Employing Sustainable Environmental Technologies in Raising the Efficiency of the Building Ecosystem

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Abstract. The last few years witnessed a growing interest in preserving the ecology of the earth which lead to sustainability and hence the improvements which enable getting the most out of environmental resources and nature's gifts. This research will explore the relationship between the informational capabilities and the capabilities of controlling the environment and reducing energy consumption, this will distinguish smart buildings which their design and work of their internal structure depend on environmentally sustainable technologies this will raise the efficiency of the ecosystem of these buildings by providing an integrated, interactive environment. The Arab environment has faced many challenges as a result of the unregulated exploitation and hence the great waste of resources, therefore the research problem was identified (The reading and analysis for the identification of sustainable and environmental technologies and their impact on raising the efficiency of the building's ecosystem). The research aimed to find the function and method of work of modern environmental technologies and the extent of their application in raising the efficiency of the ecosystem and to know the most important treatments that have been used. The research adopted the descriptive-analytical method after extracting the theoretical framework which contains a set of concepts and indicators based on which the selected examples were measured and that led to the conclusions.

1. Introduction
In recent decades, the world began to pay special attention to issues of environmental protection and sustainable development to reduce the environmental impacts resulting from various human activities, reduce waste and pollutants, and preserve the natural resource base for future generations. As a result, of those dangers to which the environment is exposed, the need to return to the concept of sustainability, including sustainable architecture emphasizing the importance of the integration and coherence of the ecological and technological aspects in achieving them. The international community began to realize the need for a combination Of political and scientific efforts to solve environmental problems, the concept of sustainable development became a cognitive model for development in the world, and it began to replace the "Development without Destruction" program presented by the United Nations Environment Program (UNEP) in the seventies and the concept of "ecological development" ( Eco development) which was implemented in the 1980s, This global interest in the environment issue emerged in confirming the methodology of human development, according to the World Human Development Report ( UNDP) published in (1995), on the element of sustainability, by emphasizing that future generations will not be harmed, whether due to the depletion of natural resources and the pollution of the environment [1].
It is the development that works on the optimal utilization of available resources in development projects without the need to exhaust other resources, which is a condition for the continuity of these projects. The general concept of sustainable development is to achieve a balance between development in its various environmental, urban, social, and economic aspects, where the role of the administration appears as an active and supportive element to achieve urban goals the social, economic, and work to follow them up. [2]

It was also known as the advancement of the standard of living for the Arab community in a civilized manner that guarantees the well-being of people, the most important condition for sustainable development is the integration of the environment and the economy in the decision-making process. [3]

2. Sustainable architecture

The concept of sustainability has been in circulation for quite some time now. It appeared clearly in the various developmental trends during the second half of the twentieth century and began to impose itself with strength and new formulas at the beginning of the twenty-first century and sustainability in itself includes an integrated and balanced analysis of the environment at its different and multiple levels. [4] Sustainable architecture is one that has an integral dimension with the environment, as it considers many priorities such as: preserving the environment, reducing pollution, rationalizing energy consumption, providing a healthy environment that is comfortable for people, and developing new methods of construction. Through many principles and strategies [5]. Sustainable architecture represents the architecture that reflects the life and spatial requirement and interact with building from the intellectual and physical side, the sustainable architecture characterized by renewal prosperity and communication between human and spiritual meanings of the place through the use of technological capabilities. [6]

2.1 The objectives for sustainable architecture

- Elimination of the negative exploitation of the environment and natural resources and the preservation of the environment from pollutants, harmful wastes and various human activities
- Excessive waste of energy, and this is one of the most prominent environmental-economic problems for buildings
- The need to reduce costs, especially operating and maintenance costs
- Reducing the phenomenon of buildings that are called metaphorically speaking "sick buildings" that arise from relying more on industrial air-conditioning devices while neglecting natural ventilation

The additional costs resulting from the waste of building materials during the implementation of the project. [7]. (Figure 1)

![Figure 1](attachment:picabue.png)  
**Figure 1.** Understanding sustainability principles by classification Picabue[4].

