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Abstract:

Since the turn of the century, the environment has dominated all research and studies in a variety of sectors.

Architecture is one of these professions, hence various names have been created to connect architecture with the environment, such as green architecture, sustainable architecture, and environmental design. All of these titles have one thing in common: they are about bridging the gap between the built and natural worlds.

The goal of this research, sustainable architecture, is to reduce the negative environmental impact by achieving operational excellence and rationality in the use of resources, people, and development zone.

When we look at traditional architecture, we can see numerous examples of how traditional methods were used to accomplish sustainability while also attempting to achieve a relationship with the natural environment. So, while sustainability is not a new concept, it has its roots in traditional design.

As a result, the study will demonstrate sustainability in both traditional and modern architecture, as well as analyze the differences in how sustainability is applied in architecture in the history and today.

This research is based on Islamic architecture, which is both a historical example of architecture and a model for sustainable design, beginning with urban and rural planning and progressing to building scale. The dense urban tissue and small, winding streets exemplify how urban planning might achieve sustainability. Building materials, proportions of openings, usage of courts, roofing, and other environmental treatments that attempt to reduce heat load are all examples of Islamic architecture that recognize sustainability at the construction scale.

Furthermore, the research will shed light on modern sustainable architecture and provide demonstrations of how new technologies can be used to achieve sustainability.

THE HISTORICAL BACKGROUND

The foundations of sustainable design were derived from ancient building techniques that were regularly updated as the 1890s and its associated activities evolved. As a result, the most recent efforts to promote sustainable architecture may be traced back at least five decades to the first Earth Day and the subsequent environmental movement and governmental engagement around the world.

Most environmental legislation dating back five decades, however, must be re-examined in light of current environmental challenges, such as climate change. This is cause enough for the building sector's stakeholders – consumers, builders, architects, and designers – to demand better building practices to solve the issue originating from one of the world's most environmentally harmful industries. The construction industry, for example, accounts for 49% of CO2 emissions in the United States.

Sustainability is becoming more important in modern design. Iso, BREEAM, and other responsibilities for achieving quality policies is applied to assure sustainable construction. Similarly, ethically architects are continuously striving hard to achieve these worldwide standards and demonstrate their commitment to sustainability. Nonetheless, a few architects and builders still utilize phrases like "sustainable," "environmental," and "ecologically" in their marketing materials. So, in addition to current knowledge and awareness, more must be done to make sustainable architecture the standard.

The following is a research summary:

- Development that is sustainable
- Architecture that is environmentally friendly
- Islamic Architecture's Sustainability
- Modern Architecture and Sustainability
- Case studies and applications

1-Sustainable development

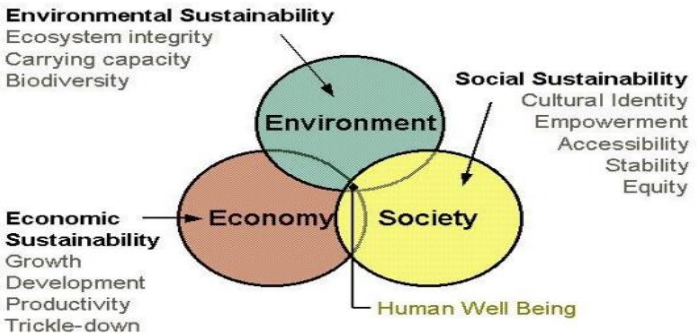
Sustainable development satisfies human needs while maintaining the environment, ensuring that these requirements are addressed not just now, but also for future generations (United Nations,1987)

Since the birth and widespread adoption of the idea of sustainable development, which proved beyond a shadow of a doubt that economic expansion cannot be sustained in the face of environmental pollutants, waste, the destruction of key systems, and natural resource depletion.

2-Sustainable architecture

In the realm of architecture, sustainable architecture is a broad word that refers to ecologically mindful design practices.

As shown in Figure 1, the environmental impact of urban, rural, and construction activities and structures have economic dimensions.



The key objective of Fig.1 is to create a sentient environment.

In general, sustainability lowers the negative consequences of climate change by enhancing productivity and being more conservative with resources, energy, and technological innovation, and it must also integrate a blend of artistic, ecological, social, geopolitical, and humanitarian purposes.

