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Impact of GRIHA parameters on Designing of Green Buildings: Field investigation analysis

Nibedita Panigrahi[1]G.R.K.D. Satya Prasad[2], Vikas kumar pandey[3], Gautam choubey[4] Rohit kumar singh[5], Peenaki priyadarsan nayak[6]

[1] *Assistant Professor, Department of Electrical Engineering, GIET, Gunupur,* Orissa, INDIA
[2] *Associate Professor, Department of Electrical Engineering, GIET, Gunupur,* Orissa, *INDIA*
[3,4,5,6]*Final Year UG student, Dept. of Electrical Engineering, GIET, Gunupur, Orissa, INDIA*

Abstract – GRIHA (Green Rating for Integrated Habitat Assessment), is one which will identify the benchmark parameters with a standard regulation to suit the local climatic condition and it was developed by TERI (The Energy resource institute). It has been identified to estimate that lot of energy is wasted with an inefficient approaches in building sector.

In this paper by considering an Engineering college Campus as its point of concern for the analysis of GRIHA parameters and checking conformance with the ECBC by using ECOnirman tool. This will help to identify the benchmark parameters to improve the energy efficiency and reducing the unnecessary energy usage in any building or campus.

Key Words: GRIHA, HVAC, Simulation, Thermal Comfort, Green buildings, ECOnirman

1. Introduction of GRIHA:

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, implementation of energy efficient building system and effective utilization of renewable energy resources to power the building.

For measuring and rating of building environmental performance in the context of varying climate conditions in India, TERI develop a tool called GRIHA (green rating of integrated habitat assessment). GRIHA quantifies parameters like energy consumption, waste generation, renewable energy adoption or the entire life cycle of the building. This initiative supports green building using minimum renewable electricity consumption, rain water harvesting and recycle waste material.

This tool will benefit the community at large with improvement in the environment by reducing green house gas emission, improving energy security and reducing the stress on natural resources. Presently there are 34 criteria's of GRIHA rating system under 4 main categories

- Selection and site planning.
- Conservation and efficient utilization of resources
- Building operation and maintenance
- Innovation

2. How to achieve rating in GRIHA

GRIHA by the name only it signifies a well structured building or a house but to achieve that structure Griha follows some rating rules. To examine all the rating others officials go through all the necessary documents to make sure the constructed building is eligible for griha rating. The evolution is done through two stages pre documentation and post documentation. With completion of registration and documentation process the building is again rated in three tier process. After finding all the result is presented to National Advisory Committee. ADARSH is responsible for all the rating based on GRIHA bench mark which compromises of 14 external members. There are 34 criteria and out of 34 criteria 8 are mandatory and others are optional. The building design should be done in cooperating with the energy conservation measures at lowest cost. For that we attach the eco glass product for energy saving window, artificial ventilation and many more setups are installed. Apart from all this things weather and climate condition are also been taken into consideration before setting up any building to achieve ratings in GRIHA. The main aim in achieving the rating system in GRIHA for constructing building is to ensure total environment free from pollution and consuming waste energy.

Technical Analysis:

Green buildings are designed under the GRIHA rating in order to construct the environment friendly building. Analysis has been done which helps in designing the energy efficient building. Considering the small study in the GIET campus we analyzed that building causes harmful effect on environment which can lead to climate deterioration and increase in carbon emission and many more.

so technically we analyze that in order to have energy efficient building first sustainable site planning has to be done. Then we have to conserve the energy using renewable energy sources. For that we have to architect the design of the building such that all the resources liker sun rays, wind direction and water bodies are available thoroughly. In order to save energy in day, windows should be designed so that day light reaches to all the space and to minimize the load of installed HVAC system to reduce energy consumption. So in order to achieve all this thing proper survey and analysis is required to make sustainable and energy efficient building

3. Possibilities of getting GRIHA rating in GIET campus

In this case study a survey has been done on GIET loads and analyzed all the loads and buildings HVAC considerations which they are applicable to GRIHA standards. .

A system survey is required in choosing the type of loads and their conservation with Green rating standards. As a result of manual load studies, the system's loads can be determined in terms of power generation and conservation and main important innovative approaches.

As a part of Mini project work; each batch has assigned a topic to target to minimize the electricity bill with latest technologies. The main task of our project batch is to coordinate with all other project batches and collect the information and finally prepare a complete report on achieving of GRIHA rating building and at the end the chances of getting star rating with ECBC.
The following table 4.1 will gives the complete idea about the division of works which are assigned for each project batch.

By taking into account of the various buildings daily energy needs in GIET campus, the load diversity factors, and energy efficiency with local climatic zone. The acceptability and understanding of the term sustainable building is applicable to different designs and approaches that can be considered. Best results in green design are achieved if concepts are integrated at the design stage. In order to equip the design team to achieve the green design intact, development of concept design through design guidelines for master planning and layout, design review, visit & preliminary analysis the following procedures has been adopted.

- Emphasize the quantification of energy saved;
- Necessitate expert inputs and simulations.
- Identifying the load pattern of the buildings
- Optimizing the Diesel generators load pattern
- Renewable source availability and feasibility

For getting GRIHA rating; calculation of Energy performance index is an important constraint.

