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**GREEN BUILDING IN INDIA: A MOVE TOWARDS SUSTAINABILITY**

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**ABSTRACT**

*The need for sustainable development in the construction sector has become significant in the last decade mostly due to the major resource consumption and contamination which buildings generate. The built environment has a profound impact on our natural environment, economy, health and productivity. Breakthroughs in building science, technology and operations are now available to designers, builders, operators and owners who want to build green and maximize both economic and environmental performance. Green buildings have the potential to minimize the negative impact on the environment and offer business and occupant health related benefits. Many countries have either already adopted the green building guidelines or are in the process of adopting them. Developing countries are experiencing exponential growth in the built environment and there is a great potential of making the design and construction practices in these countries more sustainable through green building guidelines. Rapid adoption of these guidelines is important yet challenging. With this motivation, this paper presents the background of green building movement in India. This paper is an attempt to analyse and examine the scenario and prospects of green building construction and to analyse its role in providing us a sustainable environment and understand the rating systems for green buildings in India.*

**KEYWORDS**

Green Building, Sustainability, Indian Green Building Council (IGBC), LEED, GRIHA, BEE.

**INTRODUCTION**

The Building Industry plays a leading role in our country's fast growing economy. The construction sector contributes a major share to our economy. But this uncontrolled growth possesses grave challenges for us and the environment. Large quantities of natural resources like forest, soil cover, water and energy are extensively used in building industry. The use of energy intensive materials is constantly eroding the quality of our environment. Globally, buildings are responsible for at least 40% of energy use. Almost 70% of the energy consumed in building is for lighting, air conditioning and water heating with over 40% of the global water consumption claimed by the construction industry. Building operations and inhabitant activities generate huge quantity of waste also. Almost 48 % of all solid waste is generated by building. Building activities have directly contributed to almost 50% of the air and water pollution. Urbanisation has resulted in the rapid decrease of green vegetation cover, thus contributing to global warming due to the increased use of air conditioners and emission of greenhouse gases.

Improving the environmental performance of buildings is critical to larger sustainability efforts. As a United Nation Environment Programme report states, "The building sector contributes up to 40% of greenhouse gas emissions, mostly from energy use during the life time of buildings". Considering the statistics, reducing the amount of natural resources buildings consume and the amount of pollution given off is seen as crucial for future sustainability. Identifying opportunities to reduce these emissions has become a priority in the global effort to reduce climate change. There are existent and emerging options for improving the environmental performance of homes; collectively, these options are called green building practices. By using alternative products and systems, green building practices can significantly reduce environmental impacts related to energy consumption, water use, resource use, site practices, and ventilation.

According to Indian Green Building Council (IGBC) A green building is defined as "one which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building". In simple terms, the green building concept is to build in such a way that it minimizes the environmental impact and creates a healthy indoor environment for its occupants.

**OBJECTIVES**

1. To understand the conceptual areas of green building.
2. To trace out the green building movement in India.
3. To study the green building rating systems in India.

**METHODOLOGY**

The study is based purely on secondary data. Data mainly has been collected from various secondary sources e.g. annual reports, bulletins and surveys of The Leadership in Energy and Environmental Design (LEED INDIA), Indian Green Building Council (IGBC), official websites of GRIHA, BEE, LEED, articles and newspapers.

**GREEN BUILDINGS**

A green building is one which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building. Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from sitting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building. 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.

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 employee productivity
- Reducing waste, pollution and environmental degradation

## GOALS OF GREEN BUILDING

The concept of sustainable development can be traced to the energy (especially fossil oil) crisis and the environment pollution concern in the 1970s. The green building movement in the U.S. originated from the need and desire for more energy efficient and environmentally friendly construction practices. There are a number of motives for building green, including environmental, economic, and social benefits. However, modern sustainability initiatives call for an integrated and synergistic design to both new construction and in the retrofitting of existing structures. Also known as sustainable design, this approach integrates the building life-cycle with each green practice employed with a design-purpose to create a synergy among the practices used.

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.

