A Review Paper for Converting an Existing Building into Green Building As per IGBC NORMS

Abhay Pratap Singh[1], Akash Sharma[2], Er. MD. Shariq[3], Nitin Kumar[4], Ritesh Shonkar[5]
[1]B. Tech Final Year Student, [2] B. Tech Final Year Student
[3]Head of Department, Department of Civil Engineering
Axis Institute of Technology and Management, Rooma Kanpur, U.P

Abstract **- Before going for converting any building into green building, it is important to understand the market of existing green buildings. From an economic perspective, energy efficiency upgrades represent the most cost-effective way to meet growing energy demands. Recent studies have shown that energy-efficient and certified green buildings have higher market values, greater rents, and higher occupancies. From a corporate sustainability viewpoint, greening existing buildings is a direct way to reduce a company's carbon footprint. From this it gives the result as corporate real estate managers in the United States have begun to decide in favour of greening both owned and leased buildings, seeing many economic benefits from this switch. By acquiring the data of the building, we will analyze it for the green building, feasibility study, efficient energy lighting, we will make small changes in the building to make it sustainable.**

Keywords: Green Building, Energy Efficiency, Sustainability, Existing Buildings.

INTRODUCTION

The term of "green building" is used to describe building that are designed, constructed and operated to have a minimum impact on the environment, both the indoor and outdoor. Most discussions of green buildings refer to the importance of providing an acceptable, if not exceptional, indoor environment for the building occupants. However, these discussions of indoor environment quality have not included many specific recommendation or criteria for building design, construction or operation building projects described as green building demonstrations often refer to indoor air quality, but these references are often general and quantitative. In additional rating system that have been developed to assess the "greenness" of a building are based largely on design features and are not particularly specific with respect to indoor air quality. This paper reviews the features of indoor air quality that are considered in green building discussions, demonstration project, and rating systems. These green building features are discussed in term of their completeness and specificity, and are compared to other guidance on building design, construction, and operation good in indoor air quality. A case study of indoor air quality performance in a green building is presented. This study includes adscription of the indoor air quality features of the building and the results of a short-term indoor air quality evaluation of the building involving ventilation and contaminant concentration measurements. According to the Indian Green Building Council (IGBC), as of 2021, India has achieved 7.17 billion sq ft of 'green building footprint'; and is expected to reach around 10 billion sq ft by the end of 2022. And while it is a step in the right direction, many of the existing buildings are not very sustainable. Hence, read on to understand what steps can be taken to make your existing home or building greener than before.

OBJECTIVE

1. To develop buildings which use the natural resources and emphasizes on the Reduce, Reuse and Recycle?
2. Maximize the use of efficient construction materials and practices.
3. Minimize the energy usage to run itself.
4. Use highly efficient methods for water and waste management's.
5. To ensure the minimum negative impact on the environment.
6. Waste reduction is the one of the most important concepts which we have to deal with.

7. The economic factor of project should also be considered in analysis.
8. Boosting the human productivity by making hygiene and proper conditions inside the building.

LITERATURE REVIEW

Lakshmi R. (2021) [4]

The sustainability concept in construction industry has come a long way but still there is need for new developments and inventions There are several systems for assessing the green building and rating them accordingly. In India, there exist 3 major rating systems but all of these systems only account for very large buildings or small commercial buildings. This research focus on trying to adjust a small existing residential building into the framework of one of the rating systems SVAGRIHA (Simple Versatile Affordable Green Rating for Integrated Habitat Assessment) for converting the partly conventional building into green building. Construction industry has both negative and positive impacts on the environment, economy and society. According to estimates buildings consume more than 30% of energy utilizing 40% of resources while with generating 40% of wastes and 35% of harmful green-house gases (Mane 2017). 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 siting to design, construction, operation, maintenance, renovation and deconstruction.

