recent built malls in Cairo, Egypt. The retail building was built and opened in the year 2019.

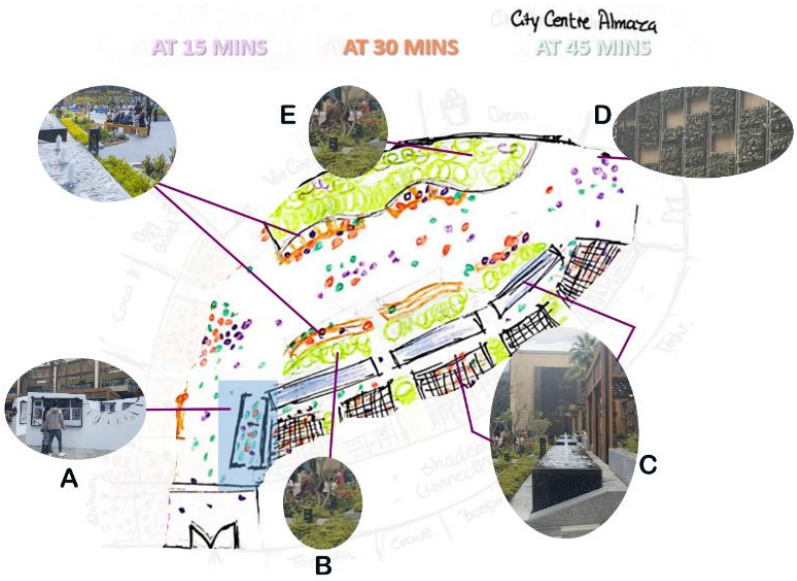


Figure 4. *Behavioral Map - Gathering Outdoor Hub (Author, 2023)*

To be able to identify what attracts users to gather in this area, behaviour mapping is used as a tool to count and allocate where users stand along a certain period of time. In other words, behavioural mapping is a research technique that involves observing and recording behaviours in a specific place at a specific time. A researcher can collect both quantitative and qualitative data via behaviour mapping, allowing for a more nuanced understanding of design and its effects.

The table below is the conclusion summary of the observations that were seen other than the count in the circulation space. The observations are later discussed in the guidelines.

Table 2. Summary of Observations (Author, 2023)

Features and Elements	Description	Illustration
Usage of green plants	Plants were distributed evenly around the circulation space with different colors and types	
Usage of water elements	Water elements were distributed evenly with repetitive units	
Usage of green walls	A green wall was found in a space within the circulation space	
Availability of seating areas/ benches	Benches are also repetitive and available	
Areas for artwork to be viewed	People were seen gathered around a gallery of artwork	

A survey questionnaire is also taken to be able to see and take the opinion of the users that actually use these retail buildings. The survey is sent to a large group of people to take as much opinions as possible and to different age groups that use retail buildings. It is done to look into how users think and understand their preference to be able to study and understand the effect on their experiences after looking into the results. The survey targeted three main parts which target to know the elements of design, motion and user mood.

6 Results and Discussion.

Case study Results.

The behavior mapping showed the results of people gathering were the most over a period of 45 minutes at 6 pm since it is the peak time where people gather before the sunset and with good period feeling and different vibes. The results are shown in the table below:

Table 3. 15mins time count results (Author, 2023)

Location	15 Minutes	30 Minutes	45 Minutes
Pathway	22	10	22
Benches	14	10	15
Green Wall	7	0	3

The pathway is seen to have the highest number of people many different features and there was one activity mainly noticeable, which is a walk in gallery as shown in the figure below. The gallery showed different stages of some history and art, which grasped the people's attention as you walk in a time line with different arts hanging around. This grabs the users' attention having an activity that will allow them to interact within the circulation space.

Next, the benches that were allocated every once in a while, helped in the increase of gatherings in an almost average count within the 45 minutes. As observed, the seating areas are allocated in a place with a different environment than the normal. There are water fountains and greenery with different types of plants. Also, the facades are designed with different materials, patterns and light toned colors. All these features served in allowing the people to sit, relax and enjoy.

The use of green walls also affected the gathering of the people. But not as much as the other elements. The group of people that were standing, were mainly there for group pictures and memories to be taken.

Along, the hour of observing how people behave, the movement of the people was always in constant flow and there was always some sort of motion and gathering areas by the benches, which means that the use of certain elements affects the circulation space experience.

