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Comparative Study of GRIHA, LEED, BREEAM Rating Systems for Green Building

Pratibha Patil[1], Alka Avasthi[2], Vijeta Kundlikar[3], Sampat Nanaware[4], Prasad Joshi[5]
Lecturer, Department of Civil Engineering[1,3,4,5]
Head of Department, Department of Civil Engineering[2]
Pimpri Chichwad Polytechnic, Akurdi, Pune, Maharashtra, India

Abstract: *The negative impacts of the industries such climate change, global warming, ozone depletion and inefficient resource consumption have received a great concern and awareness among the public, politicians and academicians and this need demand of Green or sustainable design approach in all industries and sectors. Thus, a lot of efforts have been applied either in terms of theories or practices in order to reduce the adverse impacts of the industries. Green building rating tool, is a voluntary environmental rating system which evaluates the environmental design and construction of buildings, amid growing concern about urban environmental degradation. In this study, three primary rating systems prevailing in India are selected and analysed with the aim of providing insights into the current situations; highlighting the strengths, weaknesses, successes, and failures; and making recommendations for future improvements. The common aspect of all the rating system is to create a sustainable architecture in all respect so as to minimize negative environmental impact upon the environment. Certain analysis and data have been represented in this paper with the help of case study to highlight ambiguities and shortcomings in the weighting, scoring, and rating, which is mentioned in discussions. The three most prevailing rating system in India GRIHA, BREEAM and has been studied and compared with each other on the criteria upon which that are based.*

Keywords: Green Building, Rating System, sustainable development, Criteria

I. INTRODUCTION

The rating system evaluate the performance of building from planning, designing, constructing, and operations. Green building evaluation tool measures environment performance of building through its lifecycle. Globally, green building rating systems are largely voluntary in nature have been instrumental in raising awareness and popularizing green building design. These green rating systems aim to quantify the environmental, economic and socio-economic benefits of green building design with an emphasis on sustainable site planning, optimized energy performance, efficient materials, and construction practices, water, and waste management strategies; and indoor environmental quality. India has a varying range of geographic features from north to south and from east to west. Climatic conditions also vary in these regions thus it is felt prudent to consider climatic condition of the region in a green building rating system. In this study different green building rating systems have been compared and classified broadly. These systems are subsequently compared on certain important issues such as life cycle assessment, renewability, forest certification, locally produced materials, health and safety of construction worker, project management, and climatic conditions. Subsequently, the results are discussed briefly and conclusions presented.

1.1 An Overview of Green Building Rating Systems

A.1 GRIHA (GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT)

The green rating for integrated habitat assessment (GRIHA) is India's national framework for the assessment of environmental impacts of built environments with an individual version applying to new buildings and one for existing buildings (both starting at 2,500 sqm built-up area). For both versions, the net impact of buildings on quantitative and qualitative parameters is totalled and compared against a rating table, resulting in a sustainability certification. Thereby,

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the tool aims to support the reduction of detrimental impacts of buildings. Depending on the total point score, buildings receive a sustainability rating of one to five stars.

The GRIHA rates the buildings from

- 50-60 one star,
- 61-70 two stars,
- 71-80 three stars,
- 81-90 four stars,
- Above 90 % five stars.

The system has been developed to help 'design and evaluate' new buildings (buildings that are still at the inception stages). A building is assessed based on its predicted performance over its entire life cycle – inception through operation. The stages of the life cycle that have been identified for evaluation are:

- Pre-construction stage: (intra- and inter-site issues like proximity to public transport, type of soil, kind of land, where the property is located, the flora and fauna on the land before construction activity starts, the natural landscape and land features).
- Building planning and construction stages: (issues of resource conservation and reduction in resource demand, resource utilization efficiency, resource recovery and reuse, and provisions for occupant health and well-being). The prime resources that are considered in this section are land, water, energy, air, and green cover.
- Building operation and maintenance stage: (issues of operation and maintenance of building systems and processes, monitoring and recording of energy consumption, and occupant health and well-being, and also issues that affect the global and local environment).

