



AN OVERVIEW OF THE GREEN BUILDING CONSTRUCTION IN INDIA

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Abstract: In a world exhausting our natural resources, green building has become the ethical “in-thing” in an attempt to save our planet from despair. The bitter experience of global warming has alarmed and compelled the mankind to change the way they operate on earth. Within the construction industry, the green building concept evolved and it now gaining momentum rapidly across the world. Green building involves a building which incorporates environmental consideration into every stage of the building construction with the objectives to protect occupant health, improve employee productivity, use wisely natural resources and reduce the environmental impact. The use of sustainable resources in the construction industry should be enforced by the local construction regulations in order to save the environment. The study findings revealed that the green buildings provide better health for buildings occupants due to the improved indoor quality, development of more energy efficient products and the use of less natural resources for the satisfaction and welfare of building tenants, also to protect the ecosystem. The outcome of this research shows that green building benefits should encourage clients, consultants and invest in green buildings. The researchers in this paper talks about the requirement of green building constructions in India, and tries to find out the drivers which create a demand for purchase of green buildings.

Keywords: Environment Pollution, Environmental Concern, Environmental Knowledge, Government Subsidies, Green Buildings, Green Building Purchase, Sustainable building

I. INTRODUCTION

Building and construction activity have greatly improved the quality of human’s life, but also inevitably consume a lot of resources, produce and discharge a large amount of contaminated waste, cause significant damage to ecology and the

environment. Sustainable design specially leads towards the balance between high-quality construction and low environmental impact. A lighter footprint means a longer-lasting planet, which is a win for the builder, client, and environment. A ‘green’ building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life.

Green building is a goal and a process. Viewing sustainable building as a process is important because green-building success isn’t just a matter of building with green materials. Green building combines both materials and processes to maximize efficiency, durability and savings.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are; designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving their productivity
- Reducing waste, pollution and environmental degradation
- Use of natural materials for that are available locally

Green building brings together a vast array of practices, techniques, and skills to reduce and ultimately eliminate the impacts of buildings on the environment and human health. It often emphasizes taking advantage of renewable resources, e.g., using sunlight through passive solar, active solar, and photovoltaic equipment, and using plants and trees through green roofs, rain gardens and reduction of rainwater run-off. Many other techniques are used,



such as using low-impact building materials or using packed gravel or permeable concrete instead of conventional concrete or asphalt to enhance replenishment of ground water. On the aesthetic side of green architecture or sustainable design is the philosophy of designing a building that is in harmony with the natural features and resources surrounding the site. There are several key steps in designing sustainable buildings: specify 'green' building materials from local sources, reduce loads, optimize systems, and generate on-site renewable energy. Green construction principles can easily be applied to retrofit work as well as new construction.

According to the United Nations Environment Program. Building accounts for 18% of global emissions, or the equivalent of 9 billion of CO₂ annually. As of 2018, building accounts for 28% of global emissions or 9.7 billion tons of CO₂. As of this the global CO₂ emissions would be 39 % including manufacturing of building materials. If this new technology like "Green building" are not adopted during the construction at this time of rapid growth, emissions could double by 2050. Simultaneously, it has a tremendous impact on the environment which may result in health issues to employees in office buildings, hence reducing the quality of life.

In preparing this research paper a lot of research work has been done. Different journals/Websites/Articles have been read before presenting this paper before you all. Benefits, Current scenario, Drivers for purchase, Barriers/Problems and the possible outcomes are discussed in the paper.

II. BENEFITS OF GREEN BUILDING ON SOCIAL / ECONOMICS AND ENVIRONMENTAL PERSPECTIVES:

The growth and development of our communities has a large impact on our natural environment. The manufacturing, design, construction, and operation of the buildings have a large effect on environment, human health and economy. The successful adoption of green building can maximize both the social, economic and environmental performance of the building.

The numerous benefits that green building holds, is a further justification for going green. These include the following:

2.1 Social benefits:

- Improved occupancy satisfaction, comfort, and individual productivity

- Expand market for environmentally preferable products.
- Improve indoor air quality.
- Fewer wastewater treatment plants and increased preservation efforts for water resources.
- Expand market for environmentally preferable products.
- Improve overall quality of life.

