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Design Characteristics that Achieve the Factor of Safety and Security from Fire Accidents for Users of Administrative Buildings

Ghada Mohammed Taib, Asma Hassan Al-Dabbagh*

Department of Architectural Engineering, College of Engineering, University of Mosul, Mosul 41002, Iraq

Corresponding Author Email: asma.dabbagh@uomosul.edu.iq

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ABSTRACT

The need for safety and security is one of the important human needs, as it comes in second place after the basic human needs according to Mauslow's hierarchy of human needs. Therefore, achieving the safety and security factor in the design of buildings is considered one of the important design factors, which must occupy an important space in the architectural designer's thought from the early stages of design until the completion of the design in all its details, because the issue is related to the safety of lives and property. The research adopted the theoretical analytical approach by reviewing the studies and literature that dealt with the topic of research then analyzing them to achieve the objective of the research in reaching a clear and comprehensive classification of design characteristics (architectural and non-architectural) that achieve the factor of safety and security from fire accidents for users of administrative buildings, in addition to classifying these characteristics based on their relationship to the stages of the design process. The results of the research were in the form of a clear and comprehensive table of the above design characteristics, which are design characteristics that contribute to preventing the occurrence of fire, and characteristics that reduce fire damage when it occurs (characteristics that help contain fire and characteristics that facilitate the arrival of firefighters to fight the fire and characteristics that help in the speedy evacuation of building users). The research also reached a set of conclusions, and the results, conclusions reached by the research can be used as a guide for architectural designers and specialists in the field of safety to design administrative buildings that achieve safety and security from fire accidents for their users.

1. INTRODUCTION

The need for safety and security is considered one of the important human needs, as it comes in second place after the basic human needs according to Mauslow's hierarchy of human needs [1]. Therefore, achieving the factor of safety and security in the design of buildings in general is considered one of the important design factors (human factors) that raise the efficiency of the building in general, because it contributes to preserving the lives of users (a human aspect), in addition to its contribution to preserving Property (economic aspect). Its importance increases in administrative buildings due to the large number and diversity of its users who are exposed to fire accidents, and they are internal users (employees) and external users (visitors), and the abundance and diversity of furniture, equipment and devices used in them, in addition to the large number of papers, files and archive rooms that are easy to burn, which increases the possibility of fire accidents. Its importance also increases in high-rise administrative buildings due to the difficulty of its users escaping when fire occur. Its importance also increases in administrative buildings that are located in city centers, due to the large number of neighboring buildings that the danger of fire may extend to [2], as well as administrative buildings for factories and oil installations. The architectural designer has an important role in achieving the factor of safety and security from fire accidents, as one of the studies proved that the majority of losses in lives and property in the event that buildings are exposed to risks of fire occur due to inappropriate design that increases the complexity of the problem instead of solving it [3]. Therefore, the factor of safety and security from fire accidents must be present in the thought of the designer from the early stages of the design until the completion of the design in all its details, and the role of the architectural designer is not limited to integrating some detailed design characteristics after the completion of the construction of buildings. Sometimes the architectural designer encounters some design challenges that require reconciliation between achieving the factor of safety and security and achieving the other factors of the design such as functional and aesthetic factors and others. Aesthetic, that is, the architectural designer must reconcile all design factors as much as possible and according to their importance [4]. Achieving the factor of safety and security varies from one building to another because each building has its own specificity in terms of area, number of floors, and the shape of the project. Etc., but there are general design characteristics that achieve the safety factor of safety from fire accidents for all administrative buildings, for which an attempt will be made to find a comprehensive classification in this research. The results of the research were in the form of a clear and comprehensive table of design characteristics (architectural and non-architectural) that achieve the factor of safety and security from fire accidents for users of administrative buildings, which include design characteristics that contribute

to preventing the occurrence of fire (type of non-flammable construction and finishing materials, installing signboards to prevent smoking in places exposed to the danger of fire, installing a lightning rod, and a tight electrical and mechanical system to prevent the occurrence of fire), and the design characteristics that help contain the fire (type of flammable construction and finishing materials, dividing the building into fire sectors, providing windows with a good size for vertical movement spaces to prevent the transmission of toxic fumes through the floors, linking the alarm system to the air conditioning system to prevent the transmission of toxic fumes through air conditioning pipes), and the characteristics Design that facilitates the access of firefighters (flexibility in site planning for the access of firefighting mechanisms, suitable spaces for windows and appropriate separations between them that facilitate their use as emergency exits for firefighters, designing suitable alarm and extinguishing systems), and design characteristics that help speed up the evacuation of building users, which include the design characteristics of horizontal escape paths (their standard dimensions, their direct orientation towards the escape exits, the type of construction and finishing materials, the efficiency of lighting, the flow of through them, the installation of illuminated guide boards inside them to direct towards the escape exit), and the design characteristics of the vertical escape paths (their standard dimensions, their appropriate location, the type of construction materials Finishing, door material type, lighting efficiency, windows area, installing illuminated guide panels inside them to direct towards the escape exit), and the design characteristics of the escape exits (standard dimensions, location, number, direction of openings). The research dealt with several axes, which are illustrated in Figure 1.