This could be a result of unavailability of these elements within the other circulation spaces in the mall, which does not cause any sort of gathering areas or any experience. Thus, the behavior of the users show almost no significance in their motion.

The water elements and the sound of nature caused a sense of relaxation and affected the user mood to be satisfied which is one of the reasons that caused the people to gather and enjoy. The smell and taste caused the people to go and visit the space due to complimentary food sample and that there are different kiosks which serve food and beverages. The different materials used within the space were relaxing to the eyes and using subtle colors helped the user to spend more time and enjoy the space as it affected the user experience positively. Also, the different textures found in the flooring and benches complement each other as the user feels it and gives a good sense back to the user.

Furthermore, this applied study shows that the relationship between elements of experience within the circulation space have a direct relationship with the factors that affect the experience. The factors that affect the experience as previously mentioned above in the theoretical study, show that the five user senses, which are touch, see, taste, smell and hearing are felt. This is seen within the behavior mapping which does actually

show that there is a relationship when the circulation space is designed well with the experience of the user using the fact that user senses play a major role within it.

Questionnaire Results.

Part 1: The first part results are based on general questions:

Total number of people who answered were survey were 135 participants. General questions show that most of the average age of people that participated in the survey were almost within the younger age group which is between 18-40 years old. Also, other age group participated within the ages of 40 – 60 years and above 60. Part of the survey targeted questions referring to two malls in Cairo and almost everyone that answered the survey have visited and experienced the circulation spaces to take their opinions. Moreover, retail buildings are mainly visited monthly by the users for certain activities mainly : shopping, cinema, walking, gathering, restaurants and food courts, other services respectively to which is mainly done within a retail building.

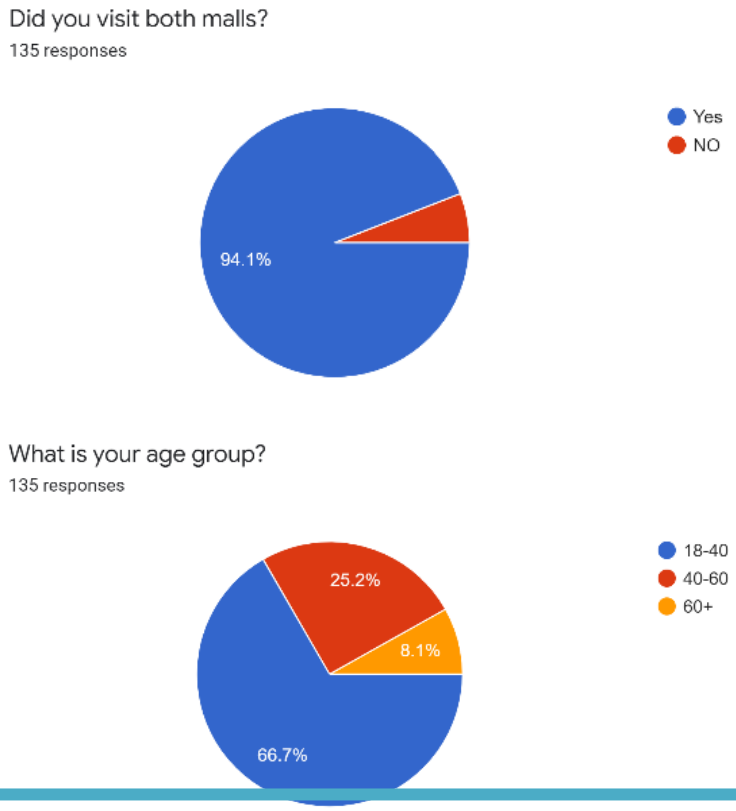
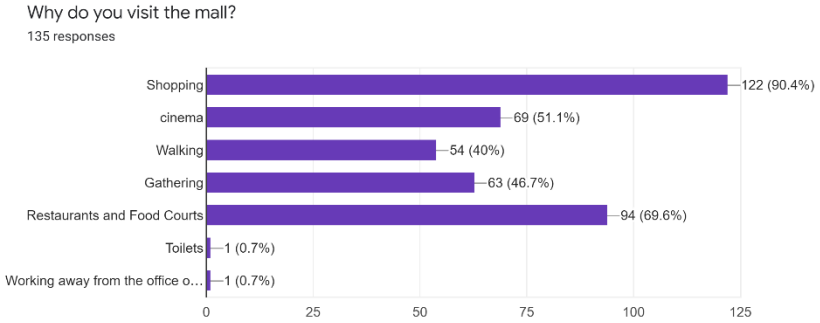


