

A Review on Conversion of Existing Building into Green Building

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Abstract: Green building construction has resulted in a slew of inventive solutions to lower energy usage. The requirement to develop a unified dimensional model for resource-saving, and environmentally friendly is a problem for assessments of green renovation (GR) of existing structures. India has three mechanisms viz. LEED (Leadership in Energy and Environmental Design), IGBC (Indian Green Building Council) GRIHA (The Green Rating for Integrated Habitat Assessment) are in place to help its fast-rising urban population to achieve ecologically sustainable growth. An attempt has been made here to review the conversion of existing structures into green buildings to save natural resources. It will be beneficial for the people who renovate their buildings or want to change to the green building concept. Green building implementation has become a need to optimize the scarce resources and to eliminate the negative impact of early cost surcharges on the green building idea should be eliminated. This review paper aims to find the solutions for existing buildings to convert them into green buildings and how life cycle cost analysis is important for the building.

Keywords: *green building, green building rating system, LEED, GRIHA, IGBC, Life cycle Cost*

1. INTRODUCTION:

The construction sector has substantial social, economic, and environmental consequences. Buildings, being one of the industry's primary outputs, generally reflect these consequences throughout their existence. Construction operations have a beneficial influence on the economy by providing structures and facilities to meet human needs, creating jobs directly or indirectly (via other businesses connected to construction), and contributing to the national economy. Buildings and construction operations have well-known harmful

consequences. These include noise, dust, traffic congestion, water contamination, and garbage disposal during the construction phase. A significant amount of natural and human resources will be depleted. Buildings continue to influence the environment even after they are done. Building blocks account for 40% of overall energy use, according to the World Business Council for Sustainable Development. Apart from energy use, buildings emit Greenhouse Gases (GHGs), which contribute to global warming. Building carbon emissions will reach 42.4 billion tonnes in 2035, up 43 percent from 2007 [1].

Many worldwide green building groups are now cooperating on green building concerns. The World GBC was created in November 1999 in California, USA, and was legally recognized by the National Assembly in 2002. Australia, Canada, Japan, Spain, Russia, the United Arab Emirates, the United Kingdom, and the United States were the inaugural members of the WGBC. There are around 100 nations on the globe today, including 18 in the Asia Pacific. WGBC is collaborating with a variety of nations in the construction sector to help the long-term growth of green buildings. WGBC now has over 100,000 structures registered, totaling over 1,000,000,000 square meters [2]. In 2014, India has 53 cities with populations of over one million people. Mumbai has an estimated population of 18 million people, Delhi has a population of 16 million, and Kolkata has a population of more than 14 million (IHS 2012). With a population of 17.5 percent of the world's population and a city population of 372 million (greater than the whole population of the United States), India confronts enormous urbanization difficulties [3]. To overcome these types of challenges and build environment-free buildings.

2. LITERATURE REVIEW:

The revolution is about green construction, intending to profoundly alter the built environment by producing energy-conscious, healthy, and productive structures that limit or eliminate buildings' enormous influence on urban life and global surroundings [4]. It's worth noting that in the past, the phrases "green building" and "sustainable building" were used interchangeably. According to Robichaud and Anantatmula, green buildings have four pillars: reducing environmental impacts, promoting occupant health, providing a return on investment for developers and the local community, and considering the life cycle during the design and construction progress [1]. Due to its substantial contribution to greenhouse gas (GHG) emissions and accompanying worries about increased global warming and climate change, the construction industry has been the focus of efforts to induce a move towards greener modes of working and construction [5]. Green

buildings, according to the World Green Building Council (WGBC), are designed to reduce negative impacts on the climate and natural environment while also creating positive effects through appropriate actions taken during the design, construction, and operation steps. Green buildings help to preserve valuable natural resources while also improving people's quality of life. In comparison to a conventional structure, the Indian Green Building Council (IGBC) defines a green building as one that consumes less water and energy, creates less waste, conserves the environment and resources, and looks after the health and well-being of its residents [7]. The techniques now available for selecting building materials are reviewed and addressed under the definition of "green building materials." At the working plan stage, when architects and engineers must choose from a variety of items on the market, a special focus is placed on material selection [10]. It's important to distinguish between researching technology and using it. It will assist us in establishing a starting point for implementing the green idea and sustainable awareness in both consciousness and methodology, as well as cultivating the demand for and interest in advanced green technologies across society. The green buildings can then enter a profitable market cycle [13]. This has prompted studies on the efficacy of green building initiatives, as well as comparisons of the aims, criteria, and processes employed by various certifications. According to studies, the geographic patterns of LEED-certified projects differ statistically substantially. However, there has been very little quantitative research on worldwide certification patterns and trends. Individual case studies exist, but a deeper look into the characteristics of these projects, how these characteristics are linked to levels of certification achievement or strategies implemented Patterns of attainment of criteria or credits, as well as other inquiries, may lead to a better understanding of certification markets, their implications, and how they might be made more successful [9]. The technique for comparing green building grading systems has been examined to have a better knowledge of the operations. Because there are significant disparities in green building grading schemes when it comes to sustainability indicators, several essential criteria have been defined and utilized as a baseline for comparison research. The location, water, energy, indoor environment quality, material, waste and pollution, and management are the most important criteria [7].

