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An inclusive vision towards a sustainable interior design for human well-being and health

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Abstract:

The environment is the shelter and the main teacher for man, since his birth he lived in the natural environment, however, he began to search for shelter or housing. With the development and progress of the world, the increasing number of people, and the emergence of buildings, this led to a decrease in human contact with nature. And man began to suffer from physical and psychological illnesses. The environment began to suffer from pollution as a result of human misuse of the environment. Therefore, intellectual trends in design appeared aiming at preserving human health, reducing harmful effects on the environment, and increasing human interaction with nature, that is sustainable design. The application of sustainability in interiors was used in ancient times in the Pharaonic and Islamic civilization, such as the use of the inner courtyard, green spaces even before the concept of sustainability appeared. But recent trends in sustainability deepened beyond form. These studies deepened into the composition of natural systems to innovate sustainable solutions in design, that would preserve the environment, the human being, and strengthen the relationship between them. Rather, it went beyond that to make the design a renewable and restorative feature for the environment. There are many terms related to sustainability, such as biophilic, bio-design, biomimetic, green... etc., So a study that defines these multiple terms, differentiates between them, defines their strategies, and presents their interiors inside and outside Egypt is needed. Hence, the aim of the research is to differentiate between these multiple terms, define their strategies, and present their interiors to find out their advantages. The research should develop an inclusive vision towards sustainable interior designs in Egypt That are in line with Egypt Vision 2030 and provide human well-being and health.

Keywords:

Ecological sustainability, Biophilia (Biophilic design) , Biomimetic design, Restorative Environmental design, Regenerative design.

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Introduction:

Since the inception of creation, man tried to adapt to the environment he lives in. Natural environment, its climate and raw materials ...etc. are the main inspiration for the design process. So, design is formed as a result of environmental, climatic, economic, social, cultural and religious factors. The relationship between the natural environment and design began to establish a distinguish science, which is sustainability or sustainable design.

Sustainable design is considered one of the recent trends in the field of design practice and education. It is a type of design activity that depends primarily on the principle of achieving compatibility and balance between

different design requirements and environmental requirements while solving design problems. This does not mean only achieving compatibility between the product and its environmental environment but working to preserve human health and well-being also.

Sustainable design trends varies so a study that differentiate between them to reach an inclusive vision for the strategies of the sustainable trend in interior design that are in line with Egypt Vision 2030 with the aim of preserving the environment, improving human well-being and preserving their health is need.

Statement of the Problem

The research problem is limited to the

following question:

1. What are the sustainable environmental directions? And what are their strategies?
2. What are the local and global interiors that apply sustainability thinking?
3. What is the possibility of benefiting from sustainable environmental systems in the field of interior design, both globally and locally?

Hypotheses:

From the previous question, the researcher assumes the following:

1. Inspiration from natural elements and environmental objects in interior design enhances the link between the user and his natural environment, and preserves the environment and the user together.
2. The link between interior design and the natural environment to create a distinctive character for sustainable environmental interior design that takes into account the functional, aesthetic and cultural aspects of the user, will preserve the environmental resources for future generations.
3. The good application of comprehensive sustainable design should line with Egypt Vision 2030 would conserve environmental resources and preserve human health and well-being.

Objectives:

This study aims to:

1. Definition of the concept of sustainable design, its branches and its applications in interior design locally and globally.
2. Emphasize the possibility of benefiting from sustainable environmental systems in the field of interior design and furniture in order to achieve the health and well-being of the user.
3. Separation of multiple concepts of sustainable design such as environmental, green, biomimicry, bionic and biophilic design then clarify the strategy of each type and its applications in interiors globally and locally.

Significance:

The importance of research lies in the following points: -

- 1- The importance of research stems from the importance of the natural environment, which is the main shelter for humans.

2-The importance of research stems from the importance of the human being, who is the focus of this universe, and the need to preserve his health and well-being.

3- To emphasize caring for the natural environment, its elements, its materials, its organisms.... etc. and to confirm that the design is affected by them to serve and serve human needs.

4- Emphasis on imparting a distinctive environmental character to the interior design in a way that achieves interconnection between the internal and external architecture and coexists with the nature of the place in order to develop the aesthetic sense and general taste in society and increase the user's bonding with his environment.

5- Applying modern environmental studies to interior design and furniture design to keep pace with global technological and design advancements.

Delimitations:

1. According to the place limits: Defined in the study of the sustainable interiors such as environmental, green, biomimicry, bionic and biophilic design locally and globally.
2. According to time limits: The middle of the twentieth century and up to the present time.

Methodology of research

1. Descriptive and analytical approach through describing samples of sustainable interiors such as environmental, green, biomimicry, bionic and biophilic design locally and globally.
2. The critical curriculum through critique and analysis of models of sustainable interiors.

Background:

First: sustainable environmental directions.

1. Sustainability
- 2.The first approach concerned with reducing negative impacts on the environment (ecological and green)
3. The second approach concerned with reducing the negative impacts on human health (bio-design)
- 4-The third approach concerned with promoting positive impacts on the environment and human health (biophilic)

5 The fourth approach combines the three previous. It concerns reducing the negative impacts on the environment and human and promoting the positive effects on human health and the environment.

Second: An inclusive Sustainable interior design that is harmonious with nature and in line with the state's sustainable development plan (Egypt Vision 2030).

First: sustainable environmental directions.

Nature was the source of meditation, knowledge, and healing. Though, civilization and development have paneled man from nature. That led in the second half of the twentieth century to the emergence of many environmental problems represented in water and air pollution, global warming, the consumption of non-renewable resources, the damage of nature, and human health. Therefore, a need for a design study in architecture and interior design that works on

the harmony of architecture and interior design with the environment is a must. the concept of harmony of architecture with nature is not new, as architectural philosophy over the ages and its reflection on interior design represents the relationship between nature, humanity, and the built environment.

1. Sustainability

The sustainable design concept appeared in the world in recent decades, taking multiple names and orientations that overlapped with each other. The researcher divided them into four directions shown in diagram no. (1). The research aims to describe these directions according to the foundations and mechanisms of sustainable design and defining their impact on humans and the environment, leading to an inclusive interior design in harmony with nature. (Huda, Yasmin 2017) These four directions will be explained and clarified.