The following are the major sustainable architectural principles (Fan Shu-Yang, 2004):

- Being attuned to nature
- Impact on the environment
- Accepting Co-creative Approach
- Interpersonal Awareness (community needs).

3-Sustainability of Islamic Architecture

Environmental limits in various places and climates were dealt with by Islamic architecture and urban planning, which converted them into constructive design tools.

From the area, the city, the house, the garden, and the solitary architectural feature, Islamic architecture has numerous faces for achieving sustainability.

Despite the fact that the environmental approaches utilized in the construction of Islamic structures were extremely relevant modern architecture, they appear to have been lost.

Buildings in this area were made of the most basic materials available locally prior to the advent of climate control, open concept, and external cladding, and interiors were engineered to be cold in warm temperatures and warming in cooler temperatures.**3-1 Islamic architecture with**

Sustainable principles in architecture

Islamic architectural ethics supplied a source of construction materials that reflected architectural components such as social, ethnic, metaphoric, and spiritual aspects of green architecture, all of which had been refined over time to enhance, alter, or even conceal its workable foundations. Because Islamic towns and environs are characterized by dryness, little rainfall, high solar radiation intensity, high radiation losses at night, and consistent relative wind in daily and seasonal patterns, they developed building strategies that are in harmony with climate data, such as:

Salsabil: A granite plaque is placed in a hole on the other side of the room or in a sitting position to absorb moisture and allow it to flow over the top, facilitating absorption and increasing air humidity.

Roofing: Vaulted ceilings in the shape of a region or 1/2 of a cylinder (vault) should always be used to help lower the roof warmth by improving the velocity of air passing over the contour (Mustafa Ibrahim, 1992).

Sahn: It is a centrally located internal open space (a courtyard).It has a rectangle or square shape and is utilized to allow fresh air into the structure. Figure 1 shows some easy morning activities in the sahn (E. Richard, 2003). (2).

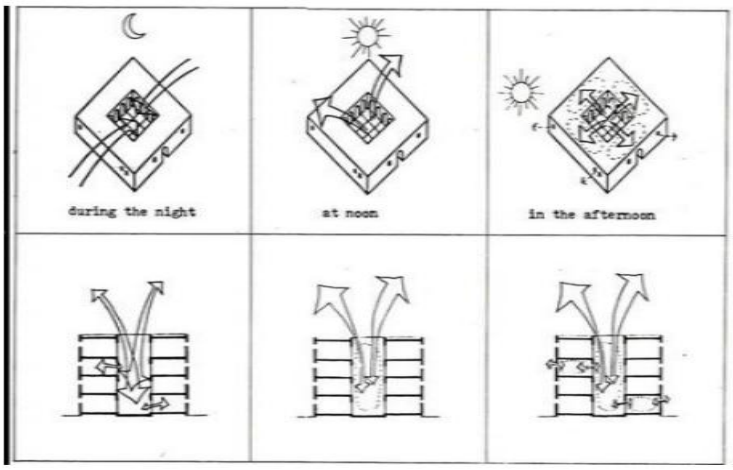


Figure (2), Illustrates the form and function of sahn

Iwan: It's a space with three closed walls and one fully open wall that faces the Sahn.

Its primary purpose is to improve natural ventilation and bring fresh air into the Iwan. (Doris, 1996), as seen in Figure (3).