Apoorva V. Kotkar et.al (2017) [2]

Green building technology is one of the most popular topics worldwide, with the goal of reducing the significant impact of the construction industry on the environment, society, and economy. Similar to how far behind the wealthy nations of the world these countries are in terms of education and research. This essay discusses the necessity for sustainable development everywhere, but especially in developing nations like China and India, which have sizable land masses, are growing quickly, and are on track to overtake the United States and the United Kingdom as the next great powers in the near future. Along with the case study of a newly designed and built magnificent residential bungalow in a small town in India, it also covers economic and sustainability studies with connections to Indian contexts.

Behnam Neyestani (2017) [3]

Climate change and global warming are among the many challenges and issues the globe is currently facing. Numerous scientific research found that various industries play significant roles in creating this illness. Particularly, the building sector is responsible for the greatest portion of these global difficulties. Without a doubt, the use of improper technology, equipment, and materials in construction has put the environment and human health in danger today. The use of certain technology and materials in the construction sector during the past few decades has been linked to environmental difficulties, according to engineers and technologists. Scientists advised that thinking about 6 "sustainable" or "green" design for buildings is the best method to combat the aforementioned dangers. Therefore, the major goal of sustainable building is to replace harmful technology and materials with innocuous ones.

Rupali Kapur (2014) [5]

For upgrading any buildings, it's important that we understand the market of greening the existing building. From an economic point of view, energy efficiency upgrades are how the most cost-effective way to meet the growing energy demand. It is obvious that the energy efficient and certified green buildings have higher market values and higher occupancy. The corporate real estate managers in United States have begun to decide in favor of greening both owned and leased building. The marketing values will be varied from geological location.

Amir Hosein et.al (2013) [1]

This study targets to includes the essence of sustainability in green building design implementations. In this regard, the study draws attention to the sustainable energy performances of green buildings to identify the influential parameters based upon the contemporary successful accomplishments. The study elaborates on the contemporary 8 trends and applications of green building design and the respective impacts on sustainable developments. As a result, the analytical review confirms that the sustainable energy performance of green buildings has been transformed

to a sensible and practical resolution to reduce the CO2 emissions and deduct the building sector energy consumption. In addition, with view to the current challenges and barriers, the study concludes that; it is still crucial to identify and develop efficient energy solutions associated with green buildings for addressing the future energy demands. Likewise, the findings highlight that the sustainable energy performances associated with integrated technologies and renewable energy systems are still intertwined with significant challenges related to the fundamental parameters of cost, maintenance, and operation.

Qain Shi (2013) [6]

Green building takes many years for implementation because of approval and collecting information for green construction. There were many associations and council were made to implement the green construction. The green construction concept was taken by China as a rapid development as result of polices on energy conservation and emission reduction and the attempt of government to promote energy conservation and ministry of construction implement these energy construction design for building that been constructed after that. For promoting green construction many different energy conservations and polices passed by the government of China. Many codes and agenda were published for promoting energy efficiency building. Agendas were considered for both urban as well as rural areas established the energy efficient standards on programming, design, construction, project, quality suspension and operational management of construction.

Himakat H. ALI (2012)

The purpose of this research is to contribute to a better understanding of the concept of green building assessment tool and its role for achieving sustainable development through developing an effective green building rating system for residential units in Jordan in terms of the dimensions through which sustainable development tools are being produced and according to the local context .This research studied international green building assessment tools such as LEED, CASBEE, BREEAM, GB Tool, and others. The outcome of the research was a suggested green building assessment tool (SABA Green Building Rating System) – computer-based program – that suits the Jordanian context in term of environmental, social and economic perspectives. It offers an opportunity to create environmentally efficient buildings by using an integrated approach of design so that the negative impact of building on the environment and occupants is reduced. Green 11 design does not only make a positive impact on public health and the environment it also reduces operating costs, enhance building and organizational marketability, increases occupant productivity, and helps create a sustainable community. Assessment measurement based on building lie cycle can produce significant long-term benefits for building problems, limiting environmental impacts, creating healthier and more productive places, and reducing building operation cost. Making green building practices easier to implement; we should develop technical services and resources for determining the “greenness” of building based on an appropriate green rating system that suits the Jordanian local context. Building sector has witnessed the development of two types of assessment tools.