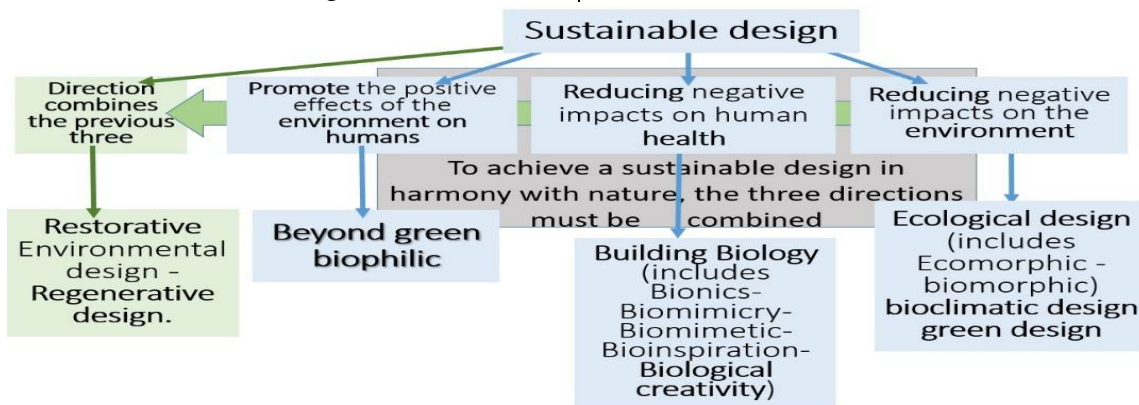


Diagram No. (1) shows the four directions of sustainable design to reach an inclusive interior design in harmony with nature. Source: the researcher

2-The first approach concerned with reducing negative impacts on the environment (ecological and green)

The Leadership in Energy and Environmental Design (LEED) organization adopted the design of architectural models with low negative impacts on the environment, as it dealt with two main directions, namely, ecological design and green design. The research will explain them.

a. Ecological environmental design

Ecology studies the relationship and interaction between living and non-living organisms (such as climate, soil), as well as the study of resource management, and the study of the **harmful effects of modern civilization on the environment**, with the aim of preventing or minimizing them.(Anwar

2018) **The ecosystem** represents a functional embodiment of the relationship between the elements and components of society and its environment, which is formed through the interaction between living and non-living organisms in one organic unit, while **the ecological domain** includes geographical location. The architectural spaces that take into account the ecological aspect of the environment must take into account three aspects: the social, economic and environmental aspect that represents the main pillars of sustainability, (Ala 2107) as shown in diagram no. (2) for the Ecological Scope.



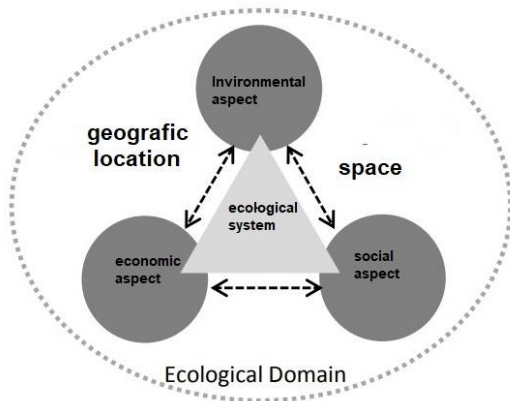


Diagram no. (2) shows ecological domain, Source; (Ala 2107)

Although The application of ecosystem thinking and compatibility with the environment has existed from ancient times as in **Islamic architecture** that applied compatibility with the environment, taking into account the social and economic aspect and reducing the negative impacts on the environment. However, the concept of simulating ecosystems has recently spread to take three distinct directions which are; -

- **A simulation method based on modern technological applications and new materials**, which contributes to creating an internal space that controls the thermal performance of the building. The GHERKIN building in London is one of the most famous buildings to implement this strategy. The oval shape of the building enhances the flow of winds around the building and on each floor a set of openings allow the flow of natural air This is in addition to the exploitation of natural sunlight in lighting. The systematic control of the climate has led to a reduction in energy consumption by 50%, and relying on natural methods of ventilation reduces the consumption of heating and cooling

methods, thus reducing its negative effects on the environment.



Photo No. (1) of the GHERKIN building, which is the most instantly recognizable tower in London for its height and is characterized by the application of ecological design compatible with the environment., Source; <https://www.thegherkinlondon.com/>

- **The Shape simulation method** for ecosystems includes two directions: - **Ecomorphic**, which is based on the principle of "formation following the flow". The building is designed as a natural ecological representation that tracks the flow of the movement of energy entering and leaving the organism or the organic system. the photos No. (2) illustrate an organic house designed by Pavie includes a formal simulation of the ecosystem where it is charged with hydrogen energy. This is Ecomorphic stimuli by simulating the energy flow in living things.



Photo No. (2) of an organic house designed by Pavie that includes an Ecomorphic simulation in the charging system with hydrogen energy., Source; <https://en.paperblog.com/in-the-50s-the-future-looked-like-this-242614/>

The second direction is the "biomorphic" system, which generates the spatial shape of the architectural structure from the inside and outside by analyzing the geometric or organic formation resulting from the ecological factors that link the organism and its housing environment. The photo No. (3) show an



Photo No. (3) shows an analysis of bird nest structures that can be used to form glass domes in buildings, and the design here depends on the intersection of two components to form the shape, Source; (Asterios, 2016).

- **The method of handling and coordinating spaces from the perspective of ecological simulation,** this is achieved by coordinating the overlap between the spaces internally and externally to achieve maximum benefit from the surrounding natural environmental conditions such as the sun

analysis of bird nest structures that can be used to form glass domes in buildings. Ecomorphic and Biomorphic systems produce complex geometric shapes that may be smooth and streamlined, and may be refracted and geometric (Asterios, 2016).

and natural ventilation. The inner courtyard is the best examples used in the past and present to enhance ventilation and natural lighting, especially if it is used with movable ceilings. To control the sun rays and air, summer, winter, day or night, as shown in the figure no. (1).