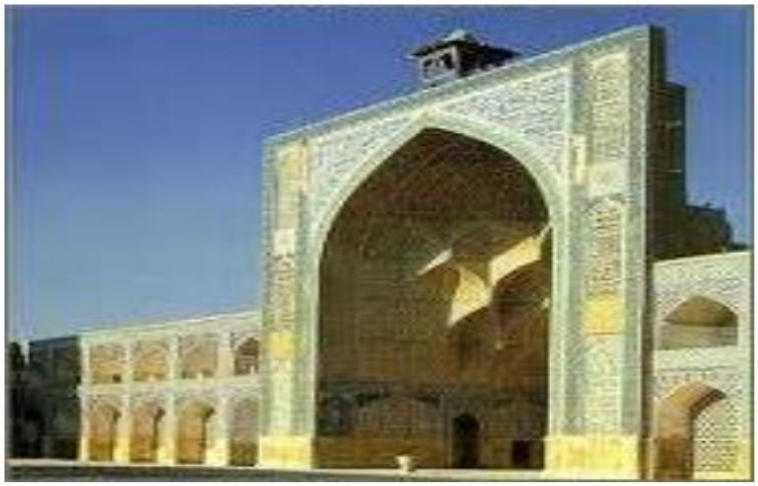


Figure (3), Great Mosque of Esfahan, View of the north iwan from the sahn

Sirdab (crypt): It is an opening that strives to shine on the terrace by allowing a passage of chilly air to displace the amusement area for generative heat and light into space, as well as the belief in maintaining natural ventilation (Mustafa & Ibrahim , 1992).

Al-Takhtabush: It is a wooden floor located above the basement to take advantage of the cellar's low-temperature air. A wooden frame with metal mesh serves as its entryway.

Al-Shokhshikha: It's commonly utilized to offer ventilation and indirect illumination in large venues. It also works with Almalqaf (wind catcher) to control air temperature by ejecting hot air from the top of the room and sending cold air to the interior. Figure from (Kamal, 1970). (4).

Figure (4), Illustrates how Al-Shokhshikha provides ventilation and indirect lighting

Al-Mashrabeya: A uniform geometrically exact grid of round wooden section units spaced by preset distances. It's highly complicated; it regulates air and light while also providing seclusion, as shown in Figure 1. (5).

Figure (5), Illustrates How Al-Mashrabia controls air and natural light in addition to provide privacy.

Fountain: The Sahn is normally placed in the middle. Its purpose is to provide the sahn an attractive aspect while also mixing air with water to create wet air that can later be moved into interior rooms. (Kamal , 1970)

(catcher of the wind): is a fanned rises above the structure and has a slot corresponding to the pavilion wind direction to pick up the air flowing over the building, which is usually colder and pushed into the building (Doris.,1996)as shown in Fig (6).

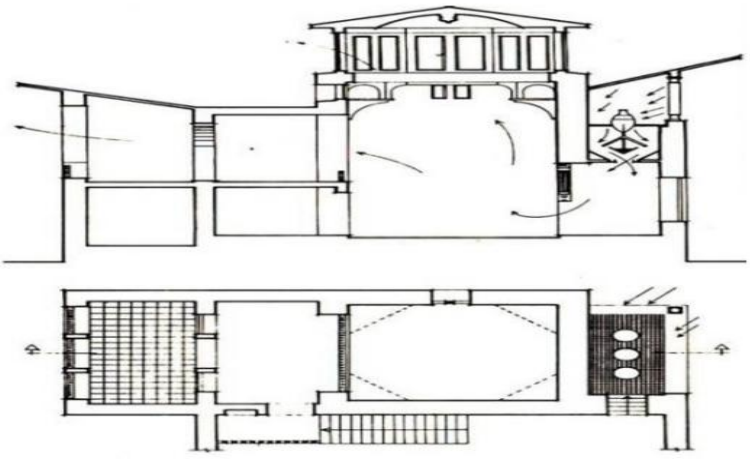


Figure (6), Illustrates the function of malqaf and the direction of the pavilion wind in the build

4- **Architecture Today's Sustainable development**

Sustainable design (also known as environmental design) is a concept of designing physical products, the urban design, and services in accordance with economic, social, and regulatory environment.

The following are the major goals of contemporary sustainable architecture (W., Terry, 2002):

• Pollution Prevention (including Indoor Environmental Quality and Noise Abatement)

• Environmental Harmonization (including Environmental Assessment)

• Systemic and integrated approaches (including the Environmental Management System)

4-1 Sustainable design methods in modern architectural

The entire aim and objective of ecological design is to find solutions that benefit building users quantitatively, qualitatively, physically, and psychologically.

There are numerous techniques to achieving this ostensibly tough task, including:

- **Conserving of Energy:** Energy conservation is a way for lowering input costs.