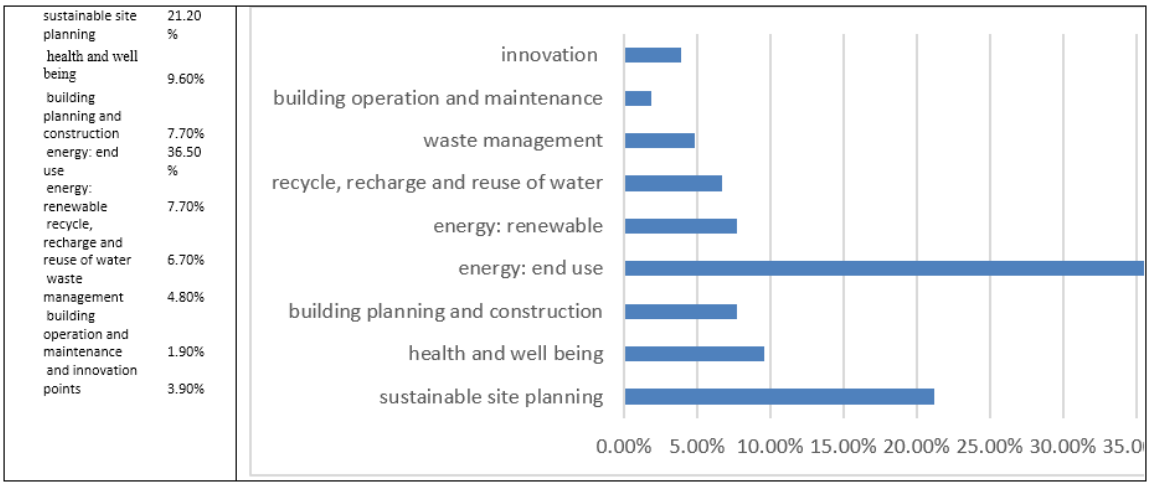

Table 1: Weight credit criteria in GRIHA

B. BREEAM (Building Research Establishment's Environmental Assessment Method)

The BREEAM was first launched in 1990 and was the first green building performance assessment method. This method was developed in the UK. The BREEAM-2011 NC assesses the performance of the building. This rating system is divided in the following areas: innovation where the percentage values represent the weights given to the respective parameter in the rating system.

85%	outstanding,
70%	excellent,
55%	very good
45%	good
30%	pass

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The assessment methods and tools are all designed to help construction professionals understand and mitigate the environmental impacts of the developments they design and build. As BREEAM is predominately a design-stage assessment, it is important to incorporate details into the design as early as possible. By doing this, it will be easier to obtain a higher rating and a more cost-effective result. The methods and tools cover different scales of construction activity. The BREEAM development is useful at the master planning stage for large development sites like new settlements and communities.

management	12%
energy use	19%
health and well being	15%
pollution	12%
transport	8%
land use and ecology	10%
materials	13%
waste	7.50%
water	6%

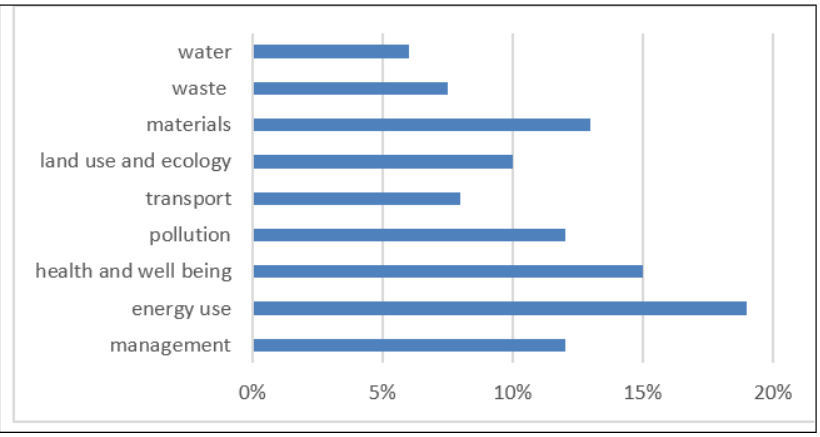

Table 2: Weight credit criteria in BREEAM

C. LEED (Leadership in Energy and Environmental Design)

The LEED rating system has been developed by the U.S. Green Building Council (USGBC) in 2000. The LEED India green building rating system was developed by IGBC (Indian Green Building Council) in October 2006. LEED India encompasses rating systems for:

- Existing Buildings (EB)
- New Construction (NC)
- Core and Shell (C&S)
- Green Homes

These represent the measurable indicators for global and local concerns in the Indian scenario. Based on the points achieved, the building may be eligible for LEED-certified, Silver, Gold or Platinum Rating. Many buildings in India register for a LEED Green Building Rating. Some of the major structures that register for a LEED rating are IT Parks, Offices, Banks, Airports, Convention centres, Educational institutions, Hotels, and Residential complexes. LEED-INDIA is, therefore, one of the chief councils to give a green rating to a structure, whether an apartment, independent home or office. This system awards rating of buildings as certified, silver, gold, and platinum. It uses simple checklist format to rate building performance. The rating system contains one element, indoor air quality (IAQ) management during construction that explicitly addresses construction worker safety and health. The intent of this element is to protect the construction workers and building occupants from potential air quality problems during the construction or renovation process. On successful implementation of an IAQ management plan, the project receives one LEED-NC credit, which is almost negligible and thus underscores the minimal consideration that the rating system gives to construction worker safety and health. It should be noted, however, that other elements within the rating system which are aimed to improve the safety and health of the end-user, such as the use of low-emitting materials, may benefit the safety and health of construction workers as well.

