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A REVIEW ON SUSTAINABLE DEVELOPMENT BY CONSTRUCTING GREEN BUILDINGS IN INDIA

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ABSTRACT

Since the late twentieth century, the construction industry has seen significant transformation. Because the demand for housing is expanding in tandem with population growth, it must be met with all available resources. The energy resources available to humanity, on the other hand, are limited and fast dwindling. In the long run, this will have a huge impact on the situation because the demand cannot be met with the available resources. As a result, resources will be depleted to a large level, causing serious problems. There are several alternatives for dealing with this scenario. Green building construction is a viable option that can be employed instead of traditional construction because it is more energy efficient. In general, the cost of constructing a green building is more than that of a conventional building, but the overall cost of the building, including upkeep, is lower. This research study focuses on the numerous facts and trends available for study about green construction, as well as the comparison between sustainable and conventional building.

Keywords: Green Building, Sustainable Building, Conventional Building.

Abbreviation – IGBC - Indian Green Building Council, GIRHA - Green Rating for Integrated Habitat Assessment, IEQ - Indoor environmental quality.

1. INTRODUCTION

Building facilities has been a human requirement for the majority of activities. Building construction, on the other hand, has both positive and bad aspects, not only during construction but also throughout operation and maintenance. The operational phase of a building, as well as its life cycle, is a crucial element in reducing energy, water, and material resources [Basten V et al., 2018]. Buildings now account for up to 40% of total end-use energy globally, with developed countries consuming the majority of their energy in this sector. The building sector has a potential savings of over 50%, making it a viable sector for addressing the concerns of global energy and climate change [Sharma and S. K. 2013]. "Going Green" appears to be the new and popular thing to do. Green construction is all the rage these days. However, there is a method for the common man to afford it. It's a simple statement to make, but it doesn't go into much information about how to deal with such a worldwide issue [S. S. Nagrale and Bais M. M. 2020].

2. WHY GREEN BUILDINGS?

A green building is a sustainable building that has minimal impacts on the environment throughout its life. For the purposes of this report 'green building' is understood to mean construction that makes efficient use of energy and resources in every aspect. This includes the production of building materials, and the design, use and eventual demolition of a building in any sector (commercial, residential, industrial, public buildings) and at all stages, from new buildings to “retrofitting” adapting existing ones [Bansal A.K. et al., 2004].

The life-cycle impact is predominantly in the energy consumed to heat, light and cool a building while it is in use. Over its lifetime, the embodied energy of building materials generally has a smaller impact on the climate. According to the US Green Building Council, the cost and amount of energy required to construct an energy-efficient office building is comparable to that of a traditionally designed structure, but there is a significant difference in operating costs [Kumar S. et al., 2010].

Green buildings have other benefits besides the obvious environmental ones. The structures are more comfortable, and people working in them become more productive, which adds to the overall economic gains. The asset values and rents of green buildings tend to be higher than for conventional structure [Parikh K. et al., 2011].

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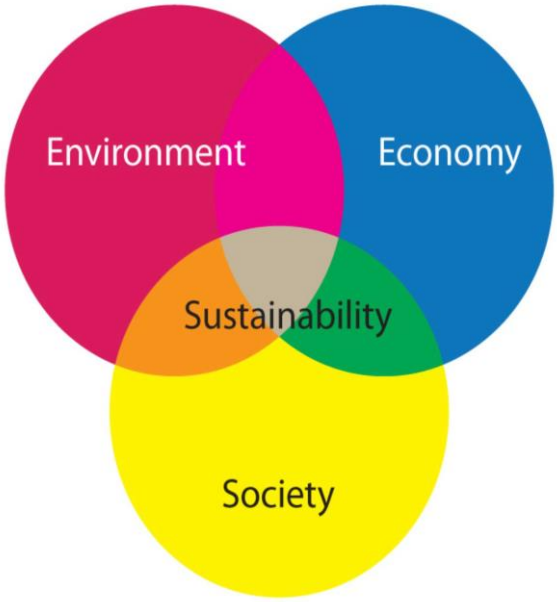

Figure – Concept of Green Building (Balancing Economic, Environmental and Societal benefits)

3. THE ROLE OF GREEN BUILDING IN CLIMATE

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.

3.1.1. Restore Habitat:

Green building can promote biodiversity by promoting and restoring surrounding habitats or conserve existing natural areas. Areas to avoid include prime farmland, flood plain, critical habitat, public parks etc.

3.1.2. Storm Water Control:

Storm water runoff can cause flooding, pollution, and significantly, soil erosion. Thus, storm water management is an important feature of green building construction. It is a process to treat, collect, reduce storm water runoff using plants, soils, microbes and engineered systems like underground detention tanks.

3.1.3. Heat Island Effect:

It is the absorption of heat by hardscapes and it is radiated to the surroundings altering microclimate and wildlife habitats. A microclimate is a local atmospheric zone where the climate differs from the surrounding area. These changes can affect native species and biodiversity. To avoid these outcomes, green building construction projects can implement strategies like shading, vegetation and installing surfaces with high solar reflectance indexes etc. Use of high albedo roofing material or heat resistant paint or china mosaic or white cement tiles or any other highly reflective materials over the roof to cover at least 50% of the exposed roof area is essential. Shade-giving trees are to be planted to cover at least 75% of the open parking areas [Shishegar N. 2014].