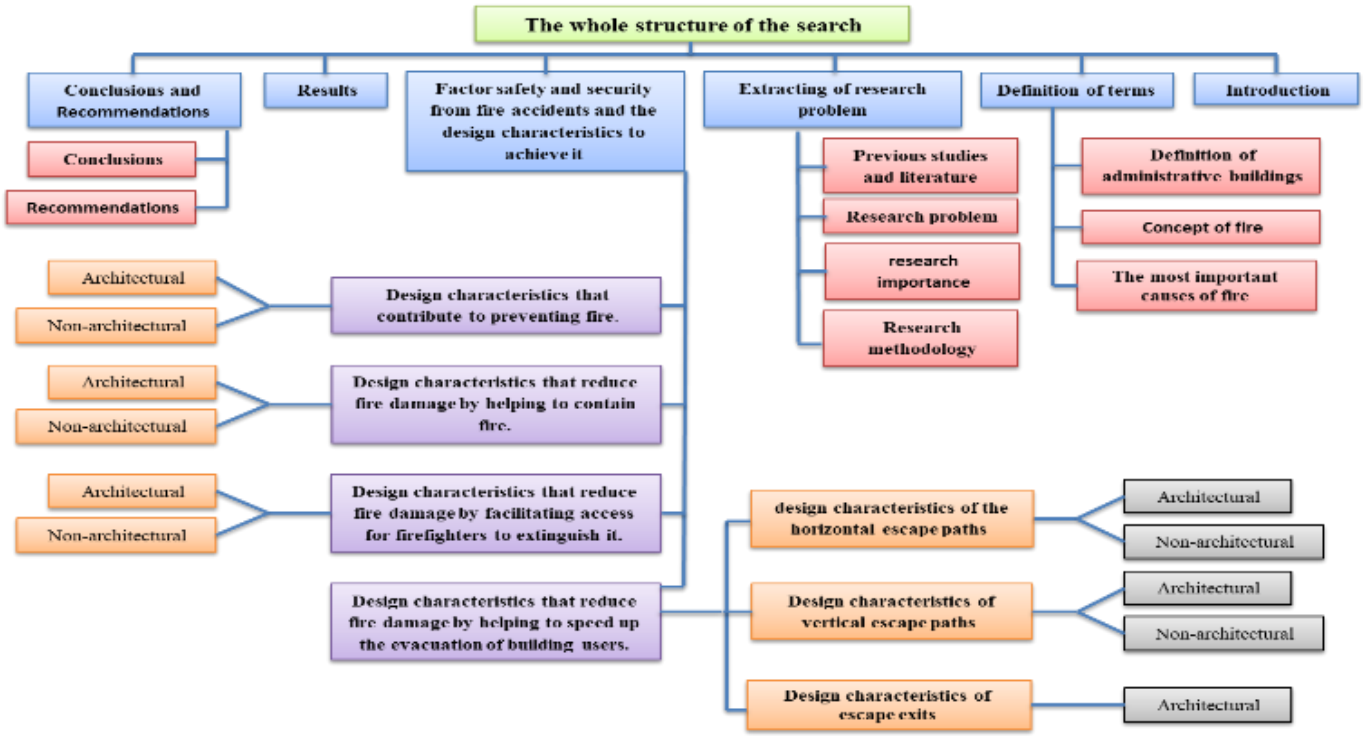

Figure 1. The whole structure of the search [Researcher]

2. DEFINITION OF TERMS (IMPORTANT CONCEPTS RELATED TO RESEARCH PHENOMENA)

2.1 Definition of administrative buildings

The author [5] defined administrative buildings as the building or parts of the building designated for conducting office work, whether it is allocated to one institution or a number of administrative institutions of different administrative styles.

2.2 Concept of fire

It is a chemical phenomenon that occurs as a result of the union of a burning substance with oxygen in the air, with the presence of a temperature effect factor. It is clear from this concept that fire occurs with the presence of three elements, namely: - 1 the substance (fuel), 2 - oxygen, 3 - heat, and this is what is called the triangle Flammability. Given the availability of flammable material (fuel) in every building, preventive measures must be taken to prevent the occurrence of fire [6].

2.3 The most important causes of fire

There are several reasons for the occurrence of fire in administrative and other buildings, the most important of which are [7]:

1- Natural causes: - such as (thunderbolts - lightning - volcanoes - high air temperature).

2- Technical reasons: - such as (leakage of flammable liquids or gases - the occurrence of electrical contacts without precaution - sparks of fixed or moving machines).

3- Reasons by voluntary human action: - such as (arson - explosion - throwing flaming objects).

4- Design reasons: The absence of design characteristics that prevent fire or reduce its damage.

