

## **An analytical and technological study of the glass bricks building system for architecture**

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### **Summary:**

Glass blocks have a great importance for use in architecture and have a long history. The stages of manufacturing have evolved since the beginning of the appearance in 1800's in the form of manufacturing the first half of the production until it reached the current known form, which works through the light through which provides visual hides. The glass block industry was developed based on the principles of lighting ergonomics in the early 1900's to provide natural light in the plant's greenhouse. Glass blocks are used in walls, partitions, separators, etc. Glass blocks have two types according to the method of automatic glass forming, whether in the form of pressing method inside the mold or casting method in a mold to take the desired shape embossed, has more than one method of composition according to each type is different from the other, and glass blocks have more than the form and method of production according to the half-automatic method in production into a mold in the furnace to form glass sculpture blocks.

The glass blocks have the advantages of: It makes the place a sense more efficient because it has the characteristic of the implementation of light through it and reflect the reflections of the lights are wonderful in the presence of sunlight with transparent glass or frosted glass, and is a good heat insulation and gives a beautiful aesthetic look in shape and high quality in the endurance, and is transparent and available colors. It can be chosen from the colors according to the shape and use, so it is used in shops destinations so that the vision is obscured and light permeability, and easy to clean, the hallow glass blocks are manufactured by the method of automatic pressing does not need to finish and polishing after production directly other than the other type (cast glass blocks). The use of modern glass blocks has varied from before and its shape has evolved in a manner suitable for modern uses and has become the most of the interior and exterior designs. Glass blocks are used in interior design of architectural and architectural facades in the past and contemporary times; to give a functional and total aspect.

### **From that point the problem is determined:**

#### **Research problem:**

- Lack of information on the different structures and adhesives for the types of glass blocks and the modern uses of it in architecture.
- The need for different forms and different from the structure known as the glass blocks "cube" for the diversity of modern uses in architecture.

**Research Goal:**

- To reach the most modern technological methods for the production of glass blocks and various installation methods in the modern era.

**Research importance:**

- Arranging various forms of engineering or nature to design the glass blocks that help architects keep up with design.
- Spread the technical awareness of the designers with the interconnectivity of the separators and partitions made of glass blocks.

**To solve the problem of search and reach the goal, the following should be studied:**

**First:** What are the glass blocks and stages of development and types in terms of modulation method in the modern era?

**Second:** Installation systems for partitions and separators of glass blocks.

**Third:** Analytical study of some types of glass blocks.

**First: What is the glass blocks and stages of development and types in terms of the method of formation in the modern era?****Stages of glass block manufacturing:**

Glass block is architectural units made of glass, can vary in color, size, texture and shape. Glass blocks provide an optical block as light passes through it. Modern glass blocks developed based on the principles of ergonomics of lighting in early 1900 to provide natural light in the greenhouses of plants. It is used in walls, partitions and separators, etc.

In the early 1800s the beginning of the appearance of the use of glass tiles and glass blocks to provide light and control, whether obscured or obscured or transparency in churches and hospitals, at first they were formed tiles square flat forms of hand-formed glass, and then evolved into a form known glass block product In a pressing way, They were then fitted into steel structures and frames in the form of medium ceilings allowing large surfaces to become transparent. With reinforced concrete, Monet used glass blocks in reinforced concrete for the first time in 1867, and the manufacturing of glass blocks was made by the machine instead of the traditional manual method.

In 1904, Joachim, a French architect, built the first dome of concrete and glass blocks. Thickness, to be installed in support structures for reinforced concrete. The following year, Joachim applied for the French patent "Le béton armé translucide".

Then the glass blocks developed into hollow and used in the work of vertical fixed partitions and separators, which offered the advantage of noise insulation and control and thermal insulation. Until 1930 there was no development in the production and shape of the glass slab, which was easier to operate, and then produced the Corning-Steuben glass block, which consists of two halves of heat-resistant glass pressed together by the pressing machine and then combined together High-temperature, modern glass block is still produced according to this method of production, namely that the block is produced in two parts by a press machine, and then combined together under high temperatures to produce a hollow block from the inside and also insulated.



Figure (1) shows the shape of the glass block Falconnier, 1886 (photo from the Museum of Modern Art, Department of Architecture and Design)

## Second: Glass Brick Types

1- Hollow Glass Blocks

2- solid Glass Blocks

### Hollow Glass Blocks:

It is a stereoscopic slab of transparent or colored glass produced by pressing on two parts and then combined together to become a vacuum inside and also called bricks or blocks because it is a method of installation and construction similar to the method of installation and construction of ordinary bricks with different materials used in construction to fit the glass.