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 [Guggemos A. A. and Horvath A. 2006]. 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 [De Silva M. L. et al., 2013]. IGBC Green Buildings rating system encourages

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use of water in a self-sustainable manner through reduce, recycle and reuse strategies. By adopting this rating programme, green buildings can save potable water to an extent of 30 - 50%.

3.3. Energy and Atmosphere

Improving energy efficiency is one of the easiest ways to save money and improve the sustainability of a building.

3.3.1. Climate approach passive design:

Passive strategies such as shading, natural ventilation can reduce the demand on active mechanical systems. After observing that which part of the building receives sunrays during afternoon and incorporate shading strategies is an usual practice. Applying window film with an solar heat gain coefficient less than 0.3 helps in blocking the Sun‘s heat. Selecting light colors for roofing and exterior painting helps to reflect heat from Sun as dark color absorbs heat. Doors and window position and sizes should be designed such that it will allow air flow so that air conditioner is used as less as possible. Effective window placement can provide more natural light and lesser need for electric light during the day [Pawar A. S. 2012]. Green building should also incorporate energy efficient lighting (e.g. LED lights), low energy appliances, high efficiency pumps and filters. Properly maintaining building and associated systems will ensure optimal energy efficiency.

3.3.2. Renewable Energy: k2

Onsite generation of Renewable Energy through Solar power, Wind power, and Hydro power can reduce the impact on resources [Pawar A. S. 2012]. Substituting renewable energy for conventional energy can substantially reduce emissions of GHGs (Green House Gases) and other pollutants. Obtaining electricity from on-site sources can produce significant cost savings. Through IGBC Green Buildings rating system, buildings can reduce energy consumption through energy efficient - building envelope, lighting, air conditioning systems, etc. The energy savings that can be realized by adopting this rating programme can be to the tune of 20 - 30%.

3.4. 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 [Misra S. et al., 2016].

3.4.1. 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. [Misra S. et al., 2016]. 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 [Pawar A. S. 2012].

3.4.2. 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.

3.4.3. 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 [Sheth K. N. 2016].

3.4.4. 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 [Mehta G. et al., 2014].

3.4.5. Water efficient materials:

Water Conservation can be obtained by utilizing products, materials and systems that help to reduce water consumption in buildings and landscaped areas, and increase water recycling and reuse [Mehta G. et al., 2014]. Other materials that should be used are high reflective paints, high performance glass, low VOC adhesives, eco-friendly chemicals, solar water heaters, efficient pumps & motors, timer based control on lawn sprinklers, LED lighting fixtures, efficient BEE labeled air conditioners and refrigerators etc. Equipments used in the building are to be free from CFCs, Halons or any other ozone depleting substances.

3.5. 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

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kitchens should be adequately designed to maintain indoor air quality [Yu C. W. and Kim J. T. 2011]. 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. In the book 'Natural Capitalism' it is written that, 'Green buildings create delight when entered, serenity and health when occupied, and regret when departed' [Frontczak M. et al., 2012].

4. THE CASE FOR GREEN BUILDING IN INDIA

Green buildings can become a strong driver of economic growth and the prerogative to "build back better."
In India's fight against climate change, the evolution and extension of its building stock is essential. Building energy use accounts for more than 40% of overall energy consumption in the country and is growing at an annual rate of 8%. Buildings would account for nearly 70% of emissions by 2050 if current inefficient building techniques continue, posing a huge challenge to India's green objectives [Satya S. S. et al., 2016].
According to the International Finance Corporation (IFC), 70 percent of the buildings required by 2030 are yet to be constructed in India. If India were to embrace the concept of green buildings to meet this huge demand, it would be a win-win for the environment and the economy. The green buildings market in India is currently at a nascent stage of development, with only 5% buildings being classified as green. While this might come across as a challenge at the outset, it does open up a wide array of opportunities for the development of green buildings [Potbhare V. et al., 2009].
There are various arguments in favor of green buildings in India. The first, and perhaps most evident, is their impact on the environment, specifically on energy usage. In comparison to conventional structures, green buildings offer lower energy expenditures. Although the building and design expenses are higher at first, they are mitigated over time by lower maintenance expenditures and electricity bills. The CII Godrej green business centre, for example, was built at a cost 18 percent higher than a normal building at the time of construction. The building's costs, on the other hand, were recouped in just seven years. Similarly, the office of Spectral Services Consultants in Noda, which was built at an 8% greater cost, paid for itself in four years [Utsav Soni 2020]. There is, thus, an urgent need to generate awareness around the fact that sustainable is affordable and bust the myth that "building green" is "costly."
Given the pandemic and its repercussions, the appeal of green buildings has grown among residents and employees of both residential and commercial structures. Individuals are likely to be more concerned about their health, well-being, and comfort post-Covid, and would want to live in buildings with greater ventilation, abundant daylight, and fresh water availability. Respiratory and lung disorders linked to poor indoor air quality are three of the top five causes of death, according to the World Health Organization (WHO). Green building characteristics have been shown to have a favorable impact on health and well-being. Natural light is maximized in the design of green houses and offices, while artificial lighting is minimized. Natural sunshine has been shown to reduce stress levels, promote psychological comfort, and enhance employee productivity by about 15% in an office setting, according to research. Companies may therefore secure higher returns on their most valuable assets, their staff, by investing in green design and development [Medha Ahuja 2020].
Another compelling argument for green buildings in India is their role in accelerating the country's green economic recovery. Post-Covid, there has been widespread agreement to "rebuild better" and invest in sectors of the economy that can both produce jobs and promote green growth. Green buildings are an excellent way to achieve this goal.

