International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 3, Issue 5(May 2014), PP.53-64

Rating Systems Awareness for Green Buildings Applications

Dr.Dina Ahmed Elmeligy

(Architecture engineering department, engineering Faculty, Tanta University, Egypt)

Abstract :- Buildings have major environmental impacts over their entire life cycle. Thus, buildings are one of the major pollutants that affect urban air quality and contribute to climate change. Hence ,the need to design a green building is the essence of which would be to address all these issues in an integrated and scientific manner.

Many official green building programs, communities and organizations launched several rating systems to help the sustainable process assessment; all of these rating systems are built in a way to adapt the idea of sustainability in architecture which seeks to minimize the negative environmental impact of buildings by enhancing efficiency in the use of materials, energy, and space. Hence ,this paper aims at clarifying and analyzing worldwide Green building rating systems such as; LEED (Leadership in Energy and Environmental Design) in U.S.A, BREEM (Building Research Establishment's Environmental Assessment Method) in UK. , GBCA (The Green Building Council of Australia) in Australia, GRIHA (Green Rating for integrated Habitat assessment) in India and GPR (The Egyptian Green Building Council) in Egypt, By understanding their basic features and methodology to spread global awareness of importance of these organizations which have significant role in the process of assessing the sustainability criteria in buildings.

Keywords: - Features, green buildings, methodology, rating systems.

I. INTRODUCTION

During the late 20th century, awareness of the impact of technology and the expanding human population on the earth increased. People started to expand their efforts to reduce their environmental impact and buildings started to be recognized as major contributors to the world's energy usage, landfill waste and diminishing green space[8].

It is critical to make the decision to build a green building early in the design process in order to maximize the green potential, minimize redesign, and assure the overall success and economic viability of the green elements of the building project [4].Therefore This paper focuses on different rating systems which evaluate sustainable design and construction off all types of buildings. Each selected system is described clearly and thoroughly, to be readily understandable to someone with no experience with the system[12].

II. GREEN BUILDING CONCEPT

Green building practices are not new phenomena. A handful of buildings integrating environmental design aspects were erected as early as the late 19th and early 20th centuries [3]. A unified green design movement did not begin to emerge until the 1970s, when design and building practices first became a focus of environmental advocates [8]. Once the decision to build green has been made, one of the first steps in the green design process is to establish firm environmental goals for the project. it is important to set specific measurable goals for things like energy efficiency, water conservation, on-site treatment of rain water and storm water, material and resource 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 [4] .This champion considers the tool that is used for different types of assessment ,Where it world-wide there are hundreds of building evaluation tools that focus on different areas of sustainable development and are designed for different types of projects. These tools include life cycle assessment, life cycle costing, energy systems design, performance evaluation, productivity analysis, indoor environmental quality assessments, operations and maintenance optimization, whole building design and operations tools, and more. So ‗sustainable building rating systems' are defined as tools that examine the performance or expected performance of a ‗whole building' and translate that examination into an overall assessment that allows for comparison against other buildings [9].

MOST WIDELY USED GREEN RATING SYSTEMS

As shown in Fig.1 rating systems timeline, that it has emerged and established many of the environmental assessment methods. The purpose of each of the assessment method was to objectively measure the environmental performance of new and existing buildings Rating systems have evolved over the years based both on user feedback and the development of new technology to improve the environmental performance of buildings. Green rating systems started out as a voluntary measure of environmental performance. However certification is now a mandate for buildings in many areas across the globe. Fifteen rating systems that offer certifications are currently available throughout the world and more are in development or pilot stages .Three systems are currently available for buildings outside of their home countries: BREEAM, Leadership in Energy and Environmental Design (LEED) and Green Globes[8] , Otherwise More than 600 sustainability assessment rating systems are available now worldwide [2].