1. IGBC Green Existing Buildings Operations & M maintenance Rating System-Pilot Version

Green Existing Building IGBC O&M is India's first rating programme designed specifically for existing building stock. It is founded on accepted environmental principles and strikes a balance between well-established practises and new ideas. The system is intended to be comprehensive in scope while remaining simple to use. Greening existing buildings can provide numerous tangible and intangible benefits. The most tangible advantages are lower water and energy consumption. Energy and water efficiency could result in operational savings ranging from 15 to 30%. The amount of consumer waste generated in the building can also be significantly reduced. Intangible benefits of green existing buildings include improved air quality, health, and occupant satisfaction.

National Priorities Addressed-

- Water Conservation:

Most Asian countries are water stressed, and the water table in countries such as India has dropped dramatically over the last decade. The Green Existing Buildings O&M Rating System encourages the use of water in a self-sustaining manner by reducing, recycling, and reusing strategies. Green existing buildings that use this rating programme can save 15-30% of their potable water.

- Energy Efficiency:

The construction industry consumes a lot of electricity. Buildings can reduce energy consumption through energy efficient lighting, air conditioning systems, motors, and pumps using the IGBC Green Existing Building O&M rating system. Adopting this rating programme can result in operational energy savings ranging from 15 to 30%.

- Occupant Health and Well-Being:

The most important aspect of Green Existing Buildings is occupant health and well-being. The IGBC Green Existing Buildings O&M Rating System ensures minimum ventilation aspects and occupant well-being facilities in a building. The rating system also recognises measures to reduce indoor air pollutants.

- Handling Consumer Waste:

Handling waste in existing buildings is extremely difficult because most waste generated is not segregated at the source and is likely to end up in landfills. This remains a challenge for municipalities that must be addressed. The IGBC intends to address this by encouraging green existing buildings to separate their waste.

IGBC RATING SYSTEM PARAMETERS

Sr.No	Category	Mandatory Requirement	Points
1	Sustainable Architecture and Design	0	5
2	Site Selection and Planning	2	14
3	Water Conservation	2	19
4	Energy Efficiency	3	28
5	Building Materials and Resources	1	16
6	Indoor Environmental Quality	2	11
7	Innovation and Development	0	7
	Total	10	100

Source-IGBC Green New Buildings Rating System Version 3.0

- Sustainable Architecture and Design

It includes an integrated design approach, site preservation, and passive architecture. Integrated design approach practises include an approach to improved building performance from the planning stage to the project's completion. Site preservation entails preserving site features and minimising negative environmental impacts such as site contour, water bodies and channels, natural rocks, existing topography / landscape, and existing trees.

Climate-responsive concepts and design elements, as well as passive cooling and heating technologies, are all part of passive architecture. This credit is worth 5 points in total.

- Site Selection and Planning

Local Building Regulations and Soil Erosion Control are mandatory requirements for site selection and planning, whereas basic amenities, proximity to public transportation, tow-emitting vehicles, natural topography or vegetation, preservation or transplantation of trees, heat island reduction, non-roof, heat island reduction, outdoor light pollution reduction, universal design, basic facilities for construction workforce, and green building guidelines are not. 14 points are awarded for site selection and planning.

- Water conservation

Rainwater harvesting (Roof and Non-roof) and Water Efficient Plumbing Fixtures are mandatory requirements for water conservation, while Landscape Design, Management of Irrigation Systems, Waste water treatment and reuse, and Water Metering are optional.

Rainwater harvesting must be done on-site for non-potable water storage purposes such as flushing, landscaping, and air cooling. Use IGBC-recommended fixtures with limited flow rates for water efficiency. Water metering entails the

mandatory installation of water metres to monitor project performance.

- Energy Efficiency

The mandatory requirements for energy efficiency include Ozone Depleting Substances, Minimum Energy Efficiency, and a Commissioning Plan for Building Equipment and Systems. Eco-friendly refrigerants, improved energy efficiency, on-site renewable energy, off-site renewable energy, commissioning, post-installation of equipment and systems, and energy metering and management all have their own points.