3. EXTRACTING THE RESEARCH PROBLEM

3.1 Previous studies and literature

To achieve the objectives of the research, many previous studies and literature related to the subject of the research were reviewed and were used in the preparation of this study. The study [7] shed light on the design (technical) determinants and the role of modern technologies in fighting fire and limiting its spread, whether that is through the use of modern construction and finishing materials, or through the use of a modern fire alarm and extinguishing system, and the practical part of the study included the analysis of a multi-use building to show the most important design determinants used to enhance safety and security factors from fire. As for the study [8], proposals were presented for the design determinants of escape exits and firefighting equipment through the use of modern technologies to reduce fire damage, and the practical part of the study included an analysis of a hospital in Tripoli, Libya, by diagnosing the advantages and disadvantages of the design and applying these proposals by submitting a proposal to develop its design to reduce fire damage. The study [9] dealt with the design elements that protect the users of the building in the event of a fire, by enabling them to escape safely and prevent the fire from spreading as much as possible. As for the study [10], the researcher identified elements of fire prevention (type of construction materials, electrical system) and elements of risk reduction (alarms, evacuation plan, and firefighting methods) in high-rise residential buildings in Gaza City. As for the study [3], it dealt with the effect of design on the ease of evacuation of crowds of users in public buildings when disasters such as fire occur. The practical part of the study included analyzing the behavior of crowds of users and their preferences for exit when a fire occurred in three public buildings, by monitoring video cameras during the evacuation and by conducting a questionnaire for them after the evacuation.

3.2 Research problem

After reviewing previous studies and literature that dealt with the issue of safety and security from fire accidents in buildings, it was found that most of the studies had dealt with non-architectural design characteristics to achieve safety and security (technical characteristics and others), while the few studies that dealt with architectural and non-architectural design characteristics did not reach a clear and comprehensive classification of the design characteristics that achieve it. These characteristics were not classified based on their relationship to the stages of the design process. Thus, the research problem is (the absence of a clear and comprehensive classification of the design characteristics that achieve the factor of safety and security from fire accidents in the administrative buildings, and the absence of a classification of these characteristics based on their relationship to the stages of the design process).

3.3 The importance of the research

1- This study clearly and accurately identified the important role of the architectural designer in achieving the factor of safety and security from fire accidents, after his role was ambiguous in most of the previous studies, and since he is considered the leader of the design team, he will direct the rest of the team members from other specializations to perform their role in achieving the factor of safety and security in the design Building.

2- This study is considered as a guide for architectural designers and specialists in the field of safety to design administrative buildings that achieve safety and security from fire accidents for their users.

3- The study takes into account the human factor for the users of the building, by highlighting the provision of one of their most important human needs (safety and security), which is one of the important design factors, and its importance comes from the fact that architecture is primarily a human product, and the building is designed to be occupied by humans, so it is necessary to take into account his human needs when designing.

3.4 Research objective and methodology

The research adopted the theoretical and analytical approach by reviewing some previous studies and literature that dealt with the subject of research, and then analyzed them to achieve the objective of the research in reaching a clear and comprehensive classification of architectural and non-architectural design characteristics that achieve the factor of safety and security from fire accidents for users of administrative buildings, in addition to classifying these characteristics based on their relationship to the stages of the design process.

4. FACTOR SAFETY AND SECURITY FROM FIRE ACCIDENTS AND THE DESIGN CHARACTERISTICS TO ACHIEVE IT

By analyzing previous studies and literature that dealt with the subject research, the research reached a definition of the factor of safety and security from fire accidents in the design of administrative buildings, which is to take into account when designing the spaces of the administrative building to achieve the need of its users for safety and security from fire accidents through the architectural and non-architectural design characteristics

The research has been classified the design characteristics that achieve the factor of safety and security from fire accidents in the administrative building, and includes architectural design characteristics (the characteristics of spaces and the relationships between them), which are within the first stages of design, and the characteristics of the architectural details of these spaces (walls, floors, ceilings, doors, windows, decor interior, furnishing), which are in the detailed final stages of the design, and the architectural designer has a major role in designing these architectural design characteristics, in addition to the non-architectural design characteristics (technical and others) in which the architectural designer has a secondary role in designing such as determining their numbers and locations, etc.

The research classified the design characteristics that are achieved factor safety and security from fire accidents into:

1- Design characteristics that contribute to preventing fire.

2- Design characteristics that reduce fire damage by helping to contain fire.

3- Design characteristics that reduce fire damage by facilitating access for firefighters to extinguish it.

4- Design characteristics that reduce fire damage by helping

to speed up the evacuation of building users.

4.1 Design characteristics that contribute to preventing fire

It is difficult for the architectural designer to fully control the prevention of fire, since with the availability of the three elements of fire, fire occurs, and therefore the main responsibility of the architect designer is concentrated in reducing fire damage to users and the building to the least possible when it occurs, and it can also contribute to preventing the occurrence of fire in a limited manner through the architectural and non-architectural design characteristics, which are as follows:

4.1.1 Architectural design characteristics

1- Type of construction and finishing materials

The use of non-flammable construction and finishing materials, as some materials used in finishing the internal and external walls have recently spread, which have aesthetic qualities and thermal and sound insulation qualities, but they are characterized by being highly flammable, and to reduce the occurrence of fire, non-flammable materials must be used for construction and finishing to prevent the occurrence of fires [11].

