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Strategies of Employing the Principles of Sustainable Architecture in Modern Buildings

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ABSTRACT

The issue of environmental preservation and its sustainability has emerged as an important topic in all fields, including the field of architecture. New methods were not familiar before they had emerged in the design and implementation of the projects that reflect the growing interest in economic development issues in light of environmental protection. Technological development has led to the emergence of modern uses of energy and access to new sources to achieve sustainability. Hence, this study aims to clarify strategies for employing the principles of sustainable architecture in modern buildings in order to benefit from global experiences in future projects. The research adopts the descriptive analytical method. To achieve the aim of the research, several procedures were adopted, including four axes. In the first axis, the concept of sustainable architecture and related concepts are discussed. Evaluation of the reality of theoretical knowledge contained in a number of architectural literature and studies that dealt with the subject of sustainable architecture is made in the second axis. In the third axis, the theoretical framework is presented, which includes the main and secondary vocabulary that have been measured in the research, while the fourth axis constitutes the research's practical side, represented by the selection of practical study models, and final results. The conclusions of this research emphasize the adoption of modern strategies to reduce energy, such as the appropriate use of materials, effective orientation of the building, the use of certain sizes and types of openings, and making the building a part of the surrounding nature.

1. INTRODUCTION

The trend towards preserving the environment is one of the most important scientific and philosophical trends that are addressed by most studies at the present time. Sustainability is the most comprehensive axis of these trends. The global trend of sustainability in the field of architecture aims to achieve the lowest energy consumption by making use of natural and renewable resources and energies, such as solar and wind energy, without producing waste or negative effects.

Energy-saving technology in sustainable design is an emerging process, having the ability to integrate several new systems and materials, in order to create a sustainable and environmentally- friendly building.

Many architects have begun to explore and crystallize architectural designs that consume the least amount of energy, while protecting the environment. New buildings have been designed, implemented and operated with advanced methods and techniques that contribute to reducing environmental impact and providing a safe and comfortable urban environment. They aim, at the same time, to create harmony between the building and its surroundings, save energy, and preserve human health.

Hence, the importance of sustainable architecture, which aims to design buildings, lies in achieving comfort and safety for the user, while respecting the environment. This, in turn, is achieved by reducing the use of natural resources and energy, by referring to the foundations of negative design and to the selection of materials and different designs compatible with the environment, by using non-toxic and recyclable materials, requiring a less consumption of energy when produced [1].

1.1 Sustainable architecture

Several definitions of sustainable architecture have been received. Shalhoob states that it is architecture that relies mainly on natural materials, in construction and finish, and that is compatible with the surrounding environment [2].

Salem, for his part, defines it as the architecture that meets the architectural needs of man, in terms of beauty, functionality and durability, with its ability to generate or reducing its consumption of energy required for its operation [3].

Also, Al-Hayali states that sustainable architecture achieves the required amount of needs, with the least resources and by investing the available capabilities, without harming the environment [4].

Related to this concept are other concepts such as sustainable green architecture, sustainable smart architecture, sustainable environmental architecture, bioclimatic architecture, and the concept of Eco-Tech .... etc., which are going to be later explained.

1.2 Sustainable green architecture

Green architecture, or environmentally friendly buildings, is one of the most important modern trends in architectural thought, which calls for laying the foundations of a new architectural and environmental thought, in a more profound and understanding manner, and in relation to nature and ecosystems as a whole [5].

It has been defined by many thinkers and architects. Architect Ken Yang believes that sustainable green architecture must meet the needs of the present, without neglecting the right of future generations, to meet their needs [6].

Furthermore, architect William Reed demonstrates that green buildings are nothing, but buildings that are designed, implemented and managed in a manner that puts the environment in the first place.

Architect Stanley Abercrombie maintains that there is an influential relationship between the building and the land, while Susan Maxman believes that Sustainable Green Architecture is an architecture that fits its surroundings and is in some way compatible with people's livelihood and all the dynamics of society.

1.3 Sustainable smart architecture

The smart sustainable architecture is the architecture that relies on modern technologies to achieve the concept of sustainability [7].

Smart buildings have been defined by the Smart Building Institute as those buildings in which multiple systems are integrated with high efficiency, to manage resources and capabilities, in order to maximize technical performance, increase revenue, achieve flexibility and rationalize operating cost. These buildings provide a responsive and effective environment, in order to achieve better performance for the users of those buildings [8].

