

# A Review on Comparative Study of Various Rating Systems

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**Abstract**— Now a days building energy efficiency rating system have been developed worldwide to manage the energy consumption of existing buildings. There are various rating systems accepted in India like LEED, GRIHA and IGBC which have their various rating criteria and rating thresholds. These various certification programs are dedicated to the design sustainable buildings by incentivizing reductions in energy, water, and building materials consumption, while at the same time enhancing occupant health and overall community connectivity. The increasing population growth, demands for buildings, services and comfort, which results in an increasing energy demand. For this reason design of energy efficient buildings are the main objective of upcoming era. The rating systems mainly focuses on energy efficiency, the reduction of the use of resources, water and materials, as well as the reduction of impacts on human health and the environment during the building's lifecycle. In this research paper, various studies are discussed related to comparison of green ratings in various countries and the performance of green buildings. This shows that various rating systems emphasizes on different criteria according to their priorities whereas, criteria should be set according to the topographical and climatic conditions of particular place.

**Index Terms**— Green building, LEED, GRIHA, rating system

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## INTRODUCTION

Green building is a design approach that reduces the impact of building on our environment through alternative building design, land use and construction approach. Green building is defined as “a practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Also green building have various benefits like emissions reduction, water conservation, temperature moderation, waste reduction, energy conservation and many more. 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.

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.

The Leadership in Energy and Environmental Design (LEED) 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 Rating for Integrated Habitat Assessment (GRIHA) 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.

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 (Kheshe 2015). Building energy efficiency rating systems have been established worldwide to systematically manage the energy consumption of existing buildings. (Koo, 2014). Energy costs and growing environmental concerns are the catalysts for a high demand for sustainable buildings

with low environmental impact. Within this context, the concept of green building, focused on the increase of energy efficiency, the reduction of the use of resources, water and materials, as well as the reduction of impacts on human health and the environment during the building's lifecycle, plays a role of primary importance. Thus many recent studies focused on the rating of the environmental aspects of buildings through the Life Cycle Assessment approach (LCA), showing that the operation phase is associated with the highest impacts, but at the same time, the construction phase could not be neglected. (Asdrubali, 2015). 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 there is hundreds of green building evaluation systems that focus on different area of sustainable development and are designed for different types of projects. However only a few systems are widely acknowledged and really set a recognizable standard for sustainable development. (Khese, 2015). According to survey, construction and maintenance of buildings are responsible for 40% of energy in the world. Water, material, resource management is having major concerned during construction of building. By keeping all this factors in mind a new revolution of building came into the picture known as Green Building. Green Building minimizes the natural resources to minimum during its construction and operation. It can be done in different ways like adoption of bioclimatic architectural principles, use of material with low embodied energy, reduction of transportation energy, incorporation of efficient structural design, and implementation of energy efficient building system and effective utilization of renewable energy resources to power the building. (Singh, 2016). 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. (Sande, 2015). 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. Different rating systems have their different criteria's for ratings and credits are allotted according to that. We also need to consider the geographical & climatic conditions while rating. Hence, this paper focuses on various rating systems adopted worldwide and their comparison which allow us to select proper rating system according to our geographical and climatical conditions.

#### **REVIEW ON PREVIOUS WORK DONE**

Nguyen and Altan (2011) followed a system of evaluating and marking for five rating systems. Which was created with 9 categories of review criteria. Each category contributed a number of points due to their importance. The maximum final score comes out to be 100 points in total. The categories and points are: Popularity and Influence 10, Availability 10, Methodology 15, Applicability 20, Data Collecting Process 10, Accuracy and Verification 10, User-friendliness 10, Development 10, Results Presentation 5. The results of the study showed that LEED and BREEAM have highest scoring of 75 points out of 100. Koo et al., (2014) worked to solve the problems of conventional energy efficiency rating system and the conventional carbon point system, the study was conducted in five steps: (i) data collection and analysis; (ii) correlation analysis between the household size and the CO<sub>2</sub> emission density; (iii) cluster formation based on the results of the correlation analysis using a decision tree (DT); (iv) establishment of a new energy efficiency rating system for existing residential buildings; and (v) establishment of a new incentive and penalty program for existing residential buildings using advanced case-based reasoning (A-CBR).