3. WHAT IS THE GREEN BUILDING MATERIAL:

It is currently no unambiguous and globally agreed definition of "green construction materials," although they are commonly referred to as "eco-friendly" or "environmental sustainability" materials. As a result of these uncertainties, some materials have been released on the market with a generic claim of "greenness,"

but no proof to back it up, or even with false claims. Several times, the green feature of materials has been simply associated with their being 'natural,' ignoring the fact that asbestos (a carcinogen once added to a variety of building materials but now banned due to its carcinogen impacts), radon (a radioactive gas possibly ejected by some stones in the building and harmful to lung cancer), or turpentine (a solvent gained by distillation of tree resins and harmful to human health) are all-natural [10]. So basically, green building materials, often known as eco-friendly building materials, are building materials that have a minimum environmental effect. They are made up of renewable rather than non-renewable materials. These must be natural and unaffected by temperature, humidity, or cold.

4. COMPARATIVE ANALYSIS OF EXISTING BUILDING AND GREEN BUILDING:

In comparison to a regular structure, a green building consumes less energy, water, and natural resources, produces less waste, and is better for the people who live within. By managing solar radiation temperature, energy consumption, water management, waste management, and interior air quality, green buildings provide an appropriate atmosphere.

Table no. 4.1 – Comparison of the existing building with green building

Components	Existing nongreen building	Green building
Energy efficient	Not present	Present
Water-efficient	Not present	Present
Material Efficient	Not present	Present
Indoor Environment Quality	Not present	Present
Waste Reduction	Not present	Present

5. INDIAN GREEN BUILDING RATING SYSTEMS:

In comparison to a conventional structure, the Indian Green Building Council (IGBC) defines a green building as one that consumes less water and energy, creates less waste, conserves the environment and resources, and looks after the health and well-being of its occupants (IGBC, 2018). A green building saves energy and water, lowers waste and pollution, and conserves all other resources to protect the environment without jeopardizing all stakeholders' health, comfort, cost, safety, or satisfaction. to protect the environment without jeopardizing the health, comfort, cost, safety, or satisfaction of all stakeholders. Such structures try to use renewable energy sources to meet a large portion of their energy consumption. Furthermore, water harvesting in green buildings reduces water consumption. The "reduce, reuse, and recycle" philosophy applies to green buildings [7]. LEED-India is affiliated with the internationally recognized LEED program, which is managed in India by the International Green Building Council (IGBC). LEED-India is a privately run green certification system that aims to promote the construction of environmentally friendly structures in India. In general, western firms and the private sector in India choose the LEED methodology for green certification. The grading system is centered on promoting the use of environmentally friendly design and construction practices in the construction of new buildings. Projects are given points for their performance in terms of sustainable site development, water conservation, energy efficiency, material selection, and indoor environmental quality. LEED-India, like other LEED systems, awards certification at four distinct levels: Silver, Gold, or Platinum certifications are available. IGBC offers the Green Homes Rating System for residential development, which focuses on energy and water conservation. The Green Townships Rating System was designed by the IGBC for bigger initiatives. "The International Green Building Council's Green Townships Rating System" is intended to combat urban sprawl, automotive reliance, and social and environmental alienation. Environmental planning, land-use planning, resource management, and community development are all considered while evaluating developments. Finally, to bring sustainable design to the workplace, the IGBC has established the Green Factory Building Rating System for industrial structures. In July 2009, this voluntary and consensus-based initiative was established. GRIHA is a quasi-public organization in India that promotes sustainable construction principles and techniques. GRIHA is an indigenous green grading system that was developed in the early 2000s and became available for project certification in 2005. It aims to solve the flaws of LEED programs. GRIHA, in particular, focuses on the long-term viability of projects by mandating continuing reporting of performance metrics as part of GRIHA

accreditation. GRIHA has a 1–5-star grading system that considers energy/power usage, water usage, water generation, and renewable energy integration. These criteria are unique to the Indian setting and differ from LEED requirements [3].

6. CERTIFICATE CRITERIA FOR GREEN BUILDING:

1. Energy Efficiency:

The use of lesser energy to do the same work or generate the same outcome is referred to as energy efficiency. Energy-efficient houses and buildings consume less energy to heat, chill, and power appliances and gadgets, while energy-efficient manufacturing facilities generate items with less energy. Energy efficiency is among the most simple and cost-effective solutions to mitigate climate change and lower consumer energy expenditures. Reduced use of fossil fuels results in clean air and water, and lands, all of which have a direct impact on human health, particularly in marginalized populations and persons with pollution-related illnesses.

