

# Influence of Advanced Technologies in The Design of Modern Facades

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## Introduction:

High-Technology is one of the most prevalent and present postmodern trends in contemporary architectural design. Societies have been affected by scientific and technological progress, which led to thinking about many of what can be achieved from that technological progress. Technological tools have become the common vision of peoples. Then the importance of these technologies in architecture and interior design emerges through the design of building facades, windows, furniture and interior spaces, meaning that there are a number of factors that affect today, and will likely affect, in the foreseeable future, in architecture and interior design, which are:

- **First:** The great development in technology: the computer, the Internet and the means of communication, in addition to the technological development in raw materials.
- **Second:** The growing awareness of the environment and the need to preserve it, and consequences on human life and societies.
- **Third:** Nanotechnology: Nanotechnology has opened wide horizons for designers in the field of design in general due to the possibilities and applications it provides, which in the past were considered a path of imagination, in addition to its many benefits in the field of sustainable interior design in terms of compatibility with the environment and providing the best environment. An interior in which the user can live, in addition to the economic benefits, where it is expected that the use of nanotechnology will become more economical than using its alternative, it is currently used in terms of saving time, effort and money.

The design of modern facades in our current age, after the tremendous technological progress, has become dependent on focusing on solving problems, which prompted designers to move away from decoration and rely on modern technologies, and the aesthetic evaluation of facades, which was based on artistic decoration, turned to relying on economic, technical, cultural and environmental solutions for the design of facades.

It will shed light on the facades of buildings and how the ways of thinking have changed, and how the facade can perform more than one function to turn into a smart facade, and then some examples of modern external facades.

- **Technology:**

Technology is a foreign word of Greek origin, consisting of two syllables, the word techno, which means a craft, skill, or art, and the word logi, which means science or study, so that the word “technology” is formulated in the sense of science application; Many scholars have given many other definitions of the word. Technology is defined as the sum of techniques, skills, methods and processes used in the production of goods or services or in achieving goals.

- **Smart Glass:**

It is the glass that gives the opportunity for environmental control in a new and exciting way, in addition to the individual's ability to change the amount of visible light entering it and give protection and privacy, control the entry of solar rays, improve thermal insulation and prevent ultraviolet waves inside the building, it is also called transformed glass, which is an electrically switchable glass which changes one of the characteristics of light transmission when voltage is applied to it, and these particular types of smart glass allow users to control the amount of light and, accordingly, the heat, and it changes from transparent to semi-transparent glass or partially prevents vision through it, while keeping the light clear through it, this glass has the ability to maintain the building temperature with different external conditions.

- **External facades of buildings:**

Building facades are the link between the internal and external spaces of the building, and they are the most striking and visible parts of the building, they protect against external factors and are one of the main elements in creating comfortable spaces as they control the gain or loss of thermal loads, the facades must have the technical ability to become adaptable to the environmental conditions of the place in which it is located.

- **Smart Interfaces:**

Smart facades are those that adapt to environmental conditions and transform themselves, responding to the changes that occur outside and inside the building, when it comes to facades, the main focus is on equalizing natural sunlight, protection from solar radiation, while controlling ventilation and (input or output) heat. These exchanges can occur through the glass, which can be considered intelligent when its light transmittance properties change due to electrical voltage, light or heat, causing a change in the appearance of the glass and thus changing the intensity of light as well as the wavelengths of light.

This research is an attempt to shed light on a number of techniques used in the exterior facades of modern buildings as a result of the rapid development of techniques used to achieve functional, aesthetic and utilitarian characteristics of the building and to open a way for designers to understand the qualities of glass and recent developments in it, and how to use it in the design of exterior facades, and many other designs.

**Changing ways of thinking in the design of external interfaces:**

The development of the concept of the use of glass has had a great importance and impact that contemporary architects have benefited from in trying to adapt the external facades and solve their problems, because of these material specifications that are not available in other materials, as it has the ability to acquire the largest amount of light and rays and distribute it in the

directions it requires. The benefit in the design, as well as reaching the upper limit with regard to its resistance to weather factors such as heat and humidity, and its great ability to isolate sound, combining the properties of solid walls and transparent openings with beautiful design and shape, and thus it was able to achieve integration between the formal (aesthetic) and functional values for its use in interior and exterior architecture.