1.4 Sustainable natural architecture

The sustainability found in natural architecture is through abandoning modern technology that depends in its operation on energy, as it deliberates, as much as possible, to dispense with devices and technologies that require that energy. It depends on good design, appropriate building materials, and possible construction methods, to achieve the lowest cost and the best production, and the best environmental performance of the architecture [9].

2. PREVIOUS SCIENTIFIC KNOWLEDGE OF SUSTAINABLE ARCHITECTURE

An assessment of the reality of the theoretical knowledge contained in a number of architectural literature and studies in which the subject of sustainable architecture was addressed.

The study of Mendler and Odell considered that architecture cannot be isolated from nature. It discussed the concept of sustainable design and reached the most important basic rules of sustainable design, represented in preserving ecosystems, reducing the manifestations of environmental degradation, and making architecture a means to save and enrich the environment, not to destroy it [10].

Heartfield and Abley's study also considered sustainable architecture compatible with nature and achieving the goals of improving the environment. It showed that sustainable design is a summary of human effort that continued through many years of experience. The study also emphasized the need to separate between modern technologies, and what must be done in order to preserve the environment, and not destroy it.

Nature, sustainable architecture combines the traditional local considerations of the region and its ecological factors without neglecting the technology factor, as it came to formulating new foundations for future architecture that combines nature and environmental values with cultural, economic and social considerations, as well as technological solutions available through modern technologies [11].

Moreover, Edward's study confirmed the existence of overlap between the concepts of sustainable and green architecture, and it indicated that both concepts seek to achieve the same goal. At a time when sustainable architecture seeks to formulate pure architecture that respects the environment and guarantees the rights of future generations, green architecture proposals emphasize the connection of nature, aesthetic values, and economic aspects, through which sustainability is achieved [12].

John's study presented five aspects of providing human comfort inside buildings, represented in providing comfort in terms of indoor air quality, thermal comfort, acoustic comfort, visual comfort, as well as functional comfort [13].

Seen from a slightly different perspective, Kharoufa's study emphasized the importance of the issue of energy in sustainable architecture, and the need to deal with traditional formulas. The latter, although suffering today from many problems, they represent the true expression of the reality of society, and the nature of its members. The study conducted a comparative analysis between the principles of urban buildings (traditional and contemporary) from the point of view of sustainability [14].

Fajal's study dealt with the steps developed in order to reduce energy consumption, and achieve the required environmental balance, and compatibility [15].

While Salem's study clarified the concept and pillars of sustainable architecture, determining the levels of use of this concept, and distinguishing it according to the layers of each, according to its specialization, where the concept of sustainable architecture was divided into a group of layers, that were clarified in this study [3].

As for the Al-Dawji's study, it clarified the performance standards, for old and modern building materials, with an explanation of the methods used to achieve sustainable construction [16].

3. THEORETICAL FRAMEWORK FOR SUSTAINABLE ARCHITECTURE

After reviewing the most important studies and proposals that dealt with sustainable architecture, the theoretical framework of strategies for employing the principles of sustainable architecture in modern buildings will be determined, by sorting and classifying a set of variables related to the principles of sustainable architecture, for the purpose of applying them to the elected buildings.

These variables are related to two main aspects, the first aspect relates to the links of sustainable architecture, while the second aspect relates to the principles of sustainable architecture.

3.1 The first aspect/ The links of sustainable architecture

The architectural design is linked to the surrounding environment, and this link is direct or indirect. The direct link is in terms of the orientation of the building, and the exploitation of environmental data, such as sunlight, wind direction, humidity, etc...

As for the indirect link, it is in terms of the formal configuration, whether at the level of the elements, and it includes the values that are related to changing the features, the colors, transparency, lightness, and hardness. Or at the level of configuration which includes values that are related to traditional patterns, modern formal patterns, complex morphological patterns, geometric shapes, shapes that mimic nature [17].

The indirect link also includes the Implementation Mechanism in terms of the use of building systems, methods used in implementation, and strategies, where building systems are classified as self-constructed, labor-dependent, partially or fully machine-based. Self-construction system relies on the self-efforts of individuals to design and build their homes, while labor-based building systems use trained workers to build buildings using locally available materials, and partial replacement of machines rather than workers, such as excavation and equipment and basic structure construction in partially machine-based building systems , while complete equipment replacement is the workplace in machine-based building systems, and the human role is to direct and control [18].

As for the selection of building materials, the development of building materials is one of the most important trends that are taken into consideration to rationalize energy consumption, and there are two trends for rationalization. The first trend seeks to search for new applications for traditional materials in order to make the most of their untapped potential energy, while the second seeks to invent new materials that have better qualities and capabilities than traditional materials [19]. See Table 1.