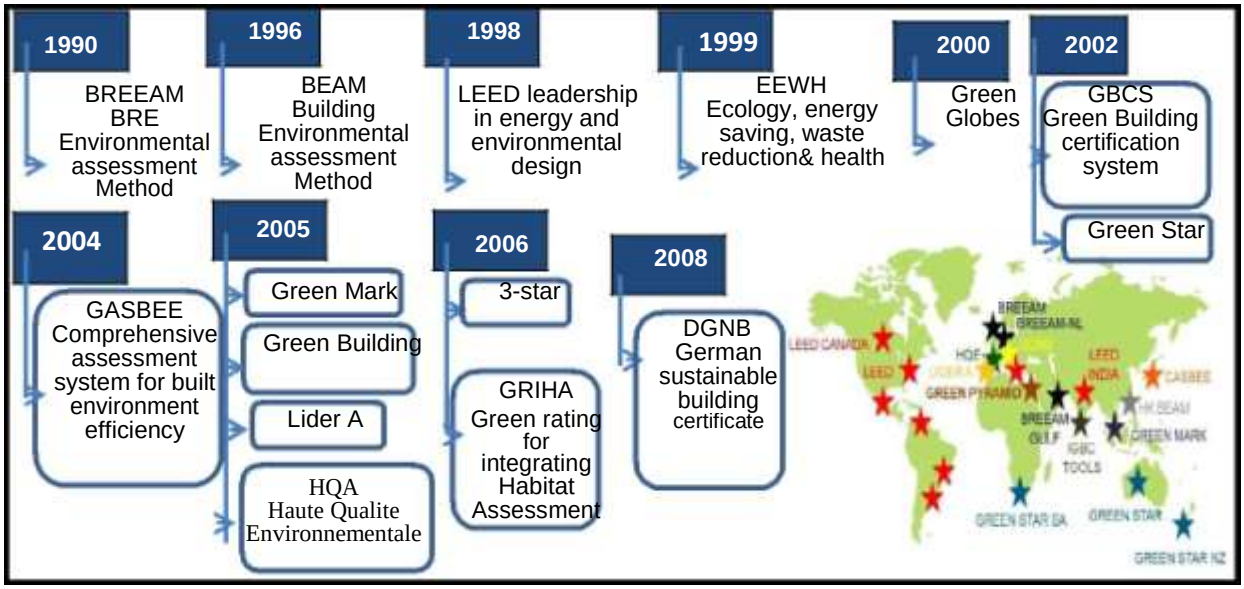


FIG. 1: RATING SYSTEMS TIMELINE & MAP [1].

So Now after the evolution of green rating systems has been introduced, the following part of the paper will take an in-depth look at some of the most widely used systems: BREEAM (Building Research Establishment's Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design), GBCA (The Green Building Council of Australia as known as Green Star) , GRIHA (Green Rating for Integrated Habitat Assessment). These systems were chosen for their popularity and their international usage. Also will be added GPRS (Green pyramid Egyptian rating system) as an example of The usability of green building rating systems in hot arid climates.

III. COMPARATIVE REVIEW FOR APPLICABLE RATING SYSTEMS

The comparative review defined in the following table 1 will be used to offer review information for each of the applicable ratings systems. where this review contribute to the credibility of the rating system. because It is critical to understand the basis of the rating systems in order to explain it to others and ensure the sustainable design environmental performance goals are being met when desired ratings are achieved. Other

credibility considerations for sustainable building rating systems include measurements of environmental impacts, development and ownership by legitimate organizations, and having a proven track record of success. [11]& [9].

Table 1. The comparative review criteria for applicable rating systems [Source : By Researcher]

The comparative review criteria for applicable rating systems	
Rating System Summaries	**Summaries of most widely used green rating systems " the five green rating systems Which have been selected"**
General information	**Year established & Country of origination.**
Applicability	**Type of Projects& Type of Buildings : such as New Construction, Major Renovations, Tenant Build-Out (leases), and Operations & Maintenance.**
Certification levels	**Define system for verifying sustainable design practices and define the score level to assess the building as a green building.**
Usability	**Cost: Identify the cost of using a system, such as cost for use or rating system materials, cost of project registration, fees associated with certification, and time typically needed to complete an application.**
Categories	**Numeric measurements facilitate absolute and relative performance evaluation.**
Case study	**The presented case study presented describes how to apply the evaluation criteria to verify the efficiency of the building as a green building.**
Sample of On-line Evaluation	**sample reporting , application form and certification pages found on-line for each rating systems.**

The following part is organized by the previous comparative review criteria. Quantifiable and comparable information was collected for each rating system. This information has been offered in alphabetical order as the following:

BREEAM

Rating System Summary: (Building Research Establishment's Environmental Assessment Method) was established in 1990and the Country of origination is United Kingdom ,this rating system is the world's leading and most widely used environmental assessment method for buildings. It is registered trademarks owned by BRE ―Building Research Establishment‖ and may not be used without BRE's written permission. It sets the standard for best practice in sustainable design and has become the de facto measure used to describe a building's environmental performance. The operation of BREEAM is overseen by an independent Sustainability Board, representing a wide cross-section of construction industry stakeholders [2] , [13] & [14 .

Applicability: It can be used to assess any building type in anywhere in the world. Which include: Courts ,Education , Health care , Homes , Industrial ,Multi residential ,Offices ,Prisons ,Retail

Certification levels: it can be used to assess the environmental impacts arising as a result of an individual building development (including external site areas) at the following stages:

1-Design Stage (DS) - leading to an Interim BREEAM Certificate 2-Post-Construction Stage (PCS) – leading to a Final BREEAM Certificate

In addition, There are a number of elements that determine the BREEAM rating; these are as follows: BREEAM rating benchmarks, BREEAM environmental weightings ,Minimum BREEAM standards ,BREEAM credits for Innovation. Credits are awarded in nine categories according to performance. These credits are then added together to produce a single overall score on a scale of Unclassified(>30%) ,Pass (≥30%) , Good (≥45%), Very Good (≥55%), Excellent (≥70%) and Outstanding (≥85%).

Usability: Many sources agree on the fact that the total cost for the application of a sustainable building assessment method always depends on the specific case and cannot be generalized. 159 The soft costs, i.e. costs for additional design, analysis, engineering, energy modelling, building commissioning and documentation, can vary from project to project. But generally the Certification Fees in was about $1,290 each stage until 2006.