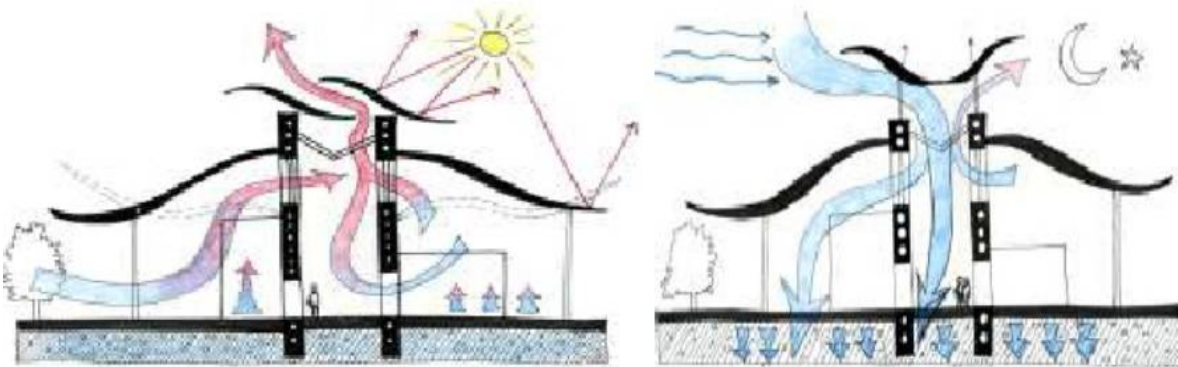


Figure No. (1) illustrate the use of the inner courtyard, the best examples used in the past and present to enhance ventilation and natural lighting, especially if it is used with movable ceilings to control sunlight and air in summer, winter, day or night. Source (Ola samir <https://www.academia.edu/1549228/>)

Ecological architecture can be defined as an architectural movement that aims to create buildings that are environmentally friendly and energy-efficient from natural sources and manage them efficiently. It encourages the use of renewable energies in buildings and also encourages "the use of building materials" that least negative impact occurs on the natural sources of water, land and air, whether in their manufacture or use. (Ehab 2006)

Ecological Building is defined as a concept associated with sustainable design that aims at (creating an appropriate environment,

achieving energy efficiency in buildings by simulating natural systems in their energy recycling, and developing natural resource management. This results in the application of the use of negative and positive solar energy, good use of materials and their disposal, whereby the outputs of the building become inputs for other processes in the environment and thus neither pollution nor burden on the environment occurs, and the damage to the so-called "free natural resources" is minimized for water, land, and air. (Ola Samir <https://www.academia.edu/1549254/>).

As for ecological design, it is a form of design that

works to reduce the destructive effects of the environment by integrating it with living processes. As the relationship between living organisms in the environment complete each other. In this context the idea of “from cradle to cradle” and “simulating nature” emerged, so the building is seen as a system that uses resources and then re-uses waste by recycling it. Sustainable design is related to the concept of ecology as a system that has a mutual influence between the elements, which looks at the design and its relationship to the environment as a system, and looks at the design and its relationship to the human as a system called the ecology of the building. Bioclimatic design falls under the concept of ecological design also. (Huda 2017)

b. The bioclimatic design

A design that draws inspiration from nature, and focuses on taking advantage of the climatic characteristics of nature and the elements of the biosphere, taking into account all economic and construction conditions, building management, providing comfort, human health and the appropriate physical conditions inside the building. It has a strategy that works to reduce the negative impact on the environment. It achieves comfort and health for building users by making the most of the surrounding climatic conditions, taking

into account a set of key issues that include: energy saving, user health and comfort, and achieving sustainability (Ihab 2006). **Bio-climatic** design is a design approach that takes advantage of the climate through a good application of design elements and building technology to control heat transfer and this control promotes energy savings and ensures comfort for building users. **Bio-climatic design** is specifically related to an understanding of local climatic features and the application of saving energy and reducing the negative impacts on the environment (Alexandra A. M. (2007).

Photo no. (4) and for " **The Mill Owners' Building** " for Le Corbusier, in Ahmedabad, India, is one of the architectural models that applied the idea of climate design. The designer focused on the importance of shading through the solar barriers that he created to ward off the harsh sun of India, while at the same time maintaining visual transparency and also allowing air circulation well through natural ventilation, and some may see his interest in the environmental aspect in the design of the building came in a predominant manner on the aesthetic side .



Photo No. (4) of " The Mill Owners' Building " for Le Corbusier, in which the distribution of interior designs is described as a play of volumes in light and shade, and this building is a good example to reduce energy consumption and maintain natural ventilation, Source: <https://www.archdaily.com/464142/ad-classics-mill-owners-association-building-le-corbusier>

There are six main variables that control the user's thermal comfort, which are air temperature, ambient temperature, humidity, air velocity, clothing, and metabolic rate as a function of activity level. Studies have indicated that the "thermal comfort zone" for humans is constant, regardless of gender, age and place of residence, skin color, body shape and weight. Bio-climatic design is concerned with studying the flow of energy paths around the building and the local climate resulting from the sun, wind, rain, vegetation, temperature and humidity in the air and the ground. The energy paths around the building are the paths which through it heat can be gained or lost between the internal climate and the exterior of the building. The methods of heat transfer and loss are conduction, convection, evaporation and radiation (Donald 2017), as shown in figure number (2).

c. Green design

Green buildings are the buildings that are designed, implemented and managed in a manner that takes into account the environment by reducing the negative effects of the building on the environment, as well as reducing the use of harmful materials to the environment and people, reducing construction, operating and energy costs, thus creating a comfortable internal and external environment for the building, improving the health of users and increasing production rates. This preserves the right of the current generation without neglecting the right of future generations to resources. It can also be seen as a call to deal with the environment in a better way the description of architecture as green is inspired by plants, which as their age increases, increases in length and strength (Dalal 2012). The green design principle deals with the building as a living being that has a life cycle that must be characterized by balance that begins in the pre-construction phase, followed by the construction phase, and then ends with the disposal phase of the building (Ehab 2006). The specifications of green buildings can be specified in diagram No. (3) Green buildings reduce energy consumption by 50%, and reduce harmful emissions by 35%. As for the interior and architectural design elements that achieve an environmentally friendly green