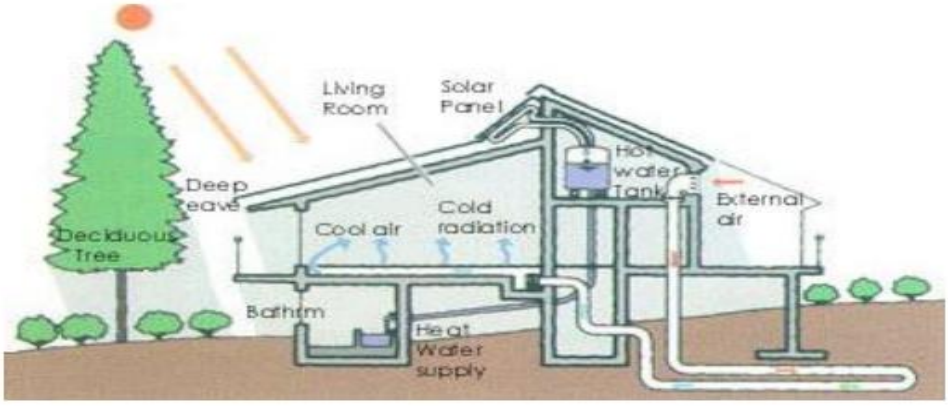
Structures need energy during construction as well as during operation, such as heating, lighting, and cooling. There are several ways to reduce a tower's energy requirements:

- **Photo-voltaic (PV):** Photovoltaic semiconductors are used to convert solar energy into direct current electricity, as seen in Figure 7. (7,8).

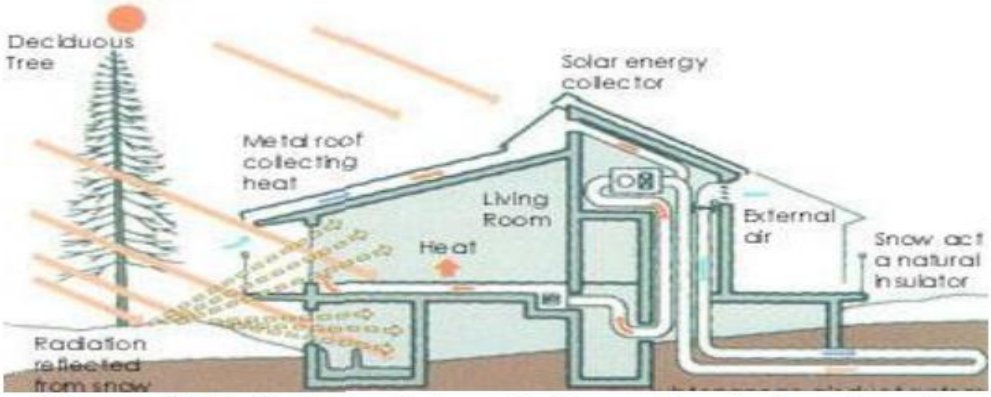
Fig (7), Solar cells produce electricity directly from sunlight

Figure (8), Photovoltaic system ' tree ' in Austria

The most significant source of energy for structures is solar radiation striking building surfaces. It provides the essential heat, light, and UV radiation for photosynthesis, as shown in Figure (9,10).



Fig(9) In summer, external air is conditioned using a subterranean air duct system. Heat from the roof is used to heat water



Figure(10) Cold winter air is preheated using the solar energy collector on the roof and the subterranean air duct system

Low-emissive (low-E) glass: It is intended to let in less light and heat from the sun into the interior of the structure (Drake, 2007).

Low-E glass conserves energy in two ways all year long:

- On a hot summer day, the Low-E coating regulates the sun's heat by minimizing heat transfer through the glass. It reduces the quantity of solar heat gain into the structure by filtering short-wave radiation from the sun.

- During the winter heating season, the sun's energy is transmitted through the window as "SHORT WAVE RADIATION." After then, the energy is converted into long wave radiation. Long wave radiation prefers to move from hot to cold.

Of course, it will attempt to break away from the confines of the glass. When radiant heat from the space is reflected back into the structure, it creates a positive energy balance. the Low-E coating inhibits this.

As shown in Fig. 11, this results in a reduced winter U-value.