Categories: include Energy, Health & well-being, Land use& Ecology Management, Materials & water, Pollution ,Transport. See fig. 2

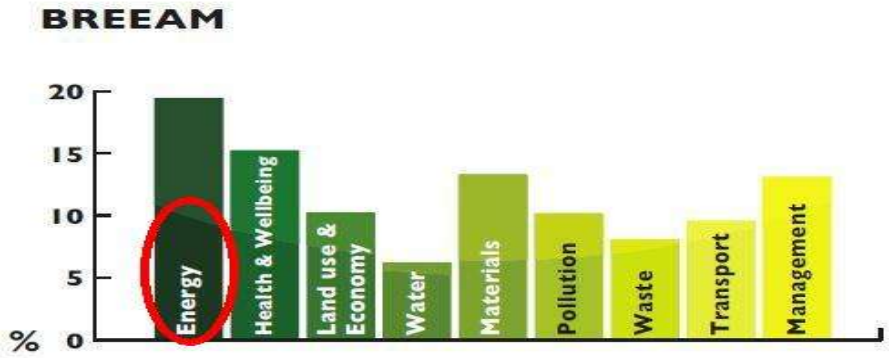


Figure 2. Comparison of Categories in BREEM [14].

BREEAM Case study: Newbury College [20] .See fig 3. The score of BREEAM is very Good-58%, The key innovative and low-impact design features of the building is thermal mass that regulates the internal temperature , in addition to the insulation of a gas absorption heat pump to reduces overall carbon emissions. So general performance certificate is ―B‖.

Figure 3. Newbury College, BREEAM case study[20].

Sample of On-line Evaluation: As shown as fig. 4 that shows sample reporting and certification pages found on-line for a BREEAM example.

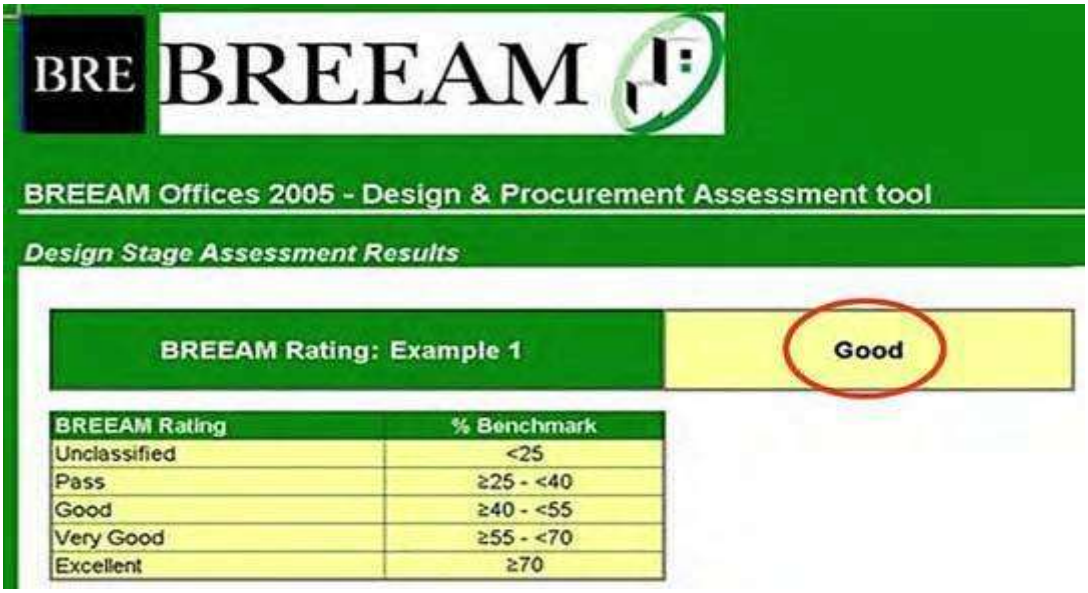


Figure.4 The on-line evaluation of BREEAM [17]

GBCA "Green Star"

Rating System Summary: The Green Building Council of Australia was established in 2002 to develop a sustainable property industry in Australia and drive the adoption of green building practices through market-based solutions. The GBCA's key objectives are to drive the transition of Australia's property industry towards

sustainability by promoting green building programs, technologies, design practices and operations as well as the integration of green building initiatives into the mainstream design, construction and operation of buildings and communities. In order to achieve these objectives, the GBCA launched the Green Star rating system in 2003. Green Star rating tools help the property industry to reduce the environmental impact of buildings, fit outs and communities, improve occupant health and productivity and achieve cost savings, while showcasing innovation in sustainable building practices [18].

Applicability: It can be used to assess any building type in anywhere in the world. Which include: Education, Health care, Industrial, Multi residential, Offices, Retail, public buildings [18].

Certification levels: awards buildings ratings of 4Star(38%)(Best Practice), 5 Star(60%)(Australian Excellence) and 6 Star(65%)(World Leader). The measured average rating of 16 buildings assessed in the last year exceeds 5 Stars providing an indication of market forces stimulating action. Since January 2004 the Green Building Council has trained more than 1800 practitioners in the use of Green Star. [5] & [18].