Figure 5. *Questionnaire results (Author, 2023)*



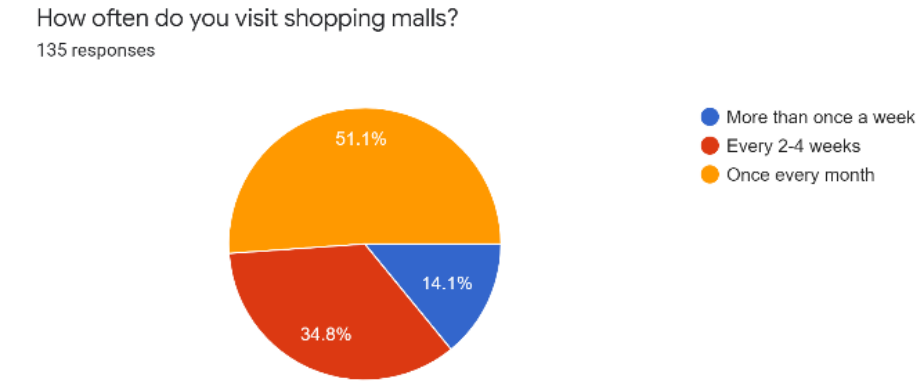
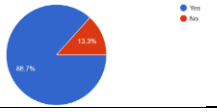
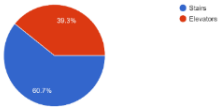
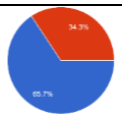


Figure 6. *Store front: city stars on the left, Center Almaza on the right (Author, 2023)*

art 2: Elements of Design

Questions	**Analysis**
Which shop attracts you the most?	Most people that have visited the shops preferred the circulation space within the Zara in City Centre Almaza (The Fig to the right). As you walk by the columns are white in color and the ceiling is bright, this is all communicated through the senses of the eye.
Which flooring in the previous pictures attract you more?	The flooring in City Centre Almaza is bright in colors, which gives a sense of pleasure, relaxation and welcoming of people.

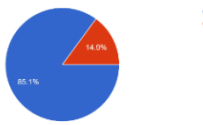
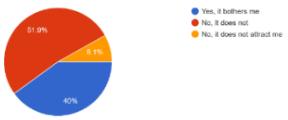
Part3: Elements of Motion

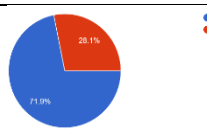
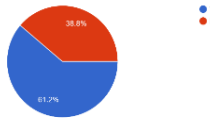
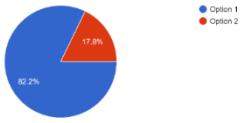
Questions	Results	Analysis
Does the presence of signage help and aid you through the process of walking?		The elements of experience aid in a faster and easier mobility, while allowing the senses to be integrated and used more and more.
Do you prefer using stairs or elevators?		As most people that answered the survey are within the young generation, so it was mainly seen that young people prefer stairs.
Would you use stairs with technology? (such as musical stairs, or stairs that can count your health vitals and update you through your cell phone)		This question also aids the fact that user senses play a great role within the effect of the user experience within circulation spaces. As all the senses of hear, touch, see, smell and taste could be felt just in the vertical circulation space.
If the elevators were to be spiral and to rotate while being transported would, you use it? or would you prefer using escalators		The dynamic effect that is given through spiral elevators would give a new sense of experience to the user within a normal regular retail store and adds a new sense to make the building space recognizable.

Part 4: Elements of Attraction:

Questions	Results	Analysis
Would you enjoy seeing an aquarium in a mall?		An aquarium in a mall, would regularly be double height and would take up so much space. The different colors and species of the fish will also add a depth to the focal point of the circulation space making it dynamic and all those feelings are again affected by the user senses.
Would you enjoy walking in a 'work of art' pathway?(ex: real life size sculptures)		The standalone gallery as seen in the previous case study showed that there is work of art and that it is a tool and element within the circulation space that will grab the users attention and to look and gain knowledge at the same time while walking in the circulation space.