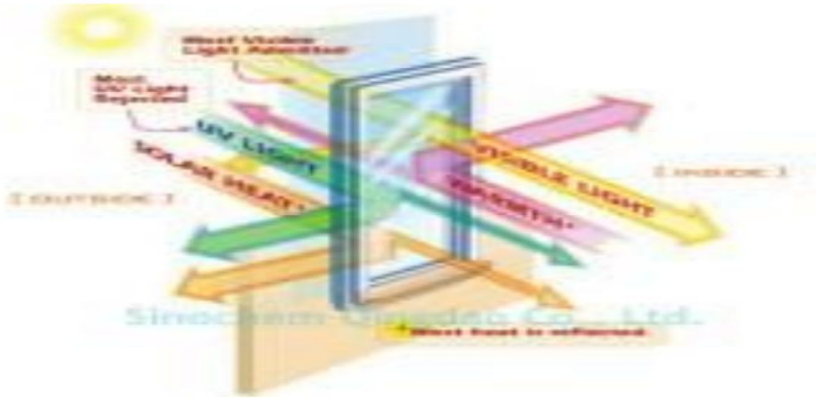


Figure (11) Low-E glass is a type of insulating glass

- Sun shading:

Sun shading, or regulating the amount of light that enters a structure, can be done in a variety of ways.

As shown in Figure, the strategies used are mostly determined by the environment and the usage of space (12).

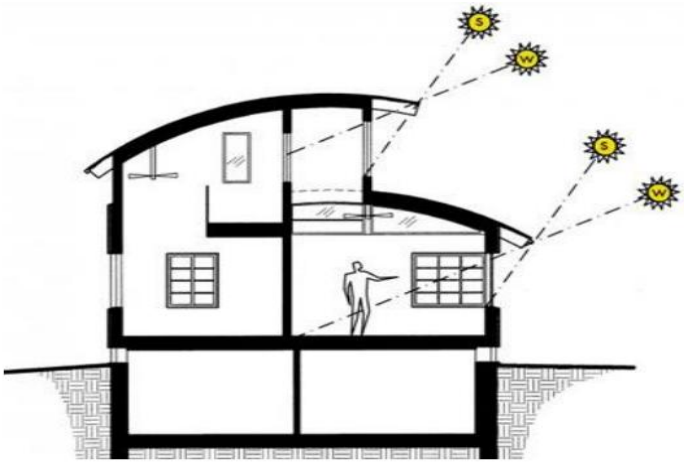


Figure (12), Passive solar diagram showing proper sun shading

Landscape, roof overhangs, and external or interior shading devices are the three primary types of shading devices. Although each has advantages, a combination of solutions is usually the best option because different tactics may be appropriate for different building orientations.

- **Green space:** Plant selection and location around structures can help to maximize the favorable effects of sunshine and airflow while reducing their negative consequences.

Plants are a low-cost, long-term investment in energy savings.

These could be used to supplement energy-saving design features such as passive solar heating, day lighting, and natural ventilation, as shown in Figure (Gregg D, 2003). (13)

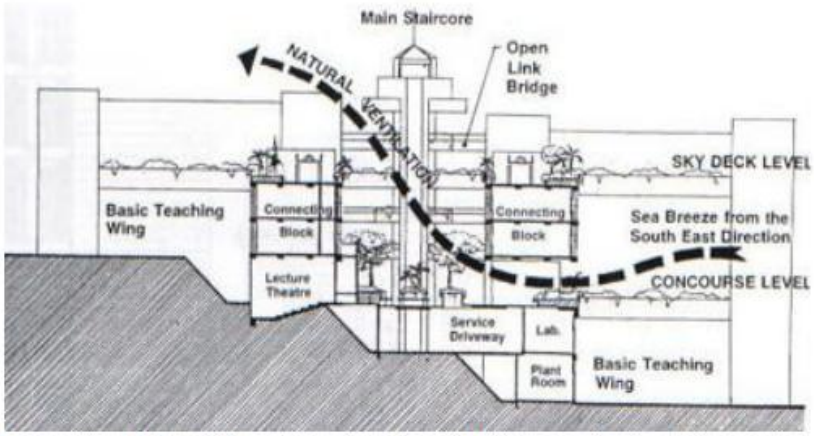
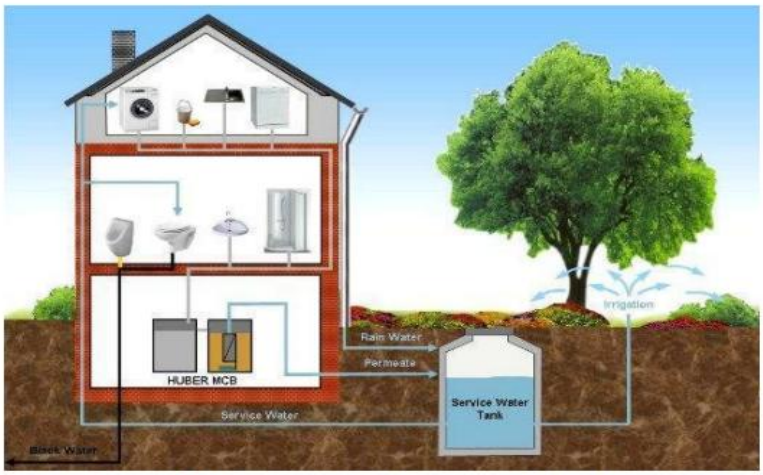


