The Role of New Technologies for Envelops of Buildings In Improving The Internal Environment Of University Buildings

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Abstract. The impact of the progress in the field of technology on the development of engineering sciences, including architecture and provided the modern technologies of the architect designed enormous possibilities in the formation and design of buildings and thus improve the environmental performance of those buildings, providing them with comfort for their occupants, and recent studies have proved the importance of the quality of the internal environment on the scientific performance in the educational buildings from here The importance of research in the role and importance of modern techniques in improving the internal environment of educational buildings, including university, where the research assumes the existence of a range of techniques employed by the designer in the design of building covers to improve internal environmental performance and The research problem was based on a discussion of the factors influencing the quality of the internal environment and a series of studies that dealt with the design of the modern buildings and their environmental impact, in order to derive the main variables and apply them in the study The process, which analyzed a range of contemporary university buildings, led to conclusions and recommendation.

Keywords: Technologies, Envelops, Environment, University Buildings.

1. Introduction.

The educational buildings of the English language colleges in the world are designed to provide educational services in their ages, because they contain a large number of occupants and for long periods that require the greatest comfort for their occupants. And environmental comfort in buildings for the first degree in heat and audio and visual comfort [1]. Therefore, the good design of the building cortex improves students’ performance and increases the level of thermal, audio and visual comfort [2]. The climatic environment is the most influential force on the internal environment of the building, especially when the environmental control devices are limited, and the techniques are weak so must adapt to them, and the human body to expend energy to adapt to environmental conditions and when the exchange of energy is a little environment is within the limits of rest [3]. Thermal comfort means that the occupants of the building do not feel the need to adapt space during their stay. Visual comfort means the quality of light that makes visual visual tasks (reading, writing, etc.) easier. Audio comfort enables the occupants of the building (teachers and students) to hear each other easily and reduce the noise that affects the internal environment [4].

2. Previous literature.

1.1. Study Kamuna and Raouf (“Integration Of The Work Of The Building As An Employee System Of Advanced Technology In The Face Of Climatic Conditions Foreign Affairs”):

The study examined the development of societies and their adaptability to the necessary and continuous changes to develop Its response to the surrounding climatic environment, and the use of modern technology in the construction of buildings characterized by enveloping High dynamic and responsive to the surrounding climatic conditions and adapt the design (form and function) to work As a whole integrated to provide comfort to the occupant and the style preserves the versatility and
provides. The study reviewed Arab experiences in this field for the purpose of drawing ideas and employing them in buildings in line with the climate of Iraq [5].

1.2. Study Al – Essawi ("The effect of the exterior design of the building on the thermal acquisition and thermal comfort of the users"): The study examined the concept of the effect of the outer shell of the building on thermal acquisition as a means of understanding the conditions and the effect on the thermal behavior of the building, finding the best solutions for the outer shell which directly helps to achieve the required thermal comfort for building users has been studied evolution Architecture through the ages has the most important influences on buildings, and the concept of climate design has been confirmed by research on the need to adopt the principle of climate design for the outer shell of the building through climate analysis, study Climatic aspects of the facades according to solar radiation Thermal loads and the exchange process by conductivity [6].

1.3. Study Halawa and Others("A review on energy conscious designs of building façades in hot and humid climates: Lessons for (and from) Kuala Lumpur and Darwin"): This study argues that there is a lack of a systematic and comprehensive analysis of the available literature regarding the energy and thermal performance of building façades based on the various possible design and technical configurations, especially in hot and humid climates. Important decisions should be made by architects and engineers during the early design stages of buildings with viewpoints to the ultimate impacts of building physics on the overall energy performance and indoor comfort conditions of buildings [7].

