Green Rating Systems Analysis

H. Ahamed Fazeel Akram, Nivedhaa B.

Abstract: ***Climate change and the exhaustion of the available natural resources are the biggest challenge to human kind. Architectural and Construction industry provide their part of solution to global citizens through sustainable and green Architecture. Architecture and Construction industry seems to be at the forefront of consumption of Energy and mega structures were built with glass boxes everywhere irrespective of the Climate, location on planet and cultural context. This paper takes a stand on how green certification can increase Energy efficiency in buildings with case studies. A case study also supports the process through which the reduction of energy consumption is pointed and the primary actions that are taken during designing and construction. This paper therefore, recommends Green Certification practices which will provide us with environmental sustenance and conserving natural resources for the Indian context.***

Keywords: ***Sustainable Green Architecture, Efficiency, Natural Resources, Environmental Sustenance, Green Rating Systems.***

I. INTRODUCTION

This paper describes about the Green Rating System for building construction Industries. The term Green Rating System defines the Method of Rating the building by using most important determining factor that affect the building like Energy, Water, Carbon Emissions and Transportation.

In worldwide context, there are different types of Green Rating Systems that are based on sustainable development and they are designed for various building projects. However, there are only few green rating systems which are acknowledged and really set for recognizable standard for sustainable Development. The following five systems are

i. BREEAM
ii. GRIHA
iii. IGBC
iv. LEED
v. GREEN STAR

Which of those are most popular by means of their credential systems?

The article reviews each of these systems and suggest which of these can be appropriate system for the Indian context.

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II. COMPARATIVE REVIEW OF GREEN RATED SYSTEMS

A. Breeam (building research establishments environmental assessment method)

I. BREEAM is the most significant sustainability assessment mechanism, which evaluate the environmental impacts of the buildings. The credits are allotted based upon the whole process of the construction from designing stage post construction view. There are about 5, 68,632 certificates that are accredited by BREEAM. [2].

B. Breeam assessments stages: [2].

BREEAM accounts different phases of evaluation, including:

- ✓ Pre-assessing the site
- ✓ Design as well as Procurement assessment
- ✓ Management as well as Operation assessment
- ✓ Post Construction Reviews
- ✓ Covers the whole life cycle of Buildings.

C. Breeam key issues. [2].

BREEAM address eight topmost persuasive Environmental issues:

- ✓ Energy and Water Use
- ✓ Materials
- ✓ Waste
- ✓ Ecology
- ✓ Health & Well Being
- ✓ Pollution
- ✓ Transport
- ✓ Management Processes.

D. Breeam certified levels [2].

BREEAM (%)	SCORE
Unclassified	Less than 30
Pass	From 30 to less than 45
Good	From 45 to less than 55
Very Good	From 55 to less than 70
Excellent	Greater than 70
Outstanding	Greater than 85

E. LEED (leadership in energy and environmental design)

LEED is a measurement tool strategy which focuses on improving efficiency performance. With over 6,300 projects certified & about 21 projects registered, LEED was initiated in 1998 [3].

F. LEED designations

- **LEED – NC –** New Construction for commercial, Institutional and High-rise residential Buildings.
- **LEED - EB –** LEED for existing Buildings. They key on Building Operation.
- **LEED – CI –** They centralize on retail spaces, office & Institutional buildings.
- **LEED – CS** – Core & Shell
  Interior core of the building & services and exterior envelope of the building are focused.
- **LEED – H –** Rating system developed for efficient residential design.
- **LEED for Schools**
- **LEED for Retails** - which comes under core & shell and Commercial Interiors.
- **LEED Neighbourhood Development** – They standardize to enroot more efficient sustainable and coherent environment.

G. LEED rating

LEED scorings are based on seven prospects:[4]

- Location and transportation.
- Sustainable Sites.
- Water Efficiency.
- Energy & Atmosphere.
- Materials and Resources.
- Indoor Environmental Quality.
- Regional Priority (Bonus credit)
- Innovation in Design.

H. Levels of leed certifications:

- Certified
- Gold
- Silver
- Platinum

I. Green star

Green Building Council of Australia launched its green rating system as GREEN STAR in 2003, The rating system then established its mark in New Zealand (Green Star NZ) and South Africa (Green Star SA) [5].