4.1.2 Non-architectural design characteristics

1- Installing guiding signs:

Putting guiding signs entitled (no smoking) in spaces that are prone to fire, such as spaces for electrical and mechanical services and storage spaces, and that they are placed appropriately to see them clearly [2].

2- Installing a lightning rod:

Installing a lightning rod on top of the building.

3- A tight system:

The electrical and mechanical system of the building must be tight [6].

4.2 Design characteristics that reduce fire damage by helping to contain fire

When a fire occurs as a result of any of the aforementioned reasons, it starts on a small scale, but quickly spreads and generates great damage to lives and property, so the necessary measures must be taken to contain it and confine it to the space of its occurrence and prevent its spread until the firefighters arrive to extinguish it, which allows the rapid evacuation of users other spaces of the building.

Fire containment is defined as:

It is limiting the fire to the space of its occurrence and preventing its spread to the rest of the building's spaces for a period of time until the arrival of firefighters to extinguish it, which allows the speedy evacuation of users of other spaces of the building [11].

4.2.1 Architectural design characteristics

1- Type of construction and finishing materials (fire resistant):

This is done by choosing construction materials with characteristics that resist fire for at least 4 hours and prevent its spread to other spaces until the firefighters arrive to extinguish it, such as foam concrete, as well as using finishing materials that are resistant to fire for a period of not less than half an hour, and are suitable for the nature of the use of the space, Such as the use of fire-resistant paint and the non-use of plastic secondary ceilings in spaces at risk of combustion due to their lack of fire resistance [10].

2- Divide the building into fire zones:

In order to limit the fire to the space in which it occurred and prevent its spread to the rest of the building spaces, the building is divided into zones called Fire Zones.

Fire zone: It is a space or a group of spaces in the building that is completely isolated from the rest of the building spaces when a fire occurs in it to prevent the spread of fire from it to the rest of the building spaces. The partitions separating it from the rest of the building spaces are fire-resistant walls for an hour or two and operate automatically when a fire occurs in it to prevent the spread of fire to other spaces, and the doors, walls, ceilings and floors in the fire zone must be made of fire-resistant materials [2]. The method of dividing the spaces of the building into zones depends on the following:

1- Type of space use

Where the fire zone can be part of a floor or an entire floor that has the same use (horizontal fire zone), and the fire zone can be a group of spaces exposed to a high probability of fire, such as spaces for technical equipment and storage spaces (horizontal fire zones), and the vertical movement space (stairs and elevators) is considered a vertical fire zone [9].

2- The area of the fire zone

The area of the fire zone should not exceed (400) square meters in all cases, whether it is a horizontal or vertical zone as shown in Figure 2.

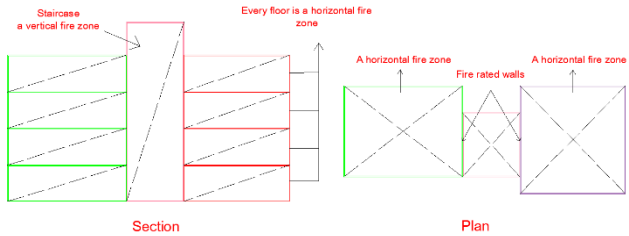

Figure 2. The spaces of the building are divided into horizontal and vertical fire zones [Researcher conducts]

3- The area of the windows of the vertical movement spaces (stairs and elevators):

A suitable space to provide good ventilation and prevent the transfer of flames and toxic fumes to other floors [7].

4.2.2 Non-architectural design characteristics

1- Connecting the early alarm system with the air conditioning system to prevent the spread of flames and toxic fumes through air conditioning pipes [7].

4.3 Design characteristics that reduce fire damage by facilitating firefighters' access to fight it

The firefighters (rescue) are considered the first line of defense to extinguish the fire, and the success of the firefighters' task depends on the design characteristics that facilitate their access to the fire space to extinguish it, which are as follows:

4.3.1 Architectural design characteristics

1- Site planning:

Taking into account the layout of the general site and the corridors and streets surrounding the building with suitable

widths (not less than 6 m wide), in order to facilitate the access and exit of civil defense equipment and mechanisms without any obstacles [7].

2- The area of the windows and the distance between the window openings:

This is done by making window openings with dimensions that ensure easy access for firefighters when using external windows as emergency exits by firefighters, so that they are wide enough for the passage of more than one person, and their width is not less than (1.2) meters, and the distance between two adjacent windows horizontally or vertically, each of them must open to a separate fire zone, which must be sufficient to prevent the transfer of flames and toxic fumes from one window to another, as it must be the distance between two horizontally adjacent external windows, each of which opens to a separate fire sector, must not be less than (0.5) m if the facade is flat [12], and the vertical distance between two vertically adjacent external windows, each of which opens to a separate fire zone, must not be Less than (1.2) m if the facade is flat, but if the distance is less than that, a protrusion should be designed outside between the two windows [13] as shown in Figures 3 and 4.