While the practices or technologies employed in green building are constantly evolving and may differ from region to region, fundamental principles persist from which the method is derived:

- Site and Structure Design Efficiency
- Energy Efficiency
- Water Efficiency
- Materials Efficiency
- Indoor Environmental Quality Enhancement
- Operations and Maintenance Optimization
- Waste and Toxics Reduction.

The essence of green building is an optimization of one or more of these principles. Also, with the proper synergistic design, individual green building technologies may work together to produce a greater cumulative effect.

Major benefits of Green Buildings include:

- Energy savings to the tune of 40-50 %
- Water savings to the tune of 20-30%
- Intangible benefits which includes: enhanced ventilation, better views and day lighting which significantly improves the productivity of the occupants
- Green corporate image
- Demonstration of the company's commitment to environmental protection.

## GREEN BUILDING MOVEMENT IN INDIA

The Indian green building movement can be mainly associated with the government initiatives to encourage sustainability in the society and the acceptance of the green building guidelines by the corporate sector. Unlike U.S., where the government policies were based on the public pressure through the environmental movements, major policy decisions by the Indian government were in response to the international events such as the OPEC oil embargo, the Brundtland Commission or the Second Earth Summit. The green building movement in India has been divided into three main phases:

1. Phase I- 1974-1996: Establishment of institutions by the government to encourage sustainability in India
2. Phase II-(2001-2003)-Formation of the Indian Green Building Council (IGBC), TERI – Business Council for Sustainable Development (BCSD), and the Bureau of Energy Efficiency (BEE)
3. Phase III-2004-2007:Launch of LEED- India and TERI – GRIHA

**Phase I (1974 – 1996): Establishment of institutions by the government to encourage sustainability in India:** In this first phase, capacity building measures were taken by the government to encourage sustainability in the Indian society. These capacity building measures can be associated as the governmental response to the energy crisis that had been triggered due to the OPEC oil embargo of 1972. The timeline of the events occurring during this phase is as follows : (1) The Energy and Resources Institute (TERI) was established. The primary mission of the institute was to address the problems in the field of energy, environment, and the future patterns of development (1974); (2) Establishment of National Hydro Electric Power Corporation (1975); (3) Establishment of National Institute of Ecology to enhance environment and conservation through education and research (1976); (4) Environmental (Protection) Act was passed in the Parliament (1986); The Indian Parliament initiated a voluntary eco-labeling program known as the “Eco-Mark” at the initiation of the Ministry of Environment and Forest (MoEF) and Central Pollution Control Board (CPCB) and The Government of India declared that 14<sup>th</sup> December of every year will be recognized as the “National Energy Conservation Day” (1991); Construction Industry Development Council was formed as a nodal agency between the government and the construction industry to address the issues of education, environmental awareness, law enforcement in the construction sector (1996).

**Phase II (2001 – 2003): Formation of major policy making and supporting organizations:** This phase marks the formation of the Indian Green Building Council (IGBC), TERI – Business Council for Sustainable Development (BCSD), and the Bureau of Energy Efficiency (BEE). These institutions have been responsible for accelerating the adoption of green building guidelines in the country. This phase also marks the first platinum rating award by USGBC to CII- Green Business Center under the LEED<sup>®</sup>-NC v. 2.2. Following is the timeline of the events occurring during this phase: (1) Indian Green Building Council was formed. The membership of this council represented the government, corporate sectors, architects, product manufacturers, institutions, etc. (2001); The Three Country Energy Efficiency Project as started by UN. The primary aim of the project was to provide the technical assistance for developing financial intermediation mechanisms for energy efficiency in India / TERI - Business Council for Sustainable Development (BCSD) was initiated as a partner of World Business Council for Sustainable Development. TERI BCSD is responsible for TERI- Green Rating for Integrated Habitat Assessment / Bureau of Energy Efficiency (BEE) was formed. BEE is an autonomous organization, with the mission to improve the energy efficiency of the country (2002); CII Godrej Green Business Center was awarded Platinum Rating by U.S. Green Building Council under LEED<sup>®</sup> v. 2.0 (2003).

