COMPARATIVE STUDY OF LEED AND GRIHA RATING SYSTEM

[1] MR. ILIYAS IKBAL SANDE, [2] PROF. MRS. N. S. PHADTARE

[1] M.E. (Construction & Management) Student, Civil Engineering Department, D.Y.P.C.O.E. Akurdi.
[2] Professor of Civil Engineering Dept., D.Y.P.C.O.E. Akurdi

Abstract - With the increasing awareness of sustainable development in the construction industry, implementation of a green rating procedure to assess buildings is becoming more important. The rating tool set benchmarks for green measures for constructing and using buildings to make them sustainable and to reduce their negative impacts on environment. The most representative building environment assessment schemes in India that are in use today are Leadership in Energy and Environmental Design (LEED) and Green Rating for Integrated Habitat Assessment (GRIHA). This paper aims to focus on the study of LEED and GRIHA rating system and compare both with regards to their assessment methods; scopes, performance criteria and energy rating scales are presented. Through this study, an attempt is made to make clear understanding of LEED and GRIHA rating system assessment criteria that need to be considered during comparison. From this Comparative study prepare a general checklist which will cover each and every aspect required for assessment and certification for any small scale green building project.

Keywords—Green building, Rating system, LEED, GRIHA, Energy performance assessment

I. INTRODUCTION

The green building trend has increased rapidly worldwide in recent decades. The idea of green rating of buildings has taken roots in India. This is in line with the global trend in which the rating tools set benchmarks for green measures for constructing and using buildings to make them sustainable and to reduce their negative impacts on environment. Based on the magnitude of green measures adopted, points are awarded to a building and, after appropriate weighting; a total score is ascribed to determine the rating of the building. This helps to convey the range of application of green measures in building construction.

A green building is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building." Green or sustainable Building is a designing concept that reduces the environmental impact of buildings through innovative land use and construction strategies. A Green Building is a building which incorporates the use of clean, renewable energy and efficient use of natural resources and recycled or recyclable materials to provide healthy indoors. The modern buildings fulfill the requirements of artificial comforts, but in turn consume excess energy and other natural resources. On the contrary, Green Buildings combine various eco-friendly concepts thereby increasing the working efficiency, providing the luxuries with the reduction in costs.

Worldwide various rating systems have been developed. In 1996, The Building Research Establishment's Environmental Assessment Method (BREEAM) in UK was developed. In year 1996, the Hong Kong Building Environmental Assessment Method (HK-BEAM) was introduced in Hong Kong. In year 1998 the Leadership in Energy and Environmental Design (LEED) green building rating system was introduced in US. In year 2002 Green building council of Australia introduced Green Star rating system. In year 2005 the building and Construction Authority of Singapore introduced Green Mark rating system. And Green Rating for Integrated Habitat Assessment (GRIHA) in India.

In the last two decades there has been a significant evolution in the way rating tool methodologies assess the building sector. In the beginning of the 1990's the rating tool technique's developed with main focus in design stage, where as the actual construction was not so important. At the start of the 21st century, this trend has gone in reverse, where most rating tool methodologies show significantly increased concern in the actual construction and a less focus in merely building design. At the same time, since 2006 a new trend in a green building rating has arose, where the main focus is now on the form of sustainable performance. This recent performance trend has expanded the implications of sustainable buildings. As the orientation in direction to the construction stage and sustainable performance expands in time, the rating tools methodologies will accommodate accordingly, shifting increasing categories and weighting from building design perspective to building performance. Hence, this will have a powerful effect on the future configuration of the building sector.

LEED India and GRIHA are the most accepted and common rating systems in Indian green building industry. In this regard, LEED & GRIHA systems are similar in aims, approach and structure to rate the performance of the building sector and create according grade levels for accreditation. However, the sustainability rating

methodology varies considerably, from tool rating system one to another in terms of measurement of building performance, scope and environmental criteria within the infrastructure sector.

