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Role of Green Buildings in Sustainable Construction Practices

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Abstract

The availability of natural resources in their pure form is limited. Human beings are responsible for the pollution and destruction of the land, air and water which have emerged as the nature's gifts upon the humanity to thrive upon. The concept of green buildings is a measure to alleviate the pressure put on by the building projects on the unscrupulous usage of resources on the society and the environment. Green buildings are the buildings certified by various rating systems built upon certain criteria based on conservation of natural resources and energy efficiency of buildings. This study focusses on the concept of green buildings in totality with a focus on the parameters for its consideration, benefits, applicability, scope of green buildings and green concepts in contrast to the conventional buildings.

Keywords: Green Buildings, Sustainability, Earth air Heat Exchanger, GRIHA and LEED rating systems

I. INTRODUCTION

The concept of conservation of energy can be traced back to the ancient history of the built environment where passive solar design was used to get solar heat in the winter season. The concept of green buildings is a measure to alleviate the pressure put on by the building projects on the unscrupulous usage of resources on the society and the environment. Buildings which are energy efficient and involve less consumption of water involve around the 3R's i.e. Reduce, Reuse and Recycle will be sustainable and effective in improving the country's gross domestic product (GDP). Green buildings refer to a structure or application of a process which is environmentally sound, sustainable and makes an efficient use of resources in all the stages including planning, design and construction, operation and occupancy. A green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use; energy, water, and materials while reducing the impact on human health and the environment during the building's lifecycle, through better design, construction, operation, maintenance and removal. The efficient use of renewable sources and the locally available materials, promoting use of recycled materials and waste materials in building construction without compromising on strength and stability would ensure a sustainable and efficient design of structures. Adoption of energy efficient materials, smart technology and use of smart gadgets, energy efficient doors and windows, use of solar energy in water heating and generating power, technique of rain water harvesting, landscaping the reduces usage of water are some of the few measures resorted to in the construction of buildings to transform them into a green building. The main focus should lie upon the reduced consumption of energy and resources being used in the construction and implementation stage of a project.

In the last ten years, several green buildings have been constructed in India, being certified to GRIHA and LEED rating systems. Nevertheless, the concept of green buildings has still not reached a noteworthy benchmark in the society. This study is an attempt to instil confidence amongst local communities, architects and people involved in the construction industry to create awareness about the advantages of a green building over a building constructed in the conventional style for sustainable development. The key aspects of green buildings include energy efficiency, conservation of natural resources, reuse of recycled or waste materials, reduction of waste generation to name a few. Construction of energy efficient buildings and maintaining high performance in compliance with the green criteria throughout the life cycle of a building would ensure greater human satisfaction in terms of socio-economic and environmental compliance.

II. NECESSITY OF GREEN BUILDINGS

In order to attain the sustainability goals, the gradual paradigm shift towards the green buildings is necessary:

- The environmental impact of building design and construction industry is significant.
- Buildings consume more than 20% of electricity used in India (BEE, 2008).
- Normal construction deprives land usage from natural biologically diverse habitats.
- Green Building practices can substantially reduce or eliminate negative environmental impacts and improve existing unsustainable design, construction and operational practices.
- As an advantage green design measures help in reducing running costs and mitigate indoor air quality problems.

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III. COMPONENTS OF GREEN BUILDING

The essential components of a green building would comprise of:

- Use of Efficient and Renewable sources of energy
- Water Efficiency
- Sustainable building materials
- Reduction in waste generation
- Toxics Reduction
- Indoor Air Quality

Sustainability aspect in building materials would mean the consumption of waste materials such as coal combustion residues such as fly ash, bottom ash, foundry sand, agricultural wates such as rice husk ash, rice straw ash, wheat straw ash, sugarcane bagasse ash, recycled materials such as construction and demolition waste in the building consumption would ensure reduction in the carbon footprint by reducing the consumption of cement, sand and natural aggregates in the manufacture of concrete which is the chief building material of construction. Thus, these waste materials replacing the conventional materials of construction would ensure reduction in consumption of conventional materials ensuring longevity of the resource bank for our future generation attaining the sustainable development goals.

