

## Consideratons for Glass Balusters Design in Architecture

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### **Introduction: -**

The architecture is rich in many architectural elements. "Stair or ladder" is one of the important elements because of its important role in linking the lower and upper floors, as well as "window and balcony" which in turn connects the outside and the inside.

The ladders and the architectural openings are divided into different shapes and types, each of which imposes considerations on the designer that must be taken into account during the process of designing the supplements of these different types, such as handrails and balusters design used for each type. In addition to functional, structural and aesthetic requirements.

The research sought to unify the architectural elements that have the same shape and function for the importance of linking the various elements in the same building such as balustrades of stairs, windows and balconies in terms of design, material and method of installation, in addition to achieving the economic aspect instead of repeating research and study. So, the search aims to balance beauty, uniqueness, economy, simplicity and ease of installation through the design of the quantitative production of glass balusters.

Because the balusters of the architectural supplements combine the function and beauty, it is produced by many different materials such as wood, concrete, iron and others, which must have several considerations that Help to optimize balusters usage. The use of flat glass has been shown in stair balusters for several years. In this research, researchers called for the creation of glass units to be used in architecture as a baluster. Considering successive economic crises that hinder cost innovation processes that are Subjected to the unit production system. The research has sought to profile these units in production to produce in different ways that are assembled and installed to be used as balustrades for stairs and various architectural openings, it could be manufactured by the methods of quantitative production of glass according to the design of these units. These methods save a lot of effort, time and money. The design process, measurements, tests and production are done once and can be used in more than one location and building. The architect can choose between them in accordance with the conditions of the building design and provide large quantities of the product to be used when needed. Spare parts are also provided for pieces that may be broken after installation and are also easily installed.

### **Key words:**

Design - Balusters – architectural openings - Stairs - Glass - Windows – Balconies

**Research Problem:**

Lack of considerations for the design of the glass balustrade which combines quantitative production in industry and the requirements of the architecture that connects the interior and exterior in terms of the requirements of stairs, windows and balconies.

**Research Objective:**

Determining a range of considerations influencing the design of glass balusters used in architecture.

**Research importance:**

- By determining the design requirements of various units of glass balusters suitable for quantitative production, it saves time and effort to the architect and the designer they spend to make a new design each time, In addition to saving the economic cost of the product as a whole
- Opening new productive areas that increase employment opportunities for young people.

**Theoretical framework: -**

The balustrade is divided in terms of its presence in the building to the balustrade in the interior architecture and balustrade in the exterior architecture each divided into different types depending on their function. The balusters in the interior architecture are divided into balustrades for stairs and balusters for and decks. In the external architecture, it is divided according to its function also to a balustrade for window and balconies, garden fencing and around swimming pools as well as balustrades in the outer stairs.

Prior to starting the details of the balustrades, the research has made a summary of the characteristics and types of stairs and architectural openings that will be use balustrades with them.

**First: - Stairs in general: -**

The stairs are divided into several types in terms of shape to: the spiral staircase - rotary ladder - curved ladder - divided ladder - ladder enclosed between two walls.

In terms of function, the stairs are used in many places, such as what is used in housing and similar buildings such as hotels, such as used in service buildings such as airports, train stations, and other stairs dominated by the process and do not concern us in this research such as basement stairs, machine rooms and fire ladders.

**Second: - Architectural openings: -**

The architectural openings that may need to install balusters to the balconies of which they are real, fake or fabricated. The windows, which are divided into types depending on their material, that may be wooden windows or metal windows, and are divided according to the movement to other groups. Wooden windows are divided into ordinary windows, sliding windows and **mat** windows. The metal windows are divided into single or double hanging windows, sliding windows and hinged windows. The research has briefly addressed these types.

The research also dealt with the determinants of the selection of fixing systems for balustrades and talked about some of them. Also, varieties of fixing handrails to the balustrades.

**Analytical framework:****Glass balusters design: -**

Balustrade is classified as functional pleasure product, as it has a function of human comfort and safety. At the same time, it is an important part of the architectural space, in which the aesthetic values that represent the visual pleasure. In its design, it is necessary to be familiar with the structural and engineering considerations, which depend on what has been mentioned before in terms of the diversity of places in which it is used and in addition to the methods of its installation. Before technical and aesthetic considerations, it is a product that is functionally dominated.

The research dealt with detailed functional characteristics that are closely related to many user considerations, age and standards. The usage function is primarily concerned with the safety conditions and the durability of the balustrades. Formal properties are largely related to the function. The soft texture of the handrail has a role, while the element of equilibrium is a basic functional element so that the user can firmly anchored on the balustrade while going up or going down the stairs, as well as the type or style of the building, The linkage between the interior and exterior balustrades helps to connect the elements of the building together in one unit.

**Design Framework: -**

The design of the glass units used for the glass balusters was divided into three trends, based on the methods of production, which in turn affect their properties in the way they are assembled together, their installation and the method of fitting the handrail to them. These trends are: -

**The first trend: -** separate flat glass units used to make the glass balusters, each of them fitted next to each other in the case of architectural openings and fitted on a tread in the case of stairs. This trend of design ideas is most compatible with the largest number of staircases and does not conflict with any angle of slope for the stairs, on condition that the width of the unit shall not exceed 10 cm in the case of the spiral stairs so as not to overlap each other in the curves. And should keep at least 12.5 cm distance between the units and each other to ensure the safety of users.

**The second trend: -** small flat glass units that are assembled on a metal structure that is installed on the walls and floors where the balusters are installed. This structure is designed for each individual case. The shapes of the glass units are not related to the shapes and angles of the staircase, but rather to the form of the metal structure or the metal columns in which the glass units are installed.

