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Necessity of sustainability in architectural practices for achieving sustainable development

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Abstract
The purpose of this research is to highlight the rising need of sustainable architecture for ensuring sustainability in development of present era. This paper specifies the definition of sustainable architecture and covers the need, aspects and advantages of sustainable architecture and green architecture in particular. It brings to fore the importance of sustainable architecture for development in a sustainable way. It highlights the techniques and methods by which sustainability in architecture can be achieved and adopted with its benefits to the environment as well as the society.

Keywords: Architectural practices, sustainable development

INTRODUCTION

Before discussing about sustainable architecture sustainability has to be defined. Sustainability does not have a rigid definition, but few major aspects of sustainability are given here:-

- Sustainability is an attempt to merge ecology and economy into one system.
- Sustainability means living a life of dignity in harmony with nature.
- Sustainability means renewing resources at a rate equal to or greater than the rate at which they are consumed.
- Sustainability means living within the resources of the planet without damaging the environment now or in the future.
- Sustainability means creating an economic system that provides for quality of life while renewing the environment and its resources.
- A sustainable community is one that resembles a living system where all of the resources (human, natural and economic) are renewed and in balance for perpetuity.
- Sustainability is creating a world where everyone can have fulfilling lives and enjoy a rich level of well-being within the limits of what nature can provide.
- Sustainability means taking the long-term view of how our actions effect future generations and making sure we don't deplete resources or cause pollution at rates faster than the earth is able to renew them.

What is sustainable architecture?

Sustainable architecture is a term that describes environmentally conscious design techniques in the field of architecture (1).

In the broader context, sustainable architecture seeks to minimize the negative environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space. The idea of sustainability, or ecological design, is to ensure that our actions and decisions today do not inhibit the opportunities of future generations. The term can be used to describe an energy and ecologically conscious approach to the design of the built environment.

Present day need of sustainable architecture

The modern day construction is largely based on the materials derived from the surroundings around us i.e., the environment. Construction activities use the forms of energy and the natural resources on a large scale with the production of huge quantities of by-products. This is leading to the consumption of the resources of the earth on a much faster rate than the regeneration of these resources. Similarly the production of tonnes of by-products is introducing unwanted materials into the environment as a result, further polluting it. The present day world is experiencing a number of problems like the different kinds of pollution (air, water, land and noise pollution), shortage of the natural resources etc.

All this highlights the very need of protecting the environment and preserving it for the future generations, points towards the high need of adopting a sustainable way of construction and architecture.

Green Architecture

Green architecture is a method of design that minimizes the impact of building on the environment. Green architecture is an outcome of a design which focuses on increasing the efficiency of resource use.

Concept of Green Architecture:

The concepts about green architecture can generally be organized into several areas of application. These areas include sustainability, materials, energy efficiency, land use, and waste reduction.

The concept of green building stems from effective utilization of energy resources including sunlight, electricity and water. It is more about sustainability, aimed at creating healthier and more resource efficient models of construction, renovation, operation, maintenance, and demolition.

Typical principles include climate-responsive design, use of local and sustainable materials, water harvesting, etc.

Advantages of sustainable architecture

- Efficient technologies: Green buildings incorporate energy and water efficient technologies that are not as readily available in traditional buildings. These technologies create a healthier and more comfortable environment as they utilize renewable energy, reduce waste, and decrease heating and cooling expenses.
- Easier maintenance: Green buildings typically involve less maintenance. For example, green buildings generally do not require exterior painting every three to five years: this simple method helps saves the environment, as well as a consumer time and money.
- Improved indoor air quality: With green buildings, the indoor air quality is improved via natural and healthy materials: green buildings utilize clean energy sources such as solar and wind power, rather than burning coal.
- Return on investment: Considering the average lifecycle of a building (50-100 years), certain green building measures, such as installing solar panels or doubling the amount of installation, can yield a strong return on investment and lead to higher resale values.
- Energy efficiency: Green building methods make the most out of energy, resources, and materials. As enforced by The Department of Energy (DOE), builders and design professionals must adhere to energy code requirements. For more information, visit Building to Energy Code.
- Tax incentives: Incentives exist on a local, state, and federal level to support building green initiatives.

Sustainable Building Methods

The layout and design of a building and grounds has an impact on energy and water consumption (2). A well-planned site will preserve much of the natural vegetation, increase the energy efficiency of the building, and reduce the amount of storm water leaving the site. In addition the amount of excavation required can be reduced, thus reducing construction costs and environmental impacts of the construction process.