2. Water Efficiency:

Human existence depends on the availability of water. Conservation is essential because this natural resource is fast depleting. It entails conserving freshwater, lowering overall water use, and limiting wastewater. It also emphasizes the use of enhanced methods and technology that provide similar or better life services while consuming less water. Water efficiency is a large part of green construction, and it involves tactics and technology that reduce the quantity of potable water used in structures. When it comes to water efficiency in Green Building development, nowadays technologies include rainwater collection, greywater recycling, and reuse, low-flow fixtures, sensors, and more.

3. Material Efficiency:

Material efficiency is a term or statistic that describes how much raw materials are used, integrated, or wasted in construction works or physical processes as compared to prior metrics. Making a useful item out of less stock than a previous edition improves the manufacturing process' material efficiency. Material efficiency is linked to green building construction and energy conservation, or any methods of using renewable resources throughout the construction process. Material efficiency also can refer to a material's ability to withstand

specific stress, strain, or weight. Material efficiency may be accomplished in a variety of ways, including the use of recycled materials, renewable energy-based materials, and other methods.

4. Indoor Environment Quality:

One of the main goals of green buildings construction is to create a healthy, comfortable, and productive interior environment for its residents. Indoor environmental quality is a term used to describe how well an indoor environment performs (IEQ). Increased occupant happiness, improved performance, and productivity decreased liability, marketing advantage, and cheaper operations and maintenance expenses may all be attributed to a good interior environment. Indoor environment quality (IEQ) is a term that describes the state of a building's environment as it relates to the health of its residents.

5. Waste Reduction:

Waste reduction, also known as waste minimization, is the technique of consuming less material and energy to reduce waste and conserve natural resources. Waste reduction also translates into financial savings. When waste-reduction methods are employed, fewer materials and energy are consumed. Waste minimization has several environmental advantages. Less energy consumption and pollutants arise from increased product efficiency in both manufacturing and usage. Natural resources are being conserved in greater numbers. Less toxic materials are employed in the products.

7. GREEN BUILDING GOALS:

The necessity and desire for more energy-efficient and ecologically friendly construction processes sparked the green building movement. There are several reasons to construct green, including environmental, economic, and social advantages. Green construction encompasses a wide range of practices and strategies aimed at reducing, and eventually eliminating, the negative effects of buildings on the environment and human health. It frequently promotes the use of renewable resources. While the methods or technology used in green building are continually developing and may change from place to region, several essential concepts remain: Energy efficiency, water efficiency, materials efficiency, indoor environmental quality enhancement, o&m optimization, and waste and toxins reduction are all areas where efficiency may be improved. Although new technologies are constantly being formed to complement current practices in

creating greener structures, the overall goal of green buildings is to reduce the impact of the building on human health and the natural environment by utilizing energy, water, and other resources more efficiently.

8. LIFE CYCLE COST ANALYSIS:

The growth of green buildings necessitated the evaluation of their performance. Many nations have their green building councils, according to the World Green Building Council (2018). The majority of these countries have developed their own green building grading systems based on a variety of essential factors such as water efficiency, energy efficiency, and land usage. Appropriate measures are essential for pursuing sustainable development. It was also discovered that several nations have established green building grading techniques, all to lower environmental impacts during the design and management stages of structures [38].

The construction industry is under more pressure to consider future operating expenses connected with a structure, which are often examined using life cycle costing like a cost evaluation technique. In the built environment, life cycle costing is a technique for estimating a building's expected economic performance throughout its whole life cycle, which includes design and construction, o&m i.e., operation and maintenance, and disposal. However, in the construction industry, the use of life cycle costing is still restricted and plagued by practical issues. Building owners' poor perceptions of life cycle cost benefits, a lack of reliable life cycle cost input data, a scarcity of actual cost and performance information about existing buildings, uncertainty associated with life cycle cost assumptions, and a lack of understanding of life cycle costing method of analysis and application are all considered major roadblocks to widespread adoption of life cycle costing in the construction industry. The overall cost connected with building design and construction, building operation and maintenance, as well as the expenses involved with building demolition at the end of its life cycle is known as the life cycle cost or LCC [6]. Following is the formula for calculating life cycle cost analysis.

$$LCC = I + \text{Replacement cost} - \text{Received cost} + L (\text{OM\&R})$$

Where; I = Initial cost

Repl = Replacement cost

Res = Receiving cost i.e., the value that can recover at the end of the time period.

L(OM&R) = Operating, Maintenance, Repair cost.

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