

GREEN BUILDING CONCEPT, RATING SYSTEM AND ITS MANAGEMENT IN CONSTRUCTION PROJECTS IN INDIA

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Abstract

As we are aware that there is enormous increase in basic facilities and development of construction field in India and it is very important sector because it creates employment on large scale and play a pivotal role in economic growth. Due to economic growth, India is witnessing increase percentage of 9.5% as estimated to world standard of 5% in construction industry. Due to growth in Construction sector and urbanization of population in India, construction sector exerts a lot of environmental pressure and consumes natural resources such as soil, water, wood, stones, metals, glass etc during construction and consume energy. Due to this, there is a rise in green growth in India because it focuses on energy conservation, energy efficiency, integration of renewables, lesser consumption of water and sustainable waste management. It also aims better indoor environment for the occupants and low emissions of CO₂ by using recycled material. The green building concept has been gaining importance in India due lesser amount of energy consumption, lesser consumption of water and better solution for waste management. It is well known that Nothing can be achieved without energy and to reduce and utilize maximum level of energy, there should be consideration of how to decrease energy consumption throughout the course of construction, renovation and operation of building. Due to global warming and environmental issue such as rise in air, water and land pollution we are at the stage where green concept building is to be adopted at war level in construction industry. As we are aware that Buildings is, enormous consumer of energy and responsible for emission of green house gases, the concept of green building is the need of the Hour. Here it's a small concept presented in paper how building can meet environmental goals with minimum use of energy and the organization involve in the management and promotion of green building.

Keywords: - Sustainability, CO₂, Ecosystem, Green Buildings, Renewable, Green Design

1. INTRODUCTION

Green buildings are adapted to climate and very efficient in terms of planning of earth resource and reducing environment influence throughout its operation. It is also recognized as high performance or green building. It creates positive impact on our climate and natural environment. It preserve natural resources and improve our quality of life. Green building Philosophy is based on the following principles:-

- Make efficient use of land preserving natural topography and vegetation.
- Efficient Use of Natural and manufacture Material through efficient planning.
- Efficient use of water, Preserve water through harvesting scheme and generate soft water through treatment plant to minimize use of potable water.
- Minimal Or no waste.
- Efficient use of energy both renewable and non renewable through different parameters and efficient planning.
- Last but not least, Provide healthy indoor environment for its occupant.

So basically a green or sustainable building focuses on an excellent use of natural resources, energy, maintain waste in efficient way and creates spaces for healthy and conformable living.

2. NEED FOR GREEN BUILDING

Due to enormous increase in basic facilities and development of construction field in India, the construction industry here is growing with the pace and prove to be biggest economic activities since it is increasing at the rate of 9.5% as estimated to world standard of 5%. Due to enormous growth of construction industry in India it poses environmental threat. Due to this growth rate now it is mandatory under environment protection act 1986, all the construction activities involving the investment more than 50 crores must obtain the certificate and approval from EIA before starting the construction.

Building industry in India is the biggest contributors to direct and indirect Greenhouse Gas (GHG) emissions in the country. As per UNEP Report, buildings add 1/3 of total global greenhouse gas (GHG) emissions. The construction industry add upto 30% of world yearly GHG production and

absorbs 40% of all energy. One of the main culprits is carbon dioxide emissions, which is implicated to contribute up to 40% of all global emissions in which India's position is 144th ranking in CO₂ emission in the world. Due to carbon emission Kyoto protocol applies from February 2005 and it aims to reduce greenhouse gas emission. It is an environmental treaty followed by different industrial nations (39 nations) to reduce CO₂ by different measures. The source of this protocol can be traced back to 1997.

Due to increase in construction and environmental issues, green building is the need of the hour and has the following:-

- **Environmental Gains:** Green buildings have environmental benefits because they reduce the use of earth's natural resources, maintain ecological balance, maintain and improve better quality of air and water and minimize waste.
- **Economic Gains:** Green buildings prove to be economically beneficial since in the long run they reduce energy bills, operational bills, rise in property value and improve the efficiency of manpower or its productivity due to a healthy environment inside the green building enclosure.
- **Health and Community Gains:** Green buildings have improved indoor air quality, good ventilation system, thermal comfort, good visibility, daylight and due to these benefits they improve the health, comforts and improve all aspects of life of the occupants as well as the nearby community. The community gets benefits due to the reduction in the uses of local infrastructure.

Last but not least it helps reduce greenhouse gases.

The green concepts in the construction industry address the following issues which are also national concerns:-

- Water Performance and reduction of potable water use by 40%.
- Energy Performance, decreasing energy use by 30-5% from baseline.
- Reduction in Non renewable energy
- Reduction in waste by 70%.
- Protect earth's natural resources.
- Boost occupant health and productivity.
- Reduce CO₂ emission by 35%.