**Phase III (2004 – 2007): Launch of LEED<sup>®</sup>- India and TERI – GRIHA<sup>®</sup>:** In this phase two green building guidelines, TERI-GRIHA<sup>®</sup> in 2005 and LEED<sup>®</sup>-India in 2007 were launched in the Indian society. The rapid developments in the field of green building guidelines can also be attributed to the international pressure on the Indian government to address sustainability in the Indian society and the rapid acceptance of LEED<sup>®</sup>- NC within the Indian corporate sectors. Also in this phase the first ever Indian Green Building Conference was held in 2005 with an objective to create awareness, bring together stakeholders and provide platform for sharing knowledge and best practices in the green building sector. Following is the timeline of the developments happening in this phase: (1) USGBC signed the LEED<sup>®</sup> licensing agreement with India during its fourth Green Building conference at Georgia / ITC Green Centre Project, Gurgaon was awarded with platinum rating under LEED<sup>®</sup> 2.1. ITC Green Centre is now the largest platinum rated building in the world. India thus had 2 of the 7 platinum rated buildings around the world (2004); The TERI GRIHA<sup>®</sup> rating system was launched with the aim to achieve efficient resource utilization, enhanced resource efficiency and improved quality of life in buildings / The first Indian Green Building conference was organized by IGBC in September 2005 at Delhi (2005); LEED<sup>®</sup> for New Construction v. 1.0 was released by IGBC / The Government of India introduced Energy Conservation Codes with the help of BEE for commercial buildings (2007).

Green Building movement in India was triggered off when CII-Sohrabji Godrej Green Business Centre building in Hyderabad was awarded with the first and the prestigious Platinum rated green building rating in India. This landmark achievement put India on the global map of green building movement, through support of all stakeholders from the construction industry. Since then, Green Building movement in India has gained tremendous impetus over the years. With a modest beginning of 20,000 sq.ft. green built-up area in the country in the year 2003, today (as on November 2014) more than 2,803 Green Buildings projects coming up with a footprint of over 2.28 Billion sq.ft with projects spread across the five climatic zones of the country are registered with the Indian Green Building Council (IGBC), out of which 547 Green Building projects are certified and fully functional in India. With this, India is on the top 3 countries in world green building map. This growth has been possible with the participation of all stakeholders in the green building movement. Today all types of buildings are going the Green way-



Government, IT Parks, Offices, Residential, Banks, Airports, Convention Centre, Institutions, Hospitals, Hotels, Factories, SEZs, Townships, Schools, etc. In India, green buildings and eco-friendly homes are gaining momentum and is estimated to account for about 20% of all the constructions by the end of 2030. Mumbai has the country's maximum number of environment-friendly buildings under construction, a survey has shown. The city has 60% more green building projects compared to Delhi and Bangalore, which are second and third on a list released by the Indian Green Building Council (IGBC). The list has six cities, including Pune, Hyderabad and Chennai. Mumbai has 319 registered projects that fall in the green building category and are spread over 229 million square feet, according to the IGBC. Delhi is second on the list with 199 projects, followed by Bangalore with 198 and Pune with 197.

### CORPORATE BACKERS

Large companies such as ITC, Infosys, Wipro, Godrej, Tata, ACC, M&M, Hero, and Raheja are among scores of other companies who have all taken to platinum- or gold-rating certification. In some ways, they are reference points for the green movement. With a chunk of a large company's costs being taken up by the energy bill, they have all put in place systems which bring down overall energy consumption. Significantly, with the State Governments encouraging setting up of solar photo-voltaic units and offering incentives for both grid-connected and rooftop systems, companies are installing renewable energy units both to meet their power requirement during peak hours as well as to save on energy costs.

The green building movement is growing with each passing day. While power-intensive factories are being covered sector-wise, be it paper and pulp, power, cement, and other manufacturing units, efforts are also on to partner with local administration in this regard. This includes offering additional floor area for construction if they apply for green certification and give importance to landscaping.