J. Green star rating schemes.

GREEN STAR Rating Schemes Which are:

➢ Design and as Built Communities: Performance, Interiors.
➢ Legacy Rating Tools: Education, Health Care, Industrial, Multi Unit Residential, Office Interiors, Retail Centre and Public Building.

K. Green star categories.

The Rating system is based on 14 specifications for Individual buildings from their Design, Construction and Operation. The Following Categories are,

- ➢ Management
- ➢ Indoor Environment Quality
- ➢ Energy
- ➢ Transport
- ➢ Water
- ➢ Materials
- ➢ Environment
- ➢ Land use & Ecology
- ➢ Emission
- ➢ Innovation
- ➢ Governance
- ➢ Design
- ➢ Liveability
- ➢ Economic Prosperity. [6]

L. Green star certification.

- ➢ 4 Star, 5 Star, 6 Star, for Design and as – built communities and Interiors.
- ➢ 1 – 6 Star for Performance

M. IGBC – (Indian green building council)

The Indian Green Building Council (IGBC) was founded in 2001, by confederation of Indian Industry. The Council is created with the primary intention to create a quality life with an integrated approach of Sustainable Practices. India's First Platinum Rated Green Business Centre is where the council head office is located.

N. IGBC rating categories.

IGBC Green Buildings Rating Systems addresses green features under the following Categories:

- ❖ Sustainable Architecture and Design
- ❖ Site Selection Criteria and Planning
- ❖ Conservation of Water
- ❖ Energy Efficiency
- ❖ Building Materials & Resources
- ❖ Indoor air Quality
- ❖ Innovation and Development

Different Level of green building certification are awarded based on the total credits earned. However, every green new building should meet certain mandatory requirements, which are non – negotiable [8].

O. IGBC certification.

IGBC Certification Levels & Recognition, they are

Best Practices	Certified
Outstanding Performance	Silver
National Excellence	Gold
Global Leadership	Platinum

P. GRIHA (green rated integrated habitat assessment)

GRIHA, established in 2007 in India is a Green Rating System which is used as a medium to accomplish a sustainable environmental Performance by the building. The system was instituted by TERI and is notarized by MNRE (Ministry of New and

Renewable Energy). An integrated principle of energy & environment is taken into account to embody the well-established practices and to materialize new concepts.

GRIHA Benchmarks to reduce energy consumption through its 5R's Principles **(Refuse, Reduce, Reuse, Recycle, Reinvent)**.An optimized building design is achieved through its attempts to reduce waste generation, environmental impacts and its Conservation and Prevention Techniques.

Q. GRIHA categories.

GRIHA attempts to quantify aspects such as:

- Energy / Power Consumption
- Waste Generation
- Water Consumption
- Renewable Energy Integration

R.GRIHA certification level & scoring.

Certification Level & Scoring, they are

- 50 – 60 Points Certified as a 1 Star GRIHA Rated Building.
- 61 – 70 Points Certified as a 2 Star GRIHA Rated Building.
- 71 – 80 Points Certified as a 3 Star GRIHA Rated Building.
- 81 – 90 Points Certified as a 4 Star GRIHA Rated Building.
- 91 – 100 Points Certified as a 5 Star GRIHA Rated Building.

III. CASE STUDY : INFOSYS TECHNOLOGIES, HYDERABAD.

Infosys Technologies Limited was started in 1981. They are a global consulting multinational corporation with more than 228,000 employees. They operate worldwide from 72 cities across 30 countries. They always believe that sustainable solutions will optimize production and also help them reduce energy consumption.

ARCHITECT : Sundaram Architect Pvt. Ltd

LOCATION : Pocharam, Hyderabad, India.

GREEN CONSULTANT : EDS

SITE AREA :43 ACRES

BUILT-UP AREA **:** 2.33 million Sq. Ft

EMPLOYEES : 2600 employees

WORKING HOURS : 8.5 hours / day.

CLIMATE : Arid

S. Planning & Concept.

- The existing and natural vegetations were preserved and soil erosion and soil runoff were prevented.
- The building is oriented in E-W to its longer axis which results in lesser solar heat gain [10].

