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Preliminary Critique by GRIHA Criteria Energy with Respect to Window Wall Ratio

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Abstract - *The second largest industry in India is Construction Industry. Owing to this fact, GRIHA realises the harmful effects the building construction has on our environment, from its phase of material procurement, construction, operation to the phase of its demolition. With globalization, opening the doors for economic development in terms of infrastructure, there is serious concern about how far we are being able to save our resources. Our civilization is being sacrificed. Our Biosphere has also been sacrificed. The environment needs to be protected. When our house falls apart, we try to fix it as early as possible, then why not environment. Here comes the role of GRIHA (Green Rating for Integrated Habitat Assessment) which is a way to ensure our survival on this planet Earth, which works to restore the environment by nullifying the catastrophic impact on environment. GRIHA has its jurisdiction in India only. It was given by TERI (The Energy And Resource Institute).GRIHA version 2015 have 31 criteria, which comes under nine different sections.*

***Key Words*: Green Building, GRIHA, WWR, EUI, AEU, Co2 Emission**

1. INTRODUCTION

Global warming and climate change are the factors through which world today has suffered. Removal of natural resources as building materials it uses energy, cause environmental degradation and offer to global warming. Buildings are the highest greenhouse gases emitters and energy consumers. Buildings are responsible for at least 40% of energy use, global. In addition, building activities contribute an estimated 50% of the world's air pollution, 42% of its greenhouse gases, 50% of all water pollution, 48% of all solid wastes and 50% of all CFCs (chlorofluorocarbons) to the environment[1,13]. Therefore Urgent changes are required relating to energy saving, emissions control, production and application of materials. Green building concept is a solution for the mitigation of CO2 emission and the reduction of energy use in the building sector. In our country India, a well-designed building is built out of concrete & bricks and may have a design life of up to 100 yrs. During such period, a building can consume unimaginable quantities of resources (these resources are energy, water, soil, trees etc).

There is a need to save Resources. CII in its report on Green Building Movement in India concluded that, "With the growing awareness on green buildings, the green building movement is well poised to reach greater heights". Green building is the way of constructing or transforming structures to be environmentally friendly, resource efficient throughout their life cycle. GRIHA is a tool that helps in making building green[2].

2. RESEARCH BRIEF

This research paper addresses the impact of WWR (Window-Wall Ratio) on energy, as maximum points in griha can be achieved from energy section. The paper presents work on the analysis of a building 'Senior Secondary School Girls, AMU, Aligarh, on the basis of one section of griha i.e. ENERGY. As per GRIHA V 2015, there are 9 sections and 31 criteria, maximum points can be achieved through energy section.There are total 100 points, to achieve minimum 1 star rating, minimum points to get is 25 and to get 5 star rated building 50 points need to be earn. Major focus of the paper is on the impact of Window to Wall Ratio on energy usage, the way in which WWR affects Energy consumption in a building.

2.1 Green Building

Green building refers to a built mass that is both resource efficient as well as environmentally efficient throughout the life cycle of the building. Green Buildings are designed with the aim to have minimum negative impact and maximum positive impact on the environment. The aim of the green building is to minimize the demand on non-renewable resources and maximize reuse, recycling and utilizing resources efficiently. This amalgamates various features like energy efficient, use of renewable energy, efficient use of water, proper waste management enhanced indoor air quality, effective building management system, effectual use of landscape, provides comfortable and hygienic indoor

working conditions. The concept of green buildings not only favors human health but also safeguards earth from harmful and poisonous after-effects, fulfilling the accountability of the concept of sustainable development[3].

2.2 Concept of Green Building

Concept of Green building evolved through the process of design that requires input from architects, landscape architect, electrical and plumbing consultants, energy consultants, etc. to work together as a team to address all the aspects of building in terms of planning, designing, construction and operation. A green building ethic is replacing the green building practices, whereby buildings built previously without thought to the negative impact on the environment, are now being planned with a conservative approach to reverse the impact [7,8]

2.3. Need of Green Building

With the growing urbanization, the demand for housing, electricity, water supply, are all increasing Indoor air quality is getting worse day by day. Also the environment is getting affected , there is scarcity of electricity as well as water in some of the cities of our country. The cause of all this is not only nature, but humans are majorly responsible for inefficient use of resources. Green building is one of the major solutions to all these problems. Also to meet 17 SDG (Sustainability Development Goals) goals, Green building concept is needed. Green building is not a matter of choice or luxury but a necessity of today's era.[12]

2.4. Goals of Green Building

i. Tackle the environmental issues as well as the design of the build mass.

ii. Make net zero energy building by using passive design strategies.

iii. Use resources effectively and efficiently.

iv. Save cost of the Building.