2.2 Economic benefits:

- Create, expand, and shape markets for green product and services.
- Enhanced energy efficiency practices leading to reduced peak power demand, reduced demand for new energy infrastructure, lower energy costs to consumers, and up to 70 percent lower annual fuel and electricity costs
- Reduced costs for site preparation, building materials, and operational costs through sustainable siting.
- Require lower maintenance costs as they are built from sustainable components which in turn adds value to the property.
- Enhanced water efficiency practices leading to reduced annual water costs and municipal wastewater treatment costs

2.3 Environmental benefits:

- Increased land preservation, lower resource and energy use, and the protection of ecological resources.
- Preservation of water resources for wildlife and agriculture.
- Lower electricity and fossil fuel use and decreased impacts of fossil fuel production
- Improved indoor air quality and, in turn, reductions in air pollution levels.
- It also reduces your carbon footprint by producing less waste and decreasing the amount of toxic gases set free into the air. In this way, the pace of climate change is slowed down, and a positive contribution to saving our environment is made.



III. GREEN BUILDING LIFE CYCLE ASSESSMENT

There are four stages during the lifecycle of a building – Material Manufacturing, Construction, Use & Maintenance and End of Life.

- 3.1 Materials Manufacturing:** This stage involves the removal of raw materials from earth, transportation of materials to the manufacturing locations, manufacture of finished or intermediate materials, building product fabrication, and packaging and distribution of building products
- 3.2 Construction:** This stage includes all the activities relating to the actual building construction of the project.
- 3.3 Use and Maintenance:** This stage includes the building operation including energy consumption, water usage, environmental waste generation, repair and replacement of building assemblies and systems, and transport and equipment use for repair and replacement.
- 3.4 End of Life:** Includes energy consumed and waste produced due to building demolition and disposal of materials to landfills, and transport of waste materials. Recycling and reuse activities related to demolition waste also can be included and have a “negative impact.”

Maximum impact to the environment occurs during the first 2 stages. Sustainable manufacturing and construction practices if adopted can reduce the impact on the environment.

The overall performance of buildings can be assessed by an extensive mechanism in five key areas, namely: Energy Efficiency, Water Efficiency, Environmental Protection, Indoor Environmental Quality, and other Green Features and Innovations.

IV. GREEN BUILDING MOVEMENT IN INDIA

The “green” movement for buildings is gaining momentum in India. In 2001, The Indian Green Building Council (IGBC) was formed as a part of the Confederation of Indian Industry (CII). The vision of IGBC is "To enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025".

Services offered by IGBC includes i) developing new green building rating programmes, ii) certification services and iii) green building training programmes. The council also Green Building Requirement in India and Factors Driving Green Building Purchase organizes Green Building Congress an annual event on green buildings. For building awareness, understanding and promoting green building concepts in the country, IGBC works closely with State Governments, Central Government, World Green Building Council and associated agencies.

Established in 2004, the CII- Sohrabji Godrej Green Business Centre (CII-Godrej GBC), serves as CII’s Developmental Institute on Green Practices & Businesses which aims at offering world class advisory services on conservation of natural resources. Advisory services are offered to the industry in the fields of Green Buildings, Energy Management, Green Companies, Renewable Energy, GHG Inventorization, Green Product Certification, Waste Management and Cleaner Production Process.

India is **one of the leading countries** in terms of green building movement. So far **2380 projects** in India has been registered as green building projects. The green building coverage was 1.82 billion sq. ft. in 2013 and is estimated to go up to 5 billion sq. ft. by end of 2017(IBEf).

Green buildings are typically defined and categorized by green building certification programs. Around the world it is seen that many countries have designed their own programs. Some of the green certification schemes are: The Building Research Establishment Environmental Assessment Methodology (BREEAM), United Kingdom, 1990; Leadership in Energy and Environmental Design (LEED), the United States, 1994; the Deutsche Gesellschaft für nachhaltiges Bauen (DGNB) system in Germany; Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan; and the Green Star system in Australia.

Though there is progress in green building construction in India still a major portion of constructions do not adopt green measures. So far there is no compulsion for all constructions to be green. Green buildings are costly and hence the demand is low for such buildings. But we cannot ignore the damage done to the environment due to construction of non-green buildings. Hence in order to generate more demand for green buildings it is necessary to increase more awareness among the consumers about the benefits of green buildings. It is



also necessary to find out drivers which may stimulate the purchase of green buildings.