Figure 1. Site of Infosys Technologies, Hyderabad.

T.Natural Lighting:

- The windows are categorized into upper panel and lower panel.
  - UPPER PANEL – DAYLIGHT
  - LOWER PANEL – VISION PANEL
- Upper glass provides less amount of glare. The lower glass allows lower visible transmittance.
- Horizontal louvers and vertical fins are provided for shade and also ensure light without any glare all through the day.
- 90% of natural light is attained. 78.54% of living areas are hit by day-light [11].

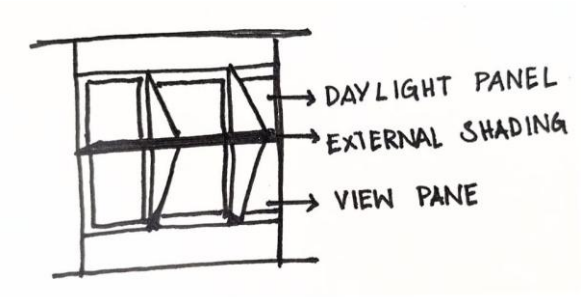


Figure 2. Exterior Lighting Factor

- Light shelves are provided between the day light panel and vision panel which delivers daylight deeper into floors.

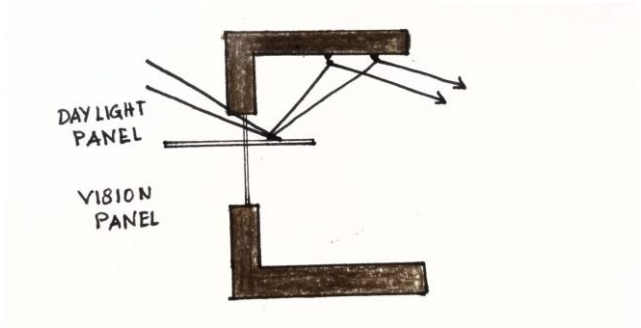


Figure 3. Light Shelves for deeper penetration of day light

- 400 kw solar plant is also installed which generates 7 lakh units per **annum.**

Figure 4. Interior Lighting Factor
(Source:http://www.greenbuildingcongress.com/site/mmbase/attachments/466271/Mr_Guruprakash_Sastry_Infosys.pdf;jsessionid=BD7C2F6DF08FB3FAFFAE2033C1AFA143)

U. Super efficient building design to reduce heat

- The building is enveloped with insulated walls and roofs making an optimization of less than 38%.
- The building envelope has also affected with reduction of heat gain of 1 watt/sf.

Wall Insulation	U value less than 0.4 W/m2 K
Roof Insulation	U value less than 0.34 W/m2 K
Low SHGC with low e glass	SHGC less than 0.2
	U value <1.2 W/m2 K

- High performance Saint Gobin Cullet glasses are used. The cullet glasses with the Argon filling reduce heat transfer from one to the other pane, by the process of conduction and radiation.
- UPPER GLASS - 6mm - 12mm - 6mm
- LOWER GLASS - 6mm - 16mm argon gap - 6mm
- External heat gain does not exceed 0.75 W/sqft.
- An enormous amount of energy production and pollution has been controlled by the implementation of recycled materials all through the construction .
- Low energy materials were used for false ceiling, internal partitions which would include aluminum, plywood and tiles.
- The roof has been painted White -HIGH ALBEDO PAINT, which has an SRI value greater than 75%.
- These paints aid to subordinate the air condition loads. 5% reduction in HVAC energy has been noticed [13].