II. AN OVERVIEW OF GREEN BUILDING RATING SYSTEMS

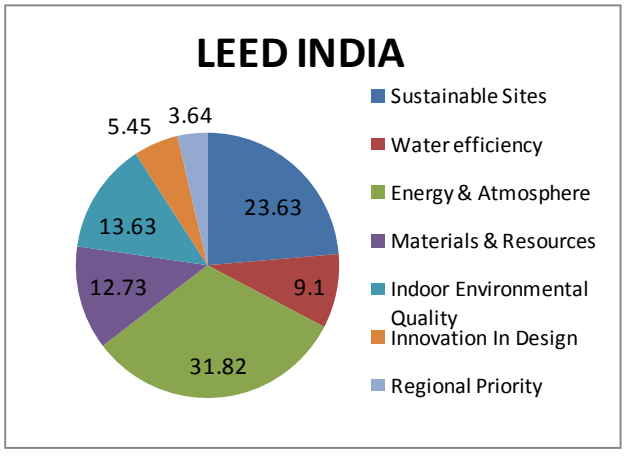
A. LEED-2011 for India NC rating system

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System represents the U.S. Green Building Council's effort to provide a national standard for what constitutes a "green building." LEED-India programmed has adapted from United States Green Building Council's (USGBC) in 2007. This is purely a private initiative which is run by the Indian Green Building Council (IGBC) in India. IGBC has set up the LEED 2011 for India Core Committee with the objective of the LEED rating system for the Indian context. LEED provides guidelines and specifications for building construction to achieve its sustainability goals and objectives. LEED is similar to checklist of credits that can be achieved 7 major categories. Following are these categories.

1) Sustainable Sites
2) Water Efficiency
3) Energy & Atmosphere
4) Materials & Resources
5) Indoor Environmental Quality
6) Innovation & Design Process
7) Regional Priority

Through its use as a design guideline and third-party certification tool, it aims to improve occupant well-being, environmental performance and economic returns of buildings using established and innovative practices, standards and technologies. LEED is similar to checklist of credits that can be achieved in 7 major categories. LEED evaluates a building for the amount of sustainability objectives it achieves and recognizes building at four certification level (Certified, Silver, Gold, Platinum) LEED is considered to be one of the most successful green building rating systems in the world because of its early market penetration and adoption by professionals. Since the CII-Godrej GBC achieved the prestigious LEED rating for its own centre at Hyderabad in 2003, the Green building movement has gained tremendous momentum. The Platinum rating awarded for this building sparked off considerable enthusiasm in the country. This rating system is based on accepted energy and environmental principles and strikes a balance between known established practices and emerging concepts. It is performance-oriented, wherein credits are earned for satisfying criteria addressing specific environmental impacts inherent in the design and construction. Different levels of green building certification are awarded based on the total credits earned. The system is designed to be comprehensive in scope, yet simple in application. The specific credits in the rating system provide guidelines for the design and construction of buildings of all sizes in both the public and private sectors. The intent of LEED 2011 for India is to assist in the creation of high performance, healthful, durable, affordable and environmentally sound commercial and institutional buildings.

Fig. 1. LEED India Evaluation criteria



- Credit Points under Different Categories

1. 100 possible points under the five core categories – SS, WE, EA, MR & IEQ
2. 6 possible points under 'Innovation in Design'
3. 4 possible points under 'Regional Priority'
4. Total possible points achieved are 110.

