The role of green architecture in improving the functional performance of a healthy dwelling

Prof. saeed hassan Abdel-rahman

Professor at Interior Design & Furniture Department – Faculty of Applied Arts – Helwan University

Prof. Doaa Abdel-rahman mohamed

Professor at Interior Design & Furniture Department – Faculty of Applied Arts – Helwan University

Lect. Mennatallah Sayed Abdou Ahmed

Demonstrator at Interior Design & Furniture Department – Higher Institute of Applied Arts – NCA

Mennatallahsayed2@gmail.com

Abstract

Housing is one of the main pillars contributing to the formation of the family and the safety of its growth, and besides providing daily shelter for the family, it positively affects its psychological well-being and socio-economic stability, access to adequate housing that meets the needs of the family often consumes a large part of its income, therefore, saving and reducing its cost to facilitate the process of obtaining and owning it. It is an important development goal in all countries of the world, and providing adequate housing for health, social and economic aspects, and enabling the family to own it at a rate of expenditure commensurate with its financial capacity has always been one of its most prominent objectives.

In modern times, as a result of the industrial revolution, environmental pollution and population accumulation, small-scale, few-blank dwellings are not suitable for activities within them. Especially since the human being used to carry out his activities inside his home and permanently dispense with the natural environment, which increased this effect on his activities, which began to dwindle to suit the basic needs and dispense with some activities that are considered very important for his health, and some consider it as secondary activities that can be dispensed, which has a negative impact on human health.

The green architecture, which is a design entrance after philosophy aimed at using energy conservation techniques and reducing the volume of material consumption, as well as the use of recycling techniques and reducing the volume of waste from the facilities and recycling and using clean and renewable energy sources to ensure human beings a healthy and safe life within his environment in general and within his home in particular.

Keywords:

Green Architecture - Quality of The Interior Environment - Health Housing

introduction

The home plays an important role in influencing the health of its residents, psychologically, physically and socially, and this impact is not limited to the ability of the home to provide protection for them from the influences of the external environment, but extends to include the possibility of dealing with the requirements and needs of the internal environment in a way that

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guarantees the human being a safe and healthy life, when fulfilling all requirements humanity is safe inside the home, as this reflects positively on human health, which results in the feeling of its inhabitants of safety, comfort and complete pleasure.

Hence the term healthy housing, in which all the basic functions and needs of the individual are realized in a way that guarantees a decent life for him, in order to achieve comfort, in addition to achieving a balance between the vital environment and the residents of the house to enhance the environmental performance and achieve the functional suitability of the human needs towards the various elements of his environment, such as providing thermal comfort efficiency and optical and acoustic comfort efficiency, therefore, the trend was to study the concept of green architecture as it represents an ideal model for healthy environmental architecture. (2, p.90)

Research problem

The research problem is concentrated in the following question:

- What is the role of green architecture in improving the functionality of a healthy home?

The research importance

The importance of the research is due to:

- Paying attention to the quality of the internal environment through the use of sustainable materials and avoiding all that causes harm to the occupants of the vacuum.
- Taking into account the achievement of green architecture standards to provide environmental, thermal and acoustic comfort in residential spaces.

Research objective

The research aims to:

- Finding environmental solutions for designing residential spaces in light of the concept of green architecture.
- Provide a healthy indoor environment appropriate to all environmental, functional, economic and aesthetic requirements.

Assignments

The research assumes that the internal designer's application of green architecture standards leads to the creation of an environmentally friendly health vacuum, which positively affects the environment and limits the depletion of its resources.

1. The concept of a healthy home

It is that housing that helps its residents to perform all physical, psychological and social functions in a natural way, and through which the interconnection between a person, the environment and society is achieved, and it can also be defined as "a residence that meets the needs of a person and protects him from external factors and keeps him safe, and possesses the characteristics that create a residence suitable for occupants.