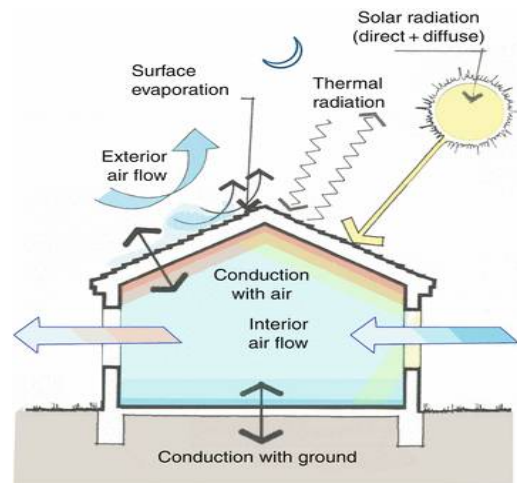


Figure No. (2) shows the energy paths around the building are the paths which through it heat can be gained or lost between the internal climate and the exterior of the building. The methods of heat transfer and loss are conduction, convection, evaporation and radiation. Source: (Donald 2017)

building, they can be summarized as shown table No. (1)

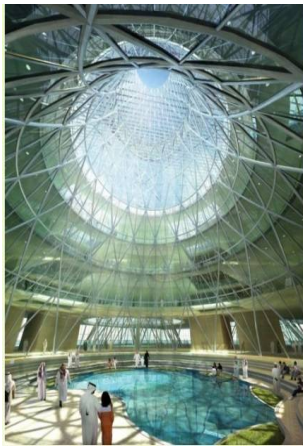
Green building specifications

- Energy efficiency.
- Environmental design of the building.
- Resource efficiency and waste management.
- The vitality of the buildings and the human comfort.
- Water use efficiency.

Architectural and interior design elements of environmentally friendly green buildings:	
1	Building materials in (walls, partitions and roofs)
2	Natural ventilation
3	Water
4	Use appropriate lighting inside the building
5	Optimal use of color
6	Appropriate acoustic design
7	Use of environmentally friendly materials

Diagram no. (3) shows Green building specifications, source (Elizabeth 2018) Table No. (1) Architectural and interior design elements of environmentally friendly green buildings (Dalal 2012).

The interior and architectural elements that achieve an environmentally friendly green building include, firstly, building materials used in walls, ceilings, floors and partitions. Heritage buildings preferred natural materials in the environment, but recently materials and construction methods used to contribute to making the building environmentally friendly. Some of them can be illustrated in Photo No. (5).



The use of ceiling openings and curtain walls to provide natural lighting and save energy



The use of metal structures and trusses, which have large prominence, enable shading



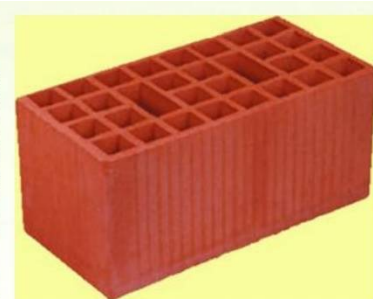
The use of the eco-block system that works on thermal insulation and is similar to double walls



The use of holes in the walls as mashrabiyas



The use of a dome with a projection to provide shade and reduce the heat inside



Use of hollow bricks

Photo No. (5) of some modern construction methods and building materials that reduce energy consumption inside green buildings

The following figure No. (3) shows the effect of daily sun movement on natural lighting on the distribution of the interior spaces of the building for best use of natural lighting and

thus reduce the burden and cost in energy consumption for an environmentally friendly green building

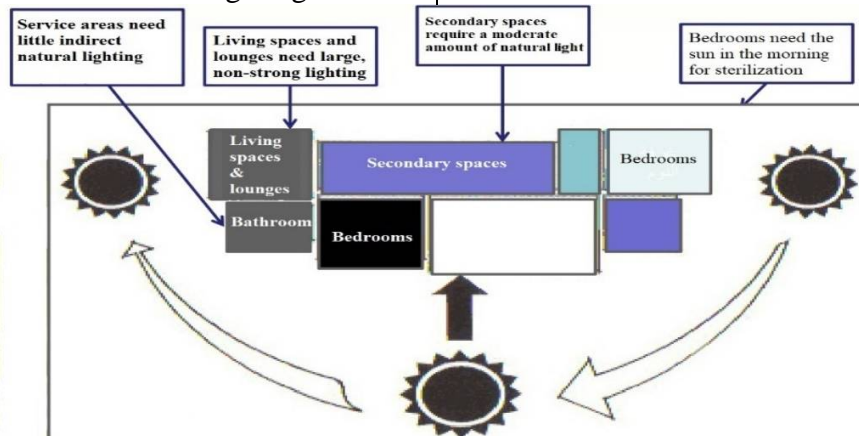


Figure No. (3) shows the effect of daily sun movement on natural lighting on the distribution of the building's interior spaces

The University of Arizona building in U.S.A. is one of the green buildings that have applied good use of the sun's rays through the use of roof openings (sky light) that enter natural lighting. And the use of certain type of glass works to enter the required heat and reduce

the thermal loads on the internal air-conditioners. The building is one of the examples of Green architecture, that use curtain walls to use natural lighting and reduce electricity consumption. The use of sun blocks to protect the building from the sun.