- Credit Point for Different Levels of Certification

Certified	40 - 49 points
Silver	50 - 59 points
Gold	60 - 79 points
Platinum	80 points and above

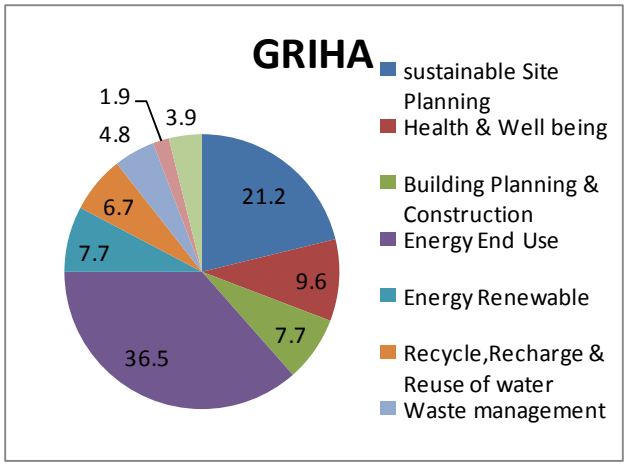
B. GRIHA rating system

GRIHA is a national rating system for Green buildings in India. Conceived by TERI and developed jointly by the Ministry of New and Renewable Energy, Government of India, it is based on nationally accepted energy and environmental principles. Over 300 projects across India of varying scale and function are being built based on GRIHA guidelines.

Most of the internationally devised rating systems have been tailored to suit the building industry of the country where they were developed. TERI, being deeply committed to every aspect of sustainable development, took upon itself the responsibility of acting as a driving force to popularize green buildings by developing a tool for measuring and rating a building's environmental performance in the context of India's varied climate and building practices. This tool, by its qualitative and quantitative assessment criteria, would be able to 'rate' a building on the degree of its 'greenness'.

The rating shall evaluate the environmental performance of a building holistically over its entire life cycle, thereby providing a definitive standard for what constitutes a 'green building'. The rating system, based on accepted energy and environmental principles, seeks to strike a balance between the established practices and emerging concepts, both national and international. The guidelines/criteria appraisal may be revised every three years to take into account the latest scientific developments during this period. On a broader scale, this system, along with the activities and processes that lead up to it, will benefit the community at large with the improvement in the environment by reducing GHG (greenhouse gas) emissions, improving energy security, and reducing the stress on natural resources. The rating applies to new building stock – commercial, institutional, and residential – of varied functions. Endorsed by the Ministry of New and Renewable Energy, Government of India as of November 1 2007, GRIHA is a five star rating system for green buildings which emphasizes on passive solar techniques for optimizing indoor visual and thermal comfort. In order to address energy efficiency, GRIHA encourages optimization of building design to reduce conventional energy demand and further optimize energy performance of the building within specified comfort limits. A building is assessed on its predicted performance over its entire life cycle from inception through operation.

Fig. 2. GRIHA Evaluation criteria



- **Credit Points under Different Categories**

5. 100 possible points under the Eight categories
6. 4 possible points under 'Innovation in Design'
7. Total possible points achieved are 104.

- **Points achieved GRIHA Rating**

One star	**50–60**
Two stars	**61–70**
Three stars	**71–80**
Four stars	**81–90**
Five stars	**91 points and above**

GRIHA was developed as an indigenous building rating system, particularly to address and assess non-air conditioned or partially air conditioned buildings. GRIHA has been developed to rate commercial, institutional and residential buildings in India emphasizing national environmental concerns, regional climatic conditions, and indigenous solutions. GRIHA stresses passive solar techniques for optimizing visual and thermal comfort indoors, and encourages the use of refrigeration-based and energy-demanding air conditioning systems only in cases of extreme thermal discomfort. GRIHA integrates all relevant Indian codes and standards for buildings and acts as a tool to facilitate implementation of the same.

III. CASE STUDY

Pimpri Chinchwad New Town Development Authority
Location : Akurdi, Pune
Site Area : 20344 sqm
Built-up Area : 10835 sqm
Air-conditioned Area : 607 sqm
Non Air-conditioned Area : 10228 sqm
Energy consumption reduction: 46% from GRIHA benchmark
Water consumption reduction: 71% from GRIHA benchmark
EPI: 17 kWh/sqm/year
Occupancy hours : 8 hours
Renewable energy installed on site : 100 kWP
GRIHA rating: 5 Stars
Client : Pimpri Chinchwad New Town development Authority
Architect : Landmark Design Group, Pune
HVAC System : Federal Consultant, Pune
Electrical Consultant : Federal Consultant, Pune
Interiors : Landmark Design Group,Pune
GRIHA Rating Consultant : The Energy and Resources Institute, New Delhi.