1.4. Study Barnaś ("Double-Skin Façades – The Shaping Of Modern Elevations – Technology And Materials"): The study showed the importance and role of design in balancing the challenges of maintaining the correct internal atmosphere of the building and providing the highest possible energy efficiency. Considering that the facade of the building is an integral part of it, and that the use of modern technologies in the design of the facades [8]. All studies confirmed the importance of employing technology in architecture to reach the best performance of buildings, see Figure 1:

![Figure 1](image.png)

**Figure 1.** Employing technology in architecture to reach the best performance of buildings (researchers)

2. **Building envelope.**

It is a building material that surrounds the internal spaces of the building with certain building techniques and is the boundary between the environment. The interior of the building and the external environment, it is also the most important element to get a suitable environment for the convenience of users. The buildings and the protection of the building.
3.1. Roof

The most exposed to climate variables in the building’s envelope, for example, exposed to the sun Throughout the day, unlike facades that are exposed to hours only during the day, and there are techniques used Treatment of ceilings:

1. Thermal Insulation Roofs: There are many insulating materials that can be used for insulation Roofs Low density materials are used to achieve the best thermal insulation.
2. The use of a reflective material for the sun: a coating of ceilings with light colors, reflective materials are considered The heat is effective in limited areas.
3. Insulation by providing air space (secondary ceilings): is to leave an air vacuum between the structural roof of the building And the secondary roof to reduce heat transfer inside the buildings as a good thermal insulation.
4. The use of the roof consists of two separate layers: leading to the movement of air between them where it works The upper layer of the umbrella leads to lower air temperature below and thus the heat is not permeable to The inner layer of the roof.
5. Shading the roof by different means, such as the surface gardens: the soil is a heat insulating material in addition to that Plants shade the ceiling and cool the air that touches it and the ceiling is built in a special way so that the weight bearing And prevents leakage of water [9].
6. The use of tilted or curved ceilings, such as vaulted or cylindrical ceilings, is part of the ceiling Often shaded .

3.2. Facades

The outer face of the building or the group of waves that we see according to the optical axis of the eye The Observer [10]. High technical interfaces:

1. Kinetic Facades These interfaces are flexible and able to change shape, configuration and routing to respond automatically For surrounding environmental factors and their changes this includes temperature, humidity, wind ... etc, (one building Ocean in Korea) so that the solar blades made of fibrous plates are used to be Strong and flexible allow light to pass through[11]
2. Using a smart and moving shading system (eg Abu Dhabi Towers Building), providing heat reduction Acquired by up to 50% which helps to reduce energy consumption up to 40% [11]
3. Solar Facades (green pix project in China) The ability to generate electricity provides up to 40% energy, thus reducing thermal bridges and providing comfort Interior [12].
4. Use of assembled facades: Trombe Well is one of the most common walls Simply consists of a single or double glass layer, an air gap and a thick wall with a single layer Dark absorbs the radiation and converts it into long wavelengths of radiation and stores them in the wall and moves Heat in the space that exists into the interior space [13].
5. The use of double skin facades: a system consisting of two shells Glass is placed in a way that allows the movement of air in the middle vacuum to be natural or mechanical With the help of fans (eg the swissre tower project). The width of the middle corridor ranges from 20 cm to 2 m. The double facade can secure the hardness of the building Reduce heat loss in winter. It may reduce energy consumption to 50% [14].
6. The use of corridor corridors (eg the Stadthur building in Düsseldorf) This interface is airflow on each floor separately where the vertical spacing is placed between the spaces to reduce From the
The corridor is so wide that it can be used as a service platform.

7. The use of adaptive interfaces: It uses two types of static systems and mobile interfaces. Mechanically responsive to surrounding environmental conditions to provide a comfortable internal environment for building users.

4. Construction Material.

The angle of rotation of the horizontal axis (330 °) of solar panel, it is moving from the extreme right to the far left to trace the motion of the sun from east to west. The angle of the vertical axis is (from 0 to 90 degrees) with any horizon moving from a level parallel to the horizon to a vertical level with the horizon to track the movement of the sun from north to south.