Usability: Many sources agree on the fact that the total cost for the application of a sustainable building assessment method always depends on the specific case and cannot be generalized. But project registration was about $450, certification fees were $1,250 - $17,500 and the time was about 7 weeks until 2006. (Simon, 2013).

Categories: include Emission, Energy, Indoor environmental quality, Innovation, Land use& Ecology, Management Materials, water, Transport. See fig. 5[21].

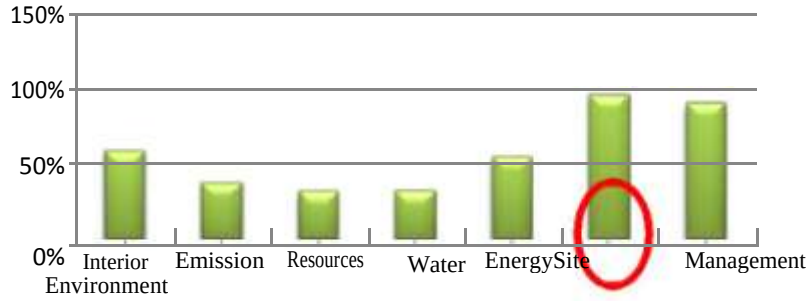
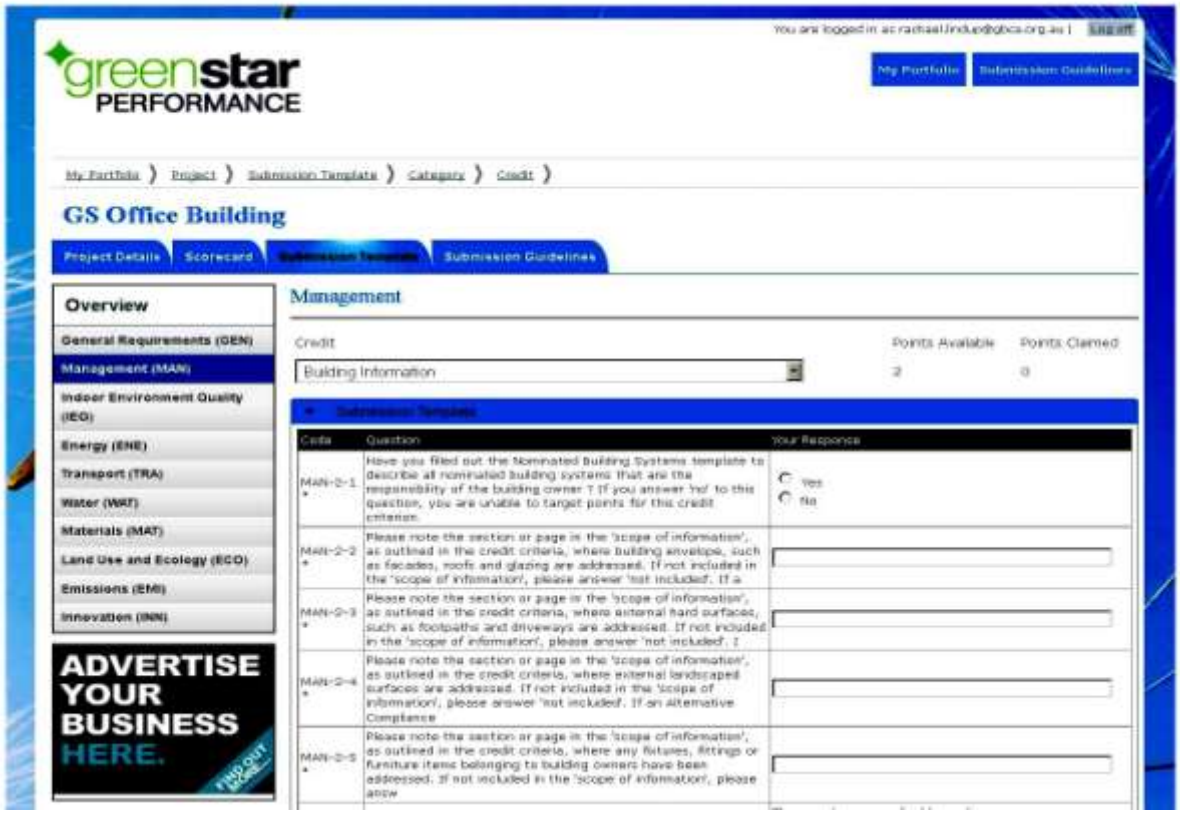


Fig.5 Comparison of Categories in GBCA. [21].

GBCA Case Study: Flinders Medical Center- New South Wing. See fig.6 The score of GBCA is 5 Star Green Star , Healthcare v1 rating , it's First health facility in Australia to achieve certification under the Green Star - Healthcare v1 rating tool, it Compared to an equivalent benchmark building, energy consumption is 42 percent less, energy costs are $400,000 less and water consumption is 20 per cent less and the site wide CO2 emissions reduced by 4,160 tones equivalent to taking 810 cars off the road for an entire year. [5] .

Figure.6 Flinders Medical Center, GBCA case study,[5].

Sample of On-line Evaluation : As shown as figure 7 that illustrates the Performance of Online Submission System Interface [17].