3. Sustainable design

Sustainable design aims to provide all the needs of buildings locally, as it focuses on design that is in line with nature in addition to forming societies that live a better lifestyle that depend on the principles of green design in providing all what cities need in terms of water, electricity, food and energy. [8] The most important meanings of sustainable design are: its keeps, continues, establishes prolongs survival, assists continuity, endures, stands, carries, assures, supports, reinforces, nourishes,
strengthens, provides the causes of life from here came the use of this term to give us meaning
Prolonging survival and supporting the environment and means of subsistence on the planet. [9]
The priorities of this sustainability are found in the early ages of architecture in terms of the use of
local materials and the resources available on the ground and smart environmental treatments that have
contributed greatly to creating an environmental compatibility between the building and the surrounding
environment, and among those treatments in our traditional architecture is the use of internal courtyards,
wind catcher and shanashel , and taking care of the shapes and sizes of windows and openings. In
addition to the exploitation and employment of plant elements in environmental conditioning. The
principles achieved by our previous architecture are early images and applications of the concept of
sustainable green architecture.

Therefore, specialists must adopt the ideas, lessons from traditional architecture from an
environmental-economic perspective, and then try to apply and employ them in modern buildings in a
modern design style in line with the needs of the age and scientific and technological progress in building
systems and materials. [10] Sustainable design is in harmony with environmental surrounding with
inserting the sustainable concepts, durability, longevity and building materials appropriate with the
sense of place. Sustainability is a concept which includes, several axis including: energy, environment
Ecosystem and community through gradual and overlapping relations with each other, all accede under
the banner of sustainability. The principles of sustainable design: sustainable design seeks to realize the environmental impact of the design. Assessment of the site, energy, materials, energy efficient design, construction methods and knowledge of the negative aspects, and try to achieve it through the use of sustainable materials and less toxic equipment and supplements (use materials& tools recyclable at the site Integration of environment design and support operations: the cooperation of all disciplines must be involved in the design process with including sustainable buildings in the initial stages to make a design decisions, sustainable design can be defined: the process of designing buildings in a manner that respects the environment, taking into account the reduction of energy and resource consumption, as well as maximizing harmony with nature. [12] and there is another definition of sustainable design is a new design trend that appeared under the name (green architecture). It focuses on the importance of the relationship between buildings and nature and seeks integration and compatibility with the environment [13].

4. Recent Studies
The research reviewed the following studies to build a comprehensive theoretical framework on the
employing sustainable environmental technology in rising the Efficiency of the Building Ecosystem.

4.1. Fakoush, Aqbat Fakoush Ahmad, Rama,(2012) “A study of employing technical development for
the direction of high-technology architecture within the framework of sustainable design
The study dealt with a statement of how to use new methods that allow providing solutions to the
problems of energy waste and the inefficiency of the building from benefiting from the environment
data that is being exhausted by all sectors of life in a random manner, especially the construction sector,
which consumes half of the total energy consumption alone and poses a danger with its many waste,
which must be emphasized. Studies and research on the most important applications of technology
architecture that allow saving energy, increasing the life of the building and making it suitable for future
generations through its advanced technological means [14].
From the aforementioned it was found that sustainability is achieved through energy conservation
strategies represented by controlling daylight rays, choosing finishing materials, designing natural
lighting, choosing the appropriate ventilation system as well as investing material, energy and heat by
recycling, operating and maintaining them, and using materials and autonomous systems.

4.2. Othman Ayman A E-2007”” Sustainable Architecture: an Investigation into the architect’s Social
Responsibility””
The study focuses on achieving sustainable architecture through achieving the social responsibility of the architect through the idea of preserving the needs of future generations, the concept of sustainable architecture, the principle of sustainable design, highlighting the responsibility of the architect towards sustainable architecture, applying the ideas and techniques of sustainable architecture as it aims to reduce the negative effects of buildings in The life cycle of the building, as well as the balance between considerations of the built environment, social and cultural requirements and determinants. As for sustainable design: the art of design that is integrated with the environment, society, and the economy, focusing on the principle of interaction between man and the natural world, and based on the principles: preservation of natural, requirements - urban planning, design for human comfort.

4.3. Berge Bjorn (2009) “The Ecology Of Building Material” Oxford: Elsevier, Amsterdam, Netherlands.

This book explains the role and potential of building materials from a technical perspective that is in line with holistic thinking while also providing humans with an acceptable standard of living. The study of the ecology of building materials attempts to present the potential of existing materials as well as evaluate new materials. It also evaluates several alternatives to partially abandoned materials, in particular plant products, often with traditional methods of processing. In the same context, it sheds light on the following aspects:

- The methods used to produce each component of the building. And how the production process and its capabilities.
- Elementary materials: conditions of material resources, their nature, distribution, and the possibility of recycling.
- Energy: the energy consumed when producing and transporting materials, and their durability.
- Pollution. Contamination during production, use, removal, and demolition.