1-Using a Smart Generator: Materials that have the ability to receive the information caused by the catalysts External and internal environment and take appropriate response. These materials are either [15][Variable properties: substances that respond by changing one of their properties (chemical, thermal, Mechanical and magnetic) and are either variable color or streamlined] [16]. It contains energy-transforming materials: substances that convert energy from one form to another directly and indirectly [16], and be either (converted to light or thermal or photoelectric or light or Electric or magnetic) Types of smart materials; (Concrete, Carbon fiber concrete, Light concrete, Transparent concrete, Aerial concrete, porous concrete, Bricks Intelligent, Cement reduces pollution) [16][18].

2-Glass: Glass develops to become an advanced construction material and plays an important role in building, like (Color-born glass, Self-cleaning glass) [19][20]

3- Aerogel material: A highly transparent gel material, the majority of which is air-like and is glass-like. Of heat insulation materials are characterized by their light weight. It is not possible Flammable and used in windows and transparent walls [17].

4- Photonics: Materials that change their color properties by exposure to light and are used to paint facades. In order to interact with the movement of the sun and light dominated [7].

5- Aluminum: Used since long periods and used as a cortex (Lawrence London Center) or cladding of facades Theology in Cambridge).

6- Plastic: It is an organic mixture with the ability to form and be on the following types: (Poly vinyl chloride, PVC-U (Basquepool Stadium London 2012), Poly Tetra Fluoro Ethylene (roof of Jeddah airport for pilgrims).

7- Ceramic Material. The materials improve the internal environment by;(Control the inside of the mini, Control of natural lighting entering the building, Refreshing thermal comfort by, reducing heat loss and thermal gain, Humidity control, Control the natural ventilation of the building to provide good air for the interior spaces.

5. Local materials.

Traditional architecture is characterized by the use of materials available in the surrounding environment such as bricks and vaulting Wood, marble and tiles. These materials (bricks and stone) are of high thermal capacity. The ability to store heat for long hours during the day and then return it to
the outer spaces during Night (after the absence of energy source) and these materials are characterized by thickness and thickness of the wall in the architecture. The traditional between \((0, 36 - 0, 75)\) according to its location and has the advantage of having a large thermal delay time ranging from \((12 - 15)\) hours. These materials are environmentally friendly because they do not emit any toxic gases or effects negative for human health such as dyes and chemical decomposition of certain substances, as it is recyclable materials. And use again.

6. The use of traditional techniques and elements.

Traditional architecture was to meet human needs and adapt them to the environment. Surrounding it is an environmentally efficient architecture so many modern studies have emerged demanding a return to use Elements used by traditional architecture in adapting to the climate environment. These elements are:

1. Using the inner courtyard: a medium or lateral space open to the sky helps to provide lighting, Natural ventilation and the use of renewable energy.

2. The picker or pedicure: A channel that rises above the building and contains at its summit an opening corresponding to the direction of the wind to pull the air passing over the building (which is cooler than the internal air) and a push into the building.

3. The Badkir is an open air channel from the four sides and inside it, two vertical poles along the channel to pull the air in any direction from it. Technology can be used in the design of the building’s envelope.

This is evidenced by the existence of a set of technical, formal and technological techniques that have been used in the design of the building’s envelope to improve the internal environmental performance of the building as shown in Table 1.

![Figure 2. Impact Of Using Technology In The Design Of The Building’s Envelope(Researchers)](image)

| Techniques used | Elevation | Envelope of building |
|-----------------|-----------|----------------------|
| Formal technics | Open      | Constance flexibility | traditional Variety |
|                 |           | Type of Shapes       | flate slop curve    |
|                 |           | Unity size           |                     |
7. Practical study.