Table 1: Works to be carried out in GIET campus and scoring of GRIHA points

Criteria No.	Description of Criteria	Assigned the work for the Project batch	Points can be scored
6	Enhance outdoor lighting system efficiency and use RE system for meeting outdoor lighting requirement	Batch 5	3
7	Plan utilities efficiently and optimize on site circulation and efficiency	All Batches	3
13	Optimize building design to reduce conventional energy demand	Batch 1,2,4,5,11,20	6
14	Optimize energy performance of building within specified comfort	Batch 2	12
18	Renewable energy utilization	Batch 2,4,11,18	5
19	Renewable energy based hot water system	Batch 19	3
23	Efficient waste segregation	Batch 11	2
25	Resource recovery from waste	Batch 11	2
27	Minimize Ozone depleting substances	Batch 17	3
33	Operations and Maintenance protocol for electrical and mechanical equipment	Batch 8, 12	2
34	Innovation(beyond 100)	Batch 15, 17,20	4

Table .2: All project batches and their related work

Batch No.	Area of the work	Main objective of the Project applicable to GIET campus
Batch 1	Wind power	Possibility of the generating wind power
Batch 2	Building optimization and HVAC	optimization of HVAC and building envelop parameters
Batch 3	UPS	Power quality issues and correct rating & sizing of batteries
Batch 4	Solar cooking	Possibility of solar cooking to Central mess
Batch 5	Lighting	Energy efficient lighting and modern controls
Batch 6	Motors and Pumps	Exchanging with Energy efficient pumps
Batch 7	Capacitor banks	Reduction in Maximum demand
Batch 8	Substation	Identifying the reliability and interruptions to from Gunupur substation to GIET campus
Batch 9	Electrical layout	Identifying the correct location of electrical equipment
Batch 10	Total load calculations	Optimizing the energy efficiency and maximum demand of the loads
Batch 11	Biomass and Kitchen waste	Identifying the possibility of generating energy from biomass and kitchen waste
Batch 12	Smart Grid	Possibility of getting income from Grid
Batch 13	GRIHA and BEE	Evaluate the rating of GRIHA
Batch 14	Diesel Generators performance	Optimization of Generators load and reduce the operating hours of Diesel Generators
Batch 15	Energy conservation	Possibility of Energy conservation by using modern techniques and latest appliances
Batch 16	Air conditioners	Better utilization of Air conditioners
Batch 17	Carbon credits	Getting Carbon credits
Batch 18	Solar power	Possibility of the generating Solar power
Batch 19	Solar Hot water	Replacing conventional hot water systems with Solar hot water systems
Batch 20	Energy performance Index	Identifying EPI of GIET and finding various options to reduce EPI to minimum level.

Table .3: Calculation of EPI

A. No. of units supplied from the Grid	14,01,792
B. No. of units generated from Diesel generators	4,88,474
C. Total No. of units Consumed by GIET campus in year 2013 C = A + B	18,90,266
D. Total area of the GIET campus in sq.m	52,247
E. For a college which will works on an average of 8 hrs. hence the constant for consider to calculate EPI	0.15
F. EPI of GIET campus = C/(D×E)= $\frac{1890266}{52247\times0.15}$	241

According to BEE Star rating for office buildings for a climatic zone of Hot and Dry area of GIET campus the EPI parameters should lie as shown in table 3.5

Table 4: Hot and Dry climatic zone

EPI (kwh/m2/year)	Star Label
190-165	1 Star
165-140	2 Star
140-115	3 Star
115-90	4 Star
Below 90	5 Star

Table .5: Final EPI calculations

	Total no. of units in year 2013	savings in No. of units	Remaining no. of units	New value of EPI
	18,90,266	----	----	241
Savings from Generator load optimization	------	76,719	18,13,547	231
Energy conservation procedures in lighting and Fans	------	1,16,498	16,97,049	217
Energy conservation procedures in Pumps	------	18,337	16,78,712	214
Energy conservation procedures in Air conditioning units	------	63,984	16,14,728	206
Computers load	------	10,000	16,04,728	205
Optimization of loads	------	22,965	15,81,763	201
Solar power	------	5,40,000	10,4,1763	132
Wind Power	------	4,33,620	60,8143	77.5

By the analysis shown in Table 3.5; initial EPI values is 241, but by adopting energy efficiency technologies, optimization of the loads by supporting with Renewable energy the final EPI values has decreased to a level of 77.5. GIET will come under 5 star categories; because according to BEE standards GIET's EPI value comes under the value of 90 EPI.

To convert a normal building to GRIHA rating building the cost considerations and payback calculations are explained in table 4.6

Table: .6: pay back analysis for GRIHA analysis

Total sq.m area of the building	52247 sq.m/ 562382 sq. feet
Construction cost	80,48,14,696 INR
Total Cost of building cost for implementing GRIHA	86,57,73,143 INR
A. Cost of considering energy efficiency measures and renewable energy options for GRIHA parameters	6,09,58,447 INR
B. Total savings including carbon credits benefits	1,52,87,210 INR
Percentage of extra cost to achieve GRIHA rating	7.57 %
Payback calculation = A/B	3 years and 9 months

Conclusion:

By the analysis shown in Table 4.5; initial EPI values is 241, but by adopting energy efficiency technologies, optimization of the loads by supporting with Renewable energy the final EPI values has decreased to a level of 77.5. According to BEE standards under the value of 90 EPI that building comes under 5 star categories.

ECOnirman Compliance report:

Building Conformance Summary

Proposed Design Electricity Use per year (kWh/year)	Standard Design Electricity Use per year (kWh/year)	Percent Savings: Electricity Use per year
20,94,247	21,17,543	1.1%
Proposed Design EPI (kWh/m²/year)	Standard Design EPI (kWh/m²/year)	Percent Savings: EPI
279	282	1.1%
10.3.2(e) of ECBC Satisfied (Y/N)?		Y
Mandatory Requirements Met (Y/N)?		N

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