2.1 Objective of Green Building

The main aim of the sustainable green building construction is to examine the technique that minimizes environmental impacts. It can be summarized as mentioned below:-

- Green building construction also helps in establishing policy regarding green building for the region and also advance green building practices in the region by setting examples by utilizing energy, water, waste and material used in a building in an efficient way.
- Green building practices also set examples to reduce environmental impact through innovative ideas and designs adopted to decrease total impact on the surrounding and also on human fitness.

- To provide research to support green building construction.
- To influence and educate others to support the construction of green building in the region.
- Green buildings also minimize the available earth resources during construction and operational stage.
- Green or sustainable building construction emphasizes use of efficient waste management practices.
- Provide comfortable and hygienic indoor conditions through ventilation and daylight.
- Reduces carbon dioxide emissions.

2.2 Advantage of Green or Sustainable Building

Sustainable buildings have many advantages and governments also promote the green projects due to its benefits and also gives compensation for green projects. Green building projects have environmental, economic and social benefits. Some of the benefits are illustrated below:-

- Green buildings promote habitat and biodiversity by minimizing disturbances and restoring the site.
- Green buildings promote how to check and curb soil erosion and sedimentation responsible for decreasing adverse impact to site and surrounding.
- Green buildings focus on the use of vehicles which use renewable energy thereby decreasing adverse effects arising from fossil fuels depends on automobiles.
- Green buildings promote the use of public transport to have low impact on environment by minimizing the use of vehicles.
- Green buildings protect and promote existing trees and plant new saplings to maintain ecology and biodiversity.
- It decreases heat island effect to have negative low impact on micro climate.
- It controls light pollution to increase view of night sky and improve the nocturnal environment.
- Green buildings enhance water table and cut potable water requirement through the efficient management of rain water harvesting scheme and also by using high efficient plumbing fixtures to reduce water loss.
- Green buildings have efficient management of irrigation system to reduce water loss in irrigation.
- Green buildings have mandatory to have sewage or effluent treatment plant to generate treated water on site to decrease the use of potable water.
- It encourages eco friendly refrigerant thereby minimizing impact on ozone layer.
- Green buildings optimize energy consumption through thermally exterior wall assembly, efficient lighting design, VFD on cooling tower, heat recovery wheels, use of high performance glass, BEE rated equipment such as chiller, pumps, DG etc. Energy saving is possible from 5% to 35% less from the baseline.
- It focuses on the generation of renewable source of energy to minimize the energy generated from fossil fuels and thus have low impact on environment. Reduces energy consumption up to 5 to 10%.

- In green building there is continuous monitoring of energy consumption through meters to identify energy consumption of each zone which helps in improving the energy performance of building.
- Green building promotes dry or wet garbage segregation to promote reuse or recycle and thus avoiding all these waste generated is being deported to land fill.
- Green building promotes ecofriendly building material, reduce use of virgin material to avoid its negative impact on environment. Also it promotes material with recycled content such as RMC, steel, Glass, Cement etc.
- Green Building provides effective measure to utilize organic waste.
- Green building provides good indoor environment quality by providing adequate outdoor air ventilation, Monitoring CO₂, Separate smoking zone area, adequate daylight, by using Low emitting materials such as paints, adhesive and sealants, carpet etc.

2.3 Conventional Building Vs Green Building

By looking at the building from outside, it is not possible to differentiate since green building and conventional building look the same and have the same utility or the use.

The main difference between green building and conventional building is that green building has efficient planning and strategies to conserve the natural resources thus minimize impact on environment. Minimizing energy consumption which results in cost saving in long run, generate less waste and enhance health and productivity of occupant.



Source: State Environmental Resource Centre

Conventional buildings don't incorporate the efficient strategy to decrease the utilization of earth's natural resources. So due to this conventional method of planning, designing and execution of building leads to the maximum utilization of earth's natural resources, high operational and maintenance cost and increase waste.

3. GREEN BUILDING RATING SYSTEM

Since building construction industry is growing tremendously in India, and construction is the second largest producer of demolition waste and greenhouse gases (35%-40%), consume enormous amount of energy and generate large amount of solid and waste water. Due to this rating system has emerged as a means to evaluate building performance based on environmental consideration. Rating systems are designed based on national background, climatic condition and natural resource available. Rating system also standardizes the practice. It helps the owner, Architects, energy analyst, engineers, building manager to achieve high performance building in a planned way from initial planning to final stage. Rating system is a powerful tool to measure green aspects in a building and can collectively make the difference.