Figure 5. White Roof.
(Sources:https://www.infosys.com/newsroom/features/Pages/commercial-radiant-cooling-building.aspx)

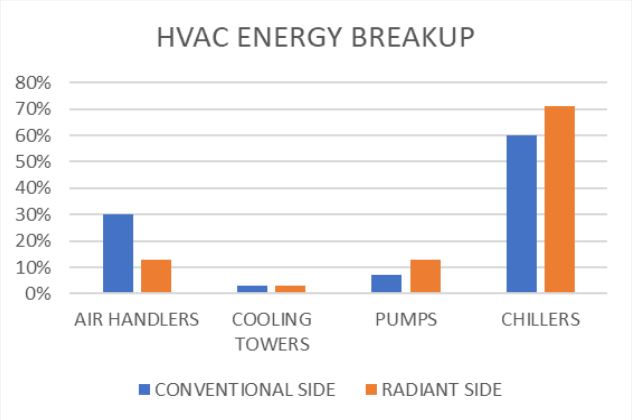
- The conventional sodium vapour lamps (250 watt) have been replaced by LEDS (75W) which are accompanied with daylight sensors and occupancy lights. This has resulted in the reduction of daylight consumption by 60%.

SYSTEM DESCRIPTION	UNITIS	NEW DESIGN	CONVENTIONAL DESIGN
Total electrical load	MW	3.5	10.0
Transformer capacity	MVA	4.0	12.0
DG set capacity	MVA	5+2.5	15+3
Annual energy consumption	Million kWh	7.5	25

V.Radiant Cooling Method`

- An effective method of cooling technology is achieved by installing concrete slabs embedded with polyethylene pipes. This is referred as "CAVE EFEECT".

- The air required by the radiant cooling side is only 1/5 because the cooling is done by the radiant slab.
- 30% more efficient than conventional HVAC systems [14].



Conventional side are cooled by conventional cooling method and radiant side are cooled by radiant cooling method.

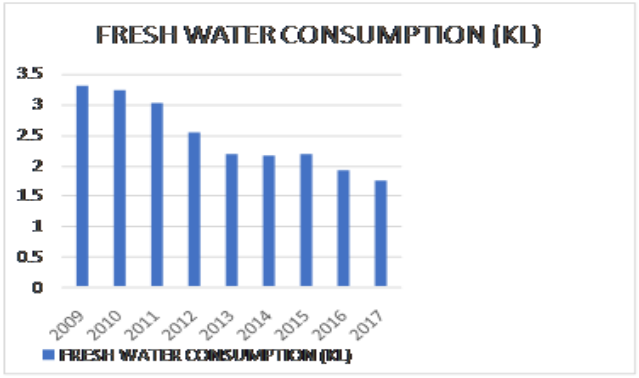
Conventional Side
Total HVAC energy :428,00kWh
HVAC Energy index :38.4 kWh/SQM
Radiant Side
Total HVAC energy: 267,00kWh
HVAC Energy index :26.1 kWh/SQM

YEAR	Kwh/employee
2007-2008	297
2008-2009	266
2009-2010	239
2010-2011	230
2011-2012	203
2012-2013	178
2013-2014	167

- 44% reduction in energy consumption is achieved over.

W. Water Efficiency

- Productive fixtures have been installed and recycle of waste water is also done. This has resulted in 51.53% less water consumption.



Fresh water consumption has reduced all through the years by adopting sustainable methods.

X. Waste management:

- Nine biogas plants and seven composting plants with collective volume to process 3.45 million kgs of waste was initiated
- These plants allow us to have a continuous monitoring and also help us with lesser manual operational errors.
- The food waste is also processed using the in-plant.
- Paper waste is sent to Trivandrum campus for recycling [15].

Figure 6. Biogas plant –
(Source:http://www.greenbuildingcongress.com/site/mmbase/attachments/466271/Mr_Guruprakash_Sastry_Infosys.pdf;jsessionid=BD7C2F6DF08FB3FAFFAE2033C1AFA143)

IV. CONCLUSION

Lesser heat load is achieved by adopting small chillers and smaller pumps which results in smaller pipes and lesser pipe insulations by which we adopt smaller transformers. As the aftermath of adopting sustainable process from the lower end , we achieve 4x better efficiency at no additional cost
With its significantly unique Green architectural practices, Infosys is referred as “Best Practices Guide for High Performance Indian Office Buildings” by the Lawrence Berkeley National Lab. The project also consumed only 1/3 of the energy of the normal building at no extra capital costs. 11 buildings have achieved LEED platinum rating. 2 buildings have achieved GRIHA 5-star rating. They have achieved a sustainable

economic advancement with their radical solutions

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