1.1 Basic needs for a healthy home

The design considerations for any dwelling and the implementation of its buildings include observing its primary health requirements, which are known internationally as "the basic needs to ensure the good performance of the dwelling, protection and psychological state of its citizens and their protection from infectious diseases and accidents", and they are divided into the following three sections as shown in Figure No. 1. [3, p.96]

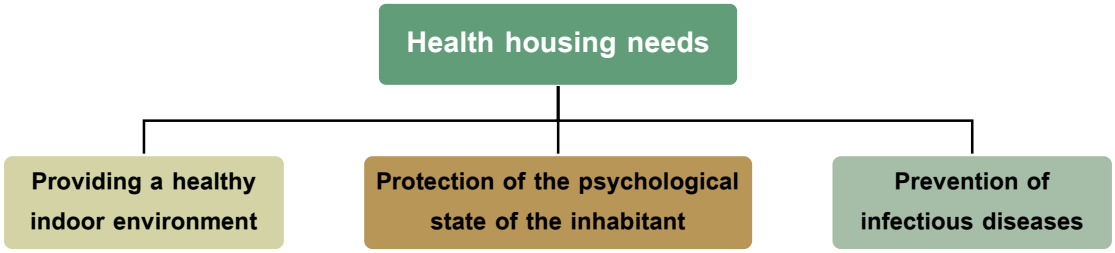

FIGURE (1) SHOWING HEALTH HOUSING REQUIREMENTS (STUDENT DESIGN)

Based on what has been mentioned from the previous needs, it was necessary to go towards finding a new thought that carries with it the principles of preserving the environment and rebalancing it, so the term green thought emerged that calls for rationalizing the use of natural resources to the extent required without wasting, and working to develop them to the extent that allows generations to be coming in a safe and healthy environment. [11]

2. Green architecture concept

Green architecture as an architectural term means that architecture is a product of its environment, i.e. starting with nature and ending with it, it achieves the maximum functional fit for human requirements towards different environmental elements such as thermal comfort and light and sound efficiency, and therefore green architecture represents an ideal model for healthy environmental architecture. [12]

Green architecture can be defined as: "Buildings that achieve a balance between the biosphere and the residents of those buildings, where they were designed and implemented in order to reduce resource consumption and then enhance the environmental performance of the building and reduce the costs of its life cycle, and to preserve the health of its residents"[2], as shown in Figure No.2.

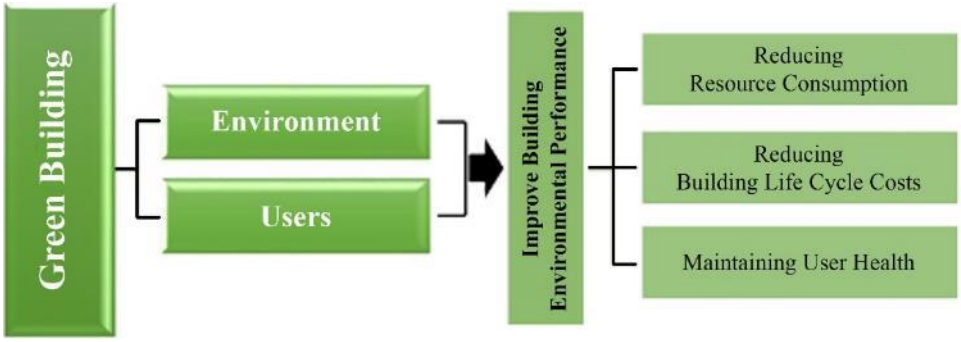

FIGURE (2) SHOWING GREEN ARCHITECTURE CONCEPT (STUDENT DESIGN)

So green architecture came with the aim of achieving resource efficiency, energy efficiency, pollution prevention, integration with the environment, minimizing the negative impacts of the building on human health and the environment through rationalizing energy consumption, water, and resources, in addition to protecting the health of building users and increasing their productivity, and reducing waste and pollutants from the building.

2.2 Healthy housing design strategies in light of the green architecture concept

The internal environment of a person needs a comfortable and safe environment in order to achieve the safety of the person inside his residence, as the human is vulnerable to infection with various diseases in the event that his residence does not match the requirements of his health inside, so a healthy internal environment must be created that provides human requirements in accordance with the concept of green architecture as in Figure No.3. (2.p.40)

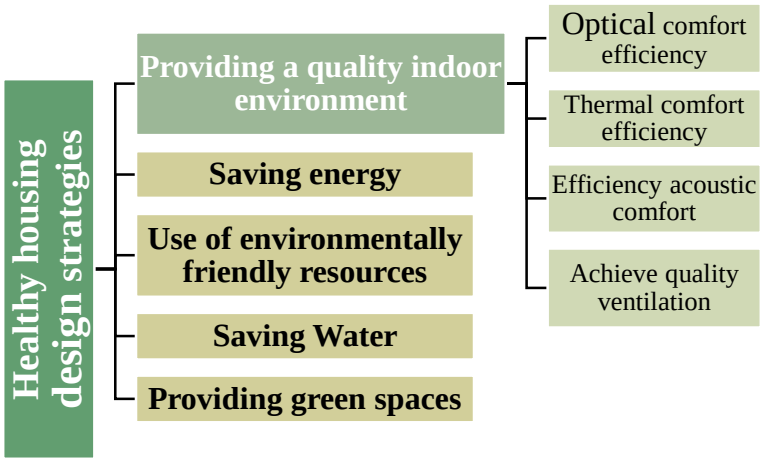

FIGURE (3) SHOWING HEALTHY HOUSING DESIGN STRATEGIES IN LIGHT OF THE GREEN ARCHITECTURE CONCEPT (STUDENT DESIGN)