There are different rating systems available in different countries based on their national background such as:-



The green building development has led to the materialization of an assortment of green rating systems. The green rating systems that are currently being adopted in India are:

- 1) **LEED India** - maintained by the Indian Green Building Council (IGBC); formed by CII (Confederation of Indian Industry) in 2001. CII - Godrej GBC, offers services in following areas:-



Source: IGBC

- 2) GRIHA - Green Rating for Integrated Habitat Assessment developed by TERI (The Energy and Research Institute) and the Ministry of New and Renewable Energy, Government of India. It is a sustainable building design evaluation system where buildings are rated and consists of 34 criteria organized in different section.
- 3) BUREAU OF ENERGY EFFICIENCY(BEE) - BEE establish its own evaluating system for the buildings based on a 1 to 5 star scale. It is based on the actual consumption or performance of a building from baseline, express in terms of its specific energy usage in kwh/sq m/year. It rate building on a 1-5 Star scale, with building having 5 Star is being most efficient. More stars mean more energy efficiency.

3.1 GRIHA – (Green Rating for Integrated Habitat Assessment)

Griha establish by TERI (The Energy and Resources Institute, New Delhi) in collaboration with MNRE (Ministry of New and Renewable Energy, Government of India). The origination of word GRIHA is from a Sanskrit word meaning – 'Abode'. Human Habitats connect with the environment in different ways.

GRIHA was establish as an domestic building rating system based on climatic condition of india, which was particularly to focus on non air conditioned or partially air conditioned building. It is an establish organization to rate all types of building such as residential, commercial, institutional building etc in india and highlights environment concerns, local climatic condition and its domestic solution.

GRIHA focuses on better indoor environment by using passive solar technique for better visual and thermal comfort inside the building. It also promote the high consumption energy using air conditioned building only in extreme cases of thermal discomfort.

The GRIHA green rating tool mainly contain 34 different criteria divided under different group, such as site planning, construction management, energy, occupant comfort and well being, water, Sustainable building material, solid waste management, socio economic strategies and performance monitoring and validation. GRIHA incorporate all compatible Indian codes and buildings standard and acts as main mechanism to expedite operation of the same.

The point split of various section according to GRIHA



Source: GRIHA

Currently, 1125 projects are being evaluated by GRIHA and 78 buildings have been rated so far. GRIHA council also conducts awareness workshop on green building. As per data available from the year 2015 the GRIHA already spread to about 25 mn Sqm registered built-up area which has resulted in a approximate generation of 18.5MW of renewable energy, 5000 kl of hot water generation through solar. By operation of these building it is resulted of annual saving of energy 40,000 million units and water is approximate save which is enough for 67,500 urban homes.

The point split of various section according to GRIHA

Sections	Criterion No.	Criterion Name	Max. Point
SITE PLANNING	1	SITE SELECTION	1
	2	LOW IMPACT DESIGN	4
	3	DESIGN TO MITIGATE UHHE	2
	4	SITE IMPERVIOUSNESS FACTOR	1
CONSTRUCTION MANAGEMENT	5	AIR AND WATER POLLUTION CONTROL, PRESERVE AND PROTECT LANDSCAPE DURING CONSTRUCTION	1
	6	CONSTRUCTION MANAGEMENT PRACTICES	4
	7	CONSTRUCTION MANAGEMENT PRACTICES	4
ENERGY	8	ENERGY EFFICIENCY	13
	9	RENEWABLE ENERGY UTILIZATION	7
	10	ZERO ODP MATERIALS	0
OCCUPANT COMFORT AND WELL BEING	11	ACHIEVING INDOOR COMFORT REQUIREMENT(VISUAL/THERMAL/ACOUSTICS)	6
	12	MAINTAINING GOOD IAQ	4
	13	USE OF LOW VOC PAINTS AND OTHER COMPOUNDS IN BUILDING INTERIORS	2
WATER	14	USE OF LOW-FLOW FIXTURES AND SYSTEMS	4
	15	REDUCING LANDSCAPE WATER DEMAND	4
	16	WATER QUALITY	2
	17	ON-SITE WATER REUSE	5
	18	RAINWATER RECHARGE	2
SUSTAINABLE BUILDING MATERIAL	19	UTILIZATION OF HIS RECOMMENDED WASTE MATERIALS IN BUILDING STRUCTURE	6
	20	REDUCTION IN EMBODIED ENERGY OF BUILDING STRUCTURE	4
	21	USE OF LOW ENVIRONMENTAL IMPACT MATERIALS IN BUILDING INTERIORS	4
SOLID WASTE MANAGEMENT	22	AVOIDED POST-CONSTRUCTION LANDFILL	4
	23	TREAT ORGANIC WASTE ON SITE	2
	24	LABOUR SAFETY AND SANITATION	1
SOCIO ECONOMIC STRATEGIES	25	DESIGN FOR UNIVERSAL ACCESSIBILITY	2
	26	DEDICATED FACILITIES FOR SERVICE STAFF	2
	27	INCREASE IN ENVIRONMENTAL AWARENESS	1
PERFORMANCE MONITORING AND VALIDATION	28	SMART METERING AND MONITORING	8
	29	OPERATION MAINTENANCE PROTOCOLS	0
	30	PERFORMANCE ASSESSMENT FOR FINAL RATING	8
	31	INNOVATION	4
		TOTAL	100