3.2 The second aspect/ Principles of sustainable architecture

The most important principles of sustainable architecture can be summarized as: Good Design, Energy conservation, Energy Efficiency, Adaptation to the climate, Reducing the use of new resources, Materials having a benign impact on the environment, Indoor healthy environment, Respecting the site, Formation related to the surrounding environment and Respect for workers and users [7].

It has been clarified in Tables 1, 2 what can be deduced from the variables and their possible values.

Table 1. Possible values of the variables for the links of sustainable architecture / the first aspect [researcher]

	Sub-variables		Possible values
Direct	Building orientation		Good Not good
	Environmental data		Compatible Not compatible
Indirect	Formal configuration	At the element level	Change traits Change colors Transparency Lightness Hardness
		At the configuration level	Traditional shaped patterns Modern formal patterns Complex morphological patterns Geometric forms Shapes that mimic nature
	Implementation mechanism	Construction systems	Subjective Labor dependent Partial use of machines Full use of machines
		Methods	Traditional creation methods Intelligent systems and towers
		Strategies	Site implementation Global implementation
	Implementation materials	Traditional materials	Stones Bricks Clay Iron Concrete Other
		Modern materials	Developed new materials Complex new materials to use New material in simulation format New materials added to traditional materials Electronic materials for digital control Other

Table 2. Possible values of the variables related to the principles of sustainable architecture / the second aspect [researcher]

sub-variables			Possible values
Design principles	Good design	Relationships Efficiency	Spaces Walk paths Building formation Mechanical systems Construction technology
		Symbolic expression	Spiritual values and principles History of the region
		Design output	Ease of use Build quality Beauty of shape
Economic and Environmental Principles	Economic aspect	Technical saving	In energy: Natural; Use of technology In effort In time
		Financial saving	In maintenance costs In spaces In areas In construction materials
	Environ-mental aspect	Natural factors	Renewable energy: Solar energy; Wind; Waves; Waterfalls
		technical factors	Photovoltaic solar cells Innovative heat insulators Technical control systems
Operational Principles	Efficiency of building materials	Continuity	Permanence Durability Hardness Resistance to natural factors Resisting human disasters
		Reduce environmental impact	Waste reduction Reduce emissions and pollutants
		Normal behavior	Material recycling Material reuse

4. PRACTICAL STUDY

After defining the theoretical framework for the research, the procedures of the practical study will be determined, as follows:

4.1 Practical study methodology

The research took the descriptive analytical approach of the selected buildings to conduct the practical study.

4.2 Selection of study models

The global experience in the field of sustainable architecture has produced many models that have proven successful in different regions of the world, and these attempts included distinctive applications that were related to the subjective orientations of the designers on the one hand, and the principles of sustainable architecture on the other hand, so the research decided to select a group of modern buildings, which were implemented according to the principles of sustainable architecture, we will explain in the next paragraphs the group of selected buildings.

4.2.1 Energy-saving buildings in Tsinghua University

This building is one of the most prestigious engineering and construction university in China, an energy-saving model building to be the first pilot, base for energy-saving technology research.

Figure 1. Energy-saving buildings at Tsinghua University

The building displays about one hundred types of the latest products in architectural energy saving. Commenting on the work, Professor Jiang Yi, a professor at the university and a member of the Chinese Academy of Engineering, said it is the first building, that combines the functions of display, exemplary performance and experience.

This building is characterized by a great ability to save energy, as it weighs 10% of the weight of an ordinary building of the same size, thanks to its special design, and it consumes almost no energy for heating in winter, and the total energy consumed annually, including energy consumed in office management, lighting, etc., is equivalent to Only 30% of the normal building consumption (Figure 1).

4.2.2 Commercial Bank Building in Frankfurt, Germany

A 53-storey conical building, which is the headquarters of a commercial bank, with an air garden providing convenience and entertainment for customers and employees of the bank.

The headquarters of the Commercial Bank is the first skyscraper, to be defined as an “environmental skyscraper”, because the design of the building took advantage of nature, in lighting and ventilation systems, to reduce energy consumption (Figure 2).

Figure 2. The Commercial Bank building in Frankfurt, Germany

4.2.3 Office tower 30 St Mary Ax in London England 2004 by designer Norman Foster

It is a 40-storey office building, located in the heart of London, completed between 2001 - 2004. The building is shaped like a cylindrical conical, and the perimeter of the building is circular, the building expands in view Lateral, as it rises and tapers towards its top. This distinctive shape responds to the limitations of the site, as the building appears more slenderer.