Photo No. (6) illustrates the use of wood as a natural non-toxic and non-radioactive material for chemicals in the occasional wooden blinds used to shade the facades of the University of Arizona building, Source: architizer.com/projects/university-of-arizona

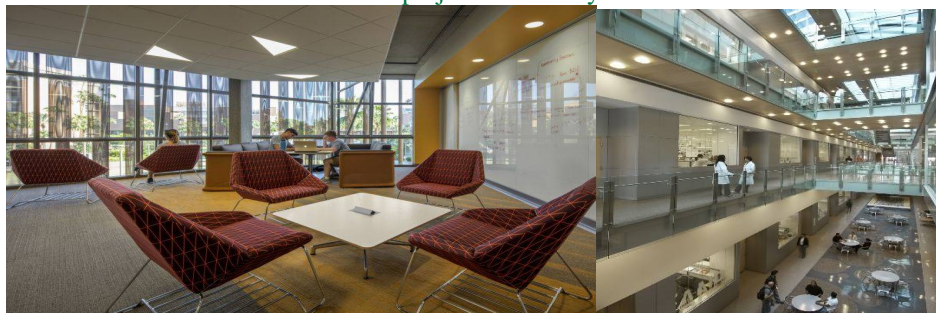


Photo No. (7) illustrates the internal spaces of the university building

3. The second approach concerned with reducing the negative impacts on human health (bio-design)

After the term "Sick Building Syndrome" SPS has appeared on the world, which are buildings whose occupants suffer from severe health effects and discomfort associated with their presence in certain spaces, and these effects disappear after they leave these spaces for a short period, and they are often health problems associated with quality of Air or air ionization, as well as electromagnetic radiation, noise and the lack of sufficient sunlight. Scientists began to pay attention to a direction in design and construction concerned with **reducing the negative effects on human health**. Concepts such as **building biology** and **biomimetic** science appeared, and the various terms synonymous with simulating nature became numerous It is necessary to

differentiate between them as shown below. The concept bio-design means simulating traits or biological systems. It is related to biology and it is specialized in examining nature and its models in order to solve human problems. The use of bio-design in ancient civilizations was limited to simulating the shape and symbol only. But with the scientific development the interest in nature became more in-depth to include the study of natural systems and to benefit from them in all aspects of life. The concept of bio-design systems has become more widespread and deeper. Bio-design is the new science that study models of nature and then take inspiration from them to solve human problems. It is a broad and comprehensive concept with many meanings Synonym, explained by the following diagram No. (3) (Maha & Doaa 2018).

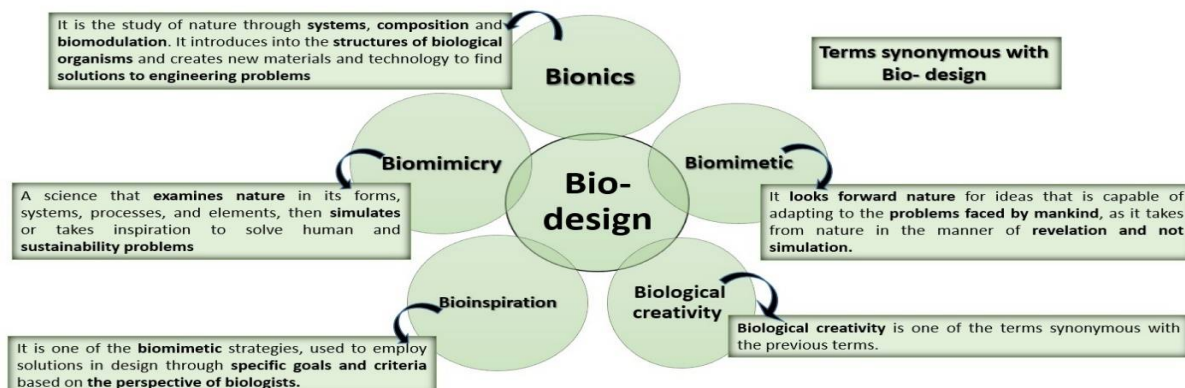


Diagram No. (3) illustrates the difference between Terms synonymous with (bio-design).

Building biology refers to how buildings affect life or the relationship between buildings and life. It aims to examine buildings and ensure their safety from electromagnetic fields. It is one of the architectural solutions that **preserve human health and the environment** (Huda 2017). **Biomimetic** is the design thought which combines biology and architecture in order to achieve the complete unity between the building and nature. It is one of the sustainable modern design strategies that rely on making use of the existing solutions in nature to solve design problems. Its importance comes from the fact that it does not mimic natural systems in form only, but rather deepens into its composition, structure, and environmental systems to inspire design solutions for the building internally and externally in a more sustainable and effective way (Amira 2017). The designer's inspiration from biological systems is not only limited to shape but includes three levels, **the first level** is organism level with its aspects and characteristics, as in picture No. () that illustrates the design of a chair based on the

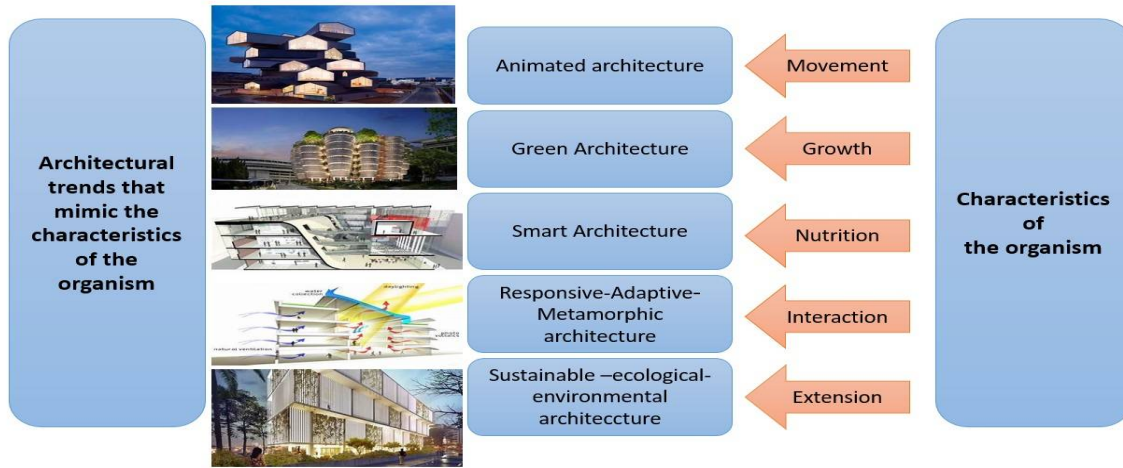
principles of human bone growth, made from lightweight epoxy material, its design is based on simulated regeneration bone tissue. **The second level** is inspired by the behavior of living being in nature, it includes simulating the behavior of a living organism and its relationship with others or the environment, such as using nano-paints that simulate the surface of self-cleaning lotus plants, as in picture No. (), it is a modern design of a chair inspired by banana leaves with very good use of colors (green-white) The fabric used is environmentally friendly and gives a positive effect.