2.2.1 Providing a quality indoor environment

A. <u>Optical comfort efficiency</u>

Most optical treatments rely on reorienting sunlight by collecting it as much as possible from direct light and focusing it so that it can be transported with less loss while raising its efficiency in the space to be lit. This is done using the nuts or mirrors and lenses installed in the way of rays or optical tube systems, and this system depends on the accuracy of integrity. The path of light where slight deviation in paths reduces its performance, and these elements include the following:

- **Light Pipe**

Optical tubes are the most suitable types to use, as natural lighting is directed throughout the day for the vacuum without making any additional adjustments, because it depends on cables of optical fibers as a light transmission medium from the upper complex placed on the roof of the building to the emitter that diffuses natural light in the spaces to be lit.

Elements of industrial lighting inside these tubes are also used to operate them when needed to increase the intensity of the lighting, or it may be entirely dependent on natural lighting, knowing that these tubes transmit natural light at midday with a capacity of 45,000 Lux [8], and one of the advantages of this system is to naturally empty the blanks with integration relative to industrial lighting with the isolation of industrial lighting sources in addition to reducing maintenance costs and allowing light to extend inside the vacuum, as well as it suits all climatic patterns. [6, p. 172]

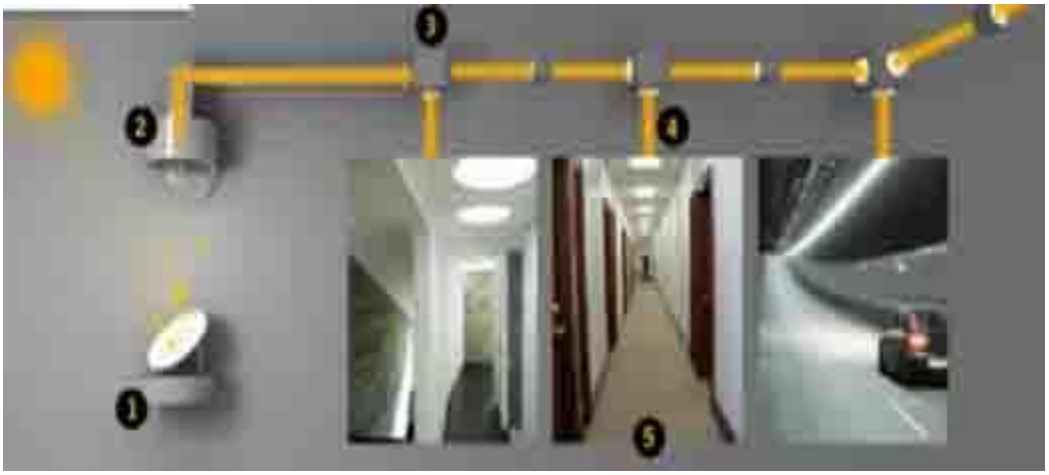

Figure (4) shows the optical tubes of different diameters to transfer the light to the emitter and spread it inside the space

Industrial lighting is also used in two cases: the first when natural lighting is not sufficient, and the second in the evening periods, and industrial lighting can be addressed within the internal spaces within the framework of the concepts of sustainability and the LEED evaluation system in terms of:

- Selectivity for industrial energy-efficient LED lighting bulbs

LED bulbs features

a) Preserving the environment, as it is the most energy-efficient unit, and does not emit harmful heat or rays (such as infrared and ultraviolet rays), thereby achieving effective energy use.
b) It is characterized by a long service life that may reach more than sixty years, according to the extent to which precision is followed in the industry, which obviates many of the costly lamp changes.
c) It is distinguished by not requiring special maintenance work.
d) It can emit lighting in all shades of desired colors in a number of no less than 265 degrees.
e) The LED can be connected to the Solar energy panel.
f) LED provides at least 50% of traditional (halogen) lighting. [13]

B. Thermal comfort efficiency

Architectural elements from ceilings, walls, openings, and floors play their role in the thermal transfer between the outside and inside of the building, and therefore their design must be taken into account in a way that reduces the heat transfer to and from the void to create a healthy fit environment comfortable for humans and reduce the burden of heat load.