From a technical point of view, the reflections are reduced by the curvature of the outer surface as a whole, so the transparency is suitable for the city atmosphere and the proportion of sunlight. From an environmental point of view, the amount of wind is reduced, because it is deflected on the ground compared to a straight tower of similar size, and this helps to maintain a normal comfort at street level, creating an equalization of pressure.

The exterior in the surroundings also helps in providing a unique system of natural ventilation. The glass is made in a triangular shape in order to allow for an interior floor space free of columns and a fully glazed facade, which, in turn, allows the building to be fully natural light.

The building is naturally ventilated, with the existence of an inner courtyard, through which natural air passes over the entire height of the building, and exits through openings in the facade. This, in turn, reduces energy consumed by the air conditioners in the tower to the half. There are gaps on each floor, that serve as a natural ventilation system for the entire building. The tower is covered with a double layer of glass, where the air is trapped in the two layers of glass, and the interior space of the offices is isolated.

The building uses several methods to save energy, as the tower consumes half the energy of any similar tower. The skylights draw warm air from the building in the summer, and they heat it in the winter through a system, the heating solar Passively. These skylights also allow sunlight to pass into the building, making working inside the tower more enjoyable as well as lowering lighting costs. The interesting point about this building is not its beautiful architectural form, but its high energy efficiency.

The building’s innovative and creative design achieves an expected saving in energy consumption of up to (50%) of the total energy consumed by a similar traditional building. Furthermore, the building’s richness in energy-saving benefits is evident in the use of natural lighting and ventilation, as the facade of the building consists of two layers of glass, the outer of which is double glazing, and the two layers surround a cavity ventilated by computer-guided curtains.

The weather sensor system on the outside of the building monitors the temperature, wind speed and the level of sunlight, closing the blinds and opening the window panels when needed. As for the shape of the building, it is designed to increase the use of natural daylight, reduce the need for artificial lighting, and allow for natural outside views even for those who are deep inside the building (Figure 3).

Figure 3. An office tower of 30 St Mary Ax in London

4.2.4 Auckland Art Fair New Zealand 2011 by FJMT+ Archimedia

This building was developed from concepts associated with organic natural forms and heritage buildings. The new building is distinguished by a series of canopy-like trees that define and cover the entry and exhibition space.

The light forms of light on the stone walls and balconies create an unforgettable image of nature, closely related to the trees, and the curtains built of natural timber are folded in organic geometric shapes, based on thin columns. These symbolic shapes give a unique image to the exhibition inspired by the landscape of the site, as the ceiling curtains draw on the natural forms, the scale, proportions, and details of the gallery's architecture, and is characterized by openness and transparency by allowing the view from all sides, inside and outside the gallery to the green landscape of the park near the gallery.

The sequence of entry to the gallery is from the street courtyard, under a canopy and then through the foyer to via a wide staircase in a large, light-filled and displaying central space accommodating all visitors. The exhibition revolves around the exhibition in a series of clear interconnected rings, Figure 4.

Figure 4. An office tower of 30 St Mary Ax in London

4.2.5 Conde Nast Tower Building in Times Square, New York by Fox and Foll Architects

It is one of the early examples that applied green sustainable architecture principles, in a large 48-story urban building, employing nearly every imaginable energy-saving technology.

The building has used a special quality of glass that allows natural sunlight to enter and keeps heat and UV rays outside the building, reducing internal heat loss during winter.

There are also two cells that operate on natural gas fuels to supply the building with all the amount of electricity it needs at night.

As for the hot water exhaust, it was produced by the fuel cells used to help heat the building and provide it with hot water. While cooling and air conditioning systems are placed on the roof, the end result is that the building consumes less energy than any similar conventional building (Figure 5).

Figure 5. Conde nast tower building in New York

4.2.6 The cocoon-tower-tange building in Japan 2008 by Tange & Associates Architects

It is located in a privileged area of Tokyo and it contains 3 different schools. The innovative and sophisticated shape embodies the concept of growth and transformation, inspired by students' lives in the facade of the building.

It is designed as a vertical complex, with the concept that the school architecture should be more than just classrooms. It should also include multi-purpose corridors and a courtyard, like a school, where relationships between students can form naturally, with three-storey high halls designed for students to rest.

