International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

Limitations of Green Building Rating Systems – A case of LEED and GRIHA

Samreen S. Makandar[1], Nadeem A. Sanadi[2]

[1]*Post Graduate Student, Department of Civil Engineering, Jain College of Engineering Belagavi, Karnataka, India*

[2]*Assistant Professor, Department of Civil Engineering, Jain College of Engineering Belagavi, Karnataka, India*

Abstract – *Green buildings work on the principle of "whatever it derives from the nature returns to it". Green buildings are resource efficient and environmentally responsible structures. There are a set of standards which a building has to fulfil to be called as a green building. Various criterions are considered for evaluation of buildings and they are ranked accordingly. Various green building rating systems such as LEED, BREEAM, CASBEE, GB-Tool etc. are adopted across the world by different countries for rating and certifying green buildings. These ratings classify the buildings performance with respect to the green building techniques adopted. This paper considers few of such green building rating systems for the study. The study emphasise on two of the most widely used rating systems in India namely LEED and GRIHA. The rating patterns, rating criterions, award of marks etc. are studied in detail and compared. Few of the limitations of these rating systems are listed and a possible solution for the same is proposed at the end.*

Key Words: LEED, GRIHA, CASBEE, BREEAM, GB-Tool, Green Buildings, Green Building Rating, etc.

1. INTRODUCTION

Buildings contribute towards major environmental impacts during their life cycle. Various resources such as soil, trees, water, and various formats of energy are used by the buildings. For instance Water, most vital resource, is consumed continuously during building construction as well as operation. Similarly several buildings along with usage of resources generate large amounts of waste, which can be recycled and can be reused. Thus, the challenge of a green building is to make optimum usage of resources and proper waste disposal at an affordable cost.

A green building depletes natural resources during its construction and operation. The aim of a green building is to reduce the demand of non-renewable resources, optimize the utilization efficiency of these resources when in use, and maximize the reuse, recycling, and utilization of renewable resources.

While designing or constructing a green building, various aspects such as Site planning, Building envelope design, Integration of renewable energy sources to generate energy on-site, Water and waste management are considered with utmost importance.

The definition of Green Buildings changes from country to country according to their needs of building sustainable habitat. The Green Buildings are defined differently from different organizations, nations and researchers. Few of the definitions of Green Building by various organization s are listed and explained below.

The National Rating system of India, GRIHA (Green Rating for Integrated Habitat Assessment) in its manual defines Green Building as "A building which is designed to minimize the demand on non-renewable resources and depletes the natural resources to a minimum during its construction, operation and maintenance". According to GRIHA a green building use minimum energy, makes use of natural lightening to the maximum, adopts efficient waste and water management practices and maximize the reuse, recycling and utilization of renewable resources.

2. GREEN BUILDINGS

2.1 Necessity of Green Buildings

The construction sector poses a major challenge to the environment. Globally, buildings are responsible for at least 40% of energy use. An estimated 42% of the global water consumption and 50% of the global consumption of raw materials is consumed by buildings when taking into account the manufacture, construction, and operational period of buildings. In addition, building activities contribute an estimated 50% of the world's air pollution, 42% of its greenhouse gases, 50% of all water pollution, 48% of all solid wastes and 50% of all CFCs (chlorofluorocarbons) to the environment.

India too faces the environment challenges of the construction sector. The gross built-up area added to commercial and residential spaces was about 40.8 million square metres in 2004–05, which is about 1% of annual average constructed floor area around the world and the trends show a sustained growth of 10% over the coming years. With a near consistent 8% rise in annual energy consumption in the residential and commercial sectors, building energy consumption has seen an increase, from a low 14% in the 1970s to nearly 33% in 2004–05.1 Energy consumption would continue to rise unless suitable actions to improve energy efficiency are taken up immediately. As per TERI estimates, there is an increased demand of about 5.4 billion units (kWh) of electricity annually for meeting end-use energy requirement for residential and commercial buildings.

Buildings are major consumers of water during construction and operation (for occupants, cooling, and landscaping). Per capita water consumption in 1990 was 2464 m3 per capita per annum, but by 2025 with an expected population of 1.4 billion, it will almost certainly be in the stress category with less than 1700 m3 per capita per annum.

2.2 Principle of Green Building

Green buildings work on five basic principles which involve methods, techniques and practices and are explained in brief as follows.

