ZERO ENERGY BUILDING; DESIGN AND SIMULATION

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Abstract - *Buildings have an important influence on energy use and the environment. Commercial and residential buildings use almost 37% of the primary energy and approximately 63% of the electricity in India. The Zero Energy Building achieve by being extremely energy efficient 50%-70% produces more energy than typical building. In the high performance building, the amount of energy used can be completely offset by renewable energy produced on or around the building. When conditions will not suitable for energy generation, the building will draw energy from the electric grid to meet it needs. When conditions improve, the onsite renewable energy systems will cover the buildingsenergy need and send excess energy back to grid to make the balance, Over the course of year, the building gives back as much energy as it takes. These zero Energy Buildings are more comfortable, more reliable and better for the environment.*

***Key Words*: Zero Energy Building, Energy efficiency, Green materials, Simulation, Solar Panels.**

1.INTRODUCTION

Zero Energy Building is characterized as the building with zero energy utilization i.e., the aggregate sum of energy utilized by the structure on yearly premise is generally equivalent to the aggregate sum ofenvironmentally friendly power made on the site. Buildings altogether affect energy use and the climate. The building area produces such incredible measure of ozone harming substance that terrible act is important to glance environment disaster. Zero Energy Building will accept a major part in checking an unfamiliar weather change in a very long time to come. Using Zero Energy structures plan objectives removes us from planning low energy buildings with percent energy saving objectives and into the place i.e known for a maintainable energy end point. The objectives that are set and characterized to achieve Superior execution building. As non-renewable energy resources are finite, it should be standard that the main specific of the upcoming buildings is extreme- low energy consumption and uniform energy consumption close to zero. While the current old structures spent from 200 to 400 kWh/(m2/year) current energy for heating, the need for heating energyfor buildings of the future generation will be from 20 to 50 kWh/m2. And many countries launch related principles of energy consumption.

This study proposes a detail design process that reflects a structure's location, heat transmission rate of the building envelope, surface to volume ratio of the building in terms of heat gain and heat loss, and also observe the possible for solar power generation. Design concept of a zero-energy building was derived by learning previous studies on the building design method.

1.1 Energy Simulation

Energy simulation is also called as building energy modelling, is the use of software to predict the energy use of the building. It output building energy use such as heating, cooling, lighting and also it can predict the energy cost. A typical energy model will have inputsfor climate, envelope, internal gains from lighting, equipment and occupants, heating cooling ventilation systems, schedule of openings and materials will be taken from material library. Simulation is a process of using computer to build a virtual replica of building, and simulation is performed by taking the building through the weather condition of an entire year. Energy analysis is done to predict the monthly energy consumption and bills, Predict annual energy cost, annual CO_2 emissions.

Simulation process consist following steps,

1. Building location and geometry
2. Building materials.
3. General operation of building.
4. All interior load values (lighting, occupant numbers, Activity level)
5. Zoning requirements

1.2 Design Builder Software for Simulation

Design Builder is simple software to analyze environmental performance data and stunning rendered images/movies at any stage of design process. Design Builder is priced competitively and simple to learn and use by which user will be able to offer advanced simulation on even the smallest project without going over budget.

1.3 Advantages of Zero Energy Building

- Isolation for building owners from future energyprice increases.
- Increased comfort due to more uniform interior temperatures.
- Reduced requirement for energy.
- Reduced total cost of ownership due to improved energy efficiency.
- Reduced total net monthly cost of living.
- Minimize Extra Cost.

2. MATERIALS AND METHODOLOGY

2.1 Materials used

Rockwool: It is utilized for residential, commercial and industrial protection. Rockwool is exceptionally dynamic for used as security behind and around electrical boxes, wires and pipes. It can fill most wall cavities, leaving almost no openings. It is also used as shower on insulating material.

Dual glassy frames: Dual glassy frames especially in combination with low-e finishing and gas cavities.

Hermetically bolted window: This allows a wider range of glass materials to be sealed related to predictable glass-to-metal shutting processes. Double glazed windows are made by taking two panes of glass separated by a insertion bar and sealing them together into a single unit.