The concept of 3 R's *i.e* reduce, reuse, and recycle holds ample importance in various stages of planning, building construction, renovation, deconstruction, demolition if any. Reduction in the generation of waste by the occupants of a building is another factor contibuting towards the green buildings category. Thus, various cost-effective and environment friendly solutions in the field of building construction is the need of the hour.

Indoor air quality is a critical component of constructing the green buildings designed to promote occupational health and comfort to the occupants of a building and ensuring durability of the structures. Minimal use of toxic materials, Zero VOC paints, formaldehyde free furnishing materials would ensure good health of the occupants of a building.

IV. GREEN BUILDING RATING SYSTEMS

The green buildings are rated by standard International and National agencies by evaluating the different parameters of green building in terms of energy efficiency. Comprehensive green building ratings commonly used include the LEED, Living Building Challenge and Green building rating systems act as a means in evaluating the overall performance of a building. GRIHA stands for "Green Rating for Integrated Habitat Assessment". This rating system is based on numerous criterions which are measures of sustainability in totality specifically focussing on minimal use of resources and reduction in waste generation. GRIHA rating system was developed based on the climatic conditions prevalent in India for buildings in different climatic zones of the country. GRIHA rating system was developed by TERI (The Energy & Resources Institute) as National Rating System after incorporating various modifications from time to time. This rating system includes the basic requirements of the National Building Code 2005, Energy Conservation Building Code 2007 of BEE and other Indian standards, local bye-laws in totality. It has a 100-point rating system with a set of 34 criterions of which some are mandatory. Some of them include site selection, planning at site, conservation and efficient utilization of resources, building operation practices, innovation in construction practices. The minimum qualifying score is 50 and rating awarded in 1-5 stars. Different star ratings are provided based on the number of points earned based on the listed 34 criteria. Buildings scoring 50 to 60 points, 61 to 70 points, 71 to 80 points, and 81 to 90 points get single star rating, two-star rating, three stars and four-star rating respectively. LEED is a nationally and internationally accepted benchmark for the design, construction and operation of high-performance green buildings developed by the U.S. green building council. There are four levels of certification with classification of being certified with 40–49 points, silver rating with 50–59 points, gold rating with 60–79 points, Platinum rating with 80 points and above.

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V COST EFFICIENCY OF GREEN BUILDINGS

The cost-benefit analysis of different categories of buildings proves that green buildings prove to be advantageous despite the hike in the investment required to build such buildings. The remuneration is obtained in a span of two to five years based on the LEED rating system (Satya et al. 2016). Constructing a green building by design is not at all costly in the long run. Popescu et al. (2012) pointed out that the benefits of energy retrofitting initiatives are reflected not only the cost savings derived from improved energy efficiency but also the potential value added to the property. Many of the recent green building projects certified by IGBC have demonstrated that cost of green building design and construction attracted insignificant incremental costs and few other projects have demonstrated leadership in bringing down the construction costs lower than conventional building's first cost. JLLM (2008) enumerated various operational savings and conservation of water with saving of 20–30% in green buildings and possibility of reuse of treated water for landscaping and air conditioning reducing the load on existing sewage system even more. Froeschle (1999) indicated that the environmental assessment process of building materials involves three basic steps such as research, evaluation & selection. He gave sustainable building material criteria as presented in Table 1.