Figure (13), showing naturally ventilated courtyard

• Water Conservation

Water conservation methods can reduce input, output, or both. This is because, in the past, municipal water treatment plants treated both the water supplied to a building and the water that exited the building as sewage (grey water), as illustrated in Figure (14).

As a result, cutting back on usage also means cutting back on waste.



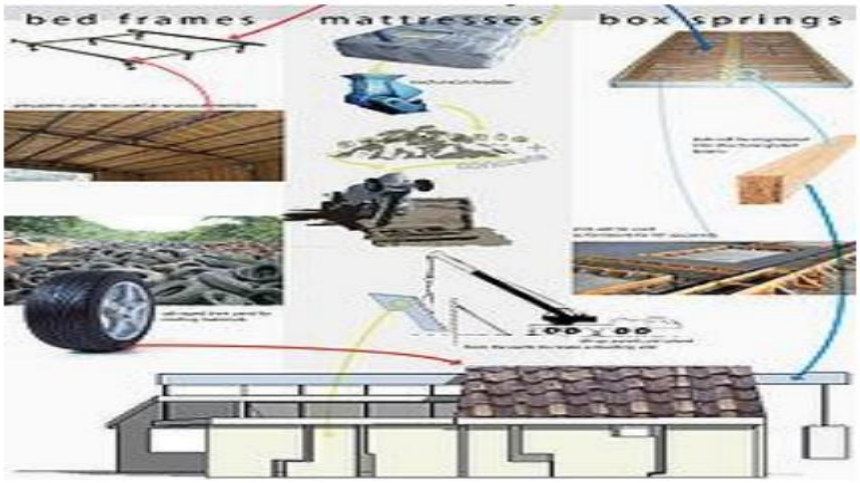
Figure(14): grey water treatment and reuse in watering gardens and flush toilets.

- Materials Conservation

The production and consumption of construction materials has a variety of local and worldwide environmental consequences.

Extraction, processing, manufacturing, and shipping building materials all have an environmental impact.

As shown in Figure 1, reducing the usage of new materials reduces embodied energy (energy consumed in the creation of materials) (15).



Figure(15) Recycling items for building

5- Case studies and projects those are both analytical and applied

Previously, a variety of sustainable architecture themes were debated, ranging from past (Islamic architecture) to present (Sustainability in Contemporary Architecture), all of which were seen as paving the way for future sustainability. The research will then examine and contrast four case studies of Islamic and modern architecture.

Conclusion

Eventually, the research revealed that sustainability was implemented in a variety of ways throughout history, and this table summarizes the distinctions in sustainability application between historical and contemporary situations previously investigated.

Which factors influence the long-term viability of a structure?

Here are some sustainable architecture features to look for:

- A commitment to reducing human environmental effect.
- Installing water-saving systems, such as those that recycle gray water or collect rainfall..
- Developing more perfect structures to meet the growing demand for environmentally friendly homes while using the least amount of energy and land. Microapartments, tiny dwellings, and other small constructions are examples of these types of structures.
- Using recycled shipping containers to construct alternative apartment complexes and residences.
- Using waterways to introduce floating architecture to address the rising need for housing in densely populated coastal locations.
- Incorporating nature through ideas like forest condo towers, rooftop gardens, and living walls decreases indoor temperature and to makes the environment cleaner and much more popular and widely for people.
- Using living walls and green roofs to provide a sustainable refrigeration fan for the comfort of the building's residents.
- Ensuring that new buildings blend in seamlessly with the surrounding environment.