GPRS (The Egyptian Green Building Council)

Rating System Summary: GPRS is The Green Pyramid Rating System that is a national environmental rating system for buildings .It provides definitive criteria by which the environmental credentials of buildings can be evaluated, and the buildings themselves can be rated [19]. It was drafted by the Housing and Building Research Centre (HBRC) in conjunction with the Egyptian Green Building Council (EGBC) in 2010, and the first edition was made available for public review in April 2011. [10].

Applicability : it can be used to assess individual new buildings at either or both of the Design Stage and/or the Post-Construction Stage . Two further documents – The Green Pyramid Rating System for New Buildings at Post-Occupancy Stage and The Green Pyramid Rating System for Existing Buildings will be produced at a later date.

Certification levels: To earn GPRS certification a project must satisfy all the stated Mandatory Minimum Requirements and may obtain Credit Points by meeting certain criteria. Projects will be rated, based on Credit Points accumulated, according to the following rating system: GPRS Certified: 40–49 credits ,Silver Pyramid: 50–59 credits ,Gold Pyramid: 60–79 credits ,Green Pyramid: 80 credits and above , Projects with less than 40 credits will be classified as ‗Uncertified' [19].

Usability: Applications must be accompanied by the appropriate fee. Fees are determined according to the different project. Fees are not refundable (and this includes projects which fail to achieve certified status). Re-approval may take place on payment of an additional fee. Fees may be changed in certain cases approved by the Council .Within 30 days the Applicant will receive a reply either accepting the application for rating or requesting further information.

Categories: The system comprises seven rating Categories which in turn contain sub-categories, Green Pyramid Category Weightings are as follows: Sustainable Site, Accessibility, Ecology (15%), Energy Efficiency (25%), Water Efficiency (30%), Materials and Resources(10%), Indoor Environmental Quality(10%), Management(10%), Innovation and Added Value(bonus).see fig.8

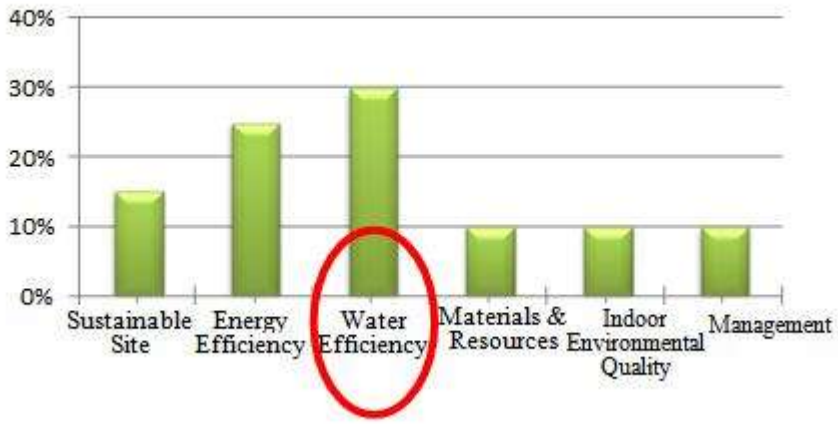


Figure.8 Comparison of Categories in GPRS, [21].

GPRS Case Study: the well-known traditional residence, Zeinab Khatoun House, the GPRS was used to assess this house in order to investigate whether the green architecture principles were applied or not. In the Zeinab Khatoun House, the use of Islamic architecture elements and features led to an average application rate of Green Pyramid Standards equals to 65%. The house may therefore be considered a historical building with green architecture attributes. See fig.9 [22].

Figure.9 Entrance Façade of Zeinab Khatoun House, Facades of the Courtyard & Vaulted Ceiling of the Bathroom [22].

Sample of On-line Evaluation : There are different forms which have been designed to be brief, understandable and accurate. All of these forms will be used at different stages in the Approval Process and completed by different parties [19] .

GRIHA

Rating System Summary: (Green Rating for Integrated Habitat Assessment) It is National Rating System of India, it has been conceived by TERI and developed jointly with the Ministry of New and Renewable Energy ,Government of India. It is a green building _design evaluation system', it will evaluate environmental performance of buildings holistically over its entire life cycle ,there is by providing a definitive standards for what constitute a green building [16].

Applicability : it is suitable for all kinds of buildings in different climatic zones of the country.

Certification levels: In order to qualify for GRIHA certification, a project must achieve at least 50 points. Therefor the Project scoring include : (50-60) points is certified as a 1 star GRIHA rated building, (61-70) is a 2 star,(71-80) is a 3 star GRIHA rating building,(81-90) is a 4 star GRIHA rated building and (91-100) is a 5 star GRIHA rated building [1].

Usability: The registration fee includes the following: A one-day workshop for the project team to explain the rating system and allocate roles and responsibilities for the consultants involved And Evaluation fee which is paid to the external evaluators who assess the project submittals. The registration fee can be calculated based on the following Formula: Built-up area <5000 m2 =Rs.3,14,000 & Built-up area >5000 m2= (Rs.3,14,000) + (Rs.3.75 per m2 above 5000) [1].