Technological development has helped spread glass aesthetically and functionally and use it in architectural facades. The advanced technology has helped to find new types that have the ability to resist heat, some of which resist fire as well as bear mechanical shock, and there are other types that are thermally treated, and another type that can be reconfigured thermally using thermal bending technique, and another that is characterized by the feature of intelligence, and also interactive glass. All of these types provided physical- thermal - mechanical - properties etc. that worked on being able to form a variety of glass surfaces that have many properties that achieve both functional and aesthetic aspects, and there are materials that can change its nature in order to improve the insulation of the building in addition to the use of technologies such as lighting the facades with LED system and light using transparent and insulating materials at the same time.

### **Smart Interfaces:**

Smart facades are those that adapt to environmental conditions and transform themselves simultaneously. This happens through their components that adapt to different conditions and respond to changes that occur outside and inside the building, which means that their functions are:

- Protection from the problems of the surrounding environment: through thermal, sound, wind, rain and various pollutions insulation.
- Connecting or separating between the interior and the exterior: depending on the function of the building, where it is possible to provide lighting and natural ventilation in different ways, as well as visual communication with the surrounding environment and residents, and privacy can be provided if the need arises.
- Excellence and attraction: there are important buildings and religious or national buildings that need to distinguish themselves in the area in which they are located, or to be distinguished from the surrounding buildings, and it has become easy to implement and design forms that were a fantasy in the past. Modern design programs and construction methods made the dream come true, as commercial and recreational buildings need to attract the public through completely transparent facades to allow identification of what is inside these stores, whether commercial or recreational, or they can be facades of public libraries or museums aimed at attracting passers-by and raising the knowledge and cultural level of the population.
- Expressing the function of the building: In ancient history, the facades of buildings were similar despite their different functions. The designers noticed this problem, and the facades began to express the functions of the building, and this trend developed so that today it has become a basic requirement in the design.

Glass facades have developed significantly in recent years in terms of the type of glass material and the high technology in its manufacture, which shows the flexibility of compatibility with the required architectural form, and in terms of the development of techniques used in

architecture, and the most important buildings in which glass has been used since ancient times all the way to the glass curtain in the period of modernity and the new spirit which it gave to these buildings, represented by smart facades to suit different conditions and requirements, as the methods of architectural design have evolved, and examples that embody this development: Burj Khalifa, Kingdom Tower, Sea Towers in Abu Dhabi, and many others.

#### **About Smart Glass used in smart interfaces:**

It is the glass that gives the opportunity for environmental control in a new and exciting way, in addition to the individual's ability to change the amount of visible light entering from the window, and give protection and privacy, control the entry of solar rays, improve thermal insulation and prevent ultraviolet waves inside the building, it is also called transformed glass and it is a switchable glass electrically and changes the properties of light transmission when voltage is applied to it, and these specific types of smart glass allow users to control the amount of light and, accordingly, the temperature. It also changes from transparent glass to semi-transparent or partially prevents vision through it, while keeping the light clear through it. This glass has the ability to maintain the temperature of the building with different external conditions.

#### **Glass and Nanotechnology:**

Nanotechnology has contributed to finding a new type of strong and unbreakable glass. Fragility occurs as a result of the presence of spaces between atoms, which was treated by reducing the spaces between atoms to a minimum - this is in addition to many properties such as:

- 1- Preventing the thermal leakage of sunlight through the windows, which results in savings in energy consumption, by using the "trichromatic" technology, which is a very thin layer coating that works on thermal insulation while providing the appropriate lighting.
- 2- Storing a measure of heat and then transmitting it again to the inner vacuum in case the temperature drops, so it works as a heating device.
- 3- Reflective of harmful ultraviolet rays of the sun.
- 4- The property of self-cleaning by analyzing organic dirt and being anti-fog.
- 5- The technique of controlling the intensity of lighting changes.

#### **Types of glass used in interior design and architectural facades:**

##### **1- Tempered glass is of two types:**

- **Tempered glass:** Bent Tempered Glass, which is fully tempered glass, and it is 5-7 times more shock-resistant than ordinary glass. The internal and external temperature differences reach 300 degrees Celsius, while the corresponding differences in ordinary glass before it is broken do not exceed 70 degrees Celsius. It is used on the first three floors of the building, and on the facades of buildings.
- **Glass Heat Strengthened:** It is characterized by a resistance to breakage equivalent to twice the resistance of ordinary glass, and its tendency to shatter is much less. When broken, it turns into a small number of large pieces and remains stuck in its frames, without opening its frames and skylights. It is also recommended in high buildings, where its use starts from the fourth floor and above, Laminated glass.

