

# A Comparative Analysis of Rating Systems in Green Building

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**Abstract** -With the increasing awareness of sustainable development in the construction industry, implementation of a green rating procedure to assess buildings is becoming more paramount. The paper presents the comparative analysis of four prominent sustainable green building rating systems namely BREEAM, LEED, GREEN STAR and GRIHA. A key similarity between these 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. 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. There are Differences between these systems in terms of popularity & influence, process, certification cost, data collection, development and certification result.

The main goal of this study to consider all aspect of the rating systems in order to ascertain of best one(s). The study provides a deep insight into sustainable green building rating systems and can be recommendation and reference for users when culling between rating systems.

**Key Words:**Green building, Rating system, BREEAM, LEED, GREEN STAR, GRIHA.

## 1. INTRODUCTION

The 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. 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.

Worldwide various rating systems have been developed. The first environmental certification system was created in year 1996 the Building Research Establishment's Environmental Assessment Method (BREEAM) in UK. In year 1996 the Hong Kong.

Building Environmental Assessment Method (HKBEAM) 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 the GREEN STAR rating system. In year 2005 the Building and Construction Authority of Singapore introduced GREEN MARK rating system.

The focal comparison of this research is centered on LEED, BREEAM, GREEN STAR and GRIHA. This study is a comprehensive assessment of every category and subcategory associated with each system. The system comparison is completed by an assessment of the incorporation of life cycle thinking. This research recommends unique green building rating system by comparing all above exiting rating system which covers each and every aspect required for the assessment and certification for green building. This unique rating system is comparatively less complex and provides the necessary perception about the project with ease. This research will focus largely on the way in which users are likely to interpret and implement the system, as opposed to focusing on requirements of system overall.

## 2. GREEN BUILDING

A green building is one whose construction and lifetime of operation assure the healthiest possible environment while representing the most efficient and least disruptive use of land, water, energy and resource. The decision to build green should be made before the site is selected, as many of the green criteria are affected by site characteristics and some sites are inappropriate for certain green projects. One of the first steps in the green design process is to establish firm environmental goals for the project like energy efficiency, water conservation, onsite treatment of rain water and storm water, material and resources management, construction waste management, and to assign responsibility for meeting these goals to specific members of the design team. Each goal needs a champion who will see that objective through to the end.

The benefits of building green include cost saving from reduced energy, water and waste, lower operation and maintenance cost, and enhance occupant's productivity and health. However, it may include higher initial cost, but higher ROI and return on assets are key benefits

## 3. GREEN BUILDING RATING SYSTEM

The sustainable building rating system is defined as tools that examine the performance or expected performance of a building and translate that examination into an overall assessment that allows for comparison against other buildings. For a rating system to add value to the sustainable design and/or operation of a building it must offer a credible and consistent basis for comparison, evaluate relevant technical aspects of sustainable design and it should avoid complexities. All Green Rating systems provide guidelines on how to make a building "green" and some of them provide certification process, while other provides opportunities for voluntary compliance. For this research following green rating systems are used.

- BREEAM (Building Research Establishment's Environmental Assessment Method) is the leading and most widely used environmental assessment method for buildings. It was developed in the UK in 1990 and is the building environmental assessment method with the longest track record.

- LEED (The Leadership in Energy and Environmental Design) Green Building Rating System, developed by the U.S. Green Building Council (USGBC)

in 1998, provides a suite of standards for environmentally sustainable construction. LEED-India programmed has adapted by the Indian Green Building Council (IGBC) from United States Green Building Council's (USGBC) in 2007. Since its inception in 1998, LEED has grown to encompass more than 14,000 projects in the US and 30 countries covering 99 billion m<sup>2</sup> of development area.

- GREEN STAR is a voluntary environmental rating system for buildings in Australia. It was launched in 2003 by the Green Building Council of Australia. The system considers a broad range of sustainable issues while also considering occupant health and productivity, and cost savings

- GRIHA (Green Rating for Integrated Habitat Assessment) Green Building Rating System, conceived by TERI and developed jointly by the Ministry of New and Renewable Energy, Government of India as of November 1 2007, 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.

## 4. COMPARATIVE ANALYSIS

Comparative analysis which is shown in Table no. 01 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 for E.g. (Urban redevelopment or reduced site disturbance or ecological value of site and protection of ecological features or mitigation ecological impact or enhancing site ecology or ecological value of site, it all means that whatever ecological features are their onsite prior to construction should not be disturbed or disrupted.)