Categories: There are 34 criteria of the GRIHA rating system under four main categories: a) Selection and site planning , b) Conservation and efficient utilization of resources ― Building Planning and Construction Stage‖ , c) Building operation and maintenance and d) Innovation.

Eight of these 34 criteria are mandatory, four are partly mandatory, while the rest are optional. see table 2 , [15].

Table.2 Comparison of Categories in GRIHA, [1].

No.	Mandatory Criteria	points	No.	Partly mandatory Criteria	points
4	Existing site features	2	1	Site Selection	1
8	Min. of sanitation/safety facilities	2	2	Preserve landscape	5
9	Reduce air pollution	2	5	Reduce hard paving	2
13	Reduce conventional energy	6	18	Renewable energy utilization	5
27	Minimize ozone depleting	3			
28	Ensure water quality	2			
32	Energy audit& validation				
33	Maintenance for electrical& mechanical equipment	2			

GRIHA case study: IIT Kanpur Centre for Environmental Sciences: 5 Star GRIHA Rated Building. this building has efficient landscape design for improved micro-climatic conditions ,ECBC complaint envelope & systems ,EAT system for pre-cooling of fresh air , solar PV to meet 30% of lighting energy consumption‖ energy consumption 98 kwh/sqm/annum for AC spaces, 14 kwh/sqm/annum for non-AC spaces‖, and water consumption reduced by 25% over BIS standards. See figure 10 [16].

Fig.10 IIT Kanpur Centre , [16].

Sample of On-line Evaluation : As shown in And Fig.11 which illustrates the Performance of Online Submission System Interface.

Fig.11 The on-line Submission of GRIHA. [17]. LEED

Rating System Summary: (Leadership in Energy and Environmental Design)it was developed and piloted in the U.S. in 1998 as a consensus-based building rating system based on the use of existing building technology. The development of LEED has been through the U.S. Green Building Council member committees. The rating system addresses specific environmental building related impacts using a whole building environmental performance approach [9]. LEED certification offers third party validation of a project‘s green features and verifies that the building is operating exactly the way it was designed to . and it‘s the nationally accepted benchmark for the design, construction and operation of high performance green buildings[7].

Applicability : LEED serves as a tool for buildings of all types and sizes. LEED certification is available for all building types including new construction and major renovation; existing buildings; commercial interiors; core and shell; schools and homes. LEED systems for neighborhood development, retail and healthcare are currently pilot testing [23].

Certification levels: Projects must be awarded a minimum number of points outlined in the rating system under which it is registered to achieve a particular level of certification, such as LEED Certified(40%), LEED Silver (50%) , LEED Gold (60%), or LEED Platinum (80%) [7].

Usability: The registration fee in LEED includes the following :The registration fee for a project is $450 for USGBC members and $600 for nonmembers. LEED certification fees vary by project size but it divide to : design review ,construction review, combined review and additional fees and the average certification cost is from $2000 [7].

Categories: in LEED 58 criteria are presented in nine categories which include (USGBC 2010): Effects of the building on the ecology, Water and energy usage ,Sustainable use and transportation of Materials , Indoor air quality ,Location of the building , Utilization of technology, Innovation and Regional issues. See fig.12 [8].