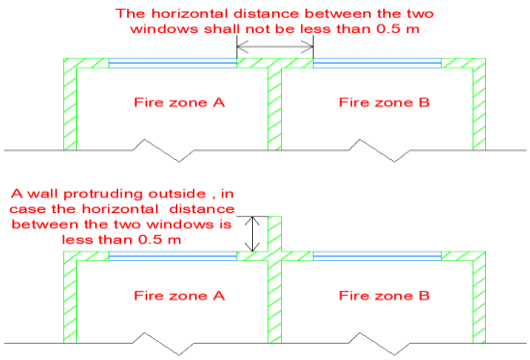

Figure 3. The distance between the window openings on the horizontal level [by the researcher]

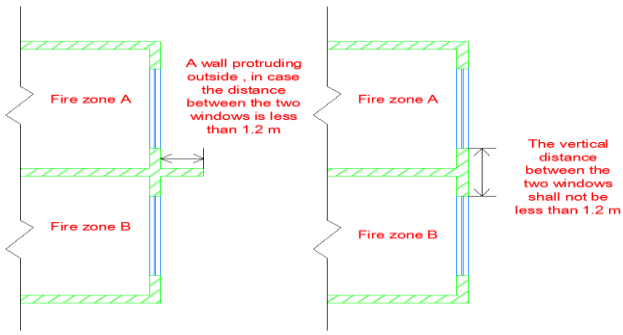

Figure 4. The distance between the window openings on the vertical level [by the researcher]

4.3.2 Non-architectural design characteristics

1- An early fire alarm system:

It is a means to warn the building users when a fire occurs so that they can get out of the building as quickly as possible, as well as to notify the firefighters of the occurrence of the fire in order to extinguish it, and it must be operated on two sources of current (mains electric current and batteries) to ensure its continuity of work in the event of a power outage when the fire occurs. It is divided into two types [2]:

A- Automatic alarm system:

It is a system that senses the fire automatically through detectors that detect (smoke, flame, heat or gas), and the detectors send a signal to the main control panel, and the control panel sends a signal to audible or visual alarms that give sounds or signals throughout the building, In order to be able to escape outside the building [3], in addition to automatically notifying the firefighters by linking the main control panel to the firefighters' control room, meaning that its main components are the detectors (which must be in numbers and locations suitable and of a quality commensurate with the materials exposed to fire in space), and the main control panel, and audio and visual alarms [14].

B- Manual alarm system:

It is an alarm system consisting of the same components as the automatic alarm system, except that it contains manual glass break keys instead of automatic fire detectors, where when a fire occurs, the person breaks the glass break key to send a signal to the main control panel, meaning that he senses the fire manually using the break keys glass instead of detectors that sense fire automatically [14]. The architect's role is secondary in designing the early alarm system by specifying the locations, numbers and types of fire detectors, glass break switches, and audible and visual alarms, as appropriate the function of each space, in addition to providing space for the main control panel.

2- Fire extinguishing system:

It is a means of extinguishing fire and is complementary to the fire alarm system, and it is divided into two types:

A- Automatic fire extinguishing system (fixed):

It is a fixed system that extinguishes fire by spraying with water or gas, and works automatically when a signal is received from the main control panel of the early alarm system, and is installed at the top of dangerous spaces such as storage spaces and spaces for electrical and mechanical services [9].

B- Manual fire extinguishing system (mobile):

It is a mobile system that consists of manual extinguishers or fire hoses, and they are placed in different places throughout the building, and they can be used by firefighters or anyone in the building when a fire occurs [14]. The role of the architectural designer is to design the firefighting system by determining the number, locations and height of spray points in the automatic firefighting system, and determining the location and number of manual extinguishers and fire hoses according to the function of each space, in addition to determining the locations and numbers of firewater sources in the warehouses and outside yards of the building [2].

4.4 Design characteristics that reduce fire damage by helping to speed up the evacuation of building users

The design of escape routes and exits is considered one of the most important design characteristics to protect the users of the building, and to design these routes and exits, the four different stages of escape must be known in the event of a fire, when the escape is through the internal stairs or emergency stairs, and the focus is on the process of escaping and evacuating the users of the building because it is one of the most important stages that must be taken into account to achieve safety and security from fire in buildings [3]. The four stages of escape are as follows:

Stage 1 (distance A): which is the movement of the person from the point at which they are located inside the building space to the door of the space when he is aware of the

occurrence of a fire. (Horizontal movement).

Stage 2 (distance B): It is the movement of the person from the door of the space, passing through the corridor overlooking the space, to the door of the stairs leading to the outside of the building (Horizontal movement).

Stage 2 (distance C): the movement of person inside the escape staircase.

Here, the movement is vertical in two directions, down or up, or down only, as it is (vertical movement) up to the roof, or down to the ground floor in the case of the normal internal escape staircase, and it is a vertical movement in one direction (down). In the case of the external escape staircase, where a door (escape exit) is opened from the end of the corridor on each floor to the external escape staircase, and then heads down until reaching the ground floor.

Stage 2 (distance D): is the distance from the end of the escape staircase on the ground floor until reaching the safety point. (Horizontal movement) as shown in Figure 5.