2.5. Misconceptions Regarding Green Building

2.5.1. Green building is all about landscaping

The People have a misconception that green building means a building that is green in terms of landscape, the building that have greenery/ landscape. Landscaping is only one part of the whole green building concept. Plants inside homes and offices can help in improving Indoor air quality by reducing carbon dioxide, whereas large open green spaces help in reducing the effect of urban heat island. Integrating landscape in site development provides shading for homes and buildings to help create a more comfortable environment [11].

2.5.2. Green buildings are expensive

Some additional costs are there during the construction phase of green building. But the operational and maintenance cost of a green-built homes are significantly less. A building designed with passive solar and high-efficiency windows require less energy to heat and cool, less workload on units also results in lower repair cost and a more years of service [3].

2.5.3. Green Building is a Fad

The new generation of homebuyer is much concerned about their carbon footprints. Consumers now look for ways to save on energy cost, Green Building is healthier for human habitation as it releases fewer pollutants and use fewer fossil fuels. So, the concept of green building is not going away. It's not a fad, it's a way of reducing negative impact on environment by maintaining it [14].

2.5.4. The reason to go Green is just to save or make money

The reason to go green is not to save money, but the green building concept, attracts the young talent. It was found in one research that office space designers and builders that work with businesses recognize that green building and energy efficient building layouts are important as natural light and open spaces allow for employee to be more productive as well as happier and healthier.

3. GREEN BUILDING RATING SYSTEM

A green building rating system is a tool that measures the environmental performance of a building through its life cycle. It consists of criteria, including various parameters related to design, construction and operation of a green building. Some set of points is assigned to each criterion and sets performance benchmarks. Once a project fulfils the rating criteria, it is awarded some points. The points are added up and the final rating of a project is decided [4, 10].

3.1. India's Own Rating Systems

1. GRIHA (Green Rating For Integrated Habitat Assessment)

2. LEED (Leadership in Energy and Environmental Design)

Following are some other India's own rating systems:

i) MNRE, 2007 – National rating system for green buildings in India.

ii) UN, 2009 – Innovative tool to measure greenness off buildings.

iii) UNFCCC, 2015 – India's own green building rating system.

iv) Mr. AI Gore, 2008 – Tool for implementing RE in the building sector (The Climate Reality Project).

v) UNEP, 2010 – Common Carbon Metric, for international building energy data[8,9].

4. OVERVIEW OF GRIHA

GRIHA stands for Green Rating for Integrated Habitat Assessment, is India's own rating system that was developed jointly by TERI (The Energy and Resource Institute) and MNRE (Ministry of New and Renewable Energy), based on the Indian agro climatic conditions. GRIHA is a five star green building rating System. It lays emphasis on passive design techniques for optimizing visual and thermal comfort. It has been developed to rate commercial, institutional and residential buildings in India are emphasizing national environmental concerns and climatic concerns. GRIHA amalgamate all relevant Indian codes and standards for buildings and acts as a tool to facilitate implementation of the same. It works as a means for main streaming green building practices by mixing regulations and voluntary programs. It is a guiding and performance-oriented system where points are earned by fulfilling the design and performance intent of the criteria [10].

4.1 Griha's Rating Process

The rating of a project is awarded in two stages

i) Pre documentation stage - A team from ADARSH along with the client's Integrated Design Team meet and determine the points being targeted by the project.

ii) Post documentation stage - All necessary proof through documents for the points targeted under various criteria is submitted. Then Evaluation by third party regional evaluators is done.

After the necessary documentation is uploaded, the building is evaluated and rated in a three-tier process. The preliminary evaluation is done by a team of experts from ADARSH. The report for evaluation given to members of an evaluation committee: external experts in building and landscape design, lighting and HVAC design, renewable energy, water and waste management, and building materials. The members independently review and award points, a provisional GRIHA rating are awarded after evaluation of documents submitted. After award of provisional rating, final rating is awarded later on.