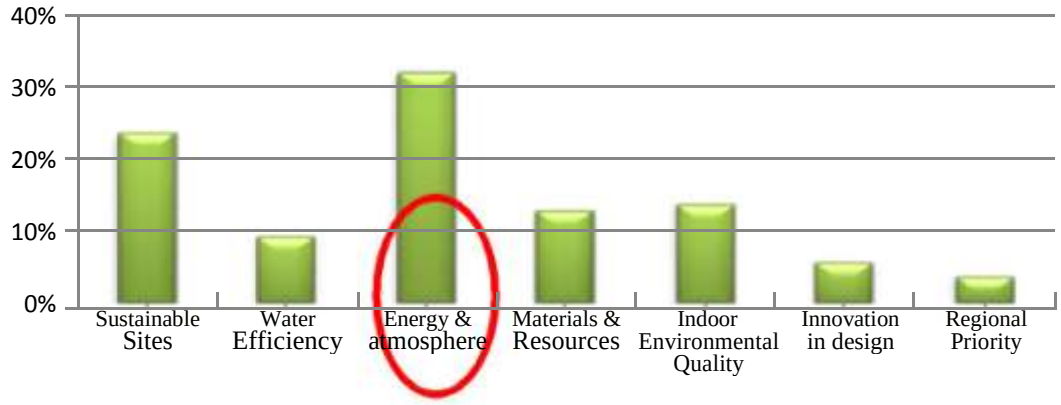
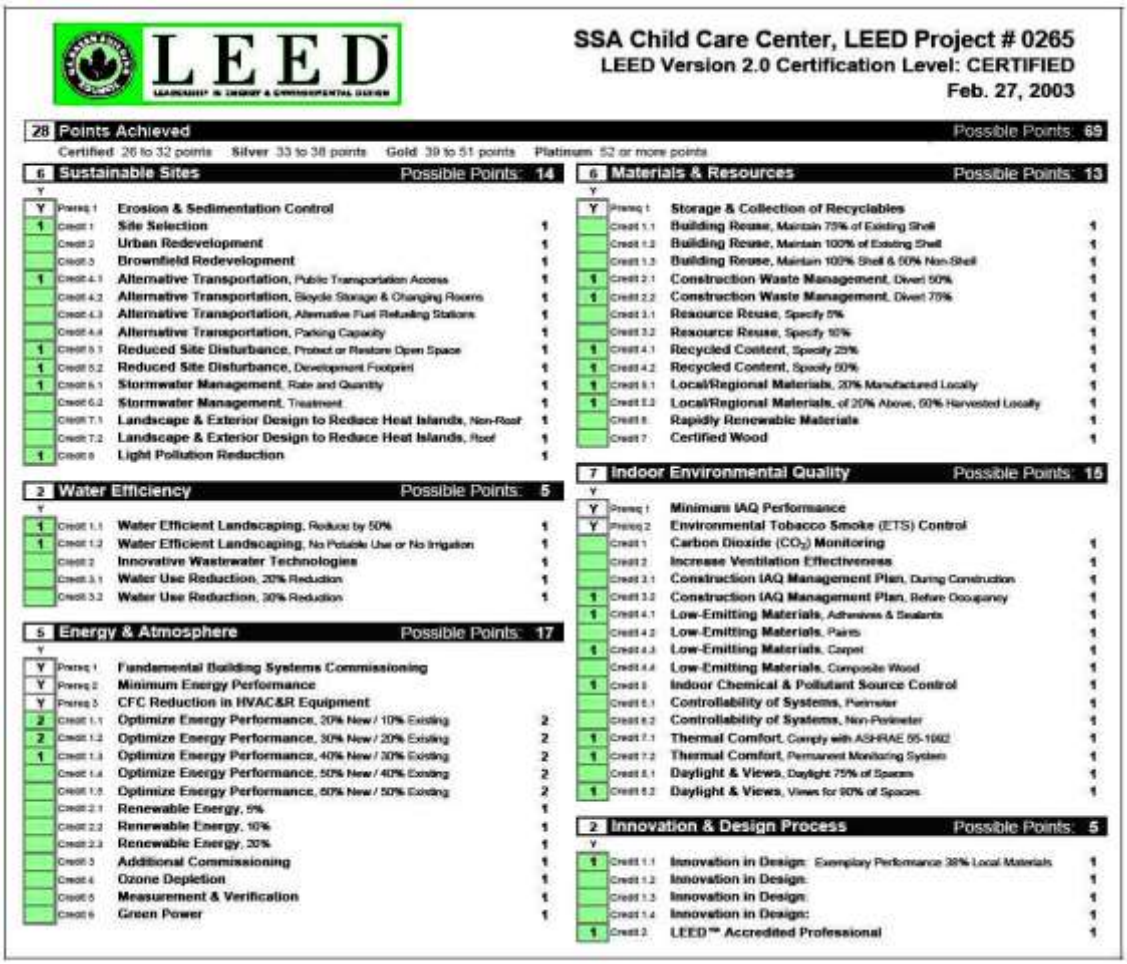


Fig.12 Comparison of Categories in LEED. [13].

LEED case study: California‘s central business district ,500 north brand .It is a multitenant office building . see figure 13. The building earned LEED-EBOM gold certification in 2010 , according to : ENERGY STAR score of 92, Carbon footprint 42 percent lower than comparable buildings and 2.1 million gallons, (7.9 million liters) of water saved annually. [8].

Sample of On-line Evaluation : LEED Online is an electronic form-based project information submittal tool located on the World Wide Web . Figure 16 clarifies an example of LEED Version 2.0 documentation found on-line [9].



LEED

SSA Child Care Center, LEED Project # 0265
LEED Version 2.0 Certification Level: CERTIFIED
Feb. 27, 2003

28 Points Achieved — Possible Points: 69

Certified 26 to 32 points Silver 33 to 38 points Gold 39 to 51 points Platinum 52 or more points

6 Sustainable Sites — Possible Points: 14

Y			
Y	Prereq 1	Erosion & Sedimentation Control	
1	Credit 1	Site Selection	1
	Credit 2	Urban Redevelopment	1
	Credit 3	Brownfield Redevelopment	1
1	Credit 4.1	Alternative Transportation, Public Transportation Access	1
	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
	Credit 4.3	Alternative Transportation, Alternative Fuel Refueling Stations	1
	Credit 4.4	Alternative Transportation, Parking Capacity	1
1	Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space	1
1	Credit 5.2	Reduced Site Disturbance, Development Footprint	1
1	Credit 6.1	Stormwater Management, Rate and Quantity	1
	Credit 6.2	Stormwater Management, Treatment	1
	Credit 7.1	Landscape & Exterior Design to Reduce Heat Islands, Non-Roof	1
	Credit 7.2	Landscape & Exterior Design to Reduce Heat Islands, Roof	1
1	Credit 8	Light Pollution Reduction	1

2 Water Efficiency — Possible Points: 5

Y			
1	Credit 1.1	Water Efficient Landscaping, Reduce by 50%	1
1	Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	1
	Credit 2	Innovative Wastewater Technologies	1
	Credit 3.1	Water Use Reduction, 20% Reduction	1
	Credit 3.2	Water Use Reduction, 30% Reduction	1

