Integration of Energy Efficiency of a Conventional Building: A Sustainable approach

Shantini A. Bokil[1], Utsav N Changole[2]

[1]*Assistant Professor, HOS, School of Civil Engineering, MIT World Peace University, Pune*

[2]*Research Student, School of Civil Engineering, MIT World Peace University, Pune*

Abstract- *Green buildings are the structures which are environment responsible and resource efficient during its life cycle. To optimize the operation and maintenance of a building, sustainable requirement should be adopted to minimize the energy efficiency. The objective of this research is to do trail to minimize the energy consumption of a traditional building by adopting energy efficient parameters and analyze the feasibility of a structure converting into sustainable building. The main aim of this research paper is to identify the various parameters which can evaluate energy efficiency. The paper emphasizes the need for adopting an integrated approach with unconventional design construction and impact of effective optimization to achieve sustainable energy efficiency in any structure.*

Keywords*: Green environment, Life Cycle analysis, Sustainability, Energy efficiency*

I. INTRODUCTION

Sustainable building construction incorporates and integrates a variety of strategies during operation construction and design of a project. We all live in a world also consuming more energy and natural resources.

The construction building consume up to 30% of energy, 40% of natural resources and generate up to 35% of Green House Gas emission. Green building construction follows the principals of development of environmental protection, economic development, and social development. Sustainable development should be applied on high standard to minimize energy consumption, reduce water levels, low use of environment impact materials, resource efficient, reduce wastage, safeguard human wellbeing.

Green Building gives benefits which include enhanced air quality, excellent daylighting, health and well-being of occupants, safety benefits and conservation of natural resources.

II. LITERATURE REVIEW

Srikant Misra et.al, (2016): Energy consumption is increasing day by day due to use non-renewable material which is not efficient and gives high operation cost. In this paper they observe and detailed out the component applicable with respect to green building and show how much they reduces the extent of overall energy consumption of building by doing simulation process using ECO-Nirman software tool. The conclusion of this paper is that they figured out how green material is superior than conventional by considering the overall energy saving and ecofriendly nature.

Chandrika Pathak et.al, (2019): This paper study describes the materials needed for converting conventional building into sustainable building by cost analysis of get the detailed idea of energy consumption and its benefits. The study conclude that initial cost of green building is high while operation and maintenance cost is low compared to conventional building.

Aishwarya Kodnikar et.al, (2018): This paper shows the implementation of sustainable practices LEED rating system which is a universal system to measure and verification of design construction and operation process in real estate industry. They conclude that by implementing green concept on existing building for converting into green building which will save up to 25% energy consumption along with that water is also conserved, recycled and reused.

Chen Min Ann et.al, (2015): Energy efficiency is a key to achieve sustainability and become a significant improvement in reducing the energy consumption. In this paper various benefits of energy efficiency are identified, exploring the obstacles for attaining energy efficiency and methods to apply efficient energy usage in Green building.

Pooja Chaudhary et.al, (2018): Sustainable building has a vast array of techniques and skills to reduce the impact on environment and human health. This paper studied the dynamics of existing structure for converting into green building. The study gives the advantageous outcomes once the building converted to green building.

C Vignesh Kumar et.al, (2014): Energy, materials, water and land are all consumed in the operation of building, construction, and infrastructure are become part of living environment and conditions. The aim of this paper to looking at appropriate tools and concept to explore environmental design and techniques for the assessment of sustainable healthy and affordable design components for the building construction. Sustainable building materials and methods should be utilized appropriately to reduce operation and maintenance cost and carbon emission also.

V Sumanteja Reddy (2016): Construction sector consume significant amount of natural resources and have social and environmental impact. Buildings consume up to 40% of raw materials and 30% of gas emission. This paper shows how sustainable design is beneficial to economic, environmental and social factor. The paper conclude that an active effort is extremely essential in construction sector along with the participation of financial and professional institutions and also have involvement of government bodies.

III. METHODOLOGY

1) Parameters to evaluate Energy Efficiency:

a) **Energy Efficiency-** Energy efficiency means the measure of energy requirement to achieve a certain benefit. The lower the loss of energy to get specific purpose then higher is the degree of energy efficiency. Energy efficient structure reduces the demand which become beneficial for environment by reducing gas emission from the construction building.

b) **Use of Natural Resources**- Natural resources is less processed and less damaging to the environment. The building products become more productive by applying natural material resources which is also energy efficient. It has lower energy consumption requirement and very less harmful than man made material resource.

c) **Reduction in Construction waste**- Minimum construction waste during installation reduces sthe need for landfill space and also provides cost savings. Use of scraps in filler spaces, clean concrete chunk and older bricks used as backfill in construction. Reduction in mistake onsite can lead to decrease in construction waste to control the onsite problem.

d) **Local Materials**- Local materials are better suited to climatic conditions and also become cost effective in area. They are not very useful for full construction but should be used selectively in possible volume requirement. Material having structural stability and durability which become justifiable to use manufactured locally near the site.

e) **Embodied Energy**- The greater the embodied energy of material then greater the amount of energy is required to produce and may impact environment. Energy consumption produces carbon gas which leads to greenhouse gas emission (GHG) so embodied energy is considered as an overall impact of building materials and system.

f) **Handling of Consumer waste-** Handling of waste from existing building is very difficult as most of the times waste is not segregated properly and have high probability for going land-fills. IGBC system intends to address by encouraging green existing building to segregate building waste.