### INDIAN GREEN BUILDING COUNCIL

The Indian Green Building Council (IGBC), was formed in the year 2001 by Confederation of Indian Industry (CII). It is a non profit research institution having its offices in CII-Sohrabji Godrej Green Business Centre, which is itself a LEED certified Green building. The vision of the council is, "To enable a sustainable built environment for all and facilitate India to be one of the global leaders in sustainable built environment by 2025". IGBC is strong with a membership base of more than 1,588 members which is progressively increasing over the years. Members are all stakeholders of the construction industry viz. Architects, Interior Designers, Landscape Consultants, MEP Consultants, Builders, Developers, Product and Equipment Manufacturers, Corporates, Institutions and Government agencies. The council closely works with several State Governments, Central Government, World Green Building Council, bilateral multi-lateral agencies in promoting green building concepts.

The council is continuously striving towards wider adoption of eco-friendly / green building concepts in the Indian Industry. IGBC promotes a whole-building approach to sustainability, based on the principles of 5 elements of nature [the Panchabutas viz. earth, water, fire (energy), air & sky] by recognizing performance in the following five key areas:

- Sustainable site development
- Water savings
- Energy efficiency
- Materials selection
- Indoor environmental quality

### GREEN BUILDING RATING SYSTEMS

Green building rating brings together a host of sustainable practices and solutions to reduce the environmental impacts. Green building design provides an integrated approach considering life cycle impacts of the resources used. An important development in the growth of green building movement is the launch of the following Green Building Rating Systems:

#### IGBC

IGBC has launched different rating programmes to suit variety of building types.

**IGBC Green Schools:** This rating system is meant for schools which are already existing and also new schools which are being constructed.

**IGBC Green Mass Rapid Transit System (MRTS):** The rating system is a tool to enable new Rail based MRTS to apply green concepts during design & construction, so as to further reduce environmental impacts that are measurable. The overarching objective of IGBC Green MRTS Rating is to ensure environmental sustainability, while enhancing commuter experience.

**IGBC Green New Buildings:** This rating system is designed primarily for new buildings. New Buildings include (but are not limited to) offices, IT parks, banks, shopping malls, hotels, airports, stadiums, convention centers, libraries, museums, etc., Building types such as residential, factory buildings, schools will be covered under other IGBC rating programmes. IGBC Green New Buildings rating system is broadly classified into two types:

1. Owner-occupied buildings are those wherein 51% or more of the building's built-up area is occupied by the owner.
2. Tenant-occupied buildings are those wherein 51% or more of the building's built-up area is occupied by the tenants.

**IGBC Green Homes Version 2:** This rating system is designed for rating new residential buildings, such as Individual homes, Gated communities and High rise residential apartments, etc.,

**IGBC Green Factory Building:** This rating system is designed for new & existing factory buildings, such as manufacturing facilities, etc.

**IGBC Green SEZs:** This rating system is designed for Special Economic Zones (SEZ). The rating meets the guidelines of Ministry of Commerce & Industry (MoCI).

**IGBC Green Townships:** This rating system is designed for rating integrated township developments

**LEED 2011 for India-New Construction:** This rating system is applicable for those buildings where the design and operation is fully in the scope and control of owner or the developer, such as, Corporate office, Institutional building, etc.

**LEED 2011 for India-Core & Shell:** This rating system can be used for projects where the developer controls the design and construction of the entire core and shell base building including MEP/FP systems, but has no control over the design and construction of the tenant fit-out. Such type of developments include: Retail Malls, IT Parks, etc.

All these rating systems are voluntary, consensus based, market-driven building programmes. The rating systems are based on the five elements of the nature (Panchabhutas) and are a perfect blend of ancient architectural practices and modern technological innovations. These ratings systems are applicable to all five climatic zones of the country. IGBC rating programmes have become "National by Choice and Global in Performance".

#### LEED CERTIFICATION

The Leadership in Energy & Environmental Design (LEED) is the rating system developed for certifying Green Buildings. LEED is developed by the U.S. Green Building Council (USGBC), the organization promoting sustainability through Green Buildings. LEED is a framework for assessing building performance against set criteria and standard points of references. The benchmarks for the LEED Green Building Rating System were developed in year 2000 and are currently available for new and existing constructions. IGBC has licensed the LEED Green Building Standard from the U.S. Green Building Council and currently is responsible for certifying LEED-New Construction and LEED-Core and Shell buildings in India. The Leadership in Energy and Environmental Design (LEED-INDIA) Green Building Rating System is a nationally and internationally accepted benchmark for the design, construction and operation of high performance green buildings.