5 Energy & Atmosphere — Possible Points: 17

Y			
Y	Prereq 1	Fundamental Building Systems Commissioning	
Y	Prereq 2	Minimum Energy Performance	
Y	Prereq 3	CFC Reduction in HVAC&R Equipment	
2	Credit 1.1	Optimize Energy Performance, 20% New / 10% Existing	2
2	Credit 1.2	Optimize Energy Performance, 30% New / 20% Existing	2
1	Credit 1.3	Optimize Energy Performance, 40% New / 30% Existing	2
	Credit 1.4	Optimize Energy Performance, 50% New / 40% Existing	2
	Credit 1.5	Optimize Energy Performance, 60% New / 50% Existing	2
	Credit 2.1	Renewable Energy, 5%	1
	Credit 2.2	Renewable Energy, 10%	1
	Credit 2.3	Renewable Energy, 20%	1
	Credit 3	Additional Commissioning	1
	Credit 4	Ozone Depletion	1
	Credit 5	Measurement & Verification	1
	Credit 6	Green Power	1

6 Materials & Resources — Possible Points: 13

Y			
Y	Prereq 1	Storage & Collection of Recyclables	
	Credit 1.1	Building Reuse, Maintain 75% of Existing Shell	1
	Credit 1.2	Building Reuse, Maintain 100% of Existing Shell	1
	Credit 1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell	1
1	Credit 2.1	Construction Waste Management, Divert 50%	1
1	Credit 2.2	Construction Waste Management, Divert 75%	1
	Credit 3.1	Resource Reuse, Specify 5%	1
	Credit 3.2	Resource Reuse, Specify 10%	1
1	Credit 4.1	Recycled Content, Specify 25%	1
1	Credit 4.2	Recycled Content, Specify 50%	1
1	Credit 5.1	Local/Regional Materials, 20% Manufactured Locally	1
1	Credit 5.2	Local/Regional Materials, of 20% Above, 50% Harvested Locally	1
	Credit 6	Rapidly Renewable Materials	1
	Credit 7	Certified Wood	1

7 Indoor Environmental Quality — Possible Points: 15

Y			
Y	Prereq 1	Minimum IAQ Performance	
Y	Prereq 2	Environmental Tobacco Smoke (ETS) Control	
	Credit 1	Carbon Dioxide (CO_2) Monitoring	1
	Credit 2	Increase Ventilation Effectiveness	1
	Credit 3.1	Construction IAQ Management Plan, During Construction	1
1	Credit 3.2	Construction IAQ Management Plan, Before Occupancy	1
1	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants	1
	Credit 4.2	Low-Emitting Materials, Paints	1
1	Credit 4.3	Low-Emitting Materials, Carpet	1
	Credit 4.4	Low-Emitting Materials, Composite Wood	1
1	Credit 5	Indoor Chemical & Pollutant Source Control	1
	Credit 6.1	Controllability of Systems, Perimeter	1
	Credit 6.2	Controllability of Systems, Non-Perimeter	1
1	Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-1992	1
1	Credit 7.2	Thermal Comfort, Permanent Monitoring System	1
	Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1
1	Credit 8.2	Daylight & Views, Views for 90% of Spaces	1

2 Innovation & Design Process — Possible Points: 5

Y			
1	Credit 1.1	Innovation in Design: Exemplary Performance 38% Local Materials	1
	Credit 1.2	Innovation in Design:	1
	Credit 1.3	Innovation in Design:	1
	Credit 1.4	Innovation in Design:	1
1	Credit 2	LEED™ Accredited Professional	1

Figure 14 . The on-line Submission of LEED, [17].

IV. CONCLUSION & RECOMMENDAIONS

This paper offered a comparative review to understand the differences in using different types of evaluation systems, particularly in categories of each one, and performance of their impact as applied to sustainability—both from the viewpoint of General information, Applicability, Certification levels, Usability, Categories and present a case study as well as a Sample of On-line Evaluation.

By this comparison, it can be concluded and recommend the following: Although there is a considerable degree of commonality between different Rating Systems which presented in this paper (BREEM-GBCA-GPRS-GRIHA-LEED), in terms of their aims, approach and structure, but there are significant differences in terms of scope of the environmental issues addressed, metrics and performance standards. Thus, it is necessary that the selection of suitable rating system according to its categories which are generally considered the most significant measure in building sustainability assessment, likewise to ensure the sustainable design environmental performance goals are being met when desired ratings are achieved. That related to the special requirements for each country because each one has different needs to achieve sustainability. It means in a building lifetime perspective, it should be remembered that differences with respect to ―fitness for use‖.

In my opinion, more research should be directed into answering the question how a rating system can be selected for different countries. When applied outside of the country of origin, questions on the applicability of the system have to be put, how it achieve its special features and its goals.

Review among some sustainability rating systems has established a trend in whole life perspective analysis as the assessment is going to cover the multidimensional aspects of sustainability and to minimize any associated environmental hazards. To figure out how much comply with green architecture.

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