IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON GREEN BUILDING DEVELOPMENT

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Abstract: Green Building is one of the most trending topic all over the world which is been put forward to reduce the significant impact of the construction industry on the environment, society and economy. The globe is an urgent need of sustainable and a smart development as the pollution and global warming is rapidly increasing all over the world. A climatic changes also been noticed and being experienced all over the world due to increase in the GREEN HOUSE GASES (CGH'S). There are already strict measures been taken to achieve a sustainable and eco-friendly development in further construction work. however, in the developing countries like India, china, Srilanka, Pakistan etc. they are far behind in achieving a sustainable development and eco-friendly construction. Also there is a lack of awareness amongst the people about this global issue in these developing countries like this paper presents need of sustainable development all over the globe especially in the developing countries like India, china which have a huge land mass and also developing rapidly and heading towards becoming the new superpowers of world soon in future. Also it includes the sustainable and economic studies with references to the Indian context with a supporting live recent case study of a newly designed and constructed luxurious residential bungalow in a small town in India. The case study is specially selected as a residential building which is designed and constructed as a sustainable and a green structure in a small town in the state of Uttar Pradesh. This paper will help Indian residential building develop sustainable and green by implementing easy, simple and economic techniques.

Index Terms **-GRIHA (Green Ratings for Integrated Habitat Assessment);IEQ(Indoor environmental Quality); LEED (Leadership in Energy & Environmental Design)**

I. INTRODUCTION

There are many definition of a green building as per different researchers. A green building depletes the natural resources to the lesser during its construction and operation. The aim of green building design is to minimize the demand on non-renewable resources, maximize the utilization efficiency of these resources, when in use and maximize the reuse, recycling and utilization of renewable resources. The concept of green building basically stands on four main points which are:-

- Reduction of the effects or rather the side effects of the structure on the environment.
- Improving and enhancing the health conditions of the occupants in the structure.
- Life cycle consideration during the planning and development process.
- Construction industry is one of the most rapidly developing industries all around the world.

At the same time the construction, the buildings produce green house gas emission, which are responsible for the global warming. This research paper will help developing green buildings and eco-friendly in India as it includes easy and simple ways to be implemented for achieving green homes and also the importance and long term profits involving green homes.

2. What Makes A Building Green?

A green or sustainable building is one which uses less water, optimizes energy efficiency, conserve the natural resources, generate less waste and provide healthier space for occupants. It often emphasizes taking advantage of renewable sources. National Building Code (NBC) provides the guidelines on energy consumption for green buildings in India. According to NBC green buildings save water (36-40%), save energy (30-40%) and save material (25-40%) compared to conventional buildings. The specific features of sustainable buildings are as follows:-

- Site selection with full respect to ecology of the area, existing environment and use of local materials
- Minimum consumption of energy by the building
- Minimum use of fresh water from external sources
- Maximum use of non-toxic, recycled and renewable material
- Highest indoor air quality without affecting the energy consumption
- Integrated Building Management System for control, monitoring, measurement and verification
- Innovation in design and construction technique
- Secured power infrastructure

3. Aspects of green building

3.1 Sustainable sites

Site selection and design play important roles in both reducing greenhouse gas emissions and helping projects adapt to the effects of climatic change. When planning a green building project, design and construction professionals will consider strategies to maintain an environmentally appropriate site. Strategies for sustainable sites include encouraging the development of an environmentally friendly transport plan, protecting and restoring the natural habitat, controlling storm water and reducing heat island effect.

3.2 Water Efficiency

We are going to face a Global water crisis in the near future according to U.S. Geological Survey. Urbanization, high population growth rates, climatic changes, lower precipitation amounts, higher temperature are the most important reasons behind ground water depletion. A hydrological study conducted by University of Arizona Cooperative Extension assess that, by harvesting rainwater, we will be able to minimize the devastating effects of droughts, rainfall runoff and non point source pollution. Rainwater collection also allows ground water accretion. Although rain water is non potable, it can be safely used for lawn irrigation, toilet flushing and washing cars. In residential buildings, the majority of water (between 50% and 80%) falls into the grey water category and can be collected for reuse. Grey water system can be introduced to save water. Grey water system is a method of collecting water that has been used for one purpose and then recycle it to use for other purpose. Green constructions ensure that water is harvested, used, purified, reused during entire construction period and also minimize water wastage and increasing recycling methods by installing mechanisms throughout the building life cycle. IGBC Green Buildings rating system encourages use of water in a self-sustainable manner through reduce, recycle and reuse strategies. By adopting this rating program, green buildings can save potable water to an extent of 30 - 50%.

3.3 Energy Savings

An energy deficient country, India is already unable to meet its energy demands and rapid urbanization is not helping. Green buildings are a clean way out at the consumer level. Buildings are designed to have correct sized rooms to let in fresh air, while cutting out heat. Energy density flyash bricks and energy efficient glasses are used which help reduce air-conditioning load. Terrace roofs are covered with material having high solar reflective index. Features like double glazed windows that allow light in while cutting the heat save lot of energy. Solar heating wind energy and gas-thermal energy are also used according to facilities available.