**2- Insulated Glass Unit:** Insulated glass consists of at least two glass plates, parallel and fastened together to form a hermetically sealed unit based on the principle of filling the cavity between the panes of glass with dry air, such as Argon, K, Argon or Kpg. Which gives thermal and sound insulation up to 85%, and this insulation is reinforced by glass units of different types (reflective, heat-absorbing, colored, galvanized, etc.) and asymmetrical thickness and unobtrusive design and the need to break, Fire-resistant glass.

**3- Laminated glass:** It consists of two or more layers of glass separated by a layer of resins (organic materials), in order to ensure a higher degree of safety. If it receives a violent shock that breaks one of the glass layers, it remains fixed in its place and does not scatter, and is used in sky openings and glass umbrellas in security buildings (embassies, ministries, airports), reducing glass for non-selective radiation penetration.

**4- Bullet-resistant glass:** Consists of several layers of laminated glass that can contain a layer of polycarbonate, and this type is the highest level of bullet-proof glass, and polyvinyl butral (PVB) is also used, where this material is used in Applications that require durability, so it is used in financial buildings, money exchange centers and in armored cars.

**5- Fire-resistant glass:** It consists of several flakes joined by transparent interlayers of certain materials. In fire, the board that faces the flame is cracked but remains in place and does not collapse and the interlayers turn, at a temperature of about 120 degrees Fahrenheit. The glow from moving to the other side of the fire, and this lasts from 45 to 120 minutes during which the protection is complete, and is used in hospitals, schools, shopping centers and commercial buildings.

**6- Self-cleaning glass:** Self-cleaning glass is a glass covered with a very thin layer of microcrystalline titanium oxide that responds to daylight, and this reaction separates the skim from the glass, without the need to use wipers, and when water falls on it, a reaction occurs that leads to dirt and water sliding off the surface of the glass, which makes the surface of the glass appears clean, and reduces the penetration of ultraviolet rays harmful to humans by 20%. It is used in all types of buildings, which contain the crystalline structure of the microscopic photovoltaic cells which are sensitive, they are making use of solar radiation incident upon energy, by loosening the gradual dirt, dust, and blocks by using electrostatic energy generated from these cells), and this makes it easy for automatic removal when rain falls upon them) or when being sprayed with water and without leaving any traces or spots.

**7- Reducing glass for non-selective radiation penetration:** It is characterized by reducing the amount of heat passing into the vacuum from solar radiation, and this depends on increasing the absorption or reflection of all types of glass.

**8- Glass with a permeability and eclecticism radiation:** It is one of the most sophisticated where it can be selected between an increase in permeability or Aqlalha depending on the circumstances of glass types, the most important glass with a permeability selective wavelength where its transparency almost does not hinder vision or entry of natural lighting, while it is less transparent to invisible rays, which leads to a reduction in solar heat gain by almost half.

**Smart windows:**

Smart windows or smart glass is a new component of smart homes that have begun to sweep in the developed countries and the rich Arab countries that want to adopt technology as much as possible for human comfort in their homes. These smart windows are special windows made of glass processed by various technological means that make him/her able to control amount of light.

Man has realized the importance of rationalizing energy and benefiting from the clean renewable energies surrounding us, hence the idea of smart windows. They are windows that control the lighting of the place by adjusting the amount of light that enters from the outside, which also helps in controlling the temperature of the place. And it is sometimes not a kind of luxury, as being the case in the famous Burj Khalifa in Dubai. This wonderful architectural edifice without the use of smart windows will not be suitable for human use because ordinary glass will cause the temperature inside it to rise sharply, making it feels like hell on the ground. One of the advantages of smart windows is that it also reflects Harmful UV rays, protect the fabrics of curtains, furniture and carpets from damage caused by exposure to sunlight.

**Examples of modern facades globally:**

- Amazon headquarters - Seattle - Washington.
- Mixed-use office building (Foster & Partner - London).

**Examples of modern Arabic interfaces:**

- Burj Khalifa - Dubai.
- Al Bahar Towers Abu Dhabi.

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