- *Sustainable Site planning* — to optimize the land use and to minimize the building's ecological footprint.
- *Energy Efficiency* — for establishing performance standards for intended use, occupancy and other energy operations for new construction and renovation projects.
- *Water efficiency* — this emphasize on proper usage of fresh water and reduction in generation of waste water through landscaping, rainwater catchments, grey water recycling, and wastewater treatment systems.
- *Building Materials* — Using sustainable construction materials and resources, green building materials to improve overall performance of the building.
- *Healthy Indoor Environmental Quality* — focus on ventilation and thermal comfort, moisture control, day lighting, environmental tobacco smoke control, and protecting indoor air quality during construction.

6. GREEN BUILDINGS IN INDIA

The Indian Green Building Council (IGBC) was formed by the Confederation of Indian Industry (CII) in 2001. The council is based out of the CII Green Business Centre Hyderabad which is India's 1st Platinum rated green building. The vision of the council is to enable 'Sustainable built environment for all. IGBC has achieved the following significant milestones.

- 5,000+ projects registered with IGBC from various parts of India and abroad, amounting to a total footprint of 4.72 billion sq. ft.
- 25 IGBC green building ratings to cover all typologies of projects - residential, commercial, industrial, healthcare, etc.
- 2,100+ IGBC Member Organizations comprising developers, corporates, architects, consultants, institutes, government, etc. 45,000 KL of Water per million sq. feet per annum
- Installation of 100 MW of Renewable Energy in IGBC certified projects
- Reduced CO2 emissions by 12,000 tons per million sq. ft. per

2.3 Cost of green buildings

At initial stages the incremental cost has been experienced between 12-18 percent and now we can observe that the incremental cost has been reduced to 5-8 per cent. Further, we are aiming at green buildings becoming less costly than conventional buildings thus making them affordable for the common.

3. GREEN BUILDING RATING SYSTEM IN WORLD AND INDIA

A green building rating system is an evaluation tool that measures environmental performance of a building through its life cycle. It usually comprises of a set of criteria covering various parameters related to design, construction and operation of a green building. Each criterion has pre-assigned points and sets performance benchmarks and goals that are largely quantifiable. Some of the successful international rating programmes are listed and explained below.

3.1 BREEAM

Building Research Establishment's Environmental Assessment Method (BREEAM) was developed in the United Kingdom in 1990 and is one of the earliest building environmental assessment methods. BREEAM covers a range of building types including—offices, homes,

industrial units, retail units, and schools. When a building is assessed, points are awarded for each criterion and the points are added for a total score. The overall building performance is awarded a 'Pass', 'Good', 'Very Good' or 'Excellent' rating based on the score. BREEAM has separate criteria/checklist for evaluation of Design and Procurement and for Management and Operation of buildings.

3.2 CASBEE

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) was developed in Japan, in 2001. The family of assessment tools is based on the building's life cycle: pre-design, new construction, existing buildings, and renovation. CASBEE presents a new concept for assessment that distinguishes environmental load from environmental quality and building performance.

Under CASBEE there are two spaces, internal and external, divided by the hypothetical boundary, which is defined by the site boundary and other elements, with two factors related to the two spaces, in which the 'negative aspects of environmental impact which go beyond the hypothetical enclosed space to the outside (the public property)' and 'improving living amenity for the building users' are considered side by side. Under CASBEE, these two factors are defined below as Q and L, the main assessment categories, and evaluated separately.

3.3 GB Tool – Green Building Tool

Developed by the International Framework Committee for the Green building Challenge .Formation of GB Tool involved more than 25 countries from 1998.Criteria for rating include section of site ,planning and development ,load on the environment, resource usage, quality of the environment, social and economic aspects etc.

Rating is awarded as -1 to the building with poor practices and ranging from 1 to 5 to the buildings following best practices where, 1 will be Good and 5 will be Very high performance .Use of non-renewable energy ,electricity usage, use of renewable materials and water, land use, basic facilities ,emission to the atmosphere, use of day light etc. are some of the criteria considered for assessment.

3.4 HK-Beam

The Hong Kong Building Environmental Assessment Established in the December of 1996.It is an assessment method based on the performance of the building with more focus on its life cycle. The evaluation of building is not conducted until all the green practices are implemented efficiently.

Rating criterion for new buildings and existing buildings are different. Major focus of HK-Beam is on health, sanitation and wellbeing, energy efficiency, etc. Assessment is % based.

3.5 LEED

Leadership in Energy and Environmental Design (LEED) was developed in the US in 1998. This is the most widely used green Building rating system in the world. The rating system is based on several environmental and building related criterions based on which the buildings are rated. The Indian Green Building Council adapted LEED system and launched LEED India version on 1st January 2007.