IV. COMPARATIVE ANALYSIS

In terms of the specific rating systems, LEED has similarities and differences with GRIHA program. A key similarity between the two programs is the use of credit based system with some flexibility for what credits or measures building developers want to pursue, along with mandatory requirements that must be met for certification. For rating new construction design, both LEED and GRIHA also use similar rating criteria's focusing on land, energy, water, indoor environmental quality. A comparison of the relative weighting of each evaluation criteria showing in fig. no 1

Comparative analysis which is shown in table no. 03 gives complete idea of the various assessment criteria i.e. Similarity and dissimilarity of green building rating systems and it also reflects whether respective rating systems have considered or not considered the various criteria while assessment. As it reflects from this analysis that there are many assessment criteria considered which have the same meaning but they are denoted by a different wording in respective rating systems. From graph 01 and graph 02 of green building rating system it is clear that there is no appropriate preference given to various assessment criteria. There are Differences between the two systems in terms of process, popularity, transparency, cost, and criteria.

PROCESS: The GRIHA rating system uses an offline questionnaire-based approach. Once the questionnaire has been completed, a report is generated that provides ratings, a list of sustainability achievements, and recommendations for improvement. An independent third-party verifier (known as a Green Globes assessor) completes the task, which eliminates the need for binders or templates, and is more adaptable to specific project requirements. LEED, on the other hand, is very documentation-intensive, more complex, time consuming and (ironically) is still a mostly paper based system.

POPULARITY: LEED is very popular in comparison to GRIHA. More than 22 countries have adopted LEED and USGBC has a stated goal of becoming the global standard for green building rating systems. Since its introduction a dozen years ago, more than 12,000 commercial projects have been certified under LEED according to USGBC. GRIHA was formed in 2006 and indicates that more than 2,000 buildings have been certified under GRIHA in India. Much of the growth in the India has been in the last 2 to 4 years, and they continue to see increasing interest in GRIHA from building owners, design professionals, and governmental agencies.

TRANSPARENCY: GRIHA use prerequisites or minimum performance requirements. However, what some might consider a disadvantage can actually mean that a building could have better all-around performance, even if it is disqualified by LEED for not meeting a minimum requirement. GRIHA awards points for implementing strategies, as well as for outcomes, whereas LEED primarily allocates points for achieving a certain

performance level. Additionally, USGBC has come under growing criticism recently for keeping its LEED process more closely held and 'internal' than many stakeholders would like to see, especially when it comes to adoption of LEED by governmental agencies.

COST: GRIHA has free associate membership, no appeal costs, and fewer registration costs. It also reduces the costs of billable hours for LEED consultants on documentation. Therefore, it is possible to certify under GRIHA for a lower cost than under LEED.

CRITERIA: GRIHA better integrates life-cycle thinking into its rating system through sourcing of materials and the durability and adaptability of the building itself. Some categories are emphasized differently in the two systems. For example, GRIHA emphasizes energy use above all other categories while LEED allocates comparatively more points to materials. This difference in emphasis may begin to shift somewhat, since LEED vision (formerly LEED India-NC) incorporates more life cycle thinking than previous versions.