3.4 Waste Reduction

Recycling is an important environmental benefit. Flooring is largely done keeping in mind materials that could be recycle. Wood and PVC flooring is preferred as it is 100% recyclable. Water is recycled for flushing and horticulture. Conversion of waste into energy or organic manure is an added advantage. Similarly developers are asked to reduce construction waste, which thereby reduce the construction cost.

3.5 Material and Resources

Though green building materials often called green materials require high initial cost for making a building but leads to low energy consumption expenses and a low maintenance cost which results in decrease in the overall cost of the building.

Reuse and Recycling of materials to reduce waste production: Green buildings emphasize on the resource usage efficiency and also press upon the three R's - Reduce, Reuse and Recycle. Reusing elements of a previously constructed building can help in sustainable development and in waste management. Vintage brick salvage, wood wastes, materials from abandoned buildings, old docks etc. can be reused in construction of new building. Some building materials include a number of ingredients where certain components may come from recyclables (e.g. of materials with recycled content include cement, rebar, paint etc. During the construction phase, one goal should be to reduce the amount of material going to landfills. The waste generated during construction should be segregated based on its utility and should be sent for recycling. Well-designed buildings also help to reduce the amount of waste generated by the occupants as well, by providing onsite solutions such as compost bins to reduce matter going to landfills.

3.5.1 Regional materials: The goal of using regional materials is to support the use of indigenous resources, help the local economy and reduce the transportation impacts.

3.5.2 Rapidly Renewable Materials: Extracting certain raw materials can have an impact on biodiversity of the area. The renewable materials have the ability to grow back, but it takes time to re-establish ecosystems. In the meantime it may increase green house emissions and affect the other species. For this reason, it is important to use rapidly renewable materials that mature in 10 years or shorter life cycle such as bamboo, wool, cotton insulation, linoleum, wheat board, straw board, cork etc.

3.5.3 Durable materials: Products should stand for a long time and require little maintenance. This will save time, money and energy on repairs at a later date.

3.6 Indoor environmental quality (IEQ)

IEQ is designed to offer comfort, productivity, and well being of occupants in buildings. Proper ventilations and air filtrations are included to ensure sufficient flow of fresh and clean air. Exhaust systems in bathrooms and kitchens should be adequately designed to maintain indoor air quality. The materials used in the interior of buildings are also should be eco-friendly with zero VOCs (Volatile Organic Compounds).Other techniques are no smoking, fixing leaks, eliminate aerosols, pet cleaning, planting, car exhaust control etc.

4. MOST POPULAR RATING SYSTEMS IN INDIA

(A) GRIHA: GRIHA or Green Rating for Integrated Habitat Assessment is the national rating system of India for any completed construction. It has been developed by TERI (The Energy and Resources Institute) and is endorsed by the MNRE (Ministry of New and Renewable Energy).It is an assessment tool to measure and rate a building‘s environmental performance. Griha is a point based rating system that consists of 34 criteria categorized under various sections such as site selection and site planning, conservation and efficient utilization of resources, building operation and maintenance, innovation etc. It helps with the improvement in the environment by reducing GHG (greenhouse gas) emissions, reducing energy consumption and the stress on natural resources, reducing pollution loads and waste generation. Some GRIHA rated buildings are CESE (Centre of Environmental Sciences and Engineering) building of IIT Kanpur, Suzlon One Earth in Pune, Fortis Hospital in New Delhi, and Common Wealth Games Village in New Delhi.

(B) IGBC: Following the formation of the Indian Green Building Council (IGBC) in 2001, the membership quickly realized the need for measuring ―green buildings‖. IGBC is the non -profit research institute having its offices in CII-Sohrabji Godrej Green Business Centre, which is itself a LEED certified building. Since it achieved the prestigious LEED rating for its own centre at Hyderabad in 2003, the Green building movement has gained tremendous momentum in India. Thus, IGBC adopted the LEED for India as an Indian partner of USGBC. It acts as a channel for registration of Indian projects under LEED programme. IGBC building rating system is quite similar to that of USGBC, but slightly modified to suit Indian conditions. The committee included architects, engineers, building owners, developers, manufacturers and industry representatives.