The building plan is simple, three rectangular classrooms revolving around an inner core at an angle of 120 degrees, from the first floor to the fiftieth floor, and three directions (east, southwest, and northwest). The cocooning of the building brings a new visual dynamism, with the school facility and the main hall open to the public.

The oval shape of the building allows viewing from all sides, increasing the land area from the top and bottom respectively. The green spaces are planted in the basement, and the view is unobstructed to the sky on the upper floors. This design puts nature within the reach of everyone, and at the same time it is a tool for powerful educational, unmatched in design, function and vision.

The white aluminum and dark blue outer glass form a curved structure, which is intersected by a network of white diagonal lines, earning it the name "cocoon tower" (Figure 6).

Figure 6. The cocoon-tower-tange building in Japan

4.2.7 Freedom Tower on the former site of the World Trade Center building in New York

It is one of the most famous sustainable buildings, and it was designed by the architects (Skidmore, Owings & Merrill and Studio Daniel Libeskind), who incorporated the advantages of environmental design throughout the building huge. The main tower, which is 1,776 feet high, contains solar panels in addition to a wind power plant (working on wind). The turbines are expected to generate about (1 megawatt) of energy, which is enough to feed the tower by 20% of its expected energy needs.

Figure 7. Freedom tower on the former site of the world trade center building in New York

Like other green buildings, the tower relies on natural lighting and ventilation, in addition to energy-efficient lighting systems and elements (Figure 7).

4.3 Analysis of the results of the practical study

After the variables were coded, and the practical study was conducted on the selected buildings, shown in Table 3, the following results were reached:

1. The elected buildings are characterized by energy saving as well as a superior ability to save energy, thanks to their special design, and this is achieved by 100% in the elected buildings.
2. The energy consumed annually, including energy consumed in lighting and others, is less than the consumption of buildings designed by traditional methods, and this is achieved by 100% in the elected buildings.
3. Taking advantage of nature in heating systems when designing the elected buildings, so as to reduce energy consumption. The use of passive solar energy for heating was 100% in the elected buildings.
4. Taking advantage of nature in lighting systems when designing the elected buildings, do as to reduce energy consumption. The elected buildings had 100% natural lighting.
5. Taking advantage of nature in ventilation systems when designing the elected buildings, so as to reduce energy consumption The elected buildings enjoy natural ventilation 100%.
6. Most of the elected buildings are characterized by the presence of visual communication and the blurring of the boundaries between the interior and the exterior, so that all spaces become visually connected with each other and with the outside world.
7. The properties of the materials used in the implementation of the selected buildings have been improved. In some buildings, glass has multiple optical properties and it transforms its qualities according to the needs of the building, having the ability to change its qualities in terms of formative and compositional aspects.
8. The use of glass facades in some of the elected buildings that are characterized by their ability to transform to meet the climatic conditions. A special quality of glass was used, allowing the entry of natural sunlight and keeping heat and ultraviolet rays outside the building, so as to reduce the loss of internal heat during winter.
9. Implementation of the elected buildings, using automated building equipment with traditional methods and local materials in construction.
10. Using innovative thermal insulation methods for walls and ceilings, which is one of the negative energy-saving techniques in some elected buildings.
11. The use of double glazing makes the external surface of the building able to cope with changing climatic conditions, which is one of the modern technologies to save energy in some selected buildings.
12. In some of the selected buildings, electricity generation techniques were employed in addition to the use of wind energy to generate energy.
13. The selected buildings were designed so that the relationship between the building and the surrounding nature is interactive. The visual communication between the building and the surrounding nature was found to be 100%.
14. The shapes adopted by the architects in the elected projects ranged from geometric shapes to shapes inspired by nature.

Table 3. The results of the practical study

Code	Principles of sustainable architecture	Check the principles in the elected buildings						
		1	2	3	4	5	6	7
X1	Energy saving	*	*	*	*	*	*	*
X2	Energy saving technology	*	*	*	*	*	*	*
X3	Passive solar heating	*	*	*	*	*	*	*
X4	Natural lighting	*	*	*	*	*	*	*
X5	Natural ventilation	*	*	*	*	*	*	*
X6	Plants and landscaping		*		*		*	*
X7	Special glass in the facade			*		*	*	*
X8	Local materials in construction	*	*	*	*	*	*	*
X9	Passive energy saving techniques	*		*		*	*	*
X10	Modern technologies to save energy			*		*	*	*
X11	Electricity generation technologies					*	*	*
X12	Wind power for power generation							*
X13	The building's relationship with the surrounding nature interactively	*	*	*	*	*	*	*
X14	Geometric shape of the building	*	*	*	*	*	*	*
X15	Nature-inspired shape of the building			*	*		*	*