There are more than 650 LEED certified green buildings in India such as CII-Godrej GBC, ITC Green Centre Gurugram, Wipro Gurugram etc. The rating pattern is as shown in the table.

Table 1 – LEED Rating Pattern

Rating	Points
LEED Certified	26-32
LEED Silver Certified Level	33-38
LEED Gold Certified Level	39-51
LEED Platinum Certified Level	53-69

3.6 GRIHA

Most of the internationally adopted rating systems have been framed to suit the building industry of that particular country. The Energy Resource Institute (TERI) New Delhi, with an objective of sustainable development, took the responsibility of developing a rating system to measure building's environmental performance in the context of India's varied climate and building practices and to encourage the construction of Green Buildings in India. The rating system will evaluate the performance of the building for its entire life cycle based on the Green Building techniques adopted during construction, operation and maintenance of the building. This rating system developed by TERI is called as *Green Rating for Integrated Habitat Assessment* (GRIHA).

GRIHA is India's official Green Building rating program. It is a 5 star rating system purely based on the environmental performance of the building. GRIHA is formed by The Energy Resource Institute New Delhi (TERI) under the Ministry of New and Renewable Energy (MNRE). The process of rating is limited to new buildings only. May it be commercial, educational and residential or any building built to serve any purpose.

The certification is based on 34 criterions for which marks are awarded out of 100 for buildings with more than 2500 sq. meter. built-up area. The rating pattern according to the marks scored by the building is as shown in the table.

Table 2 – GRIHA Rating Pattern

Marks	Stars
50-60	*
61-70	**
71-80	***
81-90	****
91-100	*****

4. COMPARISON OF LEED AND GRIHA

The following table shows the rating points shared by the two widely used green building rating pattern in India across the world namely GRIHA and LEED.The rating criterion are coupled into six major categories and combined points are represented.

Table 3 – LEED and GRIHA points

Criteria	LEED	GRIHA
Sustainable site planning	13	17
Water management	6	13
Energy optimization	17	35
Sustainable building materials	13	14
Waste management	4	5
Health and well being	9	14
Building operation and maintenance	2	2
Innovation	5	4
Total	**69**	**104**

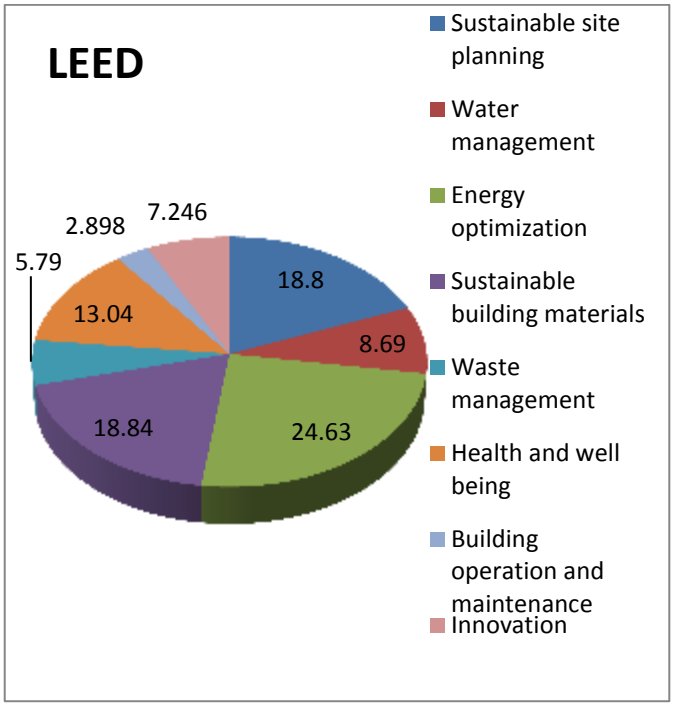

Figure 1 - LEED rating criterion

The pie chart illustration above represents the share of marks in LEED certification process. As seen the LEED system of rating gives maximum importance to energy optimization having a share of 24.63% of the total marks. Whereas, for sustainable site planning 18.8%, water management 8.69%, sustainable building materials 18.84%, waste management 5.79%, health and well-being 13.04%, building operation and maintenance 2.898% and innovation 7.246% of the total marks are allotted.