The paper in his practical study select a group of different university buildings as shown in Table 2, and the research examined the vocabulary presented by the theoretical framework, which was ascertained in Tables 3, 4.

| projects | Subhead |
|----------|---------|
| A | Tsinghua University (2006) | The building is designed as a “demonstration” of the possibility of reducing carbon dioxide emissions in China. The design incorporates negative and active strategies to control the external environment in order to improve internal environmental conditions, and the terraced gardens are designed from shaded panels that produce energy for the building. |
| B | American University in Cairo | Environmental treatments suitable for desert areas, such as directing the openings towards the northern wind and the use of internal pavements, gardens and water that contribute to air cooling, use a vegetative barrier to protect from dusty wind, use sandstone to construct 80% of external walls, Heat, energy-efficient materials, and all American university buildings generally have all the features of a smart building (automation, responsiveness, compatibility with the environment and sustainability). |
| C | King Abdullah University of Science and Technology (2009) | Project designers have inspired Bedouin tents to create a huge roof system that runs across the building blocks on the campus to prevent the sun from building facades and pedestrians. This helps to facilitate natural ventilation. And the design of wind towers that encourage air flow in the pedestrian paths, the wind towers used are solar wind tower also known as solar chimneys, the design of shading devices on the campus using Mashrabia, and the University employed many clean energy technologies, and the use of natural daylight with the presence of sensors Automatic light in addition to solar thermal arrays to heat local water. And the use of building materials that reduce any environmental effects |
| D | RMIT Design Hub University (2012) | The front of the building is envelope ed with disks that can rotate toward the sun. The building also has a number of ESD features and includes strategies for water, waste and recycling management. The exterior of the building includes automatic solar shading which reduces energy consumption and lighting is controlled by a BMS device to reduce the need for artificial lighting |

| Table 2. groups of university projects |
|   | Description |
|---|-------------|
| E | National Taiwan University (2013) The rectangular building has large openings with two or three floors. These openings reduce the size of the building block and connect it to nature. The facades of the building have balconies and concrete concrete that provide shadows for the building. The roof units took free formations resembling lotus blossoms touching at the edges. Natural, the large glass facades of the library were surrounded by water bodies that soften the heat radiation of the earth around it. |
| F | SDU Campus Kolding University (2014) The building envelope is equipped with a dynamic solar shade, which adapts to specific climatic conditions and user patterns and provides optimal daylight with sensors that continuously measure light and heat levels and are mechanically controlled. |
| G | Emerson college (2014) The exterior of the building has a traditional appearance and is equipped with screens, media links, audio, integrating lighting with the structure, making the upper deck of the building a flexible engine for outdoor displays, and transforming the wavy screens into a dynamic visual background. In response to local weather conditions, the automatic parachute system opens and closes horizontal panels of outdoor curtain walls installed on glass to reduce heat absorption while allowing increased daylight and visibility. And the use of emerging renewable energy systems. |
| H | University of Southern Denmark (SDU) (2015) The building was designed like a glass house envelope ed with a glass-paneled shade. The outer layer of the building is composed of two layers. The first is made of transparent glass panels, envelope ed by a second layer consisting of high-performance special white concrete slabs. These concrete panels consist of circular openings of seven different sizes, protect the building from direct radiation and allow natural and air lighting. And the use of low impact materials on the environment. |
| I | Energy Academy Europe University (2016) Sustainability has been the rule of design from the very first moment, a low-tech approach has been chosen to take advantage of the four natural elements to their fullest potential. The land is used for cooling or pre-cooling fresh air. The solar chimney at the top of the surface leads to normal airflow through the structure. The innovative 3-D roof also allows for maximum daylight and energy harvesting. |
| J | Brick Passive Designed University (2017) Use the porous brick screens in front of the glass façade to allow for an appropriate amount of natural light, and put in the front of the building details of the local environment, air outlet is like a chimney to allow the movement of air. The adoption of the designer on the quality of materials and the location of screens and openings and size was intended to filter and distribute light and air to Appropriate level. |
| K | Silpakorn University (2017) The building envelope is designed to allow clean air in built space and allows natural light to enter the interior spaces, thus reducing the energy consumption and filtering of the lighting entering the building and thus getting better performance of the lighting. In the process of construction, it was built on prefabricated parts and construction techniques to speed up the construction process. |
| L | Life Sciences Building for the University of Washington (2018) The building’s cover is composed of vertical glass solar fins from the outside and is expected to generate enough electricity to light more than 12,400 square feet of offices throughout the year. Other sustainable features include operable windows to cool natural ventilation, cooled beams and waves, a water reclamation system to irrigate the greenhouse, radioactive floors and solar panels on the roof [31]. |
Table 3. techniques using in design of Elavation of building(researchers)