(C) BEE: Bureau of Energy Efficiency (BEE) developed its own rating scale based on 1 to 5 star scale. More stars mean more energy efficiency. BEE has developed the Energy Performance Index (EPI). The unit of Kilo watt hours per square meter per year is considered for rating the building. The Government of India set up BEE on March, 2002 under the provisions of Energy Conservation Act, 2001. To coordinate energy efficiency, they establish systems and procedures to measure monitor and verify energy efficiency results in individual sectors as well as at macro level. The Indian Bureau of Energy Efficiency (BEE) had launched the Energy Conservation Building Code (ECBC) on February 2007. The code is set for energy efficiency standards for design and construction with any building of minimum conditioned area of 1000 Sq. mts and a connected demand of power of 500 KW or 600 KVA. The energy performance index of the code is set from 90 kW·h/sqm/year to 200 kW·h/sqm/year. Any buildings that fall under the index can be termed as "ECBC Compliant Building". Reserve Bank of India‘s buildings in Delhi and Bhubaneswar, CII Sohrabji Godrej Green Business Centre and many other have received BEE 5 star rating

5. BENEFITS OF GREEN BUILDINGS

The green buildings reduce certain negative impacts through more effective planning, design, construction, and operation based on the guidelines of green standards. Savings on energy costs and maintenance costs make green building especially attractive to owners. Moreover it provides the users to have good health condition, comfort and an improved overall quality of life. Thus, Green building construction is advantageous in social, economical and environmental aspects. These advantages are mentioned in the following:-

- Conservation of scarce national resources.
- Reduction in energy consumption without sacrificing the comfort levels. Energy savings could range from 30 - 40 % (as mentioned in National Building Code), which directly reduce energy bills.
- According to National Building Code (NBC),green buildings save material to about 25- 40% compared to conventional buildings.
- Reduction in destruction of natural areas, habitats, biodiversity etc. and prevent soil loss from erosion.
- Reduction in air and water pollution (with direct health benefits).
- Reduction in water consumption. Water is saved around 36 - 40% as mentioned in NBC.
- Limited waste generation due to recycling and reuse.
- Increase in user productivity.
- Enhanced image and marketability.
- Enhancing and protecting the health and well-being of the occupants.
- Heighten aesthetic qualities.
- Optimize life-cycle economic performance.

6. BARRIERS FOR GREEN BUILDING CONSTRUCTION IN INDIA

While green building practices are increasingly being adopted in India, there are few challenges and barriers too. They are as follows:

- Even today, a large section of Indian users is unaware of green buildings.
- Developers already go through a tedious process of multiple approvals and are apprehensive of the additional burden of green compliances in the list of approvals, which can potentially cause more delays.
- The lack of inadequacy of mandatory laws to enforce large-scale implementation of green buildings norms is not helpful.
- There are very few incentive plans, and those that exist vary across states and even cities, depending on different governing bodies.
- In India, architects, engineers, contractors and workers possess less skills and the knowledge required for green buildings construction.
- The initial cost for green building construction definitely involve a higher cost than the conventional ones.

7. Prospects of Green Buildings and Their Development

The construction of Green Building mainly focuses on reduction of electricity and water consumption. Lighting loads are biggest consumption points of electricity in buildings. Usage of Sky lights maximizes the day lighting thereby reduces usage of artificial lighting. Photo Voltaic cells are to be installed on the roof top of building to generate the electric energy. Rainwater harvesting and waste water treatment plants are also to be installed within the building to conserve the water. There are lot of options available to build green homes, a few of those are energy saving air conditioners (HVACs), high performance glass windows, water saving solutions, composting toilets, and efficient building management systems. Green powering resource output and the connected electrical load of the private house spots including public areas of the small sized Green building, to the extent possible should get balanced. For huge constructions at least the public walk-a-way area lighting and lift and pumping loads should be met by the said resource. Usage of solar window technology could not only generate electricity through nano PV cells and miniscule wires, but also illuminates the indoor area spreading the sun light without losing transparency during day time. However generated electricity can be utilized for illuminating the same area during night hours. Molten salt storage tanks can be erected on the roof for storing solar thermal energy for several hours and its fluid can be circulated for heating water instead of conventional immersion water heaters and geezers.

8. CONCLUSION

If trees are cut off to clear up the plot for building construction, the same numbers of trees are to be planted elsewhere. Only this mentality of mankind can save the Earth from destruction. The condition of our planet at present is alarming. The anthropogenic activities mainly lead to such a condition. Scientists are keeping on working for invention of technologies which have less or no negative impact on Earth. The researchers state that building construction is one of the main causes of environmental degradation. They are responsible for a huge amount of harmful emissions, accounting for about 30 percent of greenhouse gases, due to their operation, and an additional 18 percent induced indirectly by material, exploitation and transportation]. Globally, buildings are responsible for nearly 40 percent of energy use (including 60 percent of electricity use), 40 percent of waste generated (by volume), and 40 percent of material resource use. In cities, buildings occupy 50 percent or more of land area. Buildings are responsible for not just a large percentage of the world‘s water use, but a large percentage of wasted water as well. In order to mitigate the effect of buildings along their life cycle, Green Building (GB) has become a new building philosophy, which uses more environmentally friendly materials, implements strategies to save resources and energy, lowers waste generation, improves indoor environmental quality, reduces harmful gas emissions etc. This might lead to environmental, financial, economic, and social benefits. For instance, savings in operation and maintenance costs in GBs can be realized through the installation of high-efficiency illumination and insulation systems or through a suitable material.

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