The main objective of this book is to empower the various actors in the construction industry to enforce Environmental requirements, and do it more carefully to ensure an environmentally responsible building [15].

4.4. Battle & McCarthy, 2002 “Sustainable ecosystem and the built environment “

These propositions have addressed the need for the built environment to integrate several issues in order to achieve sustainability goals by moving towards comprehensive and integrated solutions to establish a sustainable future. As for the built environment, the proposals indicated the overlapping of the following issues: recyclable materials, low embodied energy materials, speed of conditioning, lack of defects, low construction waste, environmental quality, renewable energies, efficient systems and control, low-energy equipment, maintenance management. The study has focused on the concept of sustainable architecture in terms of choosing the materials and energy needed to transfer these materials, the process of constructing buildings, and their performance within the various climatic factors and the processes that go into for the sake of sustaining buildings during their life cycle, the integration of technology with renewable energies and the flexibility of spaces to provide opportunities for creating coherent and responsive architectural products. With the local factors of the the site, natural resources, cultural heritage, and climate specific to the area [16].

4.5. Gerno Minke, 2010 “Building With Earth Design And Technology Of A Sustainable Architecture “

This book shows the importance of achieving the principle of harmony between buildings and the environment and the importance of making use of all material resources that would improve building specifications and make them closer to humanity and more in line with them. The most important concepts that the book dealt with: The land was always the most productive of building materials. Especially in arid and dry climatic regions, and there is an increasing demand for building materials, such as bricks, concrete, steel, and industrial construction around the world, the source also focused on the importance of improving the internal climate of buildings to reach human comfort [18].
Through the foregoing, it was found that the proposals focused on the built environment and how to achieve sustainability goals, depending on identifying the inputs represented by the selection of materials and energy during the life cycle of the building and their integration to achieve sustainability, as well as interest in technology with renewable energies to create architectural products that are linked with local factors, climatic and available natural resources. The goal of sustainable design: moving design in general, and architectural design in particular, to a clearly new health state and not just introducing improvements, in the sense of producing a new generation of architectural product by the new design system that has the status of sustainability, after diagnosing and understanding the features, principles and elements of sustainable design.

5. Principles and techniques of sustainable environment
It is a set of principles created by the need for change and creativity, and these principles seek to provide an architectural product that achieves the link between the effects of rapid scientific progress, taking advantage of the successes of technology to produce a pattern of construction that achieves a great presence of these principles, investing a large number of characteristics of building materials and their qualities to achieve the greatest degree of flexibility and transparency. The building resembles a sophisticated god that seeks to serve the first goal of the design process, which is the function [19].

The use of these principles has been easily met by different designers who belong to cultural backgrounds. Based on these principles, products are designed in an environmentally friendly manner by taking into account the use of sustainable materials, which can achieve functional performance in harmony with the diverse surrounding environment and different geographical areas. This approach has been adopted. On the latest developments in technical successes, which made them accepted by people, and by reviewing a number of studies by specialists and those interested in sustainability, a clearer picture of sustainability and its principles can be formed [20].

The following are the most important principles and techniques of sustainable design [21]:

5.1. Optimum energy use
The energy use index is considered an effective and important indicator and a major factor in achieving sustainability by how to deal with the energy needed by the building in all its stages and reduce the use of non-renewable energy. The optimal use of energy is one of the goals of sustainable design, energy economics on the one hand and the development of alternatives on the other leads to reduce its consumption. And deal with it positively, for example: applying the idea of benefiting from solar energy from ceilings by means of panels and cells while adopting the principle of multilayers in the outer shell, such as the use of double glass insulated with an air vacuum

5.2. Improvement of the natural environment improving the quality of the indoor environment
The use of smart materials that, in addition to their construction function, have characteristics such as insulation, air purification and emission prevention. Controlling the internal temperature by managing the transfer of heat load by gain or loss through the optimal selection of building components and materials with tight control over the outer envelope of the building, with an emphasis on achieving ventilation and natural lighting throughout the year, which reduces the need for mechanical and electrical systems. And its horizontal and vertical levels to secure natural lighting.