SECTOR	End Use	Energy Savings Potential (%)
Residential	Lighting	53
	Refrigeration	33
	Water heating	23-28
	Space heating, new homes	19-39
	Space heating, existing homes	11-25
	Space cooling	16-23
Commercial	Space heating	48
	Space cooling	48
	Refrigeration	31
	Lighting	25
	Water heating	10-20

Cost-Effective Energy Saving Potential

Ref: www.umich.edu/~nppcpub/.../ARCHpdfs/ARCHdesIntro.pdf

A comprehensive site design can save money and increase the appeal of a property (National Association of Home Builders 2002). By implementing efficient technologies that save water and energy, developers, homeowners, and businesses can protect the environment while saving money. Every kilowatt (kW) of power that is not consumed reduces energy bills and decreases the amount of carbon dioxide and other pollutants released into the environment during the generation process. Each gallon of water that is conserved can help protect sensitive environmental areas, such as wetlands and streams, reduce the amount of energy required to clean the water, and lower water and sewage bills. Greater resource efficiency, in the form of energy and water conservation, results in cost savings, more so when several technologies are used in conjunction with each other.

Heating, ventilation and cooling system efficiency

The most important and cost effective element of an efficient heating, ventilating, and air conditioning (HVAC) system is a well-insulated building. A more efficient building requires less heat generating or dissipating power, but may require more ventilation capacity to expel polluted indoor air.

Significant amounts of energy are flushed out of buildings in the water, air and compost streams. Off the shelf, on-site energy recycling technologies can effectively recapture energy from waste hot water and stale air and transfer that energy into incoming fresh cold water or fresh air. Recapture of energy for uses other than gardening from compost leaving buildings requires centralized anaerobic digesters.

HVAC systems are powered by motors. Copper, versus other metal conductors, helps to improve the electrical energy efficiencies of motors, thereby enhancing the sustainability of electrical building components.).

Passive solar building design allows buildings to harness the energy of the sun efficiently without the use of any active solar mechanisms such as photovoltaic cells or solar hot water panels. Typically passive solar building designs incorporate materials with high thermal mass that retain heat effectively and strong insulation that works to prevent heat escape. Low energy designs also requires the use of solar shading, by means of awnings, blinds or shutters, to relieve the solar heat gain in summer and to reduce the need for artificial cooling. In addition, low energy buildings typically have a very low surface area to volume ratio to minimize heat loss. This means that sprawling multi-winged building designs (often thought to look more "organic") are often avoided in favor of more centralized structures. Traditional cold climate buildings such as American colonial saltbox designs provide a good historical model for centralized heat efficiency in a small scale building.

Windows are placed to maximize the input of heat-creating light while minimizing the loss of heat through glass, a poor insulator. In the northern hemisphere this usually involves installing a large number of south-facing windows to collect direct sun and severely restricting the number of north-facing windows. Certain window types, such as double or triple glazed insulated windows with gas filled spaces and low emissivity (low-E) coatings, provide much better insulation than single-pane glass windows. Preventing excess solar gain by means of solar shading devices in the summer months is important to reduce cooling needs. Deciduous trees are often planted in front of windows to block excessive sun in summer with their leaves but allow light through in winter when their leaves fall off. Louvers or light shelves are installed to allow the sunlight in during the winter (when the sun is lower in the sky) and keep it out in the summer (when the sun is high in the sky). Coniferous or evergreen plants are often planted to the north of buildings to shield against cold north winds.

In colder climates, heating systems are a primary focus for sustainable architecture because they are typically one of the largest single energy drains in buildings.

In warmer climates where cooling is a primary concern, passive solar designs can also be very effective. Masonry building materials with high thermal mass are very valuable for retaining the cool temperatures of night throughout the day. In addition builders often opt for sprawling single story structures in order to maximize surface area and heat loss.[citation needed] Buildings are often designed to capture and channel existing winds, particularly the especially cool winds coming from nearby bodies of water. Many of these valuable strategies are employed in some way by the traditional architecture of warm regions, such as south-western mission buildings.

In climates with four seasons, an integrated energy system will increase in efficiency: when the building is well insulated, when it is sited to work with the forces of nature, when heat is recaptured (to be used immediately or stored), when the heat plant relying on fossil fuels or electricity is greater than 100% efficient, and when renewable energy is utilized.

Passive Design Alternatives

After including every available conservation technique in a building design, the next step in decreasing the energy and water demands of the site are passive building designs. A passive design uses several techniques, included in the actual structural design and lot layout, to significantly reduce the amount of energy needed to heat, cool and light a building and also to reduce the runoff from the site, thus decreasing pollution and increasing infiltration of precipitation. Passive methods do not require any mechanical or electronic devices, soafter the design is implemented, minimal additional inputs are required (1).

Green roofs

Green roofs are lightweight, engineered roofing systems that protect the integrity of the roof and provide many benefits for stormwater management and energy efficiency. The “Stormwater Management Systems” section describes green roofs and the benefits for stormwater management. Below are additional benefits for energy efficiency.

