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World Green Building Rating Systems: A Comparative Study

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ABSTRACT

The green building rating systems has been in practice for last three decades around the world. The developed and developing countries have their own rating systems and assessment/certification methods to qualify the building green or sustainable. Some of the prominent rating systems are, [BREEAM (UK), LEED (USA), GREEN STAR (Australia)], [GRIHA (India), SAGRS (Saudi Arabia)] and [SBTool (collaborative)] respectively launched by developed countries, developing countries and group of countries. The green building rating systems focus primarily on energy, environmental and sustainability. The paper presents an insight into green building rating systems aspects and motives. Rating system comparative study identifies rating system according to countries status wise development. Such study will certainly be helpful in unification of building rating systems and will pave the way for coordinated effort to make green construction and sustainable development throughout the world.

1. Introduction

Green Building or Green Construction or Sustainable Building or high performance building is a process that is environmentally caring and resource-efficient throughout a building's life cycle from site planning to design, construction, operation, maintenance, renovation, and demolition. The sustainable development concept has developed during the 1960s energy crisis and environmental pollution concerns (Mao et al., 2009). The Rachel Carson (Carsen, 1962) is the one who first relates green building as a main component to sustainable development. Green building rating system can contribute in reducing the impacts of buildings on the environment and human health issues through organizing the vast array of practices, techniques, and skills (USGBC, 2009).. The buildings are assessed for green rating in pre-selected evaluation categories. The particular green rating systems select suitable evaluation categories depending on the construction project type and type of building. The evaluation categories have number of criterion to be assessed for green rating.

Following is the list of various evaluation categories used by the green building rating systems (GBRS) (Vyas and Jha, 2012).

1) Sustainable Sites 2) Water Efficiency 3) Energy & Atmosphere 4) Materials & Resources 5) Indoor Environmental Quality 6) Innovation & Design Process 7) Regional Priority 8) Location & Linkages 9) Awareness & Education 10) Health and Well-being 11) Waste Management 12) Transport 13) Management Process 14) Pollution 15) Service Quality 16) Culture and perceptual aspect 17) Social and Economic aspect 18) Innovation & Design Process 19) Ecology

Green rating systems that provide recommendations to make a building "green" are design type rating system type. The green rating systems that provide green level certification procedure are green performance type system (Ding, 2008). Reed et al. (2009) provide an international comparison of green rating systems that offers an excellent starting point for understanding the differences and similarities among the various rating systems. The benchmarks are also developed for comparing green building schemes (Lee and Burnett, 2008).

Following section provides brief review of green building rating systems (GBRS) conceived by developed countries, developing countries and group of countries. (BREEAM, 2014, LEED, 2014, Green globe 2000, EARI, 2015)

1.1. Developed countries

BREEM (Building Research Establishment Environmental Assessment Method)

BREEAM was developed in the UK in the years 1990 and was a pioneer in providing the first-ever building assessment methodology addressing wide-ranging environmental and sustainability issues. BREEAM uses benchmarking scheme for level of certification award. The measures used represent a broad range of categories and criteria from energy to ecology. They include aspects related to energy and water use, the internal

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environment (health and well-being), pollution, transport, materials, waste, ecology and management processes.

LEED (Leadership in Energy and Environmental Design)

LEED, is an internationally-recognized green building certification system, developed by the U.S. Green Building Council (USGBC) in March 2000. LEED provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions The LEED measures the overall performance in seven categories.

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

LEED system uses benchmarking scheme and credit rating scheme to level of certification award. It is the most widely used GBRS. BREEAM and LEED green rating system became the base system for the development of other country rating tools. LEED rating is applicable to new construction, existing buildings, commercial interiors, core and shell, homes, neighborhood development, school, and retail building types.

CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)

CASBEE has been developed in 2001 by coordinated effort of industry, government, academia and Japanese Ministry of Land, Infrastructure and Transport. CASBEE is composed of four assessment tools corresponding to the building lifecycle. "CASBEE Family" is the collective name for these four tools namely for Predesign, for New Construction, for Existing Building and for Renovation, to serve at each stage of the design process. CASBEE is designed to accommodate a wide range of uses (offices, schools, apartments, etc.) in the evaluated buildings. CASBEE covers the assessment fields of energy efficiency, resource efficiency, local environment, and indoor environment.

DGNB (GeSBC- German Sustainable Building Certificate)

The German Sustainable Building Certification was developed by the German Sustainable Building Council (DGNB) in 2007 and awards outstanding buildings in the categories bronze, silver, and gold. Six subjects affect the evaluation: ecology, economy, social-cultural and functional topics, techniques, processes, and location.

The certificate is based on the concept of integral planning that defines, at an early stage, the aims of sustainable construction. In this way, sustainable buildings can be designed based on the current state of technology, – and they can communicate their quality with this new certificate.

Green Globes

Green Globes based on the BREEAM rating system is launched by Canada in 2000. The seven categories are pre-selected for buildings assessment, namely, Energy, Indoor Environment, Site, Water, Resources, Emissions, and Project/Environmental Management. Green Globes helps both with the new construction of commercial buildings and with the maintenance and improvement of existing buildings.