5.3. Selection and use of materials that is recyclable, environmentally sound and sustainable
Building materials
Building materials are the most important component of sustainable buildings throughout their life cycle, so choosing materials worse than natural ones such as wood and stone require a certain amount of energy when manufactured and thus affect reducing the environmental impact, and non-natural materials such as; Metals and plastics are scarce and unavailable and should yield benefits such as prolonging their life and reducing maintenance. Composite materials, from a sustainability standpoint, are best avoided due to the inability to separate them efficiently after use [22].
Most of the important components of sustainable construction depend mainly on the efficiency of the material; the proper selection of the building material in a way that leads to enhancing its full life is obtained by choosing the materials with the least impact on the environment with the use of recyclable product, treating the local environment materials after mixing them with modern techniques in creative harmony, as in a church in Italy Pader Pio Pilgrimage where stone was used and in the Jean Marie Tjibaou Center using wood [23].

5.3.1. the most important materials that have been processed to become more sustainable:
- Green Concrete: it has a high capacity in the field of construction and a long life of more than 50 years, and the prefabricated manufacture of this concrete leads to reducing the occurrence of cracks in it. And replacing cement with ash from coal plants (Fly ash) reduces their problems, and results in a more homogeneous mixture [24].
- Iron-reinforced cement (Ferro cement): It is also called (Iron – Concrete) it has contain Of iron with cement mortar, in which multiple layers of wires are in the form of a square pit (Grid) less than half an inch, Ferrous (reinforced) cement differs from reinforced concrete, as it is another technique and another type of construction, which is commonly used
- Metals: Minerals such as (iron, aluminum, etc.) have a very high embodied energy compared to concrete, and with this, recycled iron (i.e. recycled) is used as it consumes (Kg / 10mj), i.e. (31%) From natural iron, Iron is used in the construction of large buildings that require high endurance, and it becomes the best option despite its high price, but iron forms a heat-conducting tower, as it is conductive unless isolated from both sides, it heats up quickly, which is calculated for the possibility of recycling it again, which makes it qualified as an option for sustainability if available.

These technologies (methods and treatments) seek to achieve more sustainability of the building and the exploitation of natural energy, as it has launched new measures in the environmental direction by taking advantage of environmental data and the ability to adapt to it and use it to make the building more suitable for the climate in different environments, and has become adapted to the prevailing conditions through its formation Architectural, structural and technical, where the target is the human being with his needs, comfort, and upgrading of his life standard.

6. Eco system
The ecosystem consists of a number of components, each of which has its own structure and its internal interactions with itself and with others like it who share the spatial space, and the ecosystem can be divided into [25].

6.1. The natural environment:
It is the biosphere or the space in which life is or could be life, and the environment is divided into the natural environment which is (climate factors, the nature of the land, soil, natural resources, natural materials, natural plants, etc. [25].

6.2. Artificial environment: It is the building that man-made, built and established in the biosphere space, such as various buildings, industrial centers, cities, water sewage and energy and other means on which man relies on transforming the elements of the biosphere into goods and services that satisfy the needs of society which will be studied within the scope of research and the effect of using sustainable technologies for rising the Efficiency of the Building Ecosystem [26].

7. Methodology of research
Based on what has been reached from a set of vocabulary extracted from scientific studies on the principles of environmentally sustainable architecture, these vocabulary will be applied and measured on a group of selected projects in the manner of the descriptive analytical approach in extrapolating to a group of samples through an analysis and description of these projects and knowing the extent of
application of these vocabulary to raise the efficiency of the system to reach the results and objectivity of the study, the axes of analysis were as shown in Table 1.

| Table 1. Sustainable environmental technologies analyses. |
|---------------------------------------------------------|
| First indicators                                      | Second indicators                                    | Third indicators                                   |
| Primary                                                |                                                        |                                                      |
| Methods for achieving energy efficiency and renewable energy | Treating the internal environment                    | The structural material                            |
| Direction                                              | Reducing emissions and pollutants                     | recyclable materials                                |
| Secondary                                              |                                                        |                                                      |
| Double envelope and double glazing                     | Indoor temperature control                            | conventional materials, constructs and on local materials |
| modern technologies connected to computers             | Achieve ventilation and natural lighting              | smart materials                                     |

8. Project theoretical analysis:
This paragraph included the analysis of a number of examples, which is characterized by being buildings achieving standards of sustainability with the use of environmental technologies for the purpose of benefiting from the research findings and recommendations were specific examples of Arabic, which is approaching climate of Iraq.

8.1. The American University in Cairo
The Environmental designing concept: is a new American university community in the fifth assembly one of the major projects that have interacted with the thought of sustainability design and the principles of green architecture in Egypt, the project is located in New Cairo, and the project adopted many of the ideas and techniques and construction materials that are adapted environmentally with the nature region Figure 2’[27].