4.2. Griha Version 2015

There are 31 criteria in GRIHA V 2015 rating system categorized under nine sections such as Site Planning, Construction Management, Energy, Occupant Comfort and Wellbeing, Sustainable Building Materials, Performance Monitoring, Validation and Innovation. There are total 100 points and minimum points to become griha certified building is 25 in this griha's variant. And Maximum point that is 20, can be achieved from energy section. So, energy plays important role in green buildings [4].

5. ANALYSIS OF SENIOR SECONDARY SCHOOL GIRLS, AMU, ALIGARH

Number of teaching staff = 69

Number of non-teaching staff = 23

Number of students = 1180

Total Population = 69+23+1180 = 1272

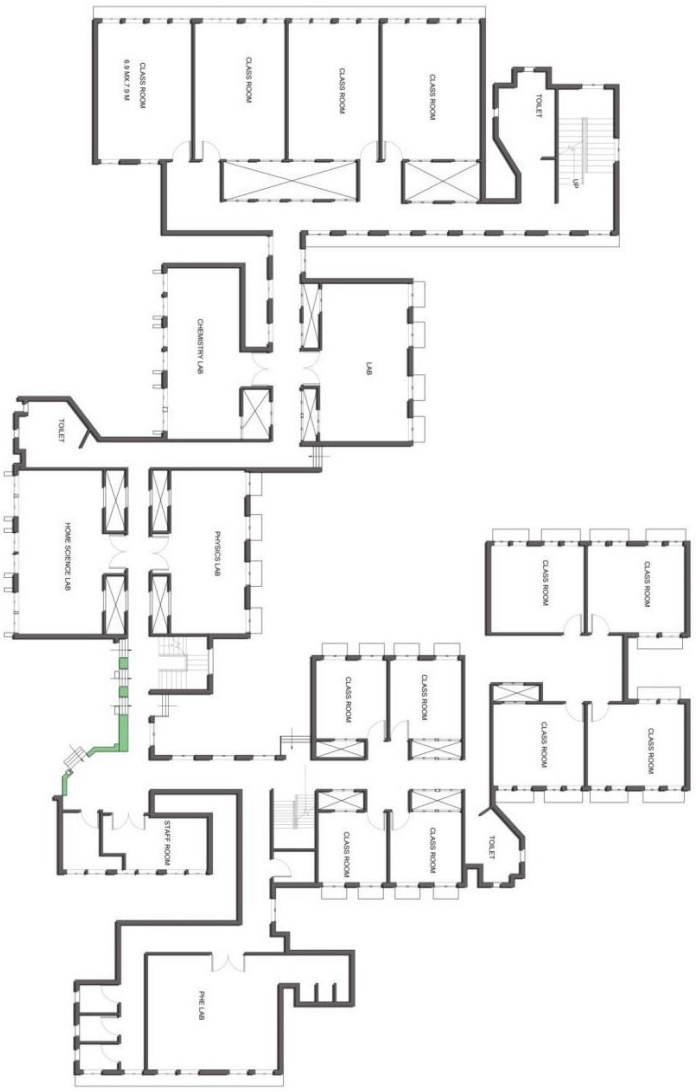

Figure-1 Typical floor plan of Senior Secondary School, Girls, AMU

i) Per Capita CO2 Emission

CO2 Emission of Building = KWH demand X CO2 emission
kwh demand = 12845 kwh
= 12845 / 1000000
= 0.012845 gwh

1 gwh = 10,069 tons
0.012845 gwh = 10,069 x 0.012845 tons
= 129.336 tons
Per capita CO2 emission of building = co2 emission of Building/ total population of school

Per capita CO2 emission of building = 129.336 / 1272

= 0.1 TON

which is much lesser than Griha base case.