Source: GRIHA

3.2 LEED India

It is consensus based green building rating system which is based on the use of existing building technology. The Indian green building council (IGBC) has modified the US LEED system as per indigenous climate condition and situation of India and launch various version for old and new construction building. The green rating System focuses on impact of building on environment and enhance the energy efficiency of building and have good indoor environment.

1. Sustainable Sites (SS) :- The Sustainable Sites (SS) category is basically interaction between the building and environment surrounding. Credit in this category is based on the following points:-

- Site Preservation by not disturbing existing areas, by providing habitat and maintaining ecological balance and restoring destructive areas.
- Measure to curb soil erosion, to reduce environment impact.
- Reduce heat island effect
- Reduce light pollution to enhance nocturnal environment.
- Site should be located nearby to basic amenities such as banks, community centre, Fire station etc.
- Site should be nearby to public transport system to reduce pollution from automobile.
- Adequate parking facility within site.
- User friendly for differently abled person.

2. Water Efficiency (WE) :- The Water Efficiency category focuses on water saving by analyzing overall consumption and how to minimize the overall consumption. Credit in this category is based on the following points:-

- Emphasize on the effective measure and management of rain water harvesting scheme to minimize the use of ground water and also to increase water table.
- Decrease utilization of potable water by treating sewerage waste water within the site and this water is further used in cooling system, flushing, washing and irrigation system.
- By limiting the installation of landscape which consumes large quantity of water.
- By efficient irrigation system.
- By using high efficient plumbing fixture.

3. Energy and Atmosphere (EA) :- The category of Energy and Atmosphere (EA) focuses on the reduction in the use of energy, efficient energy design consideration, and maximum use of renewable source of energy.

Credit in this category is based on the following points:-

- It aims to create high energy efficient building which uses less energy from base standard and through this approach it also reduces its environment impacts. It can be achieved through by considering building orientation, natural ventilation, appropriate building material, passive heating and cooling system, U value of wall and roof, efficient planning for lighting power density, solar heat gain through glazing and window, and chiller

efficiency.

- On site renewable energy at least 5% of total load and it is important that renewable source of energy makes less dependent on fossil fuels and also reduce the strain on electric grid during peak hour by generating electricity through solar panel or renewable source.
- By installing energy monitoring system.
- HCFC free air conditioning system.
- Encourage investment on offsite source of renewable energy.
- By using all BEE rated equipment.

4. Materials and Resources (MR) :- This credit category focuses on the maximum use of recycled material or recycled content material and less use of virgin material to minimize the environment impacts related to the extraction, transit, maintenance, process of manufacturing and dumping of building material.

Credit in this category is based on the following points:-

- It emphasizes on division of waste originated at the source (Post occupancy) so as to avoid such waste being sent to landfill.
- It emphasizes to reduce construction waste being sent to landfill during construction and emphasize the recycling or reuse of the same material.
- More emphasis on such type of material or product having recycled contents.
- Emphasize to use locally available material, thereby minimizing the add on environment impact.
- Emphasize the use of such material having low VOC content such as paints, carpet, adhesive and sealants etc.
- Encourage the use of green material which are easily renewable materials, having more salvaged content, and FSC certified wood product material.
- The use of certified green, products equipment or BEE rated.

5. Indoor Environmental Quality (EQ) :- This category deals with indoor environment and thermal comfort, visual, and acoustic satisfaction. Credit in this category is based on the following points:-

- Minimum fresh air ventilation for all occupied areas and in case of air conditioning building it has to meet standard prescribed in ASHRAE for minimum fresh air ventilation.
- Separate zone for smoking areas.
- Continuous monitoring of CO₂ to ensure occupant comfort and well being.
- Adequate day light provision in building
- Ensure connectivity between indoor and outdoor environment by providing adequate views.
- Encourage use materials and system with low VOC emission so as to reduce adverse health impact on building occupants.