V. DESIRE FOR GREEN BUILDING PURCHASE

Green products come at a cost. Researchers have been consistently trying to find out what factors may increase the demand for the purchase of green products which is healthy for the society at large. Several factors may impact the purchase of Green products. Environmental concern is one of the most important factor which may influence the purchase of green products.

In case of Green Buildings though the initial cost is high but in subsequent years the cost is compensated by low operating costs. The long-term benefit which has direct impact on the health of the residents and also the environment is indeed a motivating factor for consumers in purchasing a green building. Demographic, geographic, social, cultural, and political aspects may influence green building activities.

VI. DRIVERS FOR GREEN BUILDING PURCHASE

6.1 Income: Green buildings are considered premium products and as they cost more. So the demand for green buildings will be positively related to income. Thus the following hypothesis is proposed. *H1: Income has a positive impact on demand for Purchase of Green building.*

6.2 Cultural Norms: In general, while addressing environmental problems the differences in culture can be taken into consideration (Milton, 1996). The affinity towards purchasing green buildings may vary across different regions. The following hypothesis is proposed to check whether different cultural Norms has an impact on purchasing green buildings. *H2: Green building demand varies with Cultural Norms has a positive impact on demand for Purchase of Green building.*

6.3 Geography: People residing in different geographical regions have different perspectives about green buildings. In geographical regions which has been largely affected by environmental pollution, people are more concerned about adoption of green products and using green technologies. The

following hypothesis is proposed to find out whether the geographic location has a positive impact on purchase of green building. *H3: Geographical location has a positive impact on purchase of green building.*

6.4 Government Subsidies: Government of India, offers fast track environmental clearance for green building projects which are Pre-certified/Provisionally Certified by IGBC. Government in India also offers certain incentive schemes for projects which are rated by IGBC. Green buildings are usually costly and considered as a premium product by the consumers. Even after the incentive schemes given to green projects based on the rating by IGBC the costs are high. A further reduction in the price of the building by subsidizing the rates by the Government may influence the purchase of the green buildings. The following hypothesis is proposed based to check whether government subsidies have a positive impact on the purchase of green buildings. *H4: Government Subsidies have a positive impact on purchase of green building.*

6.5 Environmental Concern: Environmentalists have a love for nature and support the goals of environmental movement. They are concerned about the environmental pollution and degradation. People who are concerned for the environmental degradation have a tendency to purchase green products and also may pay more for environmentally friendly products (Kotchen and Moore, 2007, 2008; Kahn and Vaughn, 2009). The following hypothesis is proposed to find out if consumers having an environmental concern have a positive attitude towards purchase of green buildings. *H5: Environmental concern may positively impact the purchase of green buildings.*

6.6 Environmental Knowledge: Environmental knowledge is the amount of information individuals have concerning environmental issues. Individuals having a fair amount of environmental knowledge has the ability to understand and evaluate the impact of environmental pollution on society and the environment. The knowledge acquired helps the individual to understand the devastating impact of environmental pollution which may



motivate him to go for green products to reduce the environmental degradation. The following hypothesis is proposed to find out if consumers having an environmental knowledge have a positive attitude towards purchase of green buildings. *H6. Environmental Knowledge may positively impact the purchase of green buildings.*

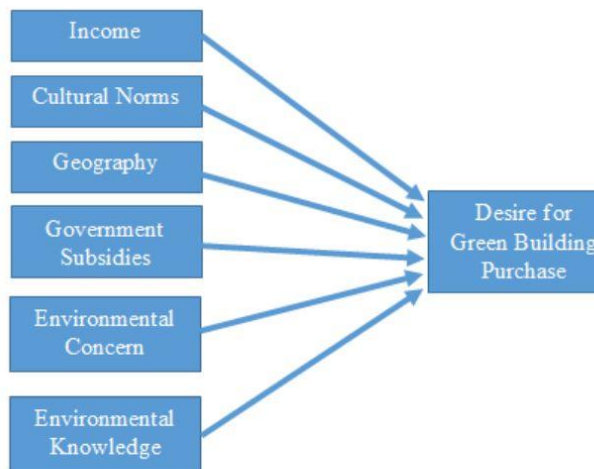


Figure 1 Drivers of Green Building Purchase

VII. FEATURES OF SOME GREEN BUILDINGS IN INDIA

- 7.1 Suzlon One Earth, Pune:** Suzlon one earth is 100% powered by onsite and offsite renewable sources. The campus has 18 hybrid wind turbines that fulfil 7% of the total energy consumption, the rest of energy demand is met from offsite wind turbines. The structure is designed in such a way that it can get a maximum daylight exposure which helps in reducing artificial lighting consumption. The infrastructure within the campus is designed to enable water percolation and thereby control storm water runoff thus, contributing towards an increased water table level.
- 7.2 Rajiv Gandhi International Airport (RGIA), Hyderabad:** The structure of the airport is planned in a way so as to consume less water, electricity and conserves natural resources. Within the campus of the airport, there is a green belt of about 273 hectares having numerous plants. RGIA has been successful in saving energy for nearly 3.97

million kWh and have reduced the carbon footprint by 3331 tons.