2) Energy Consumption:

We have carried out an analysis of energy conservation measures in existing building for that we have consider an existing educational building. In this analysis we have analyzed the energy consumption on before and after applying energy conservation measures. With the help of data, we calculated the energy consumption of building by using eQUEST Energy Simulation Software Tool on before and after applying energy conservation measures.

Following figure shows model diagram of building:

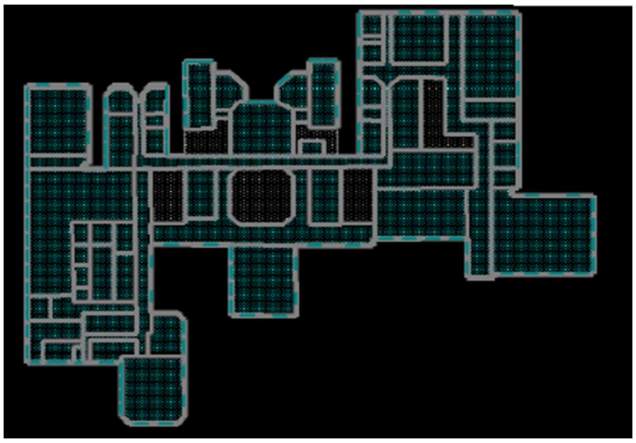

Fig.1 Building 2D Model

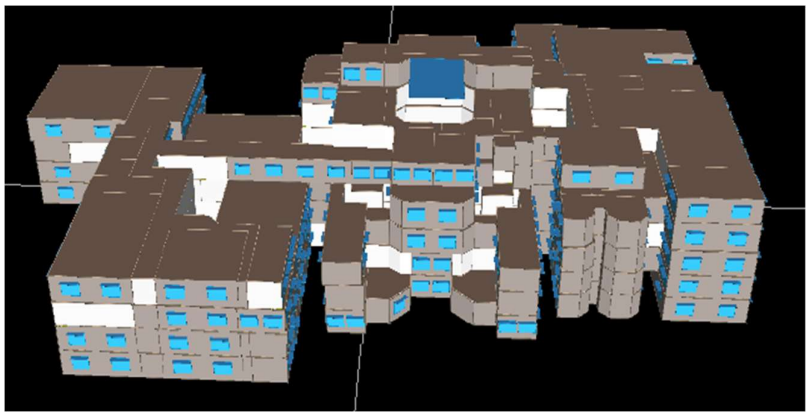

Fig.2 Building 3D Model

Energy Conservation Measures:

- 70 kWp Solar PV Power Plant.
- Highly efficient LED fixtures (130 lm/W).
- Highly Efficient HVAC system (VRF COP: 3.70).
- Occupancy sensor in passage and wash rooms.
- Timer controlled Exhaust Fan.

Table 1: Simulation Tool Input Parameters:

Input Parameter	Base Case	Design Case
Roof U value	0.47 W/m^{2}k	0.25 W/m^{2}k
Wall U value	0.095 W/m^{2}k	0.54 W/m^{2}k
WWR	24.35%	24.35%
Glazing U value	1.20	0.95
Climate	Composite	Composite
Cooling Capacity	150	150
Heating System	Electric	Electric
Building Operation Schedule	As per ECBC, Table 9.12	As per ECBC, Table 9.12
HVAC	As per ECBC, Table 9.12	As per ECBC, Table 9.12
Energy Capacity	Electricity Supply	70 kWP Solar Rooftop Plant

Table 2: Energy Simulation Result:

Month	Base Case (Wh)	Design Case (Wh)
January	82.4	63.70
February	74.4	56.79
March	85.6	6.38
April	94.7	68.74
May	98.0	70.31
June	87.4	64.55
July	90.2	68.88
August	80.9	62.21
September	86.9	66.05
October	91.5	69.22
November	75.2	57.66
December	81.8	63.44

Following Figure shows Graphical Representation of Results:

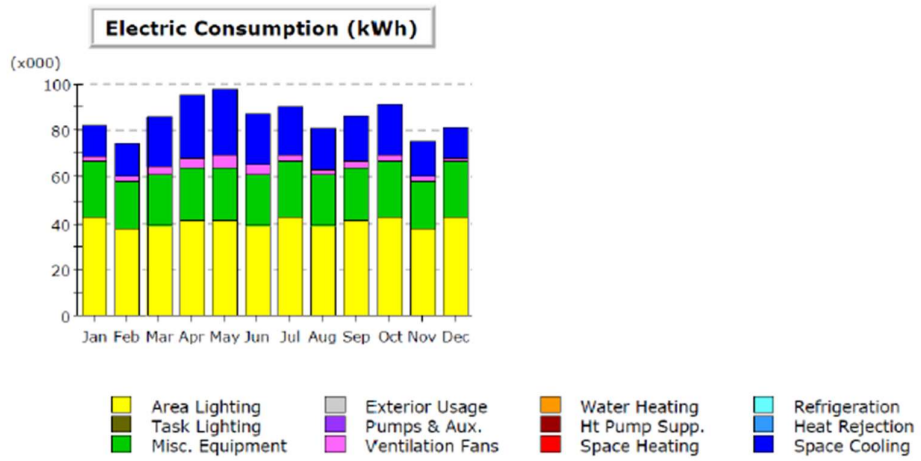

Fig.3 Base Case Design

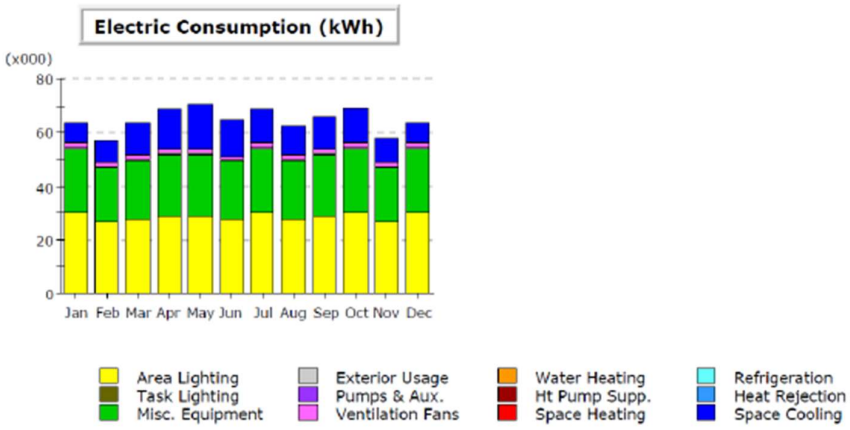

Fig.4 Design Case Results

Table 3: Percentage Improvement:

Input Particular	Baseline Results (kWh)	Proposed Results (kWh)	Energy Saving
Lighting	4,87,225	3,44,501	29.3%
Equipment	2,67,710	2,67,710	0
Pumps	22	22	0
Cooling	2,36,183	1,37,310	42%
Ventilation	33,515	20,909	37.6%
Exterior usage	4,270	4,270	0
Total	10,29,091	6,62,160	35.65%
Annual Energy Saving			35.65%

IV. CONCLUSION

This research paper highlights the methodology to optimize the operation and maintenance of a structure by minimizing the energy consumption. It can be seen that the various parameters affecting the energy efficiency can be evaluated and the result is found to be 35.65%.

This proves that by adopting integrated approach and of varying the design using simulation techniques and system can give overall perspective of the energy consumption of a structure. The energy management should be integral part of any project resource management activity having a sustainable approach in every aspect. The economic feasibility and decision making activity for any project management activity the paper highlight that every project management consultant can use this approach as effective decision making tool which will enhanced skill set lifelong.

REFERENCES

1) Srikant Misra, G.R.K.D. Satya Prasad, Navnit Kumar, Satish Kumar Sah, Sanjeet Kumar, Radheshyam Maurya , 'Comparison analysis of Green building materials and conventional materials in energy efficiency performance', International Research Journal of Engineering and Technology, volume 03, issue 05, (2016).

2) Chandrika Pathak, Sahil Kumar, 'Conversion and Comparison of a Conventional Building to a Green Building', International Research Journal of Engineering and Technology, volume 06, issue 12, (2019).

3) Aishwarya Kodnikar, Sneha Hajare, Shubham Thorat, Shantini Bokil, 'Innovations in Transforming a Traditional Building into Green Building', International Journal of Engineering Research in Mechanical and Civil Engineering, ISSN (Online) 2456-1290, (2018).

4) Chen Min Ann, Hussein Mohammed Abualrejal, 'Energy Efficiency in Green Building to achieve Sustaianablity', Proceedings of Symposium on Technology Management and Logistics, Research Gate, (2015).

5) Pooja Choudhary, Jagriti gupta, Dr. Bharat Nagar, 'Conversion of existing building into green building' International Research Journal of Engineering and Technology, volume 05, issue 09, (2018).

6) C.Vigneshkumar, K.Saravana Muthu, L.R.H Raviprakash, N.Ponmalar, 'A Smart Material to Next Generation: Sustainable (Green) Construction Methods and Technology' International Journal for Scientific Research & Development, volume 02 issue 10, (2014).

7) V. Sumateja Reddy, 'Sustainable Construction Practice in India – It's Impact on Economic, Environmental and Social Elements', International Journal for Scientific Research & Development, volume 04, issue 09, (2016).