6. Innovation and Design Process :- The aim of this category to go beyond the baseline set by IGBC to achieve more credit for the project. It also helps in Research and Analysis of green projects. It urge the professional associated in green projects to adopt new ideas which will result in better performance of green building. This category is purely based on innovation design ideas. Credit in this category is based on the following points:-

- It mainly consist of the areas of exemplary performance such as heat island reduction, natural topography or vegetation on site, water conservation, Building material and resources and outdoor views more than 95%.
- It also aims to optimize structure design to have less consumption of cement and steel without compromising standards.
- Involvement of IGBC accredited Professional in green building projects.

These are the different category of IGBC Rating system available in India which are applicable to all climatic zone. IGBC work continuously in the field of green building rating system and incorporated all the modern concept related to this. Rating system is based on the classification of building. These are the following rating category classification of IGBC rating system:

IGBC RATING CATEGORY	CERTIFIED	SILVER	GOLD	PLATINUM
IGBC Green New Buildings	40-49	50-59	60-74	75-100
IGBC Green Residential Societies	30-39	40-49	50-64	65 & ABOVE
IGBC Green Schools(EXISTING)	50-59	60-69	70-79	80-100
IGBC Green Schools(NEW SCHOOL)	55-65	66-76	77-87	88-110
IGBC Green Campus(EXISTING)	40 - 49	50 - 59	60 - 74	75 - 89
IGBC Green Campus(NEW)	36 - 44	45 - 53	54 - 66	67 - 90
IGBC Green Cities	NA	NA	NA	NA
IGBC Green Mass Rapid Transit System	NA	NA	NA	NA
IGBC Green Affordable Housing	38 - 44	45 - 51	52 - 59	60 - 65
IGBC Green Existing Buildings	50 - 59	60 - 69	70 - 79	80 - 100
IGBC Green Interiors	30 - 44	45 - 54	55 - 69	70 - 100
IGBC Green Factory Buildings	51 - 60	61 - 70	71 - 80	81-100
IGBC Green Villages	40 - 49	50 - 59	60 - 79	80 - 100
IGBC Green SEZs	51 - 60	61 - 70	77 - 80	81 - 100
IGBC Green Existing Mass Rapid Transit System	NA	NA	NA	NA
IGBC Health and Well-being Rating	50 - 59	60 - 69	70 - 79	80 - 100
IGBC Green Homes(INDIVIDUAL UNIT)	38 - 44	45 - 51	52 - 59	60 - 75
IGBC Green Homes(MULTI-DWELLING UNIT)	50 - 59	60 - 69	70 - 79	80 - 89
IGBC Green Healthcare	NA	NA	NA	NA
IGBC Green Data Center(EXISTING)	40-49	50-64	65-79	>80
IGBC Green Data Center(NEW)	40-49	50-64	65-79	>80
IGBC Green Townships	100 - 119	120 - 139	140 - 159	160 - 200
IGBC Green Landscapes(SMALL)	45 - 53	54 - 62	63 - 71	60 - 75
IGBC Green Landscapes(LARGE >5 ACRE)	50 - 59	60 - 69	70 - 79	72 - 90

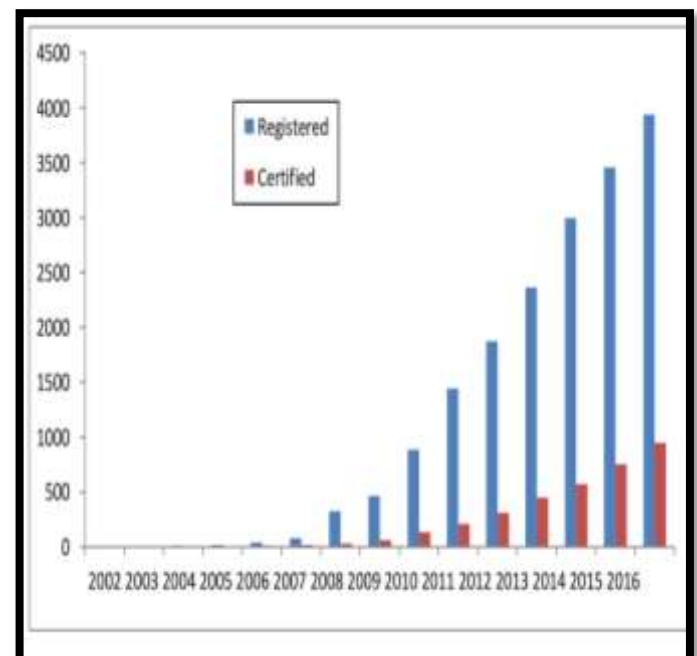
Source: IGBC

Rating systems of IGBC are based on the score achieve by the projects under key component describe above and according building is awarded as whether it is certified, silver, gold and platinum.. IGBC Rating system is suitable for all the climatic zone of country.