1.2. Developing countries

GRIHA (Green Rating for Integrated Habitat Assessment)

GRIHA launched in 2007,in India. by Centre for Research on Sustainable Building Science, TERI as TERI-GRIHA. TERI-GRIHA further modified to GRIHA as the Indian National rating system after incorporating various modifications suggested by a group of architects and experts. This assessment method has qualitative and quantitative approach, so it would be able to rate a building on the degree of its greenness. 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. This rating system is divided into: sustainable site planning, health and well-being, building planning and construction, energy: end use, energy: renewable, recycle, recharge and reuse of water, waste management, building operation and maintenance, and innovation points.

GBAS

China's green building assessment method, GBAS was introduced in 2006 and is a credit-based system. This standard is applicable for evaluation of existing residential buildings, and three kinds of public buildings: office buildings, mall buildings, and hotel buildings. Green building evaluation indicators system consists of six indicators that are: land-saving and outdoor environment, energy-saving and energy utilization, water-saving and water resources utilization, materials-saving and materials resources utilization, indoor environment quality and operation management. This system certifies buildings from 1 to 3 stars.

Pearl Rating System for Estidama

- Pearl Rating System for Estidama based on LEED rating system is developed for UAE in 2008. Pearl Rating System measures the overall performance in seven categories namely, Integrated Development Process, Natural Systems, Livable Communities, Precious Water, Resourceful Energy, Stewarding Materials, Innovating Practice. It is applicable to Community Buildings, Villas, Temporary Villas and Buildings.

1.3. Countries Group

SBTool (formerly GBTool)

SBTool for rating of green building is a collective effort of 21 developed and developing countries group and maintained by the International Initiative for a Sustainable Built Environment (IISBE). Although it is not intended for direct application by stakeholders, members of national Green Building Challenge (GBC) teams are free to draw from it in whole or part for use in the creation of assessment tools. SBTool commissioned in 2000 is a process to assess the potential energy and environmental performance of the projects.

SBTool is most modern and evolving rating system as it address very different priorities, technologies, building traditions and even cultural values that exist in various regions and countries. SBTool can assess both new building and renovated projects.

In SBTool, scores are assigned in a range of -2 to +5, where: - 2 and -1 are levels of performance below the acceptable level in your region, for occupancies specified; 0 is the minimum level of acceptable performance in your region for occupancies specified; 3 is Best Practise; and 5 is the best technically achievable, without consideration of cost.

1. Discussions

The developed and developing countries have their own rating systems and assessment/certification methods. The green building rating systems have been developed either green building design type or green building performance type. The green building certification level may be awarding based on bench marching scheme (reference value term) or credit point scheme (in absolute value term). The certification based on bench marching scheme will be suitable only for particular region region while certification based on credit point scheme will be internationally applicable. Although, the green building rating systems has been in practice for last three decades, green building activities or rather concern

of construction industry to environment and sustainability in some countries, including the development countries, started very recently. The international building council should impress these countries to implement the green tools to get the proven energy and resource benefits. The leading developed countries that are using LEED, green building rating system and have not developed self-rating system, for their green building activities are Russia (starts using from 2013) and China (starts using from 2009) . Another important issue related to green building rating systems is that most of the countries have multiple green building rating systems operating in their countries, which is creating confusion in mind of the stack holders about the green building assessment and their rating and it will hinder healthy competition and progress. Some mechanism should develop to unify or at least harmonizing the different green building rating systems followed in the particular countries. One such effort is the development of SBTool, a so-called international rating system, but its flexibility will add another rating system to the country. In US, Green Globe, Energy Star, NAHBGreen , the green rating systems are in use along with widely used LEED green rating system. In India also, LEED-India, IGBC, Eco-Housing and BEE are in-place along with government enforced GRIHA green rating system. The Green Star, NABERS, and ABGR are operational in parallel for green building rating systems in Australia.

2. Conclusions

The present paper compares the world green building rating systems and presents an insight into green building rating systems aspects and motives. The developed and developing countries have their own rating systems and assessment/certification methods to qualify the building green or sustainable. Based on the study of world GBRS, the following conclusions are drawn.

- The basis of development of global green building rating system is either green building design type (recommendations) or green building performance type (assessment). Also, the basis of green certification award is either on bench marching scheme (in reference value term) or on credit point scheme (in absolute value term)
- The developed countries have started green building activities much earlier than the developing countries.
- BREEAM (UK) is the oldest launched GBRS while DGNB (Germany) is the most recently launched GBRS for the green building rating.
- SBTool is the most advanced and evolving green building rating system.
- The energy efficiency is the main criterion for all the GBRS.
- The management process, regional ecology and, regional cultural and perceptual aspect, the important criteria, are yet to be incorporated in most of the GBRS.
- The Middle East developing countries are the only countries that consider the cultural issues as criteria for the green building assessments.
- Countries have multiple green building rating systems operating in their country, which may by confusing the minds of the stack holders. Countries should work in coordination to unify or at least harmonizing the different green building rating systems followed in the particular country.

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