Part 5: User Mood:

Questions	Results	Analysis
If a musical activity is heard from far will it direct you to its place?		People in general love gathers, and usually music is associated with gatherings, thus forcing people to go and see what is happening, it will direct the user within the circulation space and at the end giving the user something memorable to attain.
The smell of oud shops does it bother you or does is attract you?		Smell is one of the user senses that could vary from one person to another according to whether it was good or not. But overall smell whether it was food or perfume stores like the Galleries Lafayette is a great factor in user experience within circulation space.

Will interactive standalones make you want to go and learn if they are informative and for learning purposes?		Interactive Screens is the modern technology of the 21st century and all ages enjoy dealing with it. It is a great way to add it within the circulation spaces. Could be for many different purposes such as, learning and making music.
Does the slippery noise produced from the floor surface annoy you?		Finishing of the circulation spaces in retail buildings is vital. Slippery surfaces and noises could irritate the user and thus, making the user walk slower. The user unintentionally will feel the sense of suffocation and irritated by the finishing without knowing the actual reason as it is psychologically related.
Which picture do you prefer more? Option 1: Vast Space, Daylight Option 2: Full of Columns, Artificial Light		Option 1 has been chosen with a higher percentage surpassing 50%. Due to vast space, daylight and bright colors all of them are elements that affects the user moods within the circulation space. On the other hand, Option 2 is full of columns and dark , the dullness in the retail circulation spaces limits the motion within the space, thus not making it an effective space.

7 Outcome of Guidelines

Guidelines	Guidelines Description	Technique of utilization	Illustrative Image
1- Sense of Luxury	To enhance quality of the circulation space	-By use of light colors	
2- Sense of spaciousness		-Use of light colors -Use of reflective flooring to lighting	
3- Sense of vastness		-Use of double height spaces	
4- Sense of welcoming and relaxation		Use of perforated openings and double height	
1- Use of signs	Aids in the feasibility and easiness of the circulation space	Could be by using light sensors or interactive screens	
2- Use of musical stairs		Installing the new technology in normal stairs in the circulation space to direct people to it and use it	
3- Use of spiral elevators		Installing the new technology in elevators in the circulation space to have a full circulation space look	
4- Use of technology		Look for technology that acquires more senses	

1- Allow space for main focal points	- to guide the users in the circulation space - to allow the user experience new things	-Use large focal structures at main nodes (Aquariums)	
2- Areas for work of art		-Install areas of galleries and show rooms	
1- Using musical central activities	Essentiality of this point is to use the right finishing that will allow the senses to give the user a proper relaxing mood (such as, availability of green areas , for therapeutic engagement	Shows or activities that can engage the user and allow experience	
2- Use of fragrances		Kiosks and booths in the middle of circulation spaces	
3- Use of interactive screens		Screens that can animate direction and flow	
4- Choose proper finishing, and aesthetic features		-Use of light colored -Avoid dark colors - Use of greenery - Use of water features - Availability of seating areas	
5- Avoid use of surfaces that cause echoes		Choose proper finishing tiles	

Table 4. . *Conclusion of Guidelines (Author, 2023)*

Finally, this has us to the main aim to the research and study which is to develop circulation guidelines to enhance user experience using the senses within circulation spaces in retail buildings. By following the guidelines above that have, a direct sensual relationship with the user will definitely affect the user experience within retail buildings. The paper mainly focused on the circulation spaces in retail buildings and its effect on retail buildings. The table above shows a summary of the guidelines that can enhance user experience using the senses within circulation spaces in retail building.

8 Conclusion.

This study work is to provide its goal, which is a clear picture of the relationship between the circulation space and user experience in retail buildings. It was found that there are certain elements and features in the space

that have a direct effect on the user experience and also there are elements which do not have a direct effect. User senses showed that it plays a huge role in contributing to the user experience within the circulation space. A set of guidelines were deduced based on a case study with actual physical observations done at the site and using a behavior mapping tool to analyze how users move in a circulation space, and also a set of questions in a form of survey that were analyzed and reasoning were deduced from the percentages. Overall, the aim of this research was developing circulation guidelines to enhance the user experience using the senses within circulation spaces in retail buildings.

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