From the respective green building rating system, it is clear that there is no appropriate preference given to various assessment criteria for E.g. (In LEED system energy and atmosphere is given more preference and same in GREEN STAR system Indoor air quality is given more preference.) As this respective rating systems i.e. LEED, BREEAM, GREEN STAR and GRIHA are not specific enough on some points while it creates the confusion for builders and developers which rating system shall they refer. In

order to overcome this complexity there is a need of one unique, simple and user friendly rating system. Hence based on the comparative study of the green building rating systems criteria a simple and user friendly green building rating system is developed. The new developed rating is more specific for each assessment criteria, as LEED, BREEAM, GREEN STAR and GHRIHA are not very specific on some assessment criteria which has a very wide window and thus it becomes difficult to arrive at exact rating and inference from that score. The rating system developed from the above comparative study is shown in Table no. 01.

## 5. CONCLUSION

Green building is a building which is environment friendly as it is using certain principles during its design, construction and functioning phase which allow it to get maximum advantages from the environment and cause minimum damage. 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. The unique system suggested would rate the building on various factors so as to give a fair idea of where it stands in being a green building.

Various rating systems are good enough to be used in certain part of the world but they are not ubiquitous. Also they are quite complex in nature and do not necessarily give a clear idea of the project's effectiveness. Each system has certain strong points and certain weak points. As from above comparative study of green rating system LEED, BREEAM, GREEN STAR and GHRIHA are not specific on some assessment criteria thus a rating system which is simple and effective is suggested. This rating system is an integration of various system such as it carries the advantages of each system where as it overcomes the individual shortcomings.

Unique aspect as regards mandatory compliance and motivational aspect for innovation and maintenance of green features, as suggested would promote more green construction.

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**Table No. 01- Comparative Analysis of Green Rating System**

SR.NO	CATEGORY	BREEAM	LEED	GREEN STAR	GRIHA
<b>1</b>	<b>MANAGEMENT/ SUSTAINABLE SITE/ SITE &amp; PROJECT MGMT/ SITE ASPECT</b>				
a	Site selection/ Brownfield redevelopment/ Reuse of land/ Reclaimed land/ contaminated land/ sustainable construction	•	•	•	•
b	Erosion & Sedimentation control/ Topsoil & Fill Removal from site	∴	•	•	•
c	Urban redevelopment/ Reduced site disturbance/ Ecological value of site & protection of ecological features/ Mitigating ecological impact/ Enhancing site ecology/ Ecological value of site/ Greenery provision/ construction site impact/ Long term impact on biodiversity	•	•	•	•
d	Hard Landscaping & Boundary protection/ Environmental mgmt./ Environmental mgmt. practices/ Landscaping & Planters/ Microclimatic around building/ Health, Safety & Environmental mgmt./ Environmental purchasing practices	•	∴	•	•
e	Responsible construction practices/ Maintainability/ Commissioning clauses/ Commissioning building Tuning/ Environmental mgmt. Practices (CONQUAS)/ Building & Site Operation & Maintenance	•	∴	•	•
<b>2</b>	<b>ENERGY/ ENERGY EFFICIENCY/ ENERGY USE</b>				
a	Fundamental building system commissioning/ Measurement & verification/ Energy monitoring/ Energy conditional requirement/ Electrical sub-metering/ Testing & commissioning / Metering & monitoring	•	•	•	•
b	Minimum energy performance/ Optimize energy performance/ Energy efficient cold storage/ Energy eff. Lab system/ Energy eff. Transportation system/ Energy eff. Equipment/ Peak energy demand Reduction/ Eff. External lighting/ Lighting zoning & control/ Centralized energy system/ Thermal performance of building				