4. GREEN GROWTH RATE IN INDIA

The Green Building industry is growing in India due to environmental regulation and arising demand .Green building programme specially LEED transforming the green concept movement across the globe and LEED is recognized and widely used and most popular among the green rating system in the world. In India green building movement is lead by CII-Sohrabji Godrej Green Business and it was awarded as first platinum green rated building located in Hyderabad in India. The concept of green building is growing in India due to increase awareness level ,environmental benefits and government supports and it is estimated that green building will double by 2022 at 10 billion sqft valuing around USD 35-

Growth of green building over the year (Source-IGBC) 40 billion. As per data available from Indian Green Building Council there were 20,000 sqft of green built-up area in 2003 and as of now today more than 4,573 green building projects coming up with foot print of over 5.30 billion sqft registered with IGBC out of which 1384 are functional building based on green concept.



Source: IGBC

5. CASE STUDY

Achieved	Denied		
9	0	Sustainable Sites	Possible Points - 13
Y		Erosion & Sedimentation Control	Prerequisite 1 – Ver 1.0
1		Site Selection	Credit 1 – Ver 1.0
1		Development Density & Community Connectivity	Credit 2 – Ver 1.0
NOT ATTEMPTED		Brownfield Redevelopment:	Credit 3 – Ver 1.0
1		Alternative Transportation, Public Transportation Access	Credit 4.1 – Ver 1.0
1		Alternative Transportation, Low Emission & Alternative Fuel Refueling Stations	Credit 4.2 – Ver 1.0
1		Alternative Transportation, Parking Capacity	Credit 4.3 – Ver 1.0
NOT ATTEMPTED		Reduced Site Disturbance, Protect or Restore Habitat	Credit 5.1 – Ver 1.0
1		Reduced Site Disturbance, Development Footprint	Credit 5.2 – Ver 1.0
NOT ATTEMPTED		Stormwater Design, Quantity Control	Credit 6.1 – Ver 1.0
1		Storm water Design, Quality Control	Credit 6.2 – Ver 1.0
1		Heat Island Effect, Non -Roof	Credit 7.1 – Ver 1.0
NOT ATTEMPTED		Heat Island Effect, Roof	Credit 7.2 – Ver 1.0
NOT ATTEMPTED		Light Pollution Reduction	Credit 8 – Ver 1.0
1		Tenant Design and Construction Guidelines	Credit 9 – Ver 1.0
Achieved	Denied		
4	1	Water Efficiency	Possible Points - 6
1		Water Efficient Landscaping	Credit 1.1 – Ver 1.0
NOT ATTEMPTED		Water Efficient Landscaping, No Potable Water Use or No Irrigation	Credit 1.2 – Ver 1.0
	1	Water Efficiency in Air -conditioning System, 50% Reduce	Credit 2 – Ver 1.0
1		Innovative Wastewater Technologies	Credit 3 – Ver 1.0
1		Water Use Reduction, 20% Reduction	Credit 4.1 – Ver 1.0
1		Water Use Reduction, 30% Reduction	Credit 4.2 – Ver 1.0
Achieved	Denied		
7	1	Energy & Atmosphere	Possible Points - 17
Y		Fundamental Building Systems Commissioning	Prerequisite 1 – Ver 1.0
Y		Minimum Energy Performance	Prerequisite 2 – Ver 1.0
Y		CFC Reduction in HVAC&R Equipment	Prerequisite 3 – Ver 1.0
4		Optimize Energy Performance	Credit 1 – Ver 1.0
NOT ATTEMPTED		Renewable Energy, 1%	Credit 2 – Ver 1.0
	1	Additional Commissioning	Credit 3 – Ver 1.0
1		Ozone Depletion	Credit 4 – Ver 1.0
1		Measurement & Verification –Base Building	Credit 5.1 – Ver 1.0
1		Measurement & Verification – Tenant Sub-metering	Credit 5.2 – Ver 1.0
NOT ATTEMPTED		Green Power, 50%	Credit 6 – Ver 1.0
Achieved	Denied		
6	0	Material & Resources	Possible Points - 13
Y		Storage & Collection of Recyclables	Prerequisite 1 – Ver 1.0
NOT ATTEMPTED		Building Reuse, Maintain 75% of Existing Walls, Floors and Roof	Credit 1.1– Ver 1.0
NOT ATTEMPTED		Building Reuse, Maintain 100% of Existing Walls, Floors and Roof	Credit 1.2– Ver 1.0
NOT ATTEMPTED		Building Reuse, Maintain 100% of Shell+50% of Non-Shell	Credit 1.3– Ver 1.0
1		Construction Waste Management, Divert 50% from Disposal	Credit 2.1– Ver 1.0
1		Construction Waste Management, Divert 75% from Disposal	Credit 2.2– Ver 1.0
NOT ATTEMPTED		Resource Reuse, 1%	Credit 3.0– Ver 1.0
1		Recycled Content, 5% (post -consumer + ½ post -industrial)	Credit 4.1 – Ver 1.0
1		Recycled Content, 10% (post -consumer + ½ post -industrial)	Credit 4.2 – Ver 1.0
1		Regional Materials, 20% Manufactured Regionally	Credit 5.1 – Ver 1.0
1		Regional Materials, 50% Extracted Regionally	Credit 5.2 – Ver 1.0
NOT ATTEMPTED		Certified Wood, 50% of wood based materials	Credit 6 – Ver 1.0
Achieved	Denied		
5	2	Indoor Environmental Quality	Possible Points - 15
Y		Minimum IAQ Performance	Prerequisite 1 – Ver 1.0
Y		Environmental Tobacco Smoke (ETS) Control	Prerequisite 2 – Ver 1.0
NOT ATTEMPTED		Outdoor Air Delivery Monitoring	Credit 1 – Ver 1.0
1		Increased Ventilation, 30% above ASHRAE 62.1 requirements	Credit 2 – Ver 1.0
1		Construction IAQ Management Plan , (During Construction)	Credit 3 – Ver 1.0
1		Low-Emitting Materials, Adhesive & Sealants	Credit 4.1 – Ver 1.0
0		Low-Emitting Materials, Paints	Credit 4.2 – Ver 1.0
1		Low – Emitting Materials, Carpet	Credit 4.3 – Ver 1.0
	1	Low Emitting Materials, Composite Wood & Agrifiber products	Credit 4.4 – Ver 1.0
NOT ATTEMPTED		Indoor Chemical & Pollutant Source Control	Credit 5 – Ver 1.0
NOT ATTEMPTED		Controllability of Systems,Lighting	Credit 6.1 – Ver 1.0
NOT ATTEMPTED		Controllability of Systems, Thermal Comfort	Credit 6.2 – Ver 1.0
	1	Thermal Comfort, Design	Credit 7.1 – Ver 1.0
NOT ATTEMPTED		Thermal Comfort,Verification	Credit 7.2 – Ver 1.0
NOT ATTEMPTED		Daylight, Daylight 75% of Spaces	Credit 8.1 – Ver 1.0
1		Views, Views for 90% of Spaces	Credit 8.2 – Ver 1.0
Achieved	Denied		
4	1	Innovation in Design	Possible Points - 5
1		Innovation in Design	Credit 1.1 – Ver 1.0
1		Innovation in Design	Credit 1.2 – Ver 1.0
1		Innovation in Design	Credit 1.3 – Ver 1.0
	1	Innovation in Design	Credit 1.4 – Ver 1.0
1		LEED - INDIA Accredited Professional	Credit 2 – Ver 1.0
Rating Achieved: Gold Total Point Score-35			