The third level is the simulation of the ecosystem, it focuses on the environmental systems and solutions that can be deduced between the organism and the context of its environment, as in the pictures number (8) for a piece of furniture by " Larman Joris" from Amsterdam, who in 2007, designed a chair structure that simulates the bones made from specialized cells and strong, shiny, metal protein fibers, the structure designed to resist constant stresses interacts externally.



Photos No. (8), show models of three chairs that were designed in the biomimetic method with its three methods. Living organisms have natural characteristics that enable them to deal with their environment effectively, such as **movement, growth, nutrition, extinction, and interaction**. Nature has always been a precedent for man, as he draws from its technological methods to develop his life,

such as the invention of the submarine inspired by the bat. Therefore, by observing the technology of nature and biological systems, he was able to inspiration the modern trends of architecture such as moving and green architecture, etc., as shown in the following diagram no. (4): -



The effect of studies of the organism and its interaction in nature on modern architectural trends

4-The third approach concerned with promoting positive impacts on the environment and human health (biophilic)

The modern movement in sustainable design focused in its first attempts on preserving the natural environment only, but with time it realized that the environment and man must be preserved too, so the biophilic design that **enhances the positive relationship between human and his environment** appeared (Huda 2017). Tension, anxiety, nervousness, headache, and blurred vision are symptoms of a person who uses a sick building or a building suffering from SPS because these buildings ignore the human factor when designing the space. Therefore, the biophilic design (nature-loving design) which is based on the philosophy of the user’s association with nature and the mutual influence between

the overall environment surrounding the building and the internal building environment that affects the user's well-being, and the psychological and physical health his philosophy, trying to preserve the user and the surrounding environment together. (Ola 2017)

a. Biophilic interior design: -

Nature from a biophilic point of view is the living organisms and non-living components present in any ecosystem starting from the sun to the living microorganisms. The biophilic interior design is characterized by a good use of the natural world in the interiors, so it must include the elements shown in the diagram No. (5). Photos No. (9) shows models for interior designs that include elements of nature. The biophilic interior design includes several patterns illustrated in table No. (2), (3) and (4)

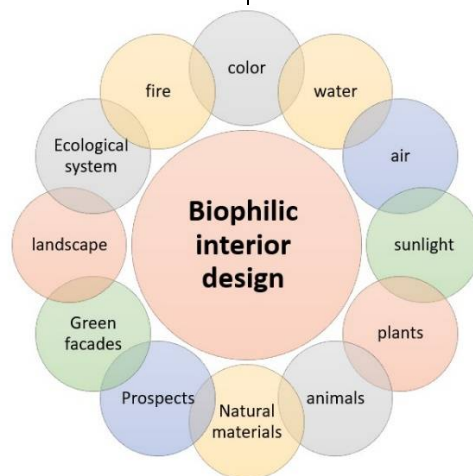


Diagram No. (5) shows elements of the internal environment in biophilic design



Picture No. (9) illustrates the use of natural materials, natural light, plants in walls cladding with climbing plants and planted ceilings (green facades) that contribute to creating a more physical and mental well-being environment for people who spend a long time inside these spaces positively affect physical contact with the natural features of the natural environment, This reduces stress and helps people feel relaxed, and Image no. () is for the Ashford Designer Outlet Center's which is the tallest green wall in the United Kingdom, Europe ,Source:

<https://www.chapmantaylor.com/zh/insights/the-importance-of-biophilic-design>

b. Biophilic Interior Design Patterns

Biophilic Interior Design Patterns

First: Nature in a void

Visual connection with nature	It is concerned with achieving the user’s vision and visual communication with the natural environment during his day’s activities in the internal spaces (examples the yard - the garden - landscapes, paintings or screens).
Non-Visual connection with nature	Stimulates the senses of hearing, smell and touch to suggest the influence of the natural environment (for example, music, the sound of water, the use of aromatic oils - houseplants touching materials that simulate nature)
Non – Rhythmic sensory stimuli	An unexpected momentary exposure to nature, the subconscious stimulates the user with immediate sensations stimulating energy (for example, planting tanks suspended in windows that attract bees or butterflies - a screen or wavy texture - materials that move with the touch of air - or shadow and light)
Thermal and airflow variability	A space that stimulates the user's senses through the diversity flow of air and heat to increase the comfort feeling and satisfaction (for example building orientation - window treatment - intermittent ventilation systems - heating and cooling systems)
Water Presence	By hearing, seeing, or touching water, which refreshes and excites the senses (for example, making a wall of water, using a fountain, aquarium or industrial water stream, or using an alternative to it through pictures)
Dynamic and diffuse light	It depends on changing the intensity of light and shade over time in order to create an atmosphere similar to what occurs in nature during the day to increase the activity of the eyes (for example direct & Indirect lighting - window treatments - rhythm lighting)
Connection with natural systems	It is used to perceive seasonal and temporary natural systems. To preserve the user's sense of the relationship of the part with the whole and increase his awareness of the life cycle and its seasons (for example materials whose shape changes or whose function expands with exposure to heat, sun, wind, rain or moisture)

Table No. (2) shows the first style of biophilic interior design, which is nature in a void



As shown in photo s (10) most hotels around the world are currently working on integrating biophilic design with large-scale design plans for their buildings in order to meet the expectations of their guests. As it has an important role in the hotel's ability to keep guests coming back through creating a holistic guest experience from visual contact

with nature to creating a sense of joy for him ,Source: <https://www.ambius.com/blog/hotels-biophilic-design/>

Biophilic Interior Design Patterns

Second: models corresponding to nature

Biomorphic forms & Patterns	It suggests an adherence to nature, and it is preferred to use it in the three horizontal projections, walls, furniture and windows to give a greater and continuous effect (for example wallpaper designs, textiles, columns, etc. that depend on the proportion of the golden sector.)
Material connection with nature	The use of local environmental materials to increase the sense of the uniqueness of the place. Which is linked to the function of the place (examples are wood grain, leather and stone texture, and natural colors, especially green.
The Complexity & Order	The spaces used for this method are characterized by a spatial sequence, which increases the sense of gravity and involvement in the details. It prevents the feeling of boredom. It is applied in the general horizontal plan and all elements of the internal space through the use of molecular engineering, and pattern.