Glass building blocks are very good insulation for heat and cold due to the vacuum filled with still air inside.



Figure (2) illustrates some of the famous shapes and models of hollow glass blocks and shows the forms of patterns

## Second: Installation systems for partitions and separators of glass blocks:

### Installation method of glass blocks:

There are two main different methods:

**Method 1:** The mortar, consisting of white cement and quartz, is used and fixed with galvanized iron skewers of 3-6 cm size as required.

**Method 2:** is the use of rubber adhesive (silicon) and sheets of reinforced cork or strips of aluminum.

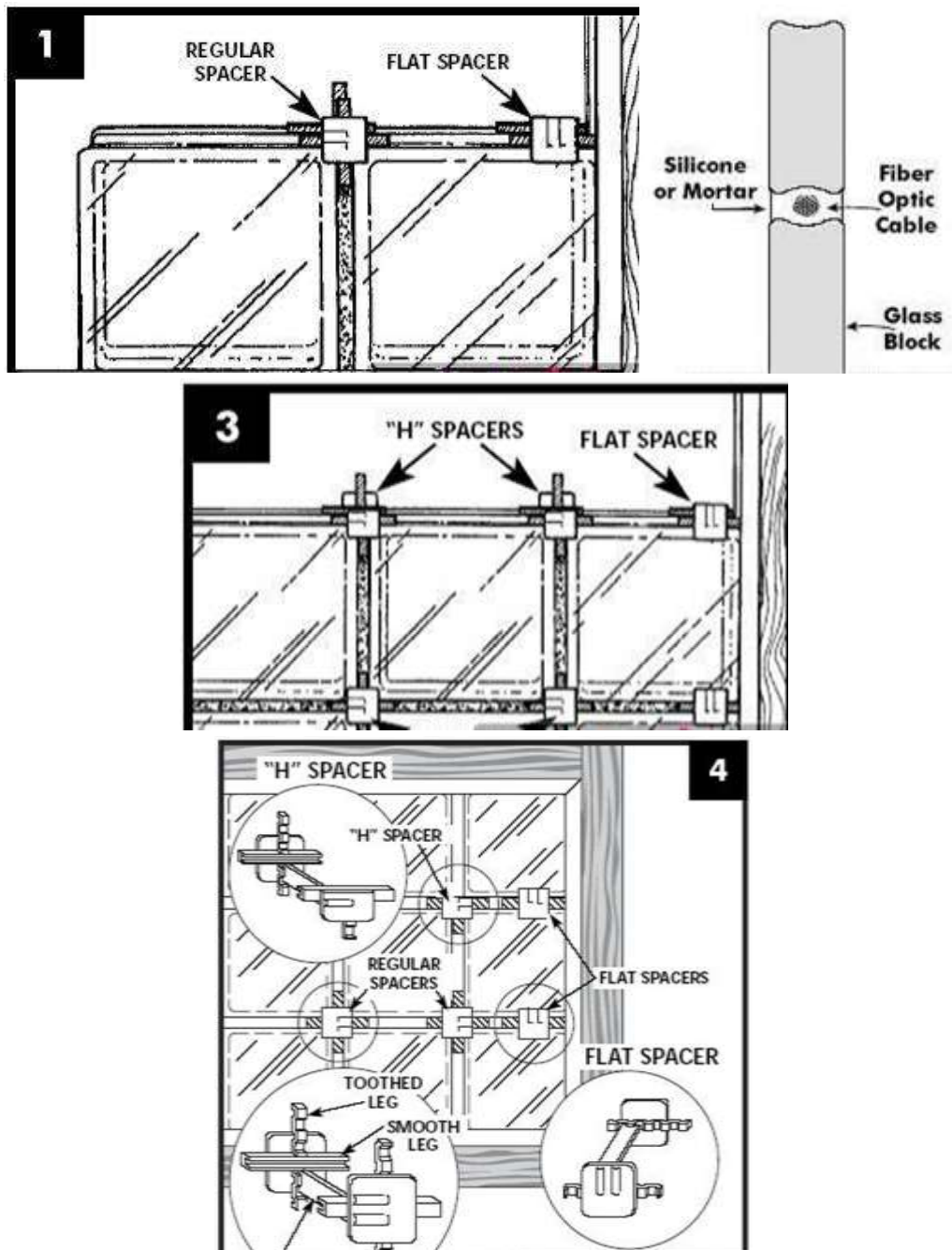


Figure (3) shows one of the ways to install glass blocks with steps

### Solid Glass Blocks:

The second type of glass block is produced by casting into stainless steel molds and then cooled quickly so that particles are not arranged to form crystals, which in turn translucent glass into opaque is not preferred.