Benefits of Green Roofs

- Reduced heating due to fewer fluctuations in roof temperature and insulating properties of vegetation
- Reduced cooling costs due to fewer fluctuations in roof temperature and heat loss due to evaporation in the summer
- Increased property value
- Extension of the life of the roof membrane because of protection from intense ultraviolet radiation and continued expansion and contraction due to fluctuating temperatures
- Noise insulation

Passive Solar Design

When sunlight strikes a building, the building materials can reflect, transmit, or absorb the solar radiation. Passive solar design maximizes the amount of solar energy absorbed and uses it to heat and light buildings. It is important to stress the need for high quality insulation when planning a passive solar design. There are three main considerations in passive solar design: building orientation, overhangs and shading, and thermal mass.

Benefits of Passive Solar Design

- Design is incorporated into building and lot design, so there is little or no upfront cost beyond the cost of the building
- Provides 30%-60% savings in heating and cooling needs
- No maintenance is required
- Benefits continue throughout the life of the house

Solar Hot Water Heaters

Hot water is the largest component of residential energy costs after heating and cooling. A solar domestic water heating system that is well designed will provide 50-80% of hot water needs, depending on the building’s geographical location and the time of year. Commercial buildings can achieve even greater benefits from solar water heating than residential if production of hot water is a major operating cost.In solar water heating systems, thermal energy from the sun is transferred directly to water through a simple design. The solar collectors are dark and readily conduct heat. When sunlight hits the collectors, the temperature of the collector is quickly elevated. When the collector sensor registers higher temperatures within the collector, a fluid, usually a water/anti-freeze mixture in colder climates is circulated through a closed loop system, passing through the solar collectors. Heat in the collectors is transferred to the fluid. The heated fluid then circulates through a heat exchanger, and thermal energy is transferred to water, producing hot water. The system is installed with an auxiliary water heater to meet 100 percent of a building’s hot water demands.

Recycled Materials

Recycling Items for Building

Sustainable architecture often incorporates the use of recycled or second hand materials, such as reclaimed lumber and recycled copper. The reduction in use of new materials creates a corresponding reduction in embodied energy (energy used in the production of materials). Often sustainable architects attempt to retrofit old structures to serve new needs in order to avoid unnecessary development. Architectural salvage and reclaimed materials are used when appropriate. When older buildings are demolished, frequently any good wood is reclaimed, renewed, and sold as flooring. Any good dimension stone is similarly reclaimed. Many other parts are reused as well, such as doors, windows, mantels, and hardware, thus reducing the consumption of new goods. When new materials are employed, green designers look for materials that are rapidly replenished, such as bamboo, which can be harvested for commercial use after only 6 years of growth, sorghum or wheat straw, both of which are waste material that can be pressed into panels, or cork oak, in which only the outer bark is removed for use, thus preserving the tree. When possible, building materials may be gleaned from the site itself; for example, if a new structure is being constructed in a wooded area, wood from the trees which were cut to make room for the building would be re-used as part of the building itself.

Lower volatile organic compounds

Low-impact building materials are used wherever feasible: for example, insulation may be made from low VOC (volatile organic compound)-emitting materials such as recycled denim or cellulose insulation, rather than the building insulation materials that may contain carcinogenic or toxic materials such as formaldehyde. To discourage insect damage, these alternate insulation materials may be treated with boric acid. Organic or milk-based paints may be used. However, a common fallacy is that "green" materials are always better for the health of occupants or the environment. Many harmful substances (including formaldehyde, arsenic, and asbestos) are naturally occurring and are not without their histories of use with the best of intentions. A study of emissions from materials by the State of California has shown that there are some green materials that have substantial emissions whereas some more "traditional" materials actually were lower emitters. Thus, the subject of emissions must be carefully investigated before concluding that natural materials are always the healthiest alternatives for occupants and for the Earth.

Volatile organic compounds (VOC) can be found in any indoor environment coming from a variety of different sources. VOCs have a high vapor pressure and low water solubility, and are suspected of causing sick building syndrome type symptoms. This is because many VOCs have been known to cause sensory irritation and central nervous system symptoms characteristic to sick building syndrome, indoor concentrations of VOCs are higher than in the outdoor atmosphere, and when there are many VOCs present, they can cause additive and multiplicative effects.

Sustainable building consulting

Sustainable building consulting is a practice or service where an intermediary party or company is utilized as a way to forecast levels of sustainability during conceptual architectural stages. This forecasting consists of the identification of adherent building techniques and norms, as well as the identification of specific building materials.

Norms and standards have been justified by rating systems like LEED and Energy Star for Homes which are performance-based. They define benchmarks to be met and provide metrics and testing to meet those benchmarks. It is up to the parties involved in the project to determine the best approach to meet those standards.

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