Cool rooftop tiles: Cool rooftop tiles generally have high solar reflectance and thermal emittance. The Solar Reflective Index (SFI), that is the limitation used to identify the degree of heat reflectance, Cool Roof Tiles usually have95%. This means that cool tiles can lower heat for about 10-15 degree Celsius on any situations. **AAC blocks:** AAC blocks are widely used in the construction of rooms and other types of residential properties, industrial and commercial buildings, such as hotels, offices, hospitals and schools. The weight of AAC blocks is about 80% less than modern red bricks and leads to a saving in the use of cement and steel, thus, saving costs. Moreover, being environmentally friendly, AAC blocks confirm better durability and improved sound and heat protection compared to bricks.

2.2 Methodology

The research objective is to prepare a detail methodology for simulation and design of zero energy building and the process is as below,

1. Study of early and present research works in this research intensively. Based down a detail summary is listed out.

2. Selected previous research recommendations are to be utilized as research objectives in order to study them to form a simple and detail design method.

3 Planning of sample building in assumed site with basic ideas as per NBC recommendations in

4. Simulation of energy efficiency for this well designed in DESIGN BUILDER /ENERGY PLUS based on ECBC code requirements.

2. Implementation of simulation data in the design.

3. Quantity Estimation and cost comparison with the additional data.

Fig 2.1 explain the stages of project methodology.

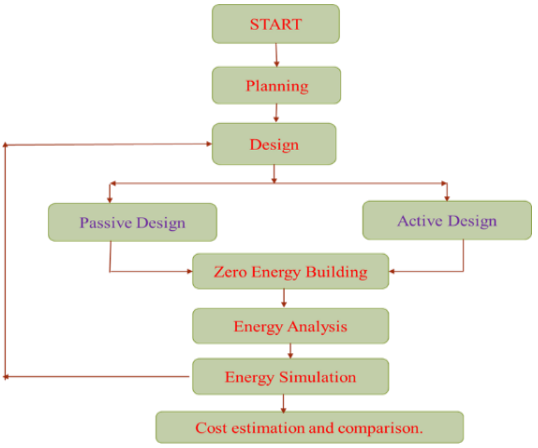

Fig 2.1 Typical flow chart of Methodology

2.2.1 AutoCAD 2D

The typical building plan is prepared and the same has been drawn using AutoCAD Software shown below.

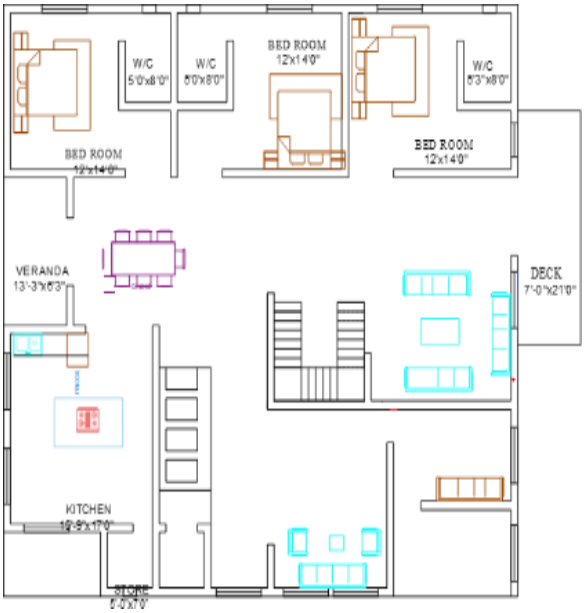

Fig 2.2: Ground floor plan 57'x 58

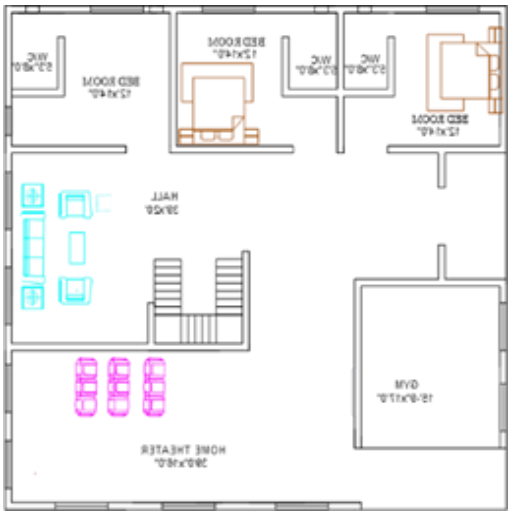

Fig2 .3 : First Floor Plan 57' x 58'