Then taken to the cooling furnace until solidification and then performed several finishing processes to take the final shape of the tile required before use.



Figure (4) shows the method of pouring the solid glass block inside the mold

#### Installation Method: By:

- 1 - the method of assembly by a strong adhesive catalyst for ultraviolet radiation to complete the adhesive or any of the strong epoxy materials so as not to affect the coefficient of thermal expansion of the glass and breakage occurs when assembly and collecting such as the method of assembly of ordinary bricks.
- 2 - Or assembled by a horizontal and vertical aluminum structure placed inside the glass brick sections as fillings.
- 3 - Or collected with mortar and white cement as the normal construction method.



Figure (5) shows the method of installing blocks inside the aluminum sections

#### Third: Analytical study of one of the types of glass blocks (solid glass blocks):

The place where the wall made of glass brick is designed is the "Chanel" building in Amsterdam, Netherlands.

$\pm 0.25$  mm is the size or size of tolerance and tolerance in the dimensions of blocks and the difference between them in the composition; Solid glass blocks of comparable dimensions (200 mm x 300 mm x 70 mm), borosilicate glass and high-precision molds are used for highly precise units. Borosilicate glass is preferred over lime soda glass; it is relatively less efficient than thermal expansion [ $3.2-4 \times 10^{-6} / K$ ] over soda-lime glass [ $9.1- 9.5 \times 10^{-6} / K$ ]. This results in much less natural contraction during cooling,

### Mortar and joint:

The thickness of the adhesive material on the surfaces 0.2-0.3 mm is optimal for the adhesive layer with maximum precision in each layer of construction. In traditional block plays a double role of bonding and absorbing tolerances in the size of blocks. However, the inability of the selected adhesive to compensate for any dimensional discrepancies in the construction can result in a cumulative offset of a few centimeters in the overall height of the facade, even when the tolerance allowed for each glass element is only  $\pm 0.25$  mm.



FIGURE (6) illustrates the method of gluing between blocks and reinforcing them with UV radiation



Figure (7) shows the image of the building after the final installation of the wall made of glass blocks

**Results:**

1- To reach the difference between solid and hollow glass bricks and the production considerations and methods of installing each type by the following:

<b>Solid glass blocks</b>	<b>Hallow glass blocks</b>	
(casting method)	(press mould machine ) press method	Production method
<ul style="list-style-type: none"> <li>- The method of assembly by a strong adhesive catalyst for ultraviolet radiation to complete the adhesive or any of the strong epoxy materials so as not to affect the coefficient of thermal expansion of glass and breakage occurs at the assembly and collected like the method of assembly of ordinary bricks.</li> <li>- Or assembled by a horizontal and vertical aluminum structure placed inside the glass brick sections as fillings and then isolated and fixed by silicon.</li> </ul>	<p>Installation methods are numerous for this type and there are two main different methods:</p> <p>Method 1: The mortar, consisting of white cement and quartz, is used and fixed with galvanized iron skewers of 3-6 cm size as required.</p> <p>Method 2: is the use of rubber adhesive (silicon) and sheets of reinforced cork or strips of aluminum.</p>	Method of installation
<ul style="list-style-type: none"> <li>- Needs finishing and polishing immediately after production</li> <li>- It is relatively a good heat insulator due to insulating coating on the surface.</li> </ul>	<ul style="list-style-type: none"> <li>- No need for finishing and polishing immediately after production.</li> <li>-It is good heat insulation due to the vacuum it contains.</li> </ul>	Advantages

2 - Contribute to the documentation and collection of complete data on the standards of production, installation and uses of glass blocks in modern architecture as well as adhesives and new structural forms of glass blocks.

**Recommendations:**

- The research recommends the completion of the scientific study curriculum as an applied study to enrich and diversify the themes of the study to the methods of design, production and installation of glass blocks.
- It is recommended to take advantage of the field of theoretical study as an applied methodology for the development and upgrading of the efficiency of Egyptian industries.

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