Table No. (3) shows the second type of biophilic interior design, which is the type of models corresponding to nature



Photo No. (11) of a stair planned in the proportion of the golden ratio as an example to biomorphic forms & patterns,

Image number (): a repetitive geometric pattern in floors and walls as an example of the complexity & order of models corresponding to nature. Source: <https://www.pinterest.com/pin/744642119622527466/>

<https://www.nycgo.com/attractions/brookfield-place/>

Biophilic Interior Design Patterns

Third: the patterns of the nature of the void

Prospect	Gives a feeling of comfort and openness to nature (for example directing the building and windows towards nature, design planning around nature, the depth of space, appropriate height of the ceiling, transparent glass partitions, use of terraces, balconies and open planes)
Refuge	A place to shelter from environmental conditions to give a sense of safety (for example, high back chairs, overhead pergolas, and partial shelter such as reading and sitting areas or dormer windows, covered beds, covered movement corridors, bedrooms, meetings and private offices.
Mystery	The partially hidden scenes tempt to travel in the depth of the environment and reflect a sense of anticipation. The design here is purposed and well thought out to achieve safety with a sense of the danger in the experience. Such as the suggestion of falling and getting wet by the water, architectural cables and transparent facades from floor to ceiling
Risk – Peril	It is a threat mixed with reliable protection, and it generates a sense of enthusiasm. The individual may feel danger but mixed with visual pleasure.

Table No. (4) shows the third type of biophilic interior design, which is the type of the patterns of the nature of the void



Photo No. (12) of an open landscape view. Picture No. (13) for a reading corner in East Hampton Public Library in the United States, and is characterized by impermeable partitions, fallen ceilings and low lighting. These are models for the biophilic interior design of the void nature pattern. Source:

<http://thenaturesanctuary.com/Estates/Floor-Plans.html>

<https://architazer.com/projects/childrens-reading-room-at-the-east-hampton-public-library/>



Photo No. (14) for the Pearson Automobile Museum in Los Angeles - the United States, and Image No. (15) for the Museum of Art and Design in Los Angeles. The entrance contains flying stone blocks. These are models for the biophilic interior design of the void nature pattern. Source: www.saaih.com

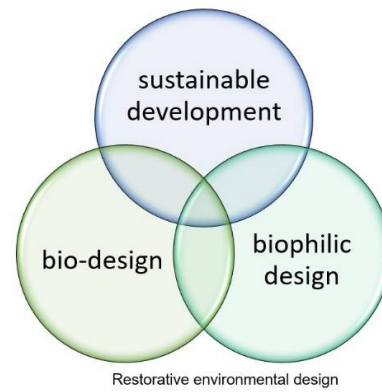
https://en.wikipedia.org/wiki/Levitated_Mass

5. The fourth approach combines the three previous. It concerns reducing the negative impacts on the environment and human and promoting the positive effects on human health and the environment.

With the very quickly increasing urbanization, a person spends a large part of his life in the built environment, which led to negative changes in his life, in addition to various health problems such as cardiovascular disease, cancer, diabetes, and depression. This has led to the necessity of studies on how to design built environments that **reduce the negative impacts on the environment and humans and promote the positive effects on human health and the environment.**

- a. Restorative environmental design " Designing Built Environments for Sustainable Community Health " Elif K. (2018).**

Restorative environmental design refers to the unification of sustainable development with biophilic design to ensure the preservation of the environment and human well-being and health. This approach recognizes the role that humans play in design. A restorative environmental design combines three aspects which are biophilic design, bio-design, and sustainable development. (Anwar 2018). Restorative environmental design has two primary goals, **reducing the harmful effects of design on nature and on human health**, as well as **enhancing the positive relationship between man and the natural environment**.



It focuses on the quality of life, the safety of natural systems, and the restore of ecosystems and natural. It works to reverse the damage that might be caused to a particular site by either nature or humans. Where his designs improve and restore the surrounding environment, such as restoring the site's natural water resources or providing lost wildlife, or plant housing. As the buildings are integrated into the natural environment with the aim of repairing the damaged surrounding environment. Thus, have a positive impact on the environment

by repairing the surrounding ecosystems, such as providing an opportunity to replant food, re-groundwater, dividing the excess energy of the building with the surrounding buildings. The wild nature of cities is not only associated with green spaces. Rather, the use of trees in streets, yards, and rooftops should be considered and shown in cities rather than hiding them as usual (Ana K. 2007). The photos No. (16) illustrate the Alhambra, in which the use of green spaces and fountains was a necessity to connect with nature.



Photo no (16) of the Alhambra Palace in Granada, Spain, is one of the best examples of restorative design, as the palace was built in successive stages of time, like a cultivated plant that grows in the environment.

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The design based on achieving the quality of life in the internal environment	Indoor air health and achieve good communication with nature Healthy lighting Eco-certified materials	
The design based on safety of ecosystems	A restorative environment nourishing all the senses The design with low environmental impact	An auditory, visual, olfactory and haptic environment A multiple senses restorative environment Energy efficiency, resource saving, pollution prevention, waste reduction
Restoration of natural and ecological systems	Recover the water resources Providing opportunities to grow food Create ecosystems for local species (lost-deactivated-destroyed)	Irrigation of crops, aesthetic uses (fountains, fish ponds, etc.) Save lost wildlife Provide lost plant housing

Table No. (5) for the study of Nousianen, Lindeos & Heino 2016 for the levels of restorative environmental design in interior architecture

b. regenerative design

- Giving a new life or energy, revitalizing,

renewing existence, to give a new character to life.



- Formation, construction or establishment of a new, especially with improvement.
- Restore, revitalize or renew the best, highest or most recent state.
- Reform spiritually or morally, or improve the spiritual condition and demonstrate a new, higher spiritual character.
- Improving a place or system, by making it more active or successful.