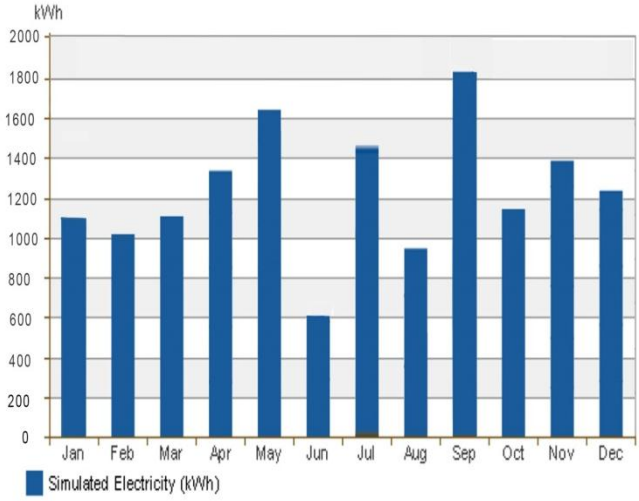

Figure2. Graphical representation of simulated electricity of SS school

ii) Window to Wall Ratio

WWR changes the thermal comfort by 20–55% and lower WWR provides higher thermal comfort and higher lighting electricity at the same time. Window to wall ratio have impact on energy consumed by different sources. Performing simulation with the help of Revit software, it was found that on an increasing percentage of WWR (window wall ratio) more amount of energy is consumed by different sources of energy. Measuring the difference on scale 0 to 15k, it was found that when WWR is 30%, energy consumed by Hp supp and vent fan range between 0to 5 k while when WWR is 60%, energy consumed by Hp supp and vent fan ranges between 0 to 7 k and when WWR is 90%, energy consumed by Hp supp and Vent fan ranges between 5k to 15k.

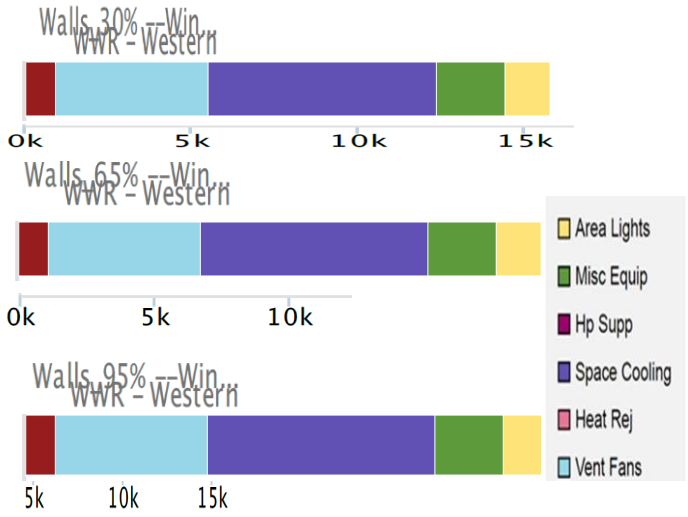

Figure-3 Energy usage with respect to Window -Wall ratio

Table-1 **EUI as per Different Wall to window Ratio**

Title and Floor Area	Annual Electricity Use (AEU)	Annual Fuel Use	EUI (Energy Use intensity)
WWR - Northern Walls 95%	179488.4	117661.1	1722.23
WWR - Northern Walls 65%	170338.8	119413.4	1651.92
WWR-Northern Walls 30%	165437.2	116890.1	1606.44

Taking Northern façade and floor area of a building be 443.51 sqm. Initially taking WWR, as 90% with this EUI of the building will be approx. 1722.23 and annual electricity demand 67.72 KWH. On decreasing WWR to 65% on the same façade, EUI comes out to be 1651.92 and annual electricity demand comes out to be 63.5 KWH. On further decreasing WWR, now taking 30%, EUI comes out 1606.44 and annual electricity demand comes out to be 60.78 KWH. It was found from a simulation that on changing wall to window ratio (in percentage) in a building, the energy used by the building changes. As WWR increases, more will be energy use intensity, more will be annual electricity demand, more will be annual fuel cost and more will be the annual electricity use, keeping orientation of the window same. So, WWR plays an important role in terms of energy. Therefore, WWR should be sufficient enough to hold required daylight and proper thermal and visual comfort so as to save energy.