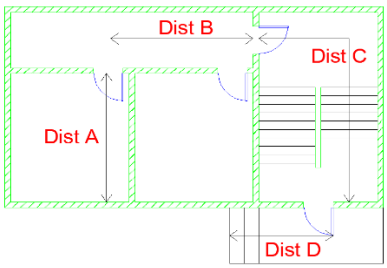

Figure 5. The four different stages of users' escape in the event of a fire [Researcher adapted]

The design characteristics that help speed up the evacuation of building users include Design characteristics for:

1- horizontal escape paths (movement corridors)

2- vertical escape paths (normal and emergency stairs) and

3- escape exits [15].

4.4.1 Design characteristics of horizontal escape paths

Architectural design characteristics

They are movement corridors that are called in the protection systems escape routes when their end leads to an escape exit, and they are safe ways that enable people in the building to evacuate by starting from any point in the building to the roof of the building or to a safe place outside the building, and they must have characteristics that ensure speed safe evacuation of the users of the building, and the characteristics include the following [9]:

1- Standard dimensions:

It should be of standard dimensions and suitable for the number of its users when escaping for ease of escape and preventing stampede when escaping, and its width should not be less than (1.5) meters [16], as the corridors that are not suitable for the number of users may lead to crowding and stampede when escaping from fire, Also, crowding may cause them confusion and failure to escape in the correct direction of the escape exit [17].

2- Direct guidance to the escape exits:

It must lead directly to the escape exits, taking into account that the corridors do not lead to dead ends for more than 6 m after the escape stair opening, as this leads to the users of the building at the time of escaping drifting towards that end and returning to the exit in reverse direction, which causes stampede and obstruction [15] as shown in Figure 6.

3- Type of construction and finishing materials:

The construction and finishing materials for the corridors (walls, ceilings, floors) must be made of fire-resistant materials for at least one hour, such as foam concrete and fire-resistant paint [9].

4- Lighting efficiency:

Entire corridors must be well lit (natural and artificial lighting), and the artificial lighting must operate on two sources of current (mains electric current and batteries) to ensure its continuity in the event of a power outage when a fire occurs [2].

5- The flow of movement in the corridors:

Taking into account the absence of any obstacles to movement such as structural columns or flower beds or the floor level difference in the corridors [6].

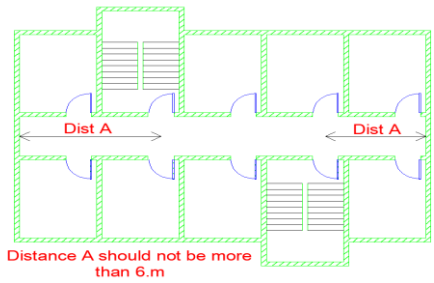

Figure 6. The maximum distance to the end of the corridor from the escape stairs [by the researcher]

The non-architectural design characteristics

1- Direct guidance to the escape exits:

Taking into account the provision of illuminated signboards and placing them appropriately to ensure their visibility so that they lead directly to the escape exit, which are powered by batteries to ensure their continued operation in the event of a power outage when a fire occurs [18] as shown in Figure 7.

Figure 7. Various guiding signs directing building users in the corridors to the escape exit [9]

4.4.2 Design characteristics of vertical escape paths (internal normal staircases and external emergency staircases)

Stairs play an important role in evacuating building users in multi-story buildings. Vertical escape paths include internal staircases, which are the normal staircases of the building that are located inside the building and are used to move between its different floors and end to the roof of the building when escaping up and end to the outside of the building when escaping down in the event of a fire. In addition to the external emergency stairs, they are installed outside the building, and are often exposed to the air, and they are installed in the event that the internal stairs are insufficient for escape, especially in buildings with more than (5) floors, and they are at the end of the escape corridor [9]. It should have design characteristics (architectural and non-architectural) that achieve the speedy evacuation of building users. As follows:

Architectural design characteristics

1- Standard dimensions:

Take into account the width of the stairs (internal and external) according to the number of building users, the building area, the type of building use, the flow rate and the time required for evacuation, taking into account the principles of stair design so that the length of the staircase is not less than (1) m, the width is not less than (0.25) m, and the height of the step does not exceed (0.19) m. The height of the quarry is about (0.85) m

2- Convenient location:

Stairs (internal and external) must be in suitable locations, and to take into account the distances traveled to reach it, and their ends shall reach the safe area for the users of the building, The locations of the external staircases must also be far from the windows and openings of the building where flames and smoke may escape, by a distance of not less than two meters [7].

3- Type of construction and finishing materials:

Its construction and finishing materials (walls, ceilings, floors) must be fire-resistant for at least one hour, such as foam concrete and fire-resistant paint. As for the external stairs, their structural structure must be made of fire-resistant materials, and they are not affected by weather changes (heat, cold, and humidity) because they are outside the building [7].

4- Type of door materials:

The doors connected to the passages must be fire-resistant and smoke-proof, like iron.