5. CONCLUSIONS

5.1 Conclusions on sustainable architecture

1. The application of the concepts of sustainability when designing and implementing buildings is of the highest importance, which makes such concepts the first consideration for the designer to adopt in the architectural design stages and at all levels of the building. This is in addition to the structural and formative details, in preparation for laying the foundations of sound thinking for the implementation phase in all its details. This can contribute to producing a building whose details and composition have the vocabulary of sustainability, whether it is cost, energy, or building materials.
2. Sustainable architecture strategies, methods and mechanisms contain dimensions and vocabulary of an environmental and social nature, perhaps through the concept of a simulation between the community (user) and the environment (location). That is, there are requirements for this user (community) realized by those methods and mechanisms for the vocabulary of sustainability at all levels and their linkages. Without conflict with the location (environment), to create harmony and harmony between the community and its environment.
3. Sustainable design is a concept that can be achieved through the use of the vocabulary of sustainability, at all design levels, whether it be the idea, the whole form, or the details, in a way that ensures the production of methods and mechanisms, giving a modern and contemporary design and taking into consideration the reduction of energy consumption and reliance on natural energies. Technology should also be used as a mechanism for positive dealing with the environment and its resources.

4. The integration between building and environment is one of the most important things to achieve for the sustainability of architecture, as the integrative relationship between building with all its details and environment is one of the foundations of sustainable design, which must be understood through harmonious reciprocal relationships at all levels to achieve the sustainable and effective link between the building and environment.

5.2 Final conclusions

1. Relying on more than one strategy to address and reduce energy consumption is within a clear mechanism through a more efficient design that takes into account energy economy at all levels and stages, whether the design, implementation or works stages. The design phase should be focused on being the primary and efficient phase in dealing with energy, which, in turn, will be achieved through the selection of construction systems and the details of these systems from all to detail.

2. The building's formal processors are of clear importance in dealing with solar energy in a positive and efficient manner, in order to achieve the concept of "Biomedical Architecture", which, in the end, gives sustainable environmental comfort. This concept is derived from a good integration between the efficient guidance of the building and the optimum use of the spaces, sizes, and types of openings, as well as the interplay between the inside and the outside of the building.

3. The use of buildings with natural and organic forms has a definite role in the production of a sustainable design that is more relevant to the ecological and natural systems as a whole, and through the use of the sources of formal inspiration from the vital fields of nature. This has been shaped by the process of abstraction and representation of structures and structures.

4. Naturally-compatible formal configurations have a clear presence in relying on sustainable environmental harmony, achieved through the idea of visual communication between inside and outside. This, in turn, was shaped by good design strategies related to indoor and outdoor environments and the handling of details at all levels.

5. The introduction of computer technologies in the design and formation of buildings has greatly helped in producing various form alternatives, whether complex or complex, which made them look different from traditional designs. This, in turn, contributed to the creation of forms that meet the requirements of sustainability through the concept of formal flexibility and optimal performance, increasing the reciprocal response between biofualism and the environment.

6. The concept of alternative energy played a prominent role in forming the idea of preserving energy and its efficiency, which was achieved through developing the way of dealing with non-traditional energy sources and searching for ways of reducing consumption through dealing with new resources, including solar energy, photovoltaic cells, etc. This has given a new focus to the search for design, operation and maintenance techniques.

7. The internal and external environment of the building are improved in order to achieve the concept of sustainable environmental integration through the creation of new and contemporary methods to deal with the external design, including trees and plants, which paves the way for the concept of green buildings of an environmental nature, through the link between the building and the earth. It provides the foundation for integrated eco-architectural thinking that is more consonant with nature and its sources.

8. The energy consumption inside the building is reduced through the optimum use of isolation and control, and through adopting smart and technological systems to reduce the physical loss and thermal gain, in a way that guarantees the preservation of energy. This opens the way to the concept of sustainable smart architecture, which relies on technological development in dealing with energy and modern design methods and providing a significant ability to control sustainable environmental performance.

9. Environmental characteristics are relied on in order to achieve the concept of sustainable architecture through the minimum of environmental pollution, providing safe and comfortable climatic conditions inside the sustainable building. This is in addition to reaching a biomedical balance based on attention to nature and its resources and adapting the buildings to the climate and its elements, and thus giving an idea of better dealing with climatic and natural resources, so as to achieve the building's biometer sustainability.

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