Ceiling heat treatments

Treatment of roofs plays a large role in the hot climate to prevent the arrival of sunlight in times of day directly on the building's mass. There are several design methods for the roof of the building that contribute to achieving thermal comfort, including:

- Using Thermal Insulation

Isolation is considered one of the most important factors at all in maintaining the climate inside the building, as it reduces or prevents the unwanted effect, whether it is extreme heat or cold in reaching the internal space, and it is the most famous insulation material (foam) that has the property of not running out of excess heat. The foam layer has a thickness of 2 cm, and the more thickness, the more efficient it is in thermal insulation. The fallen gypsum ceilings are a kind of heat-insulating treatments.

- Leave a vacuum antenna

The air is considered a relatively heat insulator, and therefore it can be used as a heat insulating air vacuum, and this is achieved by using vacuum blocks on the roof surface, or the creation of the roof from two concrete layers between them confined air vacuum, and from here the idea of creating the roof arose from two separate tiles that allow air to pass between them. (8, P.73)

Wall heat treatments

There are strategies to design the walls in an environmental manner that reduces thermal loads on the building, and thus increases the efficiency of thermal comfort inside the spaces, including:

- Create double walls that allow air to circulate between them

It depends on the same method as the double walls, but it is characterized by the presence of two openings at the top and bottom of the outer wall allowing the passage and renewal of air and reducing the heat load penetrating into space.

FIGURE (5) SHOWS THE DIFFERENCE BETWEEN THE DOUBLE WALL INSULATION SYSTEM IN WINTER AND

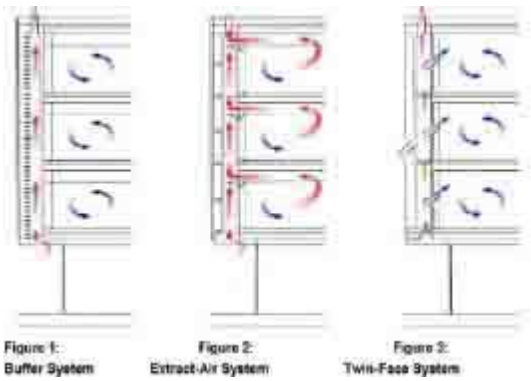

Figure (6) shows the double walls to reduce the heat load coming into space

Architectural Heat Treatments (Windows)

Shading is of great importance in reducing heat gain, as heat penetration in a glass wall is 30 times higher than in a solid wall, and if it is shaded, heat penetration becomes 3 times higher.

- External shading elements in window treatment

There are several types of fixed and moving ones, and one of its main advantages is the ability to control the solar radiation before it enters the void, as to some extent it achieves a visual link between the interior and the exterior, as shown in Figure (7)

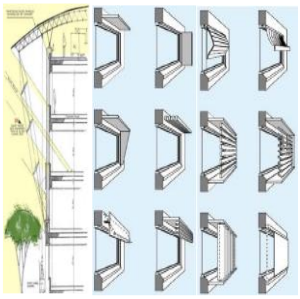

FIGURE (7) ILLUSTRATES SOME OF THE EXTERNAL

FIGURE (8) SHOWS THE METHOD OF EXTERNAL SHADING OF THE

- Interior shading elements in window treatment

Curtains of all kinds include "Venetian blind, roller blinds, curtains", some of which are retractable and some that are fixed at a specific angle where they play an important role in collecting solar radiation and controlling the amount of thermal gain.

However, one of its drawbacks is that it traps the heat close to the glass, so it is preferable to mix the internal and external shading elements, such as:

- Solar Networks

And there are those that are installed by gluing them on the glass or in the form of woven fabric that is installed as a separate sash in the window.

- Automatic blinds system

And in it, the curtains or kosher are provided with a motor that allows movement and is usually made of traditional materials or three-layer curtain fabric or leather, and all work to reduce sound and light, and despite the high cost of this lighting, it is economical as an integrated system, as it reduces the energy needed for the air cooling system and improves performance of natural daylight, as in Figure No.9 (5, p. 81)

PICTURE (9) SHOWS EXAMPLES OF INTERIOR SHADING

➢ **Type of glass used**

The glass used in the facades should provide lighting for the building as the glass has high sunlight penetration as well as sound insulation, preventing or increasing leakage of heat, and the designer must specify his need for thermal acquisition SHGC and visible light penetration VT to determine the most appropriate type of glass for interior space.