Table 1: Sustainable Criterion for Green Building Materials Assessment and Evaluation (Froeschle, 1999)

Environmental Criteria	**Product**
Low toxicity	Materials the manufacturer demonstrates to have reduced toxicity or is nontoxic and avoids carcinogenic compound and ingredients.
Minimal emissions	Products that have minimal chemical emissions, emit low or no volatile organic compounds (VOCs), and avoid the use of chlorofluorocarbons (CFCs).
Low- VOC assembly	Materials installed with minimal VOC-producing compounds or no- VOC mechanical attachment methods and minimal hazardous.
Recycled content	Products with identifiable recycled content in the material including post-industrial content with a preference for post-consumer content.
Resource efficient	Products manufactured with resource-efficient processes including reducing energy consumption, minimizing waste, and reducing green house gases.
Recyclable	Materials those are recyclable at the end of their useful life.
Reusable	Building components that can be reused or salvaged.
Sustainable	Renewable natural materials harvested from sustainably managed sources and preferably that have an independent certification.
Durable	Materials that are longer lasting or are comparable to conventional product with long life expectancies.
Moisture	Products and systems that resist moisture or inhibit the growth of biological contaminants in buildings.
Energy efficient	Materials, components, and system that help reduce energy consumption in buildings and facilities.
Water conservation	Products and systems that help reduce water consumption in building and conserve water in land scaped areas.
Improves IAQ	Systems or equipment that promotes healthy IAQ by indentifying indoor air pollutants or enhancing the air quality.
Healthfully maintained	Materials, components or systems that require only simple, nontoxic or low-VOC methods of cleaning.
Local product	Building materials, components, and system found locally or regionally saving energy and resources in transportation to the project site.
Affordable	Building product life-cycle coast comparable to conventional materials or as a whole are within a project defined percentage of the overall budget.

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The steady increase in demand for green buildings has led to lowering of cost of green products, services and materials, thus making green buildings affordable. Nowadays many materials and services are being manufactured in our country on a large scale including high performance glass, wall & roof insulation, roof tiles, bamboo-based furniture, solar photovoltaics to be installed in buildings, Wind towers, Earth air heat exchangers or Ground source heat pumps, Building Management systems, etc.

VI UTILIZATION OF RENEWABLE ENERGY RESOURCES

There is a dire need to rely on the renewable sources of energy including solar energy, wind energy, geothermal energy, tidal energy, hydropower to the greatest extent possible and reduce dependence on the limited conventional sources of energy. There is immense potential to harness these renewable resources with latest technological skills and advancements. Solar energy can be used for water heating, generation of electricity, as solar cells meeting the need of direct lighting or in collateral for for the production of fuels to be utilized at a later stage for various purposes. Geothermal Energy has a vital role to play in maintaining the ambient temperature of a building and reducing the energy requirement for heating or cooling of a building based on varying climatic conditions. It is a well-known fact that heat is present in the earth's crust in huge quantities, and even more so in its deep inner layers of the earth, often located at unavailable depths to allow mechanical exploitation. The geothermal energy systems can be developed in the form of Earth-air heat exchangers (EAHE), which make use of a passive means for the heating and cooling of buildings, are becoming a promising technology in the construction of green buildings. EAHE utilizes the thermal energy contained in the soil at certain depths for meeting the cooling/heating requirement of buildings, reducing the consumption of conventional energy for built environments. The author addressed the issues of applicability of EAHE in Chandīgarh (India) (Sobti and Singh 2015) based upon literature review particularly in Indian context and keeping in mind the nature of soil and climatic conditions of the city. It was concluded that EAHE can either be used as stand alone energy systems in small buildings or in conjunction with the conventional energy systems for major portions of the year depending upon the climatic conditions prevalent.

VII CONCLUSIONS

Upon having a clear understanding of the concept of green buildings and having understood the environmental concerns and importance of the green building concept, working out the cost benefit and addressing the feasibility issues, there is a dire need to shift to the construction of green buildings. On a broader perspective, adoption of green practices i.e. saving on to the natural resources, cutting down on the generation of waste, usage of greener materials with a low carbon footprint would make our planet a better place to live in. Thus, this study is a means to review the various aspects pertaining to the green buildings and highlight them in order to infuse confidence on the adoption of green building concept on a wider scale.

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