5- Lighting efficiency:

Taking into account clear vision and lighting within the space of the internal staircase, natural lighting is preferred during the day, and artificial lighting at night, working on two sources of current (mains electric current and batteries) to ensure its continuity of work in the event of a power outage when a fire occurs, As for the external stairs, the external lighting must be good to be visible during the night [3].

6- Window area:

Taking into account the appropriate space for the windows of the internal staircase space, which provide sufficient ventilation that does not allow the accumulation of flames and toxic fumes, and prefers natural ventilation [14].

Non-architectural design characteristics

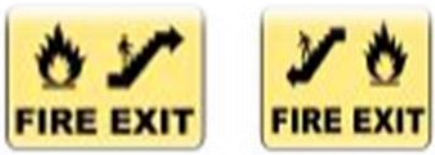

Figure 8. Guidance panels inside the vertical escape paths (the normal internal stair) [10]

1-Direct guidance to escape exits:

Taking into account the placement of guiding panels within the space of the internal staircase to clarify the movement of the direction of escape to the roof for users of the upper floors or escape to the bottom for users of the lower floors in multi-story buildings as shown in Figure 8.

4.4.3 Design characteristics of escape exits

The escape exit is defined as the door that separates the escape route from the escape staircase, or it is the door that separates the normal internal staircase on the ground floor from the outside of the building, or it is the door that separates the internal staircase from the roof, and these exits are considered basic escape exits, and there are escape exits secondary ones that can be used to escape when needed, which are the entrances of the building and the low-height window that leads to a balcony if it is on one of the upper floors, or leads to the outside if it is on the ground floor, and escape exits must have architectural and non-architectural design characteristics that achieve the speedy evacuation of users building [7].

It should be noted that although the building entrances are considered secondary escape exits, one study proved that a high percentage of users used the entrances as escape exits during the experimental study and when they were asked about the reason through the questionnaire, the most common reasons for choosing the building entrances as exits as escape exits is their knowledge of its locations (familiarity) more other exits. Another reason that was given for choosing the entrances to the building was that it was the first door that came to mind, and being the quickest option. Another reason for people who were not familiar with the building was that they chose the entrance, because the facade of some of the entrances is made of glass, which provides a view of the outside of the building, which makes them feel that the entrance door is the exit door and escape from the fire, while the other reasons were that they did not act independently, but rather followed the movement of the crowds and headed to the entrance door [3].

Architectural design characteristics

1- Dimensions of the escape exit [7]:

The escape exit must be wide enough for the passage of at least two people, and the distance between the person's shoulders is estimated at (0.56) meters, and thus the minimum width of the exit is not less than (1.2) meters [15].

2- Location of the escape exit:

When determining the location of the exit, it is taken into account that it be at a distance not exceeding (45) m from the farthest point from the building, and the length of this distance depends on the function of the building and on the type of materials used in construction and finishing and their resistance to fire [15].

3- Number of escape exits:

The number of exits required for the building is determined according to the area of the building, the number of users and the nature of use [16]. There is a mathematical equation for calculating the number of exits, which is: - The number of exits = the number of people used \ the flow rate of people from the exit * the time required for evacuation [16]. The rate of people flow is defined as the rate number of people who can leave the exit within one minute, and this rate is estimated at forty people per minute [9].

The rate time required to evacuate the building from its users is estimated from two to three minutes, depending on the type of building using and the materials for its construction and finishing. The standards for some Arab countries recommend specifying the number of exits as follows [9]:

- 2 exits if the number of people is 30 or less
- 3 exits if the number of people is from 300-600 people
- 4 exits if the number of people is from 600-1000 people

4- The direction of opening the exit:

If the exit is a door, it must open towards the outside [15].

Table 1. Design characteristics that achieve the factor of safety and security from fire accidents for users of administrative buildings