To understand the concept of green building rating system, a IT building situated in Gurugram's Sohna road have been studied and all the related points awarded and denied are mentioned in a tabular form. This IT building is about 600,000 sqft and is located in 63 acre campus in Gurugram. It is awarded as a gold certified building in 2013. In the construction phase of building importance was given to use eco friendly material and minimize the use of virgin wood. The building has different features which enable to optimize energy consumption such as orientation, High performance glass, insulation of roof and wall, efficient HVAC system with efficient centrifugal chillers, variable frequency drive (VFD) and heat recovery system. The building has some additional features to conserve potable water by using grey water in irrigation of landscape, washing, flushing and cooling towers. The Building Score 35 points and achieve certification as a gold rated building and is fully functional under the category of "Core and Shell" by IGBC.

6. COST ANALYSIS OF GREEN BUILDING

It is a point of discussion and research that a green building costs more. In India, as per data available, most green buildings have an incremental cost of 2-12% from baseline depending on rating category. Due to tremendous growth of construction industry in India and also due to environmental regulation such as EIA, the distance between the conventional and green building is decreasing and green building cost is also decreasing due to mandatory points set by EIA (MOEF). Now it is becoming a myth that green buildings cost more and now it is possible by analyzing the market, the green material is also available in abundance due to increase in demand and green growth and benefits associated with it is that green material has lower impact on environment. It is also easy to minimize the cost of green building, if all the parameters are carefully studied and incorporated at the design stage only.