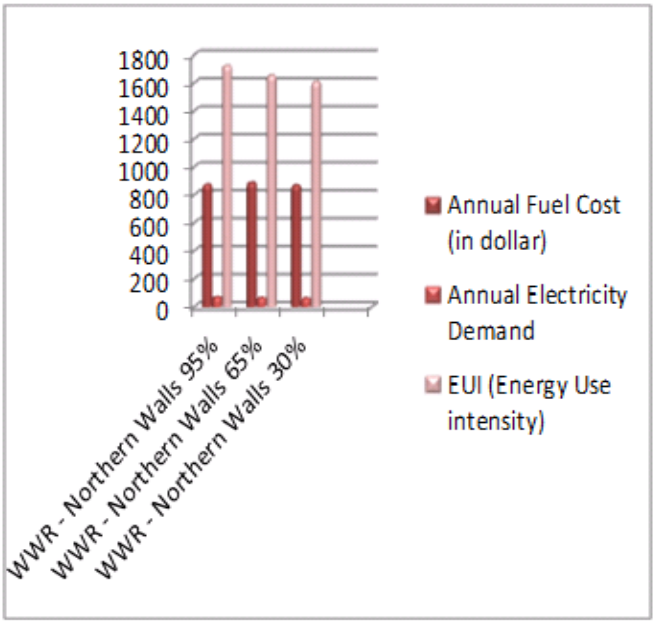

Figure 4. Graphical Representation of EUI, AED and Fuel cost w.r.t. WWR

6. CONCLUSION

From the analysis, it is found that as WWR increases, the demand for electricity also increases, usage of electricity increases, usage of fuel increases, hence EUI (Energy use Intensity) increases. *EUI* is *energy* use per square foot of space. EUI is a way of comparing the energy usage of different buildings. EUI and WWR are directly proportional to each other, to have lower EUI, WWR needs to be lower, but WWR should be sufficient enough to have proper daylight. The percentage change in lighting, electricity due to WWR is only 1.5–9.5% and therefore thermal comfort should receive more attention in deciding the WWR. For a school building, minimum WWR must be 12-14% of room area. So, using proper WWR, energy usage can be balanced, which will help in attaining the maximum point from griha, and will make building griha certified green building. There is no need to depend fully on non-renewable resources. Only one factor plays key role in reducing energy consumption. In the world where we are left with few resources, there is hardly time left, We need to act now. One of the ways to save on energy is WWR.WWR plays very important role in saving electricity, fuel consumption, hence saving resources.

REFERENCES

[1] Palak tiwari, Dr. Pankaj Jain 2015, Approach to Achieving GRIHA Existing Building Rating for Administrative Block of RGPV, IJSRST March-April,54-64.

[2] Khajuria A, Ravindranath NH 2012, Climate Change Vulnerability Assessment: Approaches DPSIR Framework and Vulnerability Index. J Earth Science Climate Change 3: 109.

[3]Buildings and Climate Change Report: Summary for Decision makers 2009, United Nations Environment Programme, 2-11.

[4]GRIHA Version 2015, GRIHA manual, 7-63.

[5] Willmott Dixon Group 2010, The Impacts of Construction and the Built Environment: briefing note, Impacts-of-construction, 2-33.

[6] Okcu, S., Ryherd, E., & Bayer, C. 2011, The role of physical environment on student health and education in green schools. Reviews on Environmental Health, 26(3), 169-179.

[7]Rajendra Mathur2012, Green Building Concept & Norms, CPWD Work Manual, Chapter-2,1-20.

[8] Richard Red, Anita Bilos, Sara Wilkinson & Karl-Werner Schulte 2009,Identification of the Greenship Professional Competence on Green Building Project, Volume No. 1, 1-22.

[9] Alwaer H, Clements-Croome, D.J, 2010, Key performance indicators (KPIs) and priority setting in using the multi-attribute approach for assessing sustainable intelligent buildings,Build.Environment-45, 799–807.

[10] Shubra Gupta 2015,Designing Techniques of Green Buildings, Journal of Civil Engineering and Environmental Technology, Volume 2, Number 3; January-March, 234-238.

[11]Intergovernmental Panel on Climate Change 2007, The long-term perspective, Climate Change: Synthesis Report, 67.

[12] Rakesh Awasthi, 2016,Green Building Rating system in India & Studying the long-term effectiveness of Green building, IRJMST Vol 7,3-7.

[13] GRIHA Volume 1,9-39.