5. PROMOTING GREEN BUILDINGS: A ROLE FOR GOVERNMENTS AND BANKS

In India, the green building industry is currently lacking in both technical expertise and financing to complete projects. These are still the most significant roadblocks to green construction, and they necessitate an entrepreneurial-regulatory state.
A number of government schemes have significant potential to provide an initial boost to the sector. The Pradhan Mantri Awas Yojana (PMAY) has been lauded for its potentially significant multiplier effects for the economy, including by providing an avenue for employment creation. If the scheme were to be pivoted towards building green, it would create even greater positive spillover effects for the economy. The PMAY and the Eco-Niwas Samhita, i.e., a green housing scheme, together can give a huge boost to the green residential buildings sector in the country.
The Indian government has also provided for numerous initiatives like the Green Rating for Integrated Habitat Assessment (GRIHA) to promote green buildings. This system restricts the use of resources by 30 percent as the ultimate goal. Government has mandated for all central government and PSU buildings to get at least 3-star ratings under GRIHA [Medha Ahuja 2020].
At the state level, several state governments have promised an increased floor-to area ratio (FAR) for GRIHA projects, incentivizing the developer to earn a greater profit by building green. For instance, the Andhra Pradesh

government offers a 25 percent subsidy on the total fixed capital investment of green projects obtaining a green rating from the Indian Green Building Council (IGBC). Due to these incentives, states like Tamil Nadu and Maharashtra have been able to build the highest number of green buildings in the country, according to a US Green Building Council (USGBC) report. The success of these pioneer state governments has begun incentivizing green construction and encouraged other governments to emulate the same. For instance, the Karnataka government has recently proposed to provide a series of incentives like reduction in property tax and stamp duty for building projects meeting certain green standards, following similar policies by Andhra Pradesh, Haryana, Punjab, West Bengal and Sikkim.

As per the Economic Survey of 2019-20, India requires an investment of US$ 1.4 trillion in the infrastructure space by 2024-25. In addition to government support, the banks can play a crucial role in facilitating investment for green buildings. Financing is a huge impediment in building green projects, as their initial cost of construction and design is high. Green projects require long-term investment, and banks can provide such investment by issuing green bonds to finance the construction of green buildings. In India, SBI, Yes Bank, Exim Bank, and Axis Bank are a few banks that issue green bonds.

Banks might tie home loan interest rates to building green ratings. To entice developers, they can also offer building loans with cheaper interest rates. India might develop a subsidised insurance scheme to assess performance and ensure quality (followed by some cities in China). Before beginning building, the developer would get a green insurance policy, committing to deliver quality and adhere to the agreed-upon performance standards. Based on the insurance coverage, the bank could then grant green credit. If the promised criteria are not reached, the insurance company is obligated to pay or repair. The government must give subsidies and incentivize developers to purchase these policies in order for this strategy to succeed [Utsav Soni 2020].

6. CONCLUSION

If trees are chopped down to make room for a building, the same number of trees must be planted somewhere else. Only by adopting this thinking will humanity be able to save the planet from catastrophe. The current state of our world is concerning. Anthropogenic activities are mostly responsible for this situation. Scientists are continuing to develop technologies that have a low or no detrimental impact on the environment [Umar U. A. et al., 2019]. According to the study, one of the primary causes of environmental degradation is building construction. They are responsible for a large quantity of harmful pollutants, accounting for around 30% of greenhouse gas emissions directly from their operations and another 18% indirectly from material, exploitation, and transportation. Buildings account for about 40% of global energy consumption (including 60% of electricity), 40% of waste generation (by volume), and 40% of material resource consumption. Buildings take up 50% or more of the land area in cities. Buildings are responsible for a considerable portion of the world's water use, as well as a large portion of the water wasted. Green Building (GB) has emerged as a new building concept that uses more ecologically friendly materials, implements ways to save resources and energy, minimizes waste creation, improves interior environmental quality, and reduces dangerous gas emissions, among other things. This could have a positive impact on the environment, finances, the economy, and society. Savings in operating and maintenance expenses in GBs, for example, can be gained by installing high-efficiency lighting and insulation systems, or by using a suitable material [Sharma N. K. 2020].

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