**The third trend: -** is separate 3D glass units which installed on the architectural openings and treads. This trend corresponds to many types of stairs whatever their slope, straightness or bending as they fitted on each tread separately, this trend may need some new ideas different from what available in the market for installation, they vary according to the forms of the units and vertical and horizontal sections, thickness and the edges of the unit. With an attempt to work out what is available in the market during production.

A comparison of these trends was presented in the research in terms of the area of the place to be installed, the design of the units, the method of fitting and the method of installing handrails.

sketches were made for the three trends and two units of the first trend were selected figure (2) and their method of installing figure (1).



Figure (1) Method of installation of the units in the ground and the way of fitting the handrail



Figure (2) The two units and their places on the stairs and balconies

**Results: -**

The research reached several considerations for the design of glass balusters in architecture Figure (3):

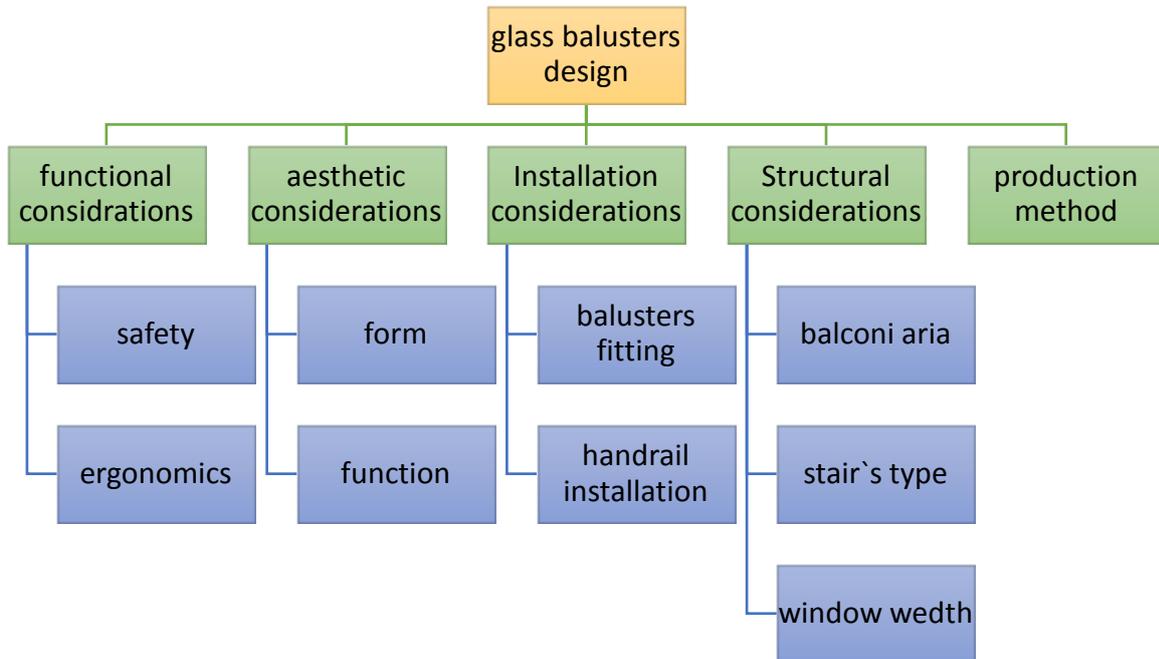


Figure (3) Design considerations of glass handrails for architecture

### • **Structural considerations:**

The structural considerations for glass balustrades concern the pitch of the stairs, the length of risers, the width of treads and the height of the ceiling from the ground, each affecting the height and width of the units of the balustrade, as well as the size of the balcony or the width of the window.

### • **Functional considerations:** -

Functional considerations are related to the purpose of building that the balustrades used in, it controls the type of balustrade and its hardness degree to afford the intensity and quality of user usage. The designer must not neglect the ergonomics in the design of the balustrades, as the height of the balustrade, the presence of the handrail and the place of installation is determined by the comfort of the users, the nature of the location and the degree of seriousness of it.

In an important architectural element like a balustrade, the most important functions is to achieve safety, security, and users' comfort. The most important safety and security considerations should be characterized for balustrade by the following specifications:

- o Be at least one meter high.
- o the gabs between the vertical railings shouldn't exceed 12.5 cm.
- o There are no horizontal or semi-horizontal bars that allow children to climb on them.
- o Good installation for handrails so that it bears users.

### • **Installation considerations:**

There are several ways to install balustrade to the floor or walls and are chosen according to the way the glass unit is produced, designed and assembled. The importance of studying the methods of installation in depth due to its direct impact on the security and safety of users. Cases of balustrade installing apply to stairs, corridors, roads, balconies and windows.

### • **aesthetic considerations:**

Three design trends were innovated for the design of glass balustrade in order to achieve a range of functional and structural considerations that are compatible with the quantitative production methods and the methods of installation in the building. This enables the designer to choose the appropriate alternative to different situations in architecture, which vary depending on the type of building, the space where it installed, structural system, straightening of the railings or customer desires. It is also necessary to observe the placement of balustrades on the architectural openings because of its impact on the façade.

### **Recommendations:**

Researchers recommend the following:

1. The need to conduct more studies of balustrades and the multiplicity of their functions and forms considering the determinants and considerations imposed by modern architecture
2. Research on the importance of developing design variations within the architectural space and solving the problems related to balustrade to raise the aesthetic value of architecture.
3. to take advantage of the potential of glass and other materials in the design of balustrades, stairs and architectural openings as a functional and aesthetic requirement.
4. Research on quantitative methods of glass production balustrades that can be efficiently installed.