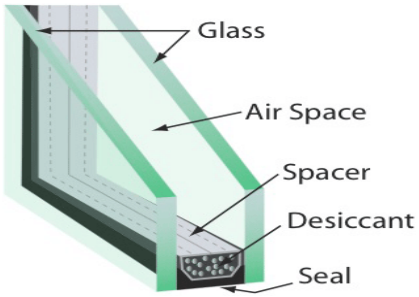

FIGURE (10) SHOWING THE DOUBLE INSULATED GLASS

- Double Glazing Insulated

It is two panels of glass with an air separator in the middle and reduces this type of heat loss in winter by the air-insulating layer, it also reduces heat transfer and allows light to travel through it. One of the advantages of this type is that it is a good heat insulator when the distance between the plates is approximately 12 mm, as in Figure No. (10).

Floor treatments

The floors are the least architectural elements of the building to transfer heat from the outside to the inside, and there are several factors that affect the transfer of heat from the outside to the interior through the floor, including:

- The material from which the floor is made (concrete differs from wood from metal).
- Area of finishing material such as ceramic, wood, marble, etc.
- The presence of an insulator between the floors affects the prevention of leakage inside architectural voids. (1, p. 20)

C. Efficient acoustic comfort

Design treatments to achieve the efficiency of the acoustic environment can be addressed within the internal spaces within the concepts of sustainability and green architecture to achieve the accreditation of the internal environment quality through:

- Perforated panels such as perforated gypsum boards used for roofs, and some types of stone and perforated metals.
- Mineral wool boards are called mineral fibers for roofs, some of which are pierced or engraved in many forms, Figure (11). (14)

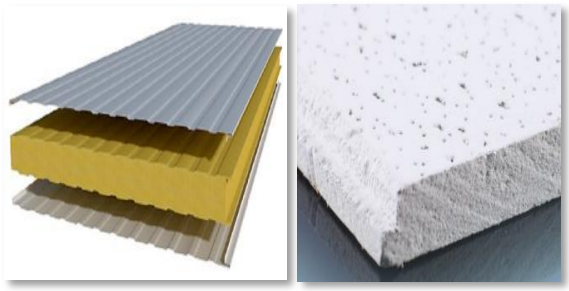

FIGURE (11) SHOWS THE SOUNDPROOF MINERAL

- Wall treatments with diaphragms that absorb sounds such as wall panels made of natural vegetable fibers absorbent to sound, and they are also environmentally friendly and fire-resistant, Figure (12, 13).

Figure (12) shows sound absorbent wall tiles made from natural vegetable

Figure (13) shows Reflector Panels that are scattering sound waves in different

D. <u>Achieve natural ventilation quality within the residential space</u>

The composition of the building must be based on foundations that allow the utilization of renewable energy sources, natural ventilation has an important role in limiting the use of mechanical methods used to ventilate the building, which reduces energy consumption which is one of the basic principles of green architecture. [4, p. 273], and the role of the interior designer is concentrated in determining the factors that affect the quality of ventilation inside the space and focus on environmental design

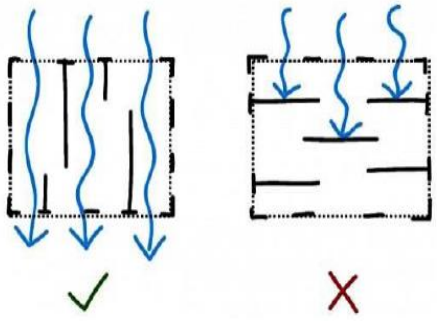

Figure (14) shows the effect of interior wall design on wind speed.

treatments that achieve the efficiency of natural ventilation.

- Wall design

The design of interior walls to divide the space affects the effect and speed of the wind, and sometimes the internal walls can be used to create paths for wind through the interior spaces that need ventilation, but it can be a design that impedes the wind and leads to the creation of foci with wind stagnation [6, p. 132], Figure (14).

- Slots design

The continuity of air movement inside the vacuum can be controlled through the availability of at least one inlet for air and one outlet for air. Hot regions so that there is a better distribution of air speed inside. Since the highest air velocity (wind) is at the smallest opening, if the air inlet is smaller than the air outlet, this leads to an increase in the air velocity to the maximum at the inlet, and thus an annoying air stream occurs at the inlet, so "it is best to have the inlet air volume larger than the size of the exit hatch so that there is a better distribution of the air velocity inside." [7, p. 118]

2.2.2 Energy conservation and natural energies

The impact of climatic factors on humans and the environment is based on the need to use energy for heating, cooling, and lighting, and for the building to be heated or cooled, we must rely on methods and systems that use electric or natural energy, and green buildings are geared towards using natural energies such as the sun, wind, and rain to help cooling, heating and lighting of buildings.