2.2.2 REVIT 3D Modelling

3D Perspective models are prepared using the Autodesk Revit. Materials are individually added with the data required for energy analysis. Location data, assumed orientation detail all are clearly specified. Fig 2.4 shows the 3D perspectiveview of the building

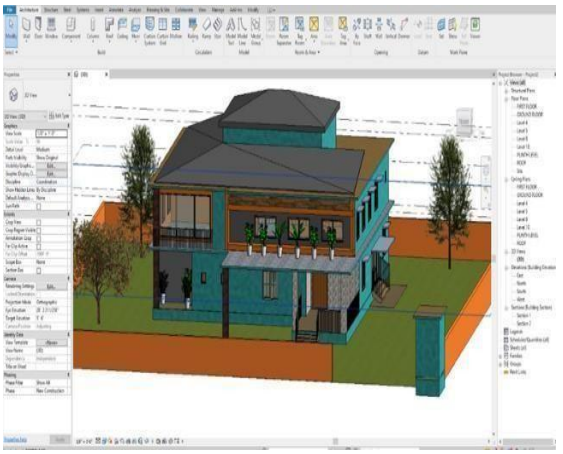

Fig 2.4: Revit work sheet

2.2 Calculation of Electric load

Individual applications and appliances in every roomare planned and specified. Based on that data electrical load calculation has been done. Table 2.5 shows the calculation of the electrical load in proposed building.

SL NO	particular	items	units	usage in hour	voltage(W)	consumption	invertor	sensible load	latent
1	Hall	LED							
		FAN	2	5	50	500	100	0.734	0.16
		TV	1	5	80	400	80	0.734	0.16
		Table lamp	1	5	60	300	60	0.734	0.16
		pop light	5	5	20	500	100	0.734	0.16
2	puja room	LED	1	24	15	360	15	0.734	0.16
	MASTER B.R	LED	2	20	15	600	30	0.734	0.16
		pop light	8	10	20	1600	160	0.734	0.16
		FAN	2	10	50	1000	100	0.734	0.16
3	KITCHEN	LED	2	4	15	120	30	0.734	0.16
		REFRIGERATOR	1	18	200	3600	200	0.734	0.16
		MIXTER	1	1	450	450	450	0.734	0.16
		Dishwash	1	4	20	80	20	0.734	0.16
		MICROWAVE	1	2	400	800	400	0.734	0.16
		WASHING MACHINE	1	1	2000	2000	2000	0.734	0.16
4	HOME THEATRE								
		LOUDSPEAKER	4	2	600	4800	2400	0.734	0.16
		AMPLFIER	1	2	100	200	100	0.734	0.16
		DVD PLAYER	1	2	10	20	10	0.734	0.16
		WOOFER	1	2	150	300	150	0.734	0.16
5	TOILET,W.C	LED	10	3	6	180	60	0.734	0.16
6	WATER PUMP		1	1	750	750	750	0.734	0.16
7	WASHING MACHINE		1	1	90	90	90	0.734	0.16
8	EXTERNAL LIGHTS		10	2	15	300	150	0.734	0.16
9	FAMILY SEATOUT	LED	2	2	15	60	30	0.734	0.16
		FAN	1	2	50	100	50	0.734	0.16
	TOILET,W.C	LED	8	3	6	144	48	0.734	0.16
	total					19254	7583		

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Table 2.1: Calculation of Electric Load

2.3 Design of panel

- Total Power for appliances =**7583W**
- For the inverter optimal ought should be around **7700W**
- Divide the total daily power requirement by the number of charge hours for thatenvironmental area = (19254*12)/6

= **3850.8W**

- Provide 250Watt individual solar panel Total Watt/250Watt solar panel =3850.8/250

=15 no's, **Provide 16 No -250 W panels**

- Number of Batteries

250W panels produce 4.8 Amps per hour,

= 15*4.8 Amp

=72.00 A

For 6hour, =72.0 A*6

=432.0Ah

105Ah batteries, should be satisfied to no more than 50%, thus we divide total Amps by (105 A*50%) = **50Ah** (approx.)

No. of batteries =432/50

= 8.64 Provide 10 Nos

10 batteries of 105Ah are required.

2.6 Simulation

Method of analysis

- Transfer of plan and 3D model to Design Builder
- Check the boundaries and missing data
- Site orientation and region is selected.
- Material of building is selected from the material library.
- Building parameters are entered in accordancewith GRIHA standards.
- Building graphics are generated to check withthe architectural features.
- Heating and cooling design are inspected and calculated.
- Simulation is done for the specified week andyield data are observed.

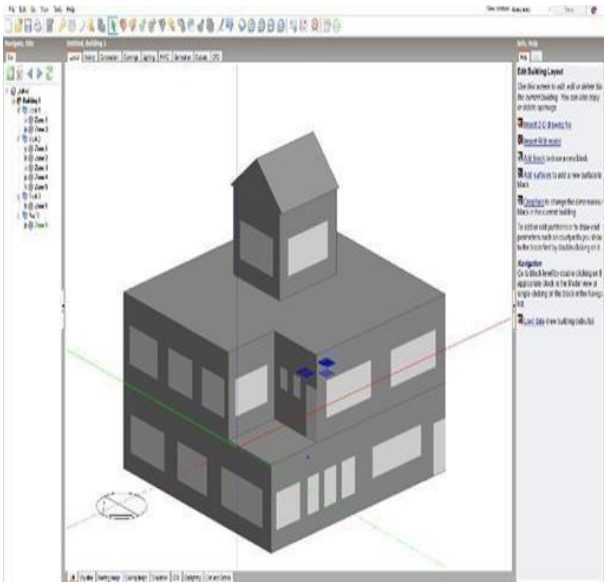

Fig 2.5: Design Builder Software

3 RESULTS AND DISCUSIONS

To complete the project and obtain the objectives, various software is used such as Revit. For planning AutoCAD software is used and Design Builder Software is used for simulating the building and also it gives the output data's in the form of graphs and charts. From this software the visual results at intermediate date for planned and actual date been traced. Environmental performance data is displayed without needing to run external modules and import data and any simulations required to generate the data are started automatically.

- Energy Plus 'Minimized HVAC' pictures gives a simple way in to detailed analysis of generally utilized warming and cooling frame works.
- Natural ventilation has been exhibited with the selection for windows to open based on a ventilation set point temperature.
- Daylighting - models lighting control frameworks and determine reserve funds in electric lighting.
- Concealing by louvers, shades and side bladesas well as inside and mid sheet binds.
- A complete range of simulation datahas been shown in yearly, monthly, daily, hourly or sub- hourly intervals:
- Results on Energy intake brokendown by fuel and end-use.

- Yields on internal temperature gains.
- Results on Weather data.
- Yields on Heat transmission through building fabric including walls, roofs, infiltration, ventilationetc.

3.1 Total cost estimation with PV panels.

Table3.1 Total cost estimation with pv panels.

Sl no	Total for structuraland architectural(GF+FF)	1,40,58,724.19
1	Electrical Plumbing Work	8,17307.19
2	Architectural Works	12,50,000.00
	4KVSolar off gridPower Plant	3,15,600.00
3	Total Amount	1,95,91,631
	Total Estimated cost ofconstruction	**RS 1,95,91,631**

3.2 Total cost estimation without PV panels.

Table3.2 **Total cost estimation without PV panels**

Sl no	Total for structural and architectural(GF+FF)	1,40,58,724.19
1	Electrical Plumbing Work	7,63,768.11
2	Architectural Works	12,50,000.00
3	Total Amount	1,60,72,649.2
	Total Estimated cost ofconstruction	**RS1,60,72,649.2**

4. Conclusion

In conclusion, we concluded that for our Zero Energy Project utilizing sun based energy is the best energy source with respect to saving energy and cost effectiveness. Photovoltaic solar panels are