Asdrubali et al., (2015) carried out the study to compare the Italian green buildings assessment tool, ITACA (Istituto per l'innovazione e Trasparenza degli Appalti e

la Compatibilit\_a Ambientale), to LEED, in this research these two methods were applied to two sustainable residential buildings located in Umbria, central Italy. Analysis was carried out with emerging concepts of six major categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation in design. Using existing validated technologies, LEED assesses the environmental performance of buildings from an overall point of view during their life cycle, starting from the design phase and during the construction and operation. The results suggests that ITACA could be optimized focusing on the site thematic, especially if applied outside Europe, in regions where the site choice is often possible. Whereas, LEED gives almost one fourth of the total score to the site sustainability, constituting a potential limit, especially when town-planning constraints do not allow to choose the most suitable place for new constructions. A shift of a part of these credits towards other macro-areas (energy, for instance) could make the score distribution more balanced. Rana and Bhatt (2016) provided a methodology for the development of the criteria weights for the modified green building rating tool for the Gujarat state. The AHP (Analytic Hierarchy Process) technique was used to make comparison between the criteria. A questioner were issued to the respective experts for the comparison and generating relative importance of the criteria. After collecting the data, using the AHP technique, generated the weights for the criteria. After studying the rating tools, a criteria framework was prepared by selecting the criteria which are most suitable and favourable for the Gujarat state. 41 criteria were selected under 7 different categories, this study gave a brief idea about the criteria covered under each of these rating tools. Analytic Hierarchy Process is a multiple criteria decision-making tool. This is an Eigen value approach to the pair-wise comparisons. The scale ranges from 1/9 for least valued than, to 1 for equal, and to 9 for absolutely more important than covering the entire spectrum of the comparison. After getting the responses from the experts, matrices were generated and the weights of each criteria, based on the relative importance, were generated. These weights were utilized for the

development of score points for the Green Building Rating Tool for Gujarat.

Khese et al., (2016) studied differences between these systems in terms of popularity & influence, process, certification cost, data collection, development and certification result. Also compared the assessment process of rating systems. The BREEAM rating system uses Checklists and Excel PreAssessmentEstimators. LEED, on the other hand, is very Documentation-intensive, more complex, time consuming and is still a mostly paper based system. It uses PDF rating Checklists and Excel Checklists. GREEN STAR use Excel tool and Technical manuals. The GRIHA rating system uses an offline questionnaire-based approach. The study results suggested the preference for selection of green building rating system in following manner LEED, BREEAM, GRIHA and GREEN STAR.

Sande and Phadtare (2016) studied differences between the two systems i.e LEED AND GRIHA in terms of process, popularity, transparency, cost, and criteria. Also compared under the heads such as Inception year, total buildings registered, buildings rated, Sq.ft registered, Sq.ft rated, professionals trained. The study provided the detailed differences in both LEED and GRIHA according to criteria and sub criteria considered in both the systems. From results author suggested 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. As LEED and GRIHA rating system have suitable points which are simple and effective can be suggested for small contractors to achieve green agenda simply and economically.

#### DISCUSSIONS

From the above studies on review of various rating systems it is seen that LEED is most globally accepted system of rating. LEED have its various criteria for carrying out the evaluation of green building. LEED focuses on some major areas which are site selection, material etc where some sub criteria need to be focused. As Asdrubali et al., mentioned that various rating



systems are based on their different logic of development and different methods of calculations which shows the difference in results for same building. Especially major area like energy where different simulation and calculation approaches are used which results in difference in their score. So, we cannot completely rely on particular rating system. For constructing a green building proper planning need to be done so that all the criteria's will be satisfied. While planning the planner must have knowledge of major criteria of rating systems. During planning many of the criteria must be focused like site selection, orientation, lighting, and ventilation etc. Basically in India while planning a building, the major focus is on making use of maximum area, economical construction and requirements of owner but some criteria like protection of landscape, sustainable construction, passive and active architectural features, criteria of construction phase are not taken into consideration. For example a particular region surrounded by river and good source of water availability at such places people are not aware of water reuse and rain water harvesting and are not willing to invest in such parameters. LEED and GRIHA are commonly accepted in India. Where both focuses on their particular major areas but some micro areas need to be focused which are important according to local conditions and which will help in achieving maximum points. And building fulfilling some certification level need to get some incentives and benefits in billing and taxes from government of India. The local state authority can study and develop the rating system for their particular region so that maximum credits will be earned. There are various factors which affects the credits earned by building such as locally available material for construction and interior, climatic conditions, surrounding of building, awareness among people for use of renewable energy in buildings. Hence rating a particular building by different rating systems will give different certification levels. In India there is lack of awareness among people for use of low VOC paints, certified wood, ecofriendly bricks like AAC blocks or mud blocks, managing waste etc. So, looking towards a particular criteria globally and locally will give different pictures which need to be studied and modified according to the conditions. All this review processes

will give detail idea to planners, architects and builders to achieve maximum points in green rating and to design a sustainable green building.

#### CONCLUSION

The literature review gives the idea of various rating systems followed worldwide and they were compared on various parameters which shows the results that all systems have certain strong points and certain weak points. Considering Indian context we follow LEED India and GRIHA, the most popular rating systems. Both the systems have their own different criteria to be followed for rating of green buildings. As India is country having different climatic zones and different geographical conditions over the country so, all the criteria cannot be followed by a particular region so which results in losing the points in certification level. Hence there must be modification in rating systems which will result in gaining maximum points in certification and achieving local incentive benefits. So there is need to decide the appropriate rating criteria according to zones, states of India. By studying local conditions for a particular state or region, decide the set of criteria which should be followed for rating of green buildings in particular state.

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