- Solar panels

A study conducted by the University of Exeter reported that solar panels made of metal called perovskite have the ability to convert solar energy into electrical current for homes at very low cost, as they are available in many colors, and they are affixed to the windows of buildings so that they block lighting and work to generate electricity at the same time.

Perovskite solar panels will be 40% cheaper and 50% more efficient than commercially produced solar panels at the present time, and unlike other solar panels, those made of perovskite can absorb most of the spectra of solar energy, as they work in various weather conditions and not in direct sunlight only. [13]

2.2.3 Renewable and environmentally friendly resources

One of the most important methods used to rationalize the use of resources is the recycling of materials and waste, and iron is one of the most used materials in buildings and it is recyclable even in its most dispersed conditions due to its magnetic properties as it is easy to be recollected. [9]

2.2.4 Preserving water inside the building

Among the factors that reduce the water consumption in buildings:

- Collect rain water from the building surface, store it, and use it to drain latrines, irrigation of gardens, and other uses. Water use is reduced by implementing effective equipment to reduce water consumption in bathrooms and toilets, which leads to a reduction in the annual consumption of drinking water by approximately 56%.
- Choose sanitary ware (water mixers) that provide water, and some bathroom fixtures that never use water, such as dry urinals, as well as organic toilets, Figure (15).

Figure (15) shows the use of water-saving mixers, as well as the use of dry

2.2.5 Provide green spaces and gardens

The plant elements are one of the most important design components that the designer is keen to employ in order to achieve ecological balance and dimensions of visual beauty, in addition to their functional uses in purifying the air from toxic pollutants, providing shade, tempering the atmosphere, protecting the building from wind and heat, and providing privacy. The plant elements play an important role in providing optical comfort, and noise reduction as shown in Figure 16. [10]

Indoor plant parts also act as room air purifiers from some chemicals, such as gasoline, formaldehyde, carbon monoxide, and nitrogen oxide, Figure (17).

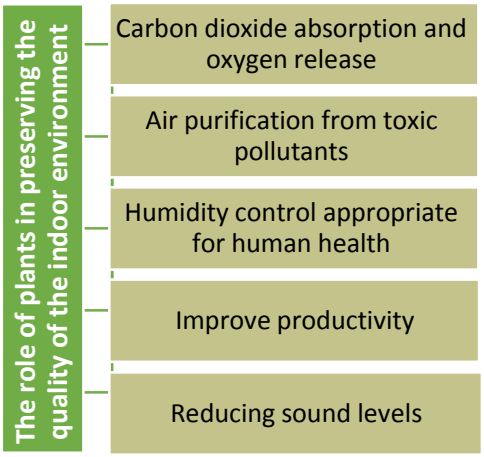

FIGURE (16) SHOWS THE ROLE OF PLANTS IN PRESERVING THE QUALITY OF THE INDOOR ENVIRONMENT

FIGURE (17) SHOWS THE ROLE OF PLANTS IN PRESERVING THE QUALITY OF THE 0UT DOOR ENVIRONMENT

1) The importance of housing and its suitability for housing depend on its ability to achieve a safe environment inside, and compatible with human health.
2) The housing must meet its design characteristics with the external environment, in order to protect the residents and provide them with a safe and healthy life.

3) The phenomenon of internal pollution suffered by contemporary housing came as a result of human attempts to provide for their functional requirements without observing environmental standards and characteristics.
4) A healthy home is a home that enables a person to perform his physical, mental and social functions in a way that guarantees him comfort and safety within the internal and external environment.
5) The interior designer has a central pivotal role in designing green buildings compatible with the environment.
6) Interior designs of green buildings affect human health. Failure to adhere to standards for choosing environmentally friendly materials and paints leads to negative impacts on the environment.
7) The interior designer must use materials that can be recycled and used to reduce waste affecting the environment.

Recommendations

1) Activating the role of the interior designer in designing green interior environments as it is considered the main axis in the majority of green building standards.
2) The use of clean energy resources in all urban projects is the best solution to preserve the environment and human health instead of the traditional energy that causes severe damage.
3) The necessity of introducing the concept of green architecture in the design and implementation stages of housing to reduce the use of energies, which has become an economic burden on man and the environment.

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