8.1.1. Methods for achieving energy efficiency and renewable energy:
• Direction: The openings of squares, courtyards, and entrances between buildings on the university campus were directed in the direction of the northwest winds towards the university garden, as the gardens help to condense the cool air that collects during the night and ventilates the entire campus during the day. ‘Figure 3’
• Double envelope and double glazing: Part of the campus has been transformed into a functioning natural ecosystem, It is in accordance with the energy management systems, which reduce the costs of using air conditioning and heating devices by at least 50%. About 80% of the outer walls of the campus were made of sandstone, which helps to make the rooms cool during the day and warm during the night. The project shows the importance of the role of universities in developing new sustainable technology.’ Figure 4’
• modern technologies connected computers: to secure the necessary thermal energy and lighting: technologies connected to computers that are fed by solar time programs to secure the necessary thermal energy and lighting inside the building, and these systems also ensure that lights are turned off by an automatic network when needed. ‘Figure 5’

8.1.2 Treating the internal environment (reducing the environmental impact):
• Reducing emissions and pollutants and reducing waste: using number of sustainability techniques to obtain the best indoor climate by using smart materials that, in addition to their construction function, have characteristics such as insulation, air purification and emission prevention, such as the use of concrete and steel in the local environment.

• Indoor temperature control: Controlling the internal temperature by managing the transfer of the heat load by gain or loss through the optimal selection of building components and materials with tight control over the outer envelope of the building. Also, the gardens help to condense the cool air that collects during the night and ventilates the entire campus during the day.

• Achieve ventilation and natural lighting which reduces the need for mechanical and electrical systems: Achieving ventilation and natural lighting throughout the year, which reduces the need for mechanical and electrical systems. The way courtyards intersecting building layers and their horizontal and vertical levels to secure natural lighting the benefit of these courtyards is to provide natural daylight as well as natural ventilation in most of the interior spaces of the buildings. ‘Figure 6’. The presence of a quantity of thermal cells helps to save energy and reduce dependence on mechanical and electrical energy for cooling.

8.1.3. The structural material:
• Use of recyclable materials: Reuse the building components, equipment and furniture as possible. Minimizing waste and debris when re-using or recycling floor finishing requires low levels of organic compounds and high levels of recycled content (gypsum board, carpet pieces, ceiling tiles, paint materials, woodwork).

• Developing conventional solutions Depending on conventional materials and constructs and on local materials: Using local materials are used from the stones available in the region that are suitable for the harsh climate and treat these stones with materials that help them reflect the heat instead of absorbing it in addition to the presence of reflectors. Misleading that limits the concentration of heat on campus and provides late levels for building occupants throughout the public ‘Figure 7’.

• Depending on smart materials : Treating local environmental materials after mixing them and modernizing techniques in creative harmony, who uses concrete, wood, or according to locally available material as it achieves an environmental and architectural reflection for the development of our architecture. ‘Figure 8’.

Figure 2. Site plan [28].

Figure 3. Squares, courtyards and entrances.

Figure 4. The university's Double walls are sandstone.
8.2. A Student centre on a university campus in Beirut

The concept of environmental design This centre is considered (an entertainment building within a university campus completed in February 2008 and located in Beirut / Lebanon, and it is considered a model for design that respects the environment and is responsive to it, including meeting rooms, a cafeteria and study spaces.

The project adopted many ideas, technologies and modern construction materials, and was chosen among the top 10 green projects for the year 2009

The buildings of the centre are organized around a network of "streets", which are radial to the sea, and together form a series of courtyards, continuous paths, and there is a difference in heights of the facades of the campus, especially the waterfront. To keep seeing the landscape, Hostler's new design combines architecture and landscape to create a diverse, rich and ecologically diverse set of spaces where people come together throughout the day and in the evening [29].

8.2.1. Methods for achieving energy efficiency and renewable energy:

• Direction: The east and west orientation of the building shapes helps to shade the outer courtyard, reducing the amount of southern exposure. This approach works to create breezes at night and sea breezes during the day to cool the outdoor spaces. ‘Figure 9’

• Double envelope and double glazing The designer replaced the double envelope and double glazing with green spaces on the rooftops allow a more physical and visual integration with the university campus that reduce the amount of exposure to sunlight. With creating a design that provides shading and ventilation for outdoor spaces. Figure 10’

• Modern technologies connected computers to secure the necessary thermal energy and lighting: the main building façades face east and west, the design of the buildings was close to each other, and a large degree of self-shading was achieved in addition to shading the adjacent spaces. Smart elevation achieve solar control windows that provide comfortable indoor conditions without any heating and cooling during the different seasons.
8.2.2. Treating the internal environment (reducing the environmental impact):

- Reducing emissions and pollutants and reducing waste: By emphasizing the air movement, the design includes radiative cooling in selected areas of the buildings in which the most concentrations occur, such as the gymnasium, swimming pool, theatre, squash courts and a café.