LEED-INDIA provides building owners, architects, consultants, developers, facility managers and project managers the tools they need to design, construct and operate green buildings. It is a voluntary, consensus – based, market-driven building rating system based on existing proven technology. It evaluates environmental performance from a whole building perspective over a building's life cycle, providing a definitive standard for what constitutes a "green building". The rating system is organised into five environmental categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources and Indoor Environmental Quality. An additional category, Innovation & Design Process, addresses sustainable building expertise as well as design measures not covered

under the five environmental categories. LEED is a measurement system designed for rating new and existing commercial and institutional buildings. It is based on accepted energy and environmental principles and strikes a balance between known established practices and emerging concepts. It is a performance-oriented system where credits are earned for satisfying criterion designed to address specific environmental impacts inherent in the design and construction. Different levels of green building certification are awarded based on the total credits earned. The system is designed to be comprehensive in scope, yet simple in operation.

#### LEED CERTIFICATION LEVELS

Certification Level	Points
Certified	26-32
Silver	33-38
Gold	39-51
Platinum	52 or more

Source: IGBC

#### BUREAU OF ENERGY EFFICIENCY (BEE)

The Indian Bureau of Energy Efficiency (BEE) had launched the Energy Conservation Building Code (ECBC). 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 where any buildings that fall under the index can be termed as "ECBC Compliant Building". More over the BEE had launched a 5 star rating scheme for office buildings operated only in the day time in 3 climatic zones, composite, hot & dry, warm & humid on 25 February 2009. IGBC rated green buildings are also able to meet or exceed the ECBC compliance.

#### GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT (GRIHA)

Green Rating for Integrated Habitat Assessment (GRIHA) is India's own rating system jointly developed by TERI and the Ministry of New and Renewable Energy, Government of India. TERI, being deeply committed to every aspect of sustainable development, took upon itself the responsibility of acting as a driving force to popularize green building by developing a tool for measuring and rating a building's environmental performance in the context of India's varied climate and building practices. The rating system called 'Green Rating for Integrated Habitat Assessment' (GRIHA) quantifies parameters like energy consumption, waste generation, renewable energy adoption over the entire lifecycle of the building. In 2007, it was adapted and adopted by the Ministry of New and Renewable Energy (MNRE) as the national rating system for green buildings in order to bring down the ecological impact of buildings in India to a nationwide acceptable level. It is a green building design evaluation system where buildings are rated in a three-tier process. The process initiates with the online submission of documents as per the prescribed criteria followed by on site visit and evaluation of the building by a team of professionals and experts from GRIHA Secretariat. GRIHA rating system 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, and Innovation points. Eight of these 34 criteria are mandatory, four are partly mandatory, while the rest are optional. Each criterion has a number of points assigned to it. It means that a project intending to meet the criterion would qualify for the points. Different levels of certification (one star to five stars) are awarded based on the number of points earned. The minimum points required for certification is 50.

Points achieved	GRIHA Rating
50-60	★
61-70	★ ★
71-80	★ ★ ★
81-90	★ ★ ★ ★
91-100	★ ★ ★ ★ ★

Source: GRIHA

#### CONCLUSION

The emergence of sustainable building, or green building, has brought about an awareness of what the building industry can do to curb high energy use, minimize waste, and create environments that are healthy and productive. Initial costs can be higher, but the payback can be quick through energy savings and productivity gains. Indians were aware of Green Building concepts from time immemorial. Conventional homes with baked red colour roof tiles and clay made walls is a really good example of energy efficient structures that are used to keep cool during summers and warm during the winters. Most of rural India is still attached to this building technology with naturally available materials like clay, wood, jute ropes, etc. Today we have advanced technologies that create smarter systems to control inside temperature, lighting systems, power and water supply and waste generation. The result is significant savings for building owners over the life of the building. In this rapidly changing world, we should adopt the technology that helps us to save precious natural resources. This would lead us to a true sustainable development.

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