- Reducing energy use by using natural ventilation, cooling, and heating systems, solar panels, and other renewable energy sources.
- Creating buildings that have a net-zero energy effect, meaning they produce as much energy as they use.
- Using renewable building materials such as soy, flax, cork, hemp, and bamboo.
- Using eco-friendly materials rather than traditional ones. For example, revolutionary bioplastics vs. traditional plastics, or hempcrete vs. concrete (hempcrete is a mix of water, lime, and hemp) (bioplastics are made from algae).
- Using up cycled and recycled materials, as well as flexible and adaptable environments made of easily recyclable natural materials.

In contrast to the abilities connected with construction in general, architecture is the art and technique of planning and building. Although it refers to both physical structures and the study, science, and art of building design, architecture is derived from the Latin term "architectura" or the Greek word "arkhitektion," where Arkhi means "chief" and tektron means "builder." A successful edifice must meet three requirements, according to Macus Virtruvius Polio Roman Architect, the oldest known written treatise on architecture from the first century AD. Firmitas, or a structure's toughness and longevity; utilities, or its suitability for the purpose for which it was built; and Venus as, or beauty, meaning the building should be aesthetically beautiful, but the fundamental challenge is how can architecture be sustainable?

Sustainability is architecture goes a long way to address the negative impacts on the environment society and buildings in general by utilizing the design methods, materials used, energy and development of spaces. It is to ensure that there is disadvantage to the ecosystem or surrounding communities. The idea behind sustainability in architecture is to ensure that the actions taken

today do not result in any negative consequences for future generations and to ensure compliance with the principles of social, economic and also ecological sustainability.

First of all sustainability in architecture into consider the need to into account the natural resources and also the conditions at the site, incorporating all these into the design of all structures. It also means utilizing material that can also minimize the structure's environmental footprint, be it energy. Intensive manufacturing processes or long distances.

Designers working on sustainable design should think about waste-harvesting technology. "How can we ensure that architecture is sustainable?" becomes the question.

Long-term architecture begins with research. The first step is to assess the natural conditions and obstacles that exist on the property. It is also the appropriate time to check on local authority's regulations and requirements in ensuring that the right person is met to discuss details of your project. Secondly many people put up construction of things by actualizing the design.

Sustainable construction aims to employ materials and practices that have a lower impact on the environment's ability to function. Using locally produced building materials and employing local laborers, for example, reduces transportation emissions.

Environmental damage should be reduced by pollution-free construction processes and industries. Sea and air. Natural habitats must be protected where as contaminated landscapes can be reversed. Any resources employed in the process of building should have a planned replacement.

Architects must specify environmentally sustainable materials throughout their entire life cycle, from initial manufacturing through end-of-use recycling.

Building materials that are natural, biodegradable, and recyclable have gained popularity in recent years. The development of renewable water and energy sources is becoming the new priority. Human resource development is an important component of the notion of sustainable

architecture. Communities based on the principle of sustainable development may seek to provide ample educational resources, career development possibilities, and social services. In addition, economic, social, and environmental factors must all be balanced in a harmonious manner.

This ensures that business and economic activities are viable in the equation of sustainability in architecture, without that it would be impossible to achieve meaningful sustainability

There exist three (3) main characteristics of sustainable architecture projects

These are:

i. Environmentally- friendly building materials.

ii. Energy and resource efficiency

iii. Efficient use of space in view of all these three main characteristics of architectures sustainability, putting up buildings with materials that are environmentally friendly is paramount in the sense that a sustainable architect must chose to employ environmentally-friendly materials with respect to its ability to undergo recycling or renewing as well as those that requires lesser energy in its manufacturing.

The focus is mostly on locally obtained woods and stones hence reducing the distance travelled by materials before being used in the contraction process.

This goes a long way to support local trade

Secondly sustainable architecture is underpinned by the philosophy that seeks the promotion of sustainable energy source. Energy efficiency design must incorporate renewable energy sources such as wind, thermal, and solar. Properties that are designed

to be energy efficient must be oriented to take advantage of seasonal changes in the sun's position.

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