	envelope/ Natural ventilated design & A/c system/ Energy eff. Features/ Annual energy use in building/ Ventilation system in mechanically ventilated building/ Lighting system in mechanically ventilated building/ Energy eff. Lighting in public areas/ Energy eff. applications/ Energy mgmt./ A/c units.	•	•	•	⊛
c	Renewable energy/ Green power/ Energy improvement/ renewable energy system	⊛	•	•	•
<b>3</b>	<b>WATER EFFICIENCY</b>				
a	Water consumption/ Water monitoring/ Water meter/ Water usage monitoring/ Monitoring & Control	•	⊛	•	•
b	Water use reduction/ Water eff. Landscaping/ Water leak detection & prevention/ Water eff. Equipment/ Occupant amenity potable water efficiency/ Landscaping irrigation water eff./ Heat rejection water consumption/ Fire system water consumption/ Potable water use in lab/ Water eff. fitting/ Irrigation system & landscaping/ Water consumption of cooling tower/ Annual water use/ Water eff. Irrigation	•	•	•	•
c	Innovative waste water technologies/ Storm water mgmt./ Water recycling effluent discharge to foul sewers	⊛	•	⊛	•
<b>4</b>	<b>MATERIALS</b>				
a	Building reuse/ Reuse of Façade/ Reuse of structure/ Building Reuse	⊛	•	•	⊛
b	Storage & collection of recyclables/ construction water mgmt./ Resource reuse/ Recycled content/ Construction waste mgmt./ Recycled aggregates/ Recycled content of concrete/ Recycled content of steel/ Recycled content and Reused products & materials/ Sustainable timber flooring/ Loose furniture/ Deconstruction/ Rapidly renewable materials/ Life cycle impacts/ Sustainable procurement/ Recycling waste storage/ Sustainable construction/ Sustainable Products/ Adaptability & Deconstruction/ Sustainable forest products/ Waste Recycling facilities/ Waste mgmt.	•	•	•	•
c	Local or Regional Materials	⊛	•	⊛	⊛
<b>5</b>	<b>INDOOR ENVIRONMENTAL QUALITY/ HEALTH</b>				

AND WELL BEING					
a	Minimum IAQ performance/ Construction IAQ mgmt. plan / Air change effectiveness/ IAQ in wet areas/ Construction IAQ mgmt./ IAQ in car parking/ IAQ in public transport interchanges	•	•	•	•
b	Environment tobacco smokes (ETS) control/ CO2 monitoring/ Low-emitting material/ Indoor chemical & pollutant source control/ CO2 & VOC monitoring & control/ Hazardous materials/ Volatile Organic Compounds/ Formaldehyde minimization/ Mould prevention/ Indoor air pollutants/ Biological contaminations/ Integrated pest mgmt./ Indoor source of air pollution	⊙	•	•	•
c	Reduced heat island effect/ Thermal comfort/ Thermal Insulation/ Thermal performance of building envelope- RETV/ Thermal comfort in centrally A/c premises/ Thermal comfort in A/c or Naturally ventilated premises	•	•	•	⊙
d	Ventilation efficiency/ Ventilation rates/ Naturally ventilated design & A/c system/ Ventilation in A/c premises/ Localized ventilation/ Ventilation in common areas	⊙	•	•	•
e	Day lighting & views/ Visual comfort/ Day lighting/ Day light glare control/ High frequency ballasts/ Electric lighting levels/ External views/ Artificial lighting/ Natural lighting/ Interior lighting in normally occupied areas/ Interior lighting in not occupied areas	•	•	•	•
f	Safety and Security/ Fire Safety/ Security	•	⊙	⊙	⊙
g	Acoustic Performance/ Internal noise Level/ Noise Level/ Room Acoustics/ Noise Isolation/ Background Noise	•	⊙	•	•
<b>6</b>	<b>TRANSPORTATION</b>				
a	Alternative transportation/ Public transport accessibility/ Commuting mass transport/ Green transport/ Local transport/ Vehicular access	•	•	•	•
b	Alternative transportation/ Cyclist facilities/ Green transport	•	•	•	⊙
c	Alternative transportation/ Travel plan/ Fuel eff. Transport/ Green transport	•	•	•	⊙

d	Alternative transportation/ Maximum car parking capacity/ Car park minimization	•	•	•	•
e	Pedestrian route/ Green transport/ Local transport	⊘	⊘	•	•
f	Proximity to amenities/ Neighborhood amenities/ Amenities features	•	⊘	⊘	⊘
<b>7</b>	<b>POLLUTION</b>				
a	Light pollution reduction/ Reduction of night K=Light pollution/ Light pollution	•	•	•	•
b	Ozone protection/ Ozone depletion potential/ Ozone depletion substances/ Impact of refrigerants/ Refrigerant GWP/ Refrigerant leak detection & recovery/ CFC reduction in HVAC & R equipment/ Reduction in CO2 emission/ Low & Zero carbon technology.	•	•	•	•
c	No emissions	•	⊘	⊘	⊘

<b>NOTE:</b>	
CONSIDERED	•
NOT CONSIDERED	⊘