Secondary safety and security factors	Design characteristics that achieve factor safety and security from fire accidents		
	Architectural design characteristics		Non-architectural design characteristics
	Characteristics of spaces and the relationships between them	Architectural details (walls, floors, ceilings, windows, doors, interior decoration, furnishing)	Technical and other characteristics
1- Contribute to preventing fire		Non-combustible construction and finishing materials for walls, ceilings and floors for all spaces Building materials that resist fire for one to two hours	Installing non-smoking panels in spaces exposed to the risk of fire Install a lightning arrester A tight electrical and mechanical system in the building
2- Help contain the fire and prevent its spread	Divide the building into horizontal and vertical fire sectors according to the type of space and area used	Type of materials for doors, walls, ceilings and floors between zones (fire resistant) Presence of automatic partitions made of fire-resistant materials separating the zones Windows area for vertical movement spaces to prevent the transmission of flames and toxic fumes to the upper floors	Connecting the early alarm system to the pipes of the air conditioning system to prevent the transmission of flames and toxic fumes through the air conditioning pipes
3- Facilitate the arrival of firefighters	Planning the site and streets around the building so that the width of the streets is sufficient for traffic and firefighting equipment	The window dimensions for each fire zone (enough for two people to pass) in addition to the distance between the window openings horizontally and vertically sufficient to prevent flames from spreading through the windows from one zone to another.	early alarm system early extinguishing system
4- Helping to speed up the evacuation of building users	The dimensions of the corridors are standard Directing the corridors towards the escape exits and not directing them to dead ends for more than 6 meters from the escape stair opening Standard dimensions for the internal and external staircase A suitable location for the internal and external staircase, taking into account the distance traveled to reach it. The location of the external staircase shall be far from the windows and openings of the building where flames and smoke may escape, by a distance of not less than (2) m.	Type of materials for finishing walls, floors and ceilings for corridors (fire resistant for at least an hour) Corridor windows area (appropriate area) to provide good natural lighting for the corridors, in addition to industrial lighting, which has two sources of energy Type of finishing materials for walls, floors and ceilings of internal stairs (fire resistance for at least one hour). Type of materials for the construction of the external stairs (fire-resistant and weather-resistant, being external) The type of material of the doors separating the internal staircase from the corridor (fire-resistant and smoke-proof) The area of the windows of the internal stairs (a suitable space) to provide good natural ventilation to prevent the accumulation of fumes and to provide good natural lighting for the internal stairs, in addition to artificial lighting with two energy sources Width of escape exit (2 persons) The location of the exit is appropriate, taking into account the distance traveled to it The number of escape exits is proportional to the number of users, their flow rate from the exit, and the speed of evacuation The direction of opening the exit if the exit is a door (outside)	Directing users to escape from the corridors to the escape exits through illuminated guiding panels that have two sources of energy (electric current and battery). Directing users to escape through the internal staircase to the escape exits (up to the roof or down to the ground floor and then outside the building) through illuminated guiding panels that have two sources of energy
Design stage	Initial design stages (programming stage and design decision-making)		Final design stages (details stage)

5. RESULTS

The research, through reviewing and analyzing previous studies and literature, reached a comprehensive and detailed classification of the design characteristics (architectural and non-architectural) that factor of safety and security from fire accidents for users of administrative buildings, as shown in Table 1.

6. CONCLUSIONS

1. The design characteristics that achieve the factor of safety and security from fire accidents in buildings are not just details added after the completion of the construction of the building, but rather design characteristics that must be included in the design from the early stages of the design until the completion of the design in all its details.

2. The architectural designer has an important role in achieving the factor of safety and security in buildings through design characteristics that contribute to preventing fire, and design characteristics that reduce fire damage to users and the building, which are (characteristics that help contain fire and characteristics that facilitate access for men Firefighting to combat fire and features that help in the speedy evacuation of building users), as follows:

A- The architectural designer has a role in contributing to the prevention of fire through the architectural design characteristics (the type of construction and finishing materials that are not flammable), and the non-architectural design characteristics (installing signboards to prevent smoking in places exposed to the risk of fire, installing lightning rods, and a tight electrical and mechanical system to prevent fire).

B - The architectural designer has an important role in helping to contain the fire through the architectural design characteristics (the type of construction and finishing materials that are resistant to ignition, dividing the building into fire sectors, providing windows with a good size for vertical movement spaces to prevent the transmission of toxic fumes through the floors), and non-architectural design characteristics (Connecting the alarm system with the air conditioning system to prevent the transmission of toxic fumes through the air conditioning pipes).

C - The architectural designer has an important role in facilitating the arrival of firefighters through the architectural design characteristics (flexibility in site planning for the access of firefighting mechanisms, suitable spaces for windows and appropriate separations between them that facilitate their use as emergency exits for firefighters) and non-architectural design characteristics (designing appropriate alarm and firefighting systems).

D - The architectural designer has an important role in helping to speed up the evacuation of building users through the architectural design characteristics of the horizontal escape routes (their standard dimensions, their direct orientation towards the escape exits, the type of construction and finishing materials, the efficiency of lighting, the flow of movement through them) and the non-architectural design characteristics (installation of panels Illuminated guidance inside it to direct towards the escape exit), as well as through the architectural design characteristics of the vertical escape routes (its standard dimensions, appropriate location, type of construction and finishing materials, type of door material, lighting efficiency, window size) and non-architectural design characteristics (installing illuminated guide panels inside it to direct towards the escape exit), as well as through the architectural design characteristics of the escape exits (their dimensions, location, number, direction of the exit opening).

3. The design characteristics that achieve the factor of safety and security from fire accidents include architectural design characteristics (the characteristics of spaces and the relationships between them), which are within the early stages of design, and the characteristics of the architectural details of these spaces (walls, floors, ceilings, doors, windows, interior decoration Furnishing), which are in the detailed final stages of the project, and in which the architectural designer has a major role in designing them. It also includes non-architectural design characteristics (technical, etc.), in which the architect has a secondary role in designing them, such as determining their numbers and locations etc.

4. The successful architectural designer reconciles the different design dimensions, so that achieving the safety and security dimension does not conflict with the functional dimension of the building, but if the aesthetic dimension conflicts with the safety and security dimension when designing, then the architectural designer must give priority in achieving the safety and security dimension over the dimension Aesthetic because it is related to the safety of life and property.

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