| Techniques | Elavation | Projects |
|------------|-----------|----------|
| Types of shapes | Constance | A | B | C | D | E | F | G | H | I | J | K | L |
| | Flexibility | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | traditional | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| opens | Variety | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Unity | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Size | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | shape | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| formal | Traditional | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Technology | Smart | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Sustainability | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Traditional | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Structure | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| constructional | Traditional | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Table 4. techniques using in design of roof of building(researcher)

| Techniques | Roofs | Projects |
|------------|-------|----------|
| Types of shapes | flat | A | B | C | D | E | F | G | H | I | J | K | L |
| | slop | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | curve | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| opens | Varity | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Unity | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Size | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | shape | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| formal | Traditional | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Technology | Smart | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Sustainability | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Traditional | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Structure | One layer slab | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Two layer slab | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Materials | insulation | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Translation | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | photovolic | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
8. Discussion of results.

The results of applying the effect of the use of modern technologies in the envelopes of university buildings and for the projects elected in the practical study, which is shown in Table 5.

Table 5. the effect of the use of modern technologies in the envelopes of university (researcher)

| Effect of using techniques on envelopes | Projects |
|----------------------------------------|----------|
|                                        | A  | B  | C  | D  | E  | F  | G  | H  | I  | J  | K  | L  |
| Reduce convection                      | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Provide natural lighting               | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Control of ventilation                 | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Noise control                          |     |    |    |    |    |    |    | 1  |    |    |    |    |
| Reduce environmental pollution         | 1  | 1  |    |    |    | 1  |    |    |    |    |    |    |
| Energy saving                          | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |

The proportion of flexible forms used by elected projects 54.5% the proportion of traditional and fixed forms by 36% At the level of openings, the percentage of the unit in the form was 72% and the percentage of the unit in size was 36%. The percentage of diversity in the use of openings was 18% of the total projects selected, The use of smart technologies was 54.5%, while the use of sustainability techniques was 63.6%, while the traditional was 45.4% of the total projects. At the level of structural structure, the ratio of double skin use was 54.5%, Projects used variable building materials by 18.1%, while adaptive materials were 54.5% and energy converters 36.3%, while traditional materials were 18.1%. And Results on the level of roof: flat shape were used by 81.1%, while sloping and curved ceilings were 18.1%. The use of smart technologies was 27.3% or sustainable 63.6% and Photovoltaic cells used 27.3%.

9. Conclusions:

The new techniques used in the university buildings to improve the internal environment of these buildings through a set of mechanisms used by the designers in the building’s envelope (the façade, roofs) discussed by the paper. The results of the application showed the concentration of designers to employ formal techniques through the use of flexible forms and the adoption of the unit in the formation Openings. Technological techniques included the use of sustainable mechanisms in the design of facades and ceilings, such as the use of solar cells, moving vents and green elements in the roof of buildings. The technology influenced the internal environment of the university buildings through its effect on the heat transfer through the building envelope and by 91.6% while it provided natural lighting for the buildings where 100% of the total buildings were used and thus reduced the amount of energy and its availability. This confirms the trend of designers to achieve environmental sustainability. For their university buildings as an important and necessary direction in the design of university buildings through the techniques of the design of the facades and ceilings of these buildings. The envelope is the direct part that plays the main role in balancing and providing comfort in the internal environment of occupants of university buildings while designers adopted the use of construction techniques by separating the structural structure of The building side to find a corridor to move the air and the use of smart building materials and adapted to obtain the best environmental performance and improve the internal environment.
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