Table 01- Details of LEED & GRIHA rating system

Heads	**LEED/IGBC**	**GRIHA**
Inception year	1998/2006	2007
Total Building's Registered	2000	550
Total buildings rated	553	Not Provided
Square ft registered	833 million Ft^2	Not Provided
Square ft rated	Not Provided	Not Provided
Professionals trained	557	
Total footprints	1.2 billion ft^2	20 million ft^2

Table 02- Comparative analysis of LEED and GRIHA rating system

No.	CATEGORY	LEED	GRIHA
1	MANAGEMENT/SUSTAINABLE SITE		
a)	Site selection/Reuse of land/Reclaimed land/Sustainable construction	✓	✓
b)	Preserve and protect the landscape during construction / Preserve top soil / Existing vegetation	✓	✓
c)	Soil conservation/Top soil laying & stabilization/Hard landscaping & boundary protection	×	✓
d)	Brownfield redevelopment	✓	×
e)	Design to include existing site features	✓	✓
f)	Building & site operation & maintenance	×	✓
g)	Project management	×	✓
2	ENERGY/ENERGY EFFICIENCY/ENERGY USE		
a)	Renewable energy utilization	✓	✓
b)	Minimum energy performance/Optimize ozone depletion	✓	×
c)	Fundamental building commissioning/Measurement & verification/ Energy monitoring/metering & monitoring	✓	✓
d)	Ozone depletion	✓	✓
e)	Additional commissioning	✓	×
f)	Energy improvement/Green power	✓	✓
3	INDOOR ENVIRONMENTAL QUALITY		
a)	Optimize building design to reduce the conventional energy demand/Naturally ventilated design/Localized ventilation	✓	✓
b)	Day lighting & views / Visual comfort / Day lighting / External views / Artificial lighting minimization / Interior lighting normally specified.	✓	✓
c)	Reduced heat island effects/Thermal comfort/Thermal insulation/Thermal performance of building	✓	×
d)	Low emitting material/Indoor chemical and pollutant source control/CO2 monitoring and control / Hazardous material / Indoor air pollutants/ETS control	✓	✓
e)	Minimize ozone depleting substance/HCFC & CFC free HVAC/Low &	✓	✓

	Zero carbon technology		
f)	Acceptable indoor & outdoor noise levels / Acoustic performance /Background noise	×	✓
4	HEALTH & WELL BEING		
a)	Minimum level of sanitation/Safety facilities for construction workers	×	✓
b)	Reduce air pollution during construction	✓	✓
5	RECYCLE, RECHARGE & REUSE OF WATER		
a)	Water consumption/Water monitoring/Water meter/Water usage monitoring	×	✓
b)	Waste Water Treatment	✓	✓
c)	Water recycle & reuse	×	✓
d)	Minimize waste generation/Waste segregation/ Storage & disposal/Recovery from waste	×	✓
e)	Innovative waste water technologies/ Storm water management / Water recycling effluent discharge to foul sever.	✓	✓
6	MATERIALS		
a)	Building reuse/Reuse of façade/Reuse of structure	✓	×
b)	Conservation and efficient utilization of resources	✓	✓
c)	Utilization of fly ash in the building structure	×	✓
d)	Storage and collection of recyclables/Construction water management / Resource reuse / Recycled content / Construction waste management / Recycled aggregates / Recycled content of concrete / Recycled content of steel / Recycled content of reused products& materials	✓	✓
e)	Reduce volume, weight & time of construction by adopting an efficient technology	×	✓
f)	Use low energy materials in the interiors	✓	✓
g)	Sustainable procurement/Recycling waste storage / Sustainable construction/Sustainable products / Adaptability & Deconstruction / Sustainable forest products / Waste recycling facilities / Waste management	✓	✓
h)	Local or regional materials	✓	×
7	TRANSPORTATION		
a)	Alternative transportation / Public transport accessibility / commuting mass transport / Green transport / Local transport / Vehicular access	✓	✓
b)	Alternative transportation/Cyclist facilities	✓	×
c)	Alternative transportation / Travel plan / Fuel efficient transport	✓	×
e)	Pedestrian route/ Local transport	✓	✓
f)	Proximity to amenities/ Neighborhood amenities/ Amenities features	✓	×
8	INNOVATION		
a)	Innovation in design	✓	✓