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sustainable sites	23.63%
water efficiency	9.10%
energy and atmosphere	31.82%
materials and resources	12.73%
indoor environmental quality	13.63%
innovation in design	5.45%
regional priority	3.64%

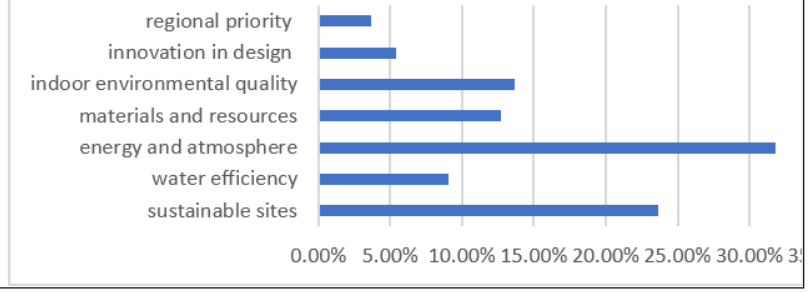

Table 3: Weight credit criteria in LEED

1.2 Comparison of different green building rating system

Table No.4 shows the comparison between different green building rating system. The symbol ✓ indicates presence or consideration of the issue in question in the given rating system. The symbol X indicates absence. For example, life cycle assessment is present/considered in the four rating systems: BREEAM, LEED and GRIHA, while this is not considered in Green Star and GBAS rating systems. The results are discussed in the following section.

Criteria	BREEAM Weight		LEED Weight		GRIHA Weight	
Life Cycle Assessment (LCA)	✓		✓		✓	
Life Cycle cost	✓	7%	X		✓	1%
Renewability	✓	4%	✓	8%	✓	14%
Certification of materials used	✓	0.5%	✓	1%	X	
Locally Produced Materials	✓	3%	✓	2%	✓	1%
Health and safety of construction worker	X		X		✓	2%
Project Management	✓	12%	✓	2%	✓	4%
Climatic condition	X		✓	4%	X	

Table 4: Camparision of rating criteria based on Weight credit

II. Discussion

Life cycle stages considered in BREEAM are: design stage (DS) - leading to an interim BREEAM certified rating, and post-construction stage (PCS) – leading to a final BREEAM certified rating. Further, in BREEAM there are two approaches to the assessment at the post-construction stage: a post-construction review of an interim design-stage assessment and a post construction assessment. Renewability is considered in all the rating systems and in the LEED, 1 point is allotted if 5% of the total value of building materials comes from rapidly renewable sources, defined as 10-year rotation or less. In the BREEAM, 4 credits for construction waste management and 1 credit for recycled aggregate is allotted. In green star, 5 points for recycling waste storage, recycled content and reuse of materials is allotted. In GRIHA, 5 points is reserved for re-newable energy utilization (partly mandatory), 3 points for re-newable energy based hot- water system, 2 points. For waste water treatment, 5 points for water recycle and reuse (including rain-water) and 6 points for utilization of fly-ash in building structure. In the BREEAM it is mandatory to carry out programme for the endorsement of forest certification (pefc)- tier level 3. In the LEED, 1 point is reserved if 50% or more of the wood-based materials and products are fsc certified. In green star, 2 points are given if forest stewardship council (fsc) certified timber is used**.** The BREEAM reserves 1 credit for materials which are transported from nearby area. In green star, no credit is allotted for this. In the LEED, one gets 1 point if a minimum 10% of total building materials were extracted, processed and manufactured within a 500-mile radius; a second point for 20% minimum of total building materials. In the GRIHA, 2 points are allotted for minimum 40% usage of flyash (by volume of materials used), for 100% load bearing and no-load

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bearing walls. Health and safety of worker is equally important as of occupant which is not considered in the BREEAM, LEED and green star. But in the GRIHA, 2 points are allotted for at least, minimum level of sanitation/safety facilities for construction workers (mandatory criteria).the BREEAM rating system assigns 12% weightage for project management aspect whereas 18 points are given in green star and 6% weightage is given in the GRIHA.

III. CONCLUSION

Green building is not a simple fusion of green design, techniques, and materials. It is a holistic solution to achieve the concept of sustainable development in the project life cycle including project planning, designing, constructing, operating and demolishing. In this paper different rating systems that are used in developing countries like India, China and developed countries like the USA, UK, Germany are compared and it is observed that life cycle assessment is not included in the Green Star and GBAS but in the BREEAM, it has been considered and 10 points are allotted for life cycle assessment of green building. In the context of developing countries, economy is more important so it is necessary to consider life cycle cost of green building which is not taken into account in the GRIHA, the GBAS, and the LEED. All rating system however considers renewability. As timber is the most important material in building construction and cutting of wood is harmful to environment, points should be given to wood that comes from a sustainable source and is certified through any credible program. Forest certification is not considered in the GRIHA and the GBAS. The authors believe that, similar to end-user safety and health, construction workers safety and health must be considered in green building. Project management is important to achieve economy and reduce construction waste on site. In the BREEAM, Green Star, Green Globe, and the GRIHA, project management aspect is considered. In India, topography and climate changes from north to south and from east to west. For such varied conditions, a rating system should also consider topographical and climatic factor.

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