It should be kept in mind that if green building costs a little more but it has benefits such as reduced electricity bill, reduced water bill, reduced operating cost, better comfort and better health. Nowadays the payback for green building is hardly 1 to 2 years.

Building	Year awarded	Built-in Area (sq. ft)	Rating Achieved	% increase in cost	Payback (Yrs)
CII-Godrej GBC, Hyderabad	2003	20,000	Platinum	18 %	7 years
ITC Green Centre, Gurgaon	2004	1,70,000	Platinum	15 %	6 years
Wipro, Gurgaon	2005	1,75,000	Platinum	8 %	5 years
Technopolis, Kolkata	2006	72,000	Gold	6 %	3 years
Spectral Services consultant's office, Noida	2007	15,000	Platinum	8 %	4 years
Hyderabad Institute of Technology and Management	2007	78,000	Silver	2 %	2 years
Grundfos Pump	2007	40,000	Gold	2 %	3 years

Source: CII

By analysis and research regarding cost in green building, there are some parameters which increase the cost and some parameters decrease the cost. Some of the parameters which reduce the cost in the building by adopting green features are as follows:-

- By adopting passive architecture design features such as orientation, skylight, courtyard, shaded corridor, shading device, passive cooling and heating etc., it is possible to design building envelope in such a way that it will reduce dependency on air conditioning and artificial lighting and it will bring down initial construction cost as well as its operating cost.
- By selecting brown field because the land has lower market value.
- By easy access to basic amenities, and public transportation system and hence it will result in lower fuel consumption.
- By water conservation scheme through harvesting and use of treated water in cooling towers, landscape irrigation, car washing and flushing can reduce the use of potable water and hence reduce cost associated with them.
- Lower maintenance cost of equipment due to BEE rated equipment and green certified equipment.
- Due to minimize use of virgin material it can cut first cost of purchase.
- Due to use of salvage material in the building, material cost will reduce in green building.
- By optimization in structure design which will reduce the consumption of steel and cement. By using AAC block and fly ash in concrete, the use of cement and steel can be minimized by 5% and it will result in reduce in cost.

Some of the parameters which increase the cost in the building by adopting green features are as follows:-

- By adopting parameters to reduce heat island effect, it will increase the cost in green building.
- By using all BEE rated equipment it will put extra cost in green building in initial stage though have low maintenance cost in long term.
- By setting on site renewable source of energy, it will have major cost addition in initial stage though in long running it will be cost saving.
- Insulation of wall and roof will have cost addition in green building though it will reduce heat load on air conditioning system.
- Use of high performance glass as per green norms will have additional cost in initial stage.
- Use of certified wood and certified green equipment will cost more in green projects.
- High efficient plumbing fixture to reduce water consumption will have initial cost more in green building.
- CO₂ monitoring system to maintain occupant and well being will have additional cost in green building.

- Building Management system (BMS) in green building will cost more due to maintenance and managing efficiency of building as per norms.

The overall cost analysis comparison cannot be justified unless all the parameters is studied and analysed. The overall cost comparison of green and conventional cannot be justified by cost increment or decrement method unless actual projects are studied and analysed.

7. CONCLUSION

Due to tremendous growth in construction industry and urbanization of population has resulted in maximum utilization of land and other earth natural resources which has put immense burden on the same. So the LEED /Green building can be regarded as game changer because green building is design in such a way that it can be reduce environment impact that are measurable. Also green building can reduce CO₂ emission, water consumption and material use and also green building prove to be energy efficient building. Since India is developing country and have huge population, have impact on energy uses and energy uses is growing day by day .So it is very necessary since building consume a lot of energy. Government also promoting green concept and the use of energy based on renewable source. It's important to review financial aspect during planning and construction phase of a project to reduce development first cost in delivering green and sustainable building.

FUTURE SCOPE

Green building Technology is the only way the construction would be taken up in future due to enormous growth in construction sector and urbanization of population. It is very important in India since demand of energy consumption is more than supply and there is shortage of energy. In the coming future all construction in India should be green and low carbon. The green construction costing based on the life cycle is considerably low and it requires more professional knowledge. The future belongs to Green construction and professionals practicing it. A lot of people are becoming conscious of the concept of green buildings and profit associated with it and low impact on environment. In coming future green building will be more emphasize and promoted for better environment and society. The result coming out from the recently rated functional green building is very encouraging. It optimize energy consumption which result in reducing CO₂ emmision. Now due to large foot print it is becoming cost effective. Day by day the green building concept is growing and implemented in construction worldwide.

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