- Indoor temperature control: From a study of the hostelrets plan, it is clear that each building is programmed to follow the prevailing north-south winds and local air flow conditions. The cycle of land breezes during the day and marine breezes at night provides constant air movement to cool and ventilate the interior spaces. External walls facing north and south allow air to circulate around the buildings. Multiple openings in the east and west walls facilitate ventilation in the summer months. Sixty percent of spaces are naturally ventilated. The Hostler Centre uses the excess steam produced by the American University of Beirut to provide additional heating. ‘Figure 11’

- Achieving ventilation and natural lighting which reduces the need for mechanical and electrical systems: Achieving ventilation and natural lighting: As a result of changing patterns in sun shading and air movement, social activities such as the swimming pool, gym, and café enjoy strong daylight and natural ventilation. 76 percent of the centre’s interior enjoys daylight, and large areas of glass give a beautiful view and the mountains outside. ‘Figure 12’

8.2.3. The structural material

- Use of recyclable materials: Using products that contain recyclable materials, using local materials, this achieves sustainability and at the same time reduces import costs. Building systems make use of local building technologies and materials, including on-site concrete, masonry, wood floors, and interior plaster.

- Developing conventional solutions Depending on conventional materials and constructs and on local materials: The traditional Lebanese wall building technique is a single hollow brick wall covered with plaster. The U value for this system is 2.5 W / m2K, and to achieve the required U-value of 7 W / m2K, a double stone and wall concrete cavity was used. As for the roof, it is an economical construction using pre-tensioned columns. The outer walls are sandstone, and the inner surfaces are covered in plaster. There is a variety of shading and ventilation systems at strategic locations throughout the project. ‘Figure 13’

- Depending on smart materials: the project relied on linking traditional techniques with modern technologies that aim to increase social interaction, and all strategies also focus on reducing energy and water consumption requirement. ‘Figure 14’

Figure 9. Orienting Buildings [30].
8.3. Abraj Al Bahar in Abu Dhabi 2012
The design idea of the project consists of two twin towers closer to the cocoon and covered with a membrane similar to a crystal crystal and is in the form of a beehive, meaning each crystal is in a hexagonal shape intertwined with each other to envelop 98% of the front of the two towers, the idea is based on a pattern derived and inspired by the Arab Islamic heritage in architecture. The eastern houses, where the two towers are covered with a layer of dynamic crystal membrane.[31] ‘Figure 14’.

8.3.1. Methods for achieving energy efficiency and renewable energy:

- Direction: The two towers are located on the eastern side of Abu Dhabi city, and the space between the two towers is occupied by an artificial lake and protected by palm trees. Each of the towers rises by 140 meters to form 25 floors.
- Double envelope and double glazing: The crystal cover has the ability to save 20% of the energy consumed for cooling the towers, as well as to block approximately 98% of the total rays falling on the two towers. Figure 15’

- modern technologies connected computers to secure the necessary thermal energy and lighting: Using technologies connected to computers that work on opening and closing dynamically with the movement of the sun at sunrise and sunset and changing weather conditions to provide the appropriate amount of light for offices and block the bulk of the sun and its rays. ‘Figure 16’

8.3.2. Treating the internal environment (reducing the environmental impact):

Figure 10. Gardens and green areas.
Figure 11. Day light.
Figure 12. Air movement.
Figure 13. Exterior wall.
Figure 14. Integrated between traditional and modern technologies.
• Reducing emissions and pollutants and reducing waste: The use of the most important modern technology, which is the dynamic solar cover style inspired by the Islamic heritage, with the use of the building management system to control the windows that can be opened and closed mechanically in line with the angle of sunlight falling on the two towers as part of the process of cooling the air and the floor of the building.

• Indoor temperature control: Controlling the temperature through the presence of artificial lakes and protected from palm trees that act as environmental technological references, as this green spot confined between the two towers acts as a natural coolant to the air trapped between the two towers and provides it with moist air. ‘Figure 17’

• Achieve ventilation and natural lighting which reduces the need for mechanical and electrical systems: Exploiting the natural light of the sun in the lighting of the two tower offices without lighting any light bulbs except in time of need. These technologies help in cutting and assembling each mechanical cell separately and collecting them together on site.