CONSIDERED	✓
NOT CONSIDERED	×

Table 03 - Small Commercial Green Building Checklist

Sr No.	Categories
	Building Energy Efficiency
1	Appropriate orientation of building
2	Energy efficient appliances
3	Efficient lighting system (Use of LED,CFL)
4	Use of renewable energy sources (Solar, Wind)
5	Effective insulation of walls and roof (Protection)
6	Use of UV reflective glass to prevent heat again
7	Appropriate balance of openings and optimized shading
8	Good management, Maintenance and monitoring for continuous performance improvement
9	Use of reflective material on roof

	Site Aspect
10	Site Selection
11	Soil Erosion Control
12	Retention of Ecology on site
13	Building Regulations
14	Basic Amenities
15	Facilities for construction work force
16	Green building guidelines for post occupancy
	WATER EFFICIENCY
17	Recycling of waste water
18	Rain water harvesting systems
19	Water saving fixtures
20	Sewerage treatment plant
21	Water efficient landscaping
	MATERIALS FOR CONSTRUCTION
22	Recycling of materials from the construction site
23	Use of renewable materials such as Fly Ash blocks
24	Use of locally available materials
25	Use of certified wood for construction
	INDOOR ENVIRONMENTAL QUALITY
26	Ensuring maximum daylight and natural views
27	Allowing natural ventilation
28	Use of low VOC adhesives, Sealants, Paints etc

V. CONCLUSION

There are many factors which have to be considered while constructing a green building. It is very necessary to know how effective a particular project is in term of its environment friendliness. This brief comparison would check the building on various points so as to give a fair idea of where it stands in being a green building. Both rating systems are good enough to be used in certain part of the country but they are not unique in nature. Since these two systems are based on different parameters, there is a possibility of the both rating systems rate the same buildings differently. Also they are quite complex in nature and do not necessarily give a clear idea of the projects effectiveness. Each system has certain strong points and certain weak points and they are not specific on some assessment criteria. Due to this both systems are currently confusing the Indian developers, builders over the certification of their projects and buildings.

As from above comparative study of LEED and GRIHA rating system some suitable points for green building which is simple and effective is suggested for small contractors to achieve green agenda simply and economically. This point is an integration of various points such as it carries the advantages of both system where as it overcomes the individual shortcomings.

VI. REFERENCES

[1] **Bo Xia1; Jian Zuo2; Martin Skitmore3; Stephen Pullen4; and Qing Chen5** "Green Star Points Obtained by Australian Building Projects." Journal of Architectural Engineering, Vol. 19, No. 4, December 1, 2013. ©ASCE, ISSN 1076-0431/2013/4-302–308

[2] **Peng wu1 and sui pheng low2** "Project Management and Green Buildings: Lessons from the Rating Systems." Journal of Professional Issues in Engineering Education and Practice, Vol. 136, No. 2, April 1, 2010. ©ASCE, ISSN 1052-3928/2010/2-64–70

[3] **J. T. Kevern, A.M.ASCE1** "Green Building and Sustainable Infrastructure: Sustainability Education for Civil Engineers." Journal of Professional Issues in Engineering Education and Practice, Vol. 137, No.2, April 1, 2011. ©ASCE, ISSN 1052-3928/2011/2-107–11

[4] **Vyas Gayatri Sachin and Jha K. N.** " Comparative study of rating systems for green building in developing and developed countries" ICCIDC-III July 4-6,2012, Bangkok, Thailand.

[5] **Ninza Z. Khanna, John Romankiewicz, Nan zhou and Wei feng** " From platinum to three stars: Comparative analysis of U.S. and China green building rating programs" ACEEE summer study on energy efficiency in buildings. 2-402-414.

[6] **R.G. Saigaonkar, S.S.Pimplicar, P.D. Aher**, "Unique rating system for green building; By compairing various existing rating ayatems" ISSN: 2248-9622, Vol. 4, Issue 1 (Version 2), Jan 2014, 197-206