- 7.3 CII- Sohrabji Godrej Green Business Centre, Hyderabad:** The building doesn't let out any waste and recycles it all within. It can be said that building is literally made up of only recycled materials.
- 7.4 Infosys Limited, Mysore:** The 5 storey structure has been built keeping in mind a holistic approach to sustainability in five key areas, including – Sustainable site development, Water savings, Energy efficiency, Materials selection and Indoor environmental quality. The smart mechanism and efficient equipments lead to 40% of less energy consumption.
- 7.5 Infinity Benchmark, Kolkata:** The building is furnished with CO2 monitor sensors, rainwater harvesting, waste water recycling system and humidification controls. The exterior of the building is made of brick wall block while the roof comprises of deck thick polyurethane foam for better insulation.
- 7.6 I-Gate Knowledge Centre, Noida:** The building is built over 4,60,000 sq.ft. in Suburban Noida and is designed in a way that it captures 73% of daylight within the office. Nearly 50% of land is covered with grass which doesn't let wastes and sewage water go out.
- 7.7 Bank of India, Goa:** A world of eco-friendly lights and air-conditioning, intelligent glazing, modern capsule lifts, and indoor fountains – this is what sums of this popular bank in Goa. The building uses Nano Misty Blue, softening colour glass manufactured by Saint Gobin Glass, India for producing the cool effect and saving energy. The glass has solar control and thermal insulation properties. The building is a complete package of modern look of today's bank.
- 7.8 Biodiversity Conservation India Ltd. (BCIL), Bangalore:** The building was established with an aim of creating eco-friendly living habitats, especially in the urban space. It is a wonderful example of smart homes where one can turn lights off using mobile phones. The building has 44 interconnected rainwater percolation wells that lead to a 400,000 litre water tank. The building makes use of central reverse osmosis system to purify water without the



use of chemicals. Grey water is directed to the gardens, toilets and for washing cars.

- 7.9 Olympia Tech Park, Chennai:** This tech park has the lowest energy consumption, high natural lighting systems, 100 per cent water recycling and other environment-friendly practices.

VIII. 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.

IX. POSSIBLE SOLUTIONS

- 9.1 Myth About High Costs Involved:** There is a huge myth that costs to build green homes are higher than conventional homes. In fact, the truth is that green homes are cost-effective in the long run. But, there is still a gap left between green architecture and potential real estate developers across the country. Lack of knowledge about benefits and pricing myth associated often leaves

real estate developers in India ignorant towards green homes.

- 9.2 Lack of Awareness About Administrative Support:** National Housing Bank (NHB) and HFCs such as IIFL Home Loan are working towards bringing together industry experts on a common platform to address developers on the benefits of green home in India. NHB is playing a significant role to promote affordable green housing in India. NHB has signed an agreement with Agence Française de Développement (AFD), France to implement the project called "Sustainable Use of Natural Resources and Energy Finance (SUNREF) Housing India".

- 9.3 Awareness in The People:** Most of the people are still not aware of the benefits of green architecture and sustainable living, making them disinterested in the idea. Under Promoting Green Housing Refinance Scheme (PGHRS), NHB will also provide refinancing support to eligible PLIs for their individual housing loans on green homes located in residential areas. This will reduce the cost of such homes while first time home buyers can also avail CLSS subsidy under Pradhan Mantri Awas Yojana.

To draw their attention towards making green homes, there has to be a collective effort of experts in green and sustainable infrastructure arena along with developers to succeed in achieving sustainable real estate in the country. Creating awareness among people about environmental consequences is important. Training camps, workshops, news broadcasts etc. can educate developers and end users on addressing the sustainable living in India.

X. CONCLUSION

If trees are cut off to clear up the plot for building construction, the same number 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 keep 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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