8.3.3. The structural material:

• Use of recyclable materials: Reuse the building components, equipment and furniture as possible.

• Developing conventional solutions Depending on conventional materials and constructs and on local materials: A vertical bar was left along the two towers without covering them with these parachutes or bumpers in order to reduce costs and to exploit the western square of the two towers that the sun does not reach during the day.

• Depending on smart materials: The project is characterized by the environmental considerations from the technological side in terms of providing artificial energy and exploiting natural energy sources in providing what the building needs in terms of electricity, lighting, ventilation.

Figure 15. The view.

Figure 16. Dynamic crystal membrane. Figure 17. Technical strategies
9. The result

After application to the selected examples of the practical study, the results showed the employment of each of the primary and secondary indicators in the design of the building and the results were as in Table 2 and Table 3.

Table 2. practical analysis

| Primary indicator                       | Project(1) Secondary indicator | 1 weak.2 medium.3 strong |
|-----------------------------------------|--------------------------------|-------------------------|
| a-Methods for achieving energy efficiency and renewable energy |                               | 1 weak.2 medium.3 strong |
| Project(1)                              |                               | 1 weak.2 medium.3 strong |
| Direction Double envelope and double glazing |                               | 1 weak.2 medium.3 strong |
| modern technologies to secure the necessary thermal energy and lighting |                               | 1 weak.2 medium.3 strong |

| Project(1)                              |                               | 1 weak.2 medium.3 strong |
|-----------------------------------------|--------------------------------|-------------------------|
| Achieve ventilation and natural lighting which reduces the need for mechanical and electrical systems. |                               | 1 weak.2 medium.3 strong |

| Project(1)                              |                               | 1 weak.2 medium.3 strong |
|-----------------------------------------|--------------------------------|-------------------------|
| Use of recyclable materials Developing conventional solutions Depending on conventional |                               | 1 weak.2 medium.3 strong |

Figure 18. Interior view [32].
| Primary indicator | Secondary indicator | 1 weak.2 medium.3 strong |
|-------------------|----------------------|------------------------|
| a-Methods for achieving energy efficiency and renewable energy | Project(2) | 1 2 3 |
| Direction | Double envelope and double glazing | 1 2 3 |
| | modern technologies to secure the necessary thermal energy and lighting | 1 2 3 |
| b-Treating the internal environment (reducing the environmental impact) | Reducing emissions and pollutants and reducing waste | 1 2 3 |
| | Indoor temperature control | 1 2 3 |
| | Achieve ventilation and natural lighting which reduces the need for mechanical and electrical systems. | 1 2 3 |
| c-The structural material | Use of recyclable materials | 1 2 3 |
| | Developing conventional solutions | 1 2 3 |
| | Depending on conventional materials and constructs and on local materials | 1 2 3 |
| | Depending on smart materials like the green cement fortified with iron and Nano materials | 1 2 3 |
| | Sustainable materials with technologies | 1 2 3 |
| Project(3) | Secondary indicator | 1 weak, 2 medium, 3 strong |
|------------|---------------------|---------------------------|
| a-Methods for achieving energy efficiency and renewable energy | | 1 2 3 |
| Double envelope and double glazing | • |
| modern technologies to secure the necessary thermal energy and lighting | • |

| Project(3) | Secondary indicator | 1 weak, 2 medium, 3 strong |
|------------|---------------------|---------------------------|
| b- Treating the internal environment (reducing the environmental impact) | | 1 2 3 |
| Reducing emissions and pollutants and reducing waste | • |
| Indoor temperature control | • |
| Achieve ventilation and natural lighting which reduces the need for mechanical and electrical systems. | • |

| Project(3) | Secondary indicator | 1 weak, 2 medium, 3 strong |
|------------|---------------------|---------------------------|
| c- The structural material | | 1 2 3 |
| Use of recyclable materials | • |
| Developing conventional solutions and constructs and on local materials | • |
| Depending on smart materials like the green cement fortified with iron and Nano materials | • |
| Sustainable materials with smart technologies | • |
Project 1, 2 achieved a percentage in employing traditional materials in smart ways that reflect the ability of technology in design as well as implementation and performance, especially our traditional materials within our local environment with sustainable characteristics as in the examples using materials according to the country’s environment such as limestone, sandstone, wood material, (Achieving the third indicator of sustainable environmental technologies –the structural material-by reusing local materials with technological means in construction also the using double glazing to save energy with the added benefit of reducing noise. A closed air gap