Regenerative design is a system of techniques and strategies based on understanding the inner workings of ecosystems that generate regenerative designs rather than the consuming the life support systems and resources. To contribute in improving the health and vitality of human and natural societies (psychological, economic and ecological). Regenerative architecture is defined as engaging the natural world as a means of generating architecture. Or it is a practice that employs a complete and comprehensive understanding of the living and natural systems involved in the design of a building. Where regenerative design is based on the premise that everything that is built has the potential to integrate the natural world as an equal partner in architecture.

Regenerative design aims to design buildings that contribute in enhancing the health of the environment, increase biological diversity, and maintain living relationships with the surrounding environment. In order for these buildings to be alive and renewed, they do not produce emissions that pollute water, air or soil, and do not affect the health aspects, as they are flexible and designed to adapt to changing needs and conditions.

The regenerative design also aims to

develop buildings and cities in a way that makes them regenerate lost ecosystems, by focusing on adaptiveness, resilience, regeneration and sophistication through how the building responds to sudden changes, such as the use of internally moving components, the provision of open spaces and multi-use furniture.

Regenerative design can be achieved in a number of ways, including design flexibility. As well as the flexibility of internal spaces through several methods, which are the design of multifunctional and changeable spaces through mobile partitions, Reuse of existing spaces in new jobs, the use of the open space that allows the practice of multiple activities in it and can be divided flexibly, the multi-use space where the nature of its use changes with the factor of time like a space used as a living in the morning and then a dining room at another time then bedroom sleep at night, repartitioning the spaces internally according to the change of the place or the goal of it in what is called the long-term harmonization. Regenerative design includes all sustainable green design strategies from reduction, reuse and recycling, but also bypassing it in material recycling, reuse and reduction of consumption. It includes three principles for internal spaces, which are the efficient use of energy-saving resources, and the strengthening of social ties to achieve the health and well-being of users, and communication with nature to restore and enhance local ecosystems. The values of regenerative architecture can be merged and summarized in table No. (6).



Photo No. (17) for multi-use furniture as one of the models of regenerative design that aims to achieve flexibility through the ability to respond to changing needs and requirements from time to time through flexible and modern solutions that meet the changing needs of users

Efficiency of flexible interior architecture	reinvestment of interior architecture spaces Open plan Long-term alignment	Mutual use of space New Functional reuse of space Multiuse plan	The use of the fourth dimension Flexible furniture
Retrofits	Efficient use of resources to improve interior design	Redivide space using internal moving components Integration of functionally integrated spaces Development of existing power systems	Development of existing inner Plants- Integration of energy management systems- Finding effective energy management and store systems- Integration of Passive Design Systems with Natural Systems Climatic, cultural, Aesthetic compatibility
		Compatibility of the environment with materials	Improve structural internal systems architecture- Adjust or control humidity and air leakage Recycling -Reuse - Reducing consumption
		Safety of internal spaces	
		Green Techniques	
		Enhancing social bonds by providing a public internal space to enhance opportunities for interaction between occupants Design with an adaptive direction to the changes of climate to minimize the future side effects	

Table No. (6) for the levels of regenerative design in interior architecture

Egypt's strategy for sustainable development (Egypt Vision 2030) is a national agenda launched in February 2016, which reflects the country's long-term strategic plan to achieve the principles and goals of sustainable development in all fields, and settle it in the various Egyptian state agencies. It is based on the principles of "comprehensive sustainable development" and "balanced regional development". The Egypt Vision 2030 reflects the three dimensions of sustainable development: the economic, the social, and the environmental. The fifth objective of this plan focuses on the achievement of an integrated and sustainable ecosystem by confronting the effects of climate change, enhancing the ability of ecosystems to adapt, enhancing resilience and the ability to face risks and natural disasters, increasing dependence on renewable energy, preserving nature, protecting its resources, biodiversity, adopting sustainable consumption and production patterns, and achieving the best use of natural resources. Hence, several initiatives were launched with the aim of achieving the best use of natural resources. A package of policies are prepared such as canceling subsidies to rationalize energy consumption and improve the efficiency of electric energy production

and transmission. Among the initiatives that were launched with the aim of achieving increased dependence on renewable energy is local and foreign development and investment in renewable energy projects, which helped meet the growing energy needs without stopping service. And among the initiatives that were launched with the aim of achieving conservation of nature and protecting its resources is the launch of the campaign "Prepare for green, prepare for the future", which helped raise awareness among citizens about environmental issues.

Second: An inclusive Sustainable interior design that is harmonious with nature and in line with the state's sustainable development plan (Egypt Vision 2030):

The state's plan towards sustainable development aims to improve the quality of life. Sustainable architecture strategies must be applied in construction and in interior design to achieve compatibility with the state's general orientation and to preserve the natural environment and improve human health and well-being. Many new cities in Egypt take into account the distribution of green spaces, whether public or personal to couple with the state's plan and to achieve the comfort and well-being of users. The state has also developed a system to assess the



sustainability of buildings called the Green Pyramid Evaluation System, which designers can use to determine the points to be taken into account during the construction of the building from inside and outside.

Results: -

1. 1. Human communication with nature is an essential part of his human nature. We must work to increase man's connection with his environment through internal design to obtain better user performance and better health.
2. 2. The design of the building should not stop at the point of not harming nature. Rather, care must be taken to renew the design as well as reform it to the environment around it
3. 3. The design of interior spaces and sustainable buildings does not stop at the limit of aesthetic design and visual contact with the environment only, but also includes a good utilization of resources, from the used building materials and environmentally friendly materials to natural energy sources, and even the way the building and the users dealing with the natural environment in a restorative manner.

Recommendations: -

1. The results of studies and researches on sustainability must be applied, whether in buildings or interior design, in order to preserve the opportunity for future generations in resources and the opportunity to live better for the current generations while preserving the surrounding environment.
2. It is recommended that the principles of sustainability must be applied in construction and interior design work, not only in line with the state's plan for sustainable development, but for the sake of preserving people and the environment, as they are the most valuable investment in life.
3. It is recommended that the interior designer should be aware of his role in improving the user's taste and awareness through the application of the principles of sustainability in design and raising the user's awareness of the need to apply these

standards in order to preserve his health and health of future generations.

4. It is recommended to increase awareness campaigns on the importance of sustainability and its role in building to create a better life and future

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