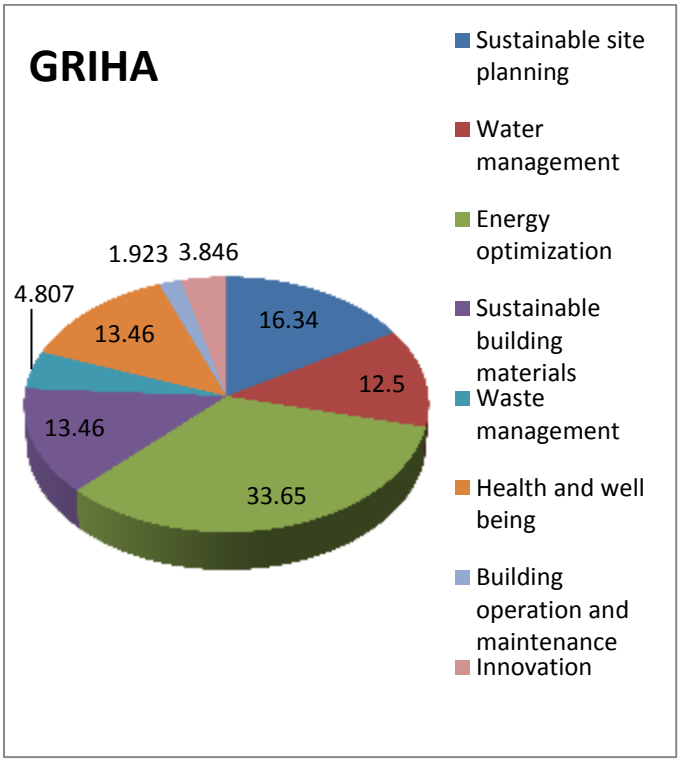

Figure 2 - GRIHA rating criterion

The pie chart above shows the % share of the GRIHA rating system and it can be seen that priority is given to energy optimization having a share of 33.65% of the total marks followed by sustainable site planning 16.34%, water management 12.5%, sustainable building planning materials 13.46%, waste management 4.807%, health and well-being 13.46%, building operation and maintenance 1.9235% and innovation 3.846% of the total marks.

4.1 Limitations of LEED and GRIHA

LEED and GRIHA rating systems are not reliable at all the places of India or they are suitable for high budget large sized projects only. These rating systems will not give efficient results when small scale housing projects of less and very less built-up area are considered.

The rating criterions of these systems take into account metro cities and surrounding areas, where as small cities and towns are not considered. Both LEED (8.69%) and GRIHA (12.5%) give less preference to water usage whereas; in small cities water is given prime importance.

Both the rating processes are designed for new buildings only which are either under construction or newly constructed neglecting large scale old buildings which are under operational and maintenance stage consuming a lot of resources.

Hence, there is a need to develop a system which takes into account small scale projects of small towns and cities along with already constructed old buildings of any scale. The system should also give preference to innovation in construction industry which can be encouraged by giving special allowances of recognition to the particular building.

5. CONCLUSIONS

All the buildings which are being built newly should focus on adopting green building techniques in its possible way. Use of renewable sources, recycling wastes and water, cost effective building techniques should be adopted etc. willingly by the builders and developers while constructing a structure.

The existing Green Building Rating systems should also rate already constructed old buildings. If not, a new rating pattern for rating of old buildings should be developed. A new rating system for small scale projects considering the views and needs of the small cities should be designed keeping in mind the local scenario. By doing this the interest of the people as well as developer community towards adopting green building techniques may see a hike.

REFERENCES

[1] Hemant Kumar, Vaishali Sahu, “Performance and Rating of Residential Green Building”, Civil Engineering and Urban Planning: An International Journal, Volume 2, June 2015.
[2] Avinash Shivajirao Pawar, “Green Buildings”, Journal of Engineering Research and studies, Volume III, Issue I, January-March 2012.
[3] C. Subramaniam, “Griha Rating System”, Indian Society of Heating Refrigerating and Air conditioning Engineers (ISHARE), 2009.
[4] Jignesh C. Sailor, Himanshu A. Naik, Viralkumar I. Makwana, “Green Building – Leader in Energy and Environment Design for Building Sector”.
[5]GRIHA Manual, Volume -1, 2010.
[6] LEED Manual, Version-4, 2013.

6. BIOGRAPHIES

Samreen Makandar is a graduate in Civil Engineering and currently perceiving Post Graduation in Construction Technology from Jain College of Engineering Belagavi. Sustainable and Affordable housing, Green Buildings are authors field of interest.

Nadeem A. Sanadi is an Assistant Professor in the Department of Civil Engineering in Jain College of Engineering Belagavi. He is a graduate in Civil Engineering and Post Graduate in Construction Technology. He has over two years of industrial experience in execution of major bridges and one year of teaching experience.