Table 3 The following charts illustrate the measurement of practical results as varying percentages in the projects' use of sustainable technologies and raising the efficiency of the ecosystem

| Chart 1 | Shows the percentage of achievement of each of the projects for (Methods for achieving energy efficiency and renewable energy) |
|---------|---------------------------------------------------------------------------------------------------------------|
| Methods for achieving energy efficiency and renewable energy |
| Percentage |
| project3 | project2 | project1 |
| direction | double envelope & double glazing | modern technology connected to computer |
| Axis Title |

| Chart 2 | Shows the percentage of Treating the internal environment (reducing the environmental impact) |
|---------|------------------------------------------------------------------------------------------------|
| treating the internal environment |
| Percentage |
| project3 | project2 | project1 |
| Reducing emissions and pollutants | Indoor temperature control | Achieve ventilation and natural lighting |

| Chart 3 | Shows the percentage of how the effect for The structural material on rising efficiency of eco system |
|---------|------------------------------------------------------------------------------------------------|
| the structural material |
| Percentage |
| project3 | project2 | project1 |
| Use of recyclable materials | Depending on conventional materials and constructs and on local materials | Smart materials |
between the two parts acts as an additional layer of insulation. This added thermal resistance reduces the amount of heat that escapes the heat in the winter and keeps the building at a more comfortable temperature. Double glazing has a reverse effect in summer, by preventing unwanted heat from entering the building.

- Projects 1, 2 and 3 have achieved a very large proportion of the intermarriage between technologies and sustainability standards, specifically with regard to the environmental aspect, raising the efficiency of the ecosystem and creating a comfortable environment for the building occupants. (Achieving the second indicator of sustainable environmental technologies by treating the internal environment (reducing the environmental impact like Using technologies connected to computers that work on opening and closing dynamically with the movement of the sun at sunrise and sunset and changing weather conditions to provide the appropriate amount of light for offices and block the bulk of the sun and its rays in project no. 3)

- Project 3 achieved a high percentage in the use of high-performance materials (smart materials), which had a great impact in reducing energy costs and preserving resources from depletion, as these materials provide, in the long run, strong support for a building because it is sustainable in nature and can be developed from traditional materials. (Achieving the first indicator of sustainable environmental technologies by using important modern technology, which is the dynamic solar cover style inspired by the Islamic heritage)

- Project 3, it relied heavily on modern technologies through the external dynamic envelope of the building, which works on environmental control of the solar energy entering the building, the presence of artificial lakes and a protected palm tree for environmental treatments. (Achieving the first and second indicator of sustainable environmental technologies, the building management system to control the windows that can be opened and closed mechanically in line with the angle of sunlight falling on the two towers as part of the process of cooling the air and the floor of the building).

10. Conclusion

Through what has been presented from Arab projects that use modern sustainable technologies and by using the descriptive and analytical approach and after the conceptual framework and the design of the research were drawn that included a set of applied measures, it was found:

- Modern technology has become with its innovative solutions to create an effective ecosystem by utilizing natural and organic resources and energies and employing them with contemporary technologies to raise the efficiency of the building's ecosystem.

- Technology has contributed to popularizing production while achieving buildings that respond to environmental conditions through the use of modern technologies connected to computers and special programs to secure energy and to increase their efficiency and suitability.

- Adopting smart technologies with special sensors on the surfaces to neutralize harsh environmental conditions and control solar radiation.

- The pursuit of a suitable environmental life characterized by low costs and a life free from industrial pollution and global warming by using modern technologies for building materials.

- Adopting smart materials such as green concrete and nanomaterials, where these materials work in addition to their structural function with characteristics such as insulation and air purification, preventing emissions, controlling the internal temperature, managing the transmission of heat load gain or loss through the optimal selection of building components and materials with tight control over the outer shell of the building. To achieve ventilation and natural lighting throughout the year, which reduces the need for mechanical and electrical systems. The method of courtyards interspersing the building layers and its horizontal and vertical levels can be considered to secure natural lighting.
11. Recommendations

- Spreading environmental awareness in our world by investing in environmental design techniques and striving to reduce the use of fuel energy and rely more on natural energies and sustainable technologies.
- Encouraging the establishment of renewable energy research centers that would develop technologies and their applicability.
- The design includes a comprehensive plan to control energy consumption throughout the project phases, along with proposing systems for follow-up and monitoring of that consumption after the building is operational.

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