- Building Materials and Resources

It has 11 points, and waste segregation is a mandatory requirement. Segregation of waste and organic waste management aim to segregate waste at the source and recycle material to avoid waste being disposed of in landfills. Similarly, sustainable building materials aim to reduce reliance on materials that may have a negative impact on the environment. The IGBC suggests At least 2.5% of the total building material should be salvaged or reused. Furthermore, 95% of construction waste should be diverted away from landfills.

- Indoor Environmental Quality

Its mandatory requirements include fresh air ventilation and tobacco smoke control. Whereas the purpose of credit CO2 monitoring is to regulate the level of CO2 occupant comfort and well-being. The IGBC recommends that 75% of regularly occupied spaces in the building achieve a minimum daylight illuminance of 110 Lux in clear sky conditions, as demonstrated by computer simulation. In addition, building occupants must have access to the sky, flora and fauna, or both. To reduce the negative health impact on occupants, use low or no VOC paints and coatings for 95% of interior wall and ceiling surface area.

- Development and Innovation

It contains credits for innovation as well as one IGBC AP credit. The project team should include at least one IGBC AP. Whereas valid innovations are expected that are not guided by the IGBC. It is recommended that structural design optimization demonstrate a saving of at least 5% by weight of steel and cement. Also recommends replacing at least 10% of potable water with treated waste water as long as the quality of construction is not compromised.

METHODOLOGY TO BE ADOPTED

This study is done of Axis Colleges Rooma Kanpur, Uttar Pradesh. It is a very big college in term of area (63 acres) also and it has all basic utilities that are required in any institutional building, as tines with all utilities such as AC's, Fans, Tube lights, Computer, Water coolers etc. so it consumes very huge amount of electricity for which the monthly electricity bill comes in lakhs, so to avoid wastage of electricity as well as money we have to do a case study to install solar panels as per requirement which will be a onetime investment later on the college will be benefitted as they will get the payback in few years and will somehow help the country.

There are many steps involved in this analysis which are used in the greening of the building as given below-

1. Data Acquisition:

We have to do the data acquisition of the building by walking in the building and we calculated the area of the building through GPS, we calculated the usage of electricity in every particular room by going inside each and every room particularly.

2. Selection of latest & best suitable technologies:

2.1.Storm Water Management:

The storm water management has to be carried out as per the local environment factors. This comes under sustainable site credit according to IGBC rating system. The intent is to limit disruption of natural water hydrology by reducing impervious cover. increasing onsite infiltration and managing storm water runoff. The strategy employed is to design the project site to maintain natural storm water flows by promoting infiltration.

2.2.Rainwater harvesting:

The rainwater harvesting for this project can be carried out by calculating the rainwater storage collected from the roof top and land surface. The principal components consist of the catchment area, conveyance system and collection device.

2.3.Roof-Heat Island Effect:
The heat island effect of roof in considered under the sustainable site- credit. The intent is to reduce the heat islands or the thermal gradient differences between developed and undeveloped areas to minimize impact on microclimate, human and wild life habitat.

2.4.Energy Efficient Lighting:
This comes under the energy & atmosphere credit. The intent is to optimize energy performance of the building and reduce wastage. For the commercial green building complex under study, following energy efficient lighting system are proposed.

• CFL to LED LAMPS
Fluorescent Lamps are about 3 to 5 times as efficient as standard incandescent lamps and can last about 10 to 20 times longer. Since the luminous efficacy of incandescent lamp, 100W is 14 Im/W, where as that of a 40W CFL is 49 W. The saving potential is 80%.

• T12 to T8/T5
The luminous efficiencies of the specified fluorescent lamps are given below, which clearly shows that T-8 and T-5 are more energy efficient. The saving potential of changing from 40W TL to 28 W T-5 is 50%

• Luminaires
An efficient luminaire optimizes the system performance of each of its components. There are a few types of luminaires that offer opportunities for energy conservation in a lighting system design. Many of these provide indirect light to brighten the ceiling or are designed to brighten walls or task surfaces. Most of them are fluorescent and are easily controlled for further energy savings.

• Renewable Energy
This comes under the energy & atmosphere credit. The intent is to encourage and recognizes increasing levels of self-supply through renewable technologies to reduce environmental impacts associated with fossil fuel energy use. The strategy is to assess the project for renewable energy potential including solar, wind, geothermal, biomass, hydro, and bio-gas strategies. When applying these strategies, advantage should be taken of net metering with the local utility.
• Natural Fiber Carpet
There are two basic types of natural fibers, namely plant and animal. They are stuck directly to a dry, flat surface. Plant fiber includes sisal, coir, jute, seagrass etc. But these fibres are quite expensive and are not resistant to fading and staining.

• Bamboo Flooring
The advantages of bamboo flooring are that it is extremely hard, stronger than many hardwoods. Some species have been rated higher than maple and almost double that of the red oak. It is also highly moisture resistant. Disadvantages of bamboo flooring are that the technology is pretty inconsistent. Some bamboo forests are being destroyed due to unsustainable management. The embodied energy for transport is high, whenever the bamboo comes from distant forests.

• Reclaimed Hard Wood Flooring
Advantages of reclaimed hard wood flooring are that it is easy to clean and maintain irrespective of its color. It has disadvantages such as that it is expensive, because only natural materials can be used instead of synthetic ones. It takes time to set hardwood flooring as it has to be laid in strips or planks. The wood loses its shine over time, giving a dull look to the floor. Sometimes the hardwood flooring becomes slippery and dangerous to walk on in socks.

• Low Volatile Organic Content Paints
Low VOC use water as a carrier instead of petroleum based solvent. Paints and stains must not contain VOC in excess of 200 g A. Varnishes must not contain VOC in excess of 300 g/l. Benefits of low VOC paints are that it lets out lower levels of ozone pollution and fewer emissions of smog forming chemicals. Low VOC paints are cost competitive and no special equipment is needed.

3.Feasibility Study:
• Analyses the rating system that can be aimed for this project
• Identify the improvements that are required
• Identify and enhance the Indoor Environmental Quality
• Analyses the issues in adoption of green building technologies.

EXPECTED OUTCOMES

We are expecting the following outcomes from this analysis that we are doing on the existing building of E-Block of Axis Colleges –

1. The building will be mainly dependent on the natural and renewable sources of energy.
2. Maximize the use of efficient construction material and methods.
3. Building will be more sustainable by making small changes in the plan of this building.
4. It will use less energy as compared to before.
5. We are supposing that it will reduce the money expenditure of electricity by 3-4 lakhs approximately.
6. Wastage of water will be reduced.
7. There will be proper rainwater harvesting system that will help in minimizing the blockage of rain water.
8. For recycling of water there will be a proper sewage treatment plant in the college campus.
9. The human productivity will also be increased.

REFERENCE

[1] Amir Hosein "Sustainable energy performance of green buildings", Elsevier,vol. 25, September 2013
[2] Apoorva V. Kotkar "A review paper on green building research", IJARSE, vol.no. 06,issue no. 07, July 2017
[3] Behnam Neyestani "A review on sustainable green building", SSRN Electronic Journal 6(1), January 2017
[4] Lakshmi R. "Conversion of existing conventional building to green building using simple versatile affordable green rating for integrated habitat assessment and cost analysis", IJRD, vol. no. 06, issue no. 12, December 2021
[5] Rupali Kapur "Parameters of upgrading existing building into green building", IJERA, vol. 04, issue no. 02, February 2014
[6] Qian Shi "Identifying the critical factors for green construction", Elsevier, October 2013
[7] Textbook of "Building Materials" by S.K. Duggal
[8] https://igbc.in/igbc/html_pdfs/abridged/IGBC%20Green%20EB%20O&M%20Rating%20System%20(Pilot%20Version)
[9] https://igbc.in/igbc/
[10] https://igbc.in/igbc/redirectHtml.htm?redVal=showratingSysnosign
[11] https://igbc.in/igbc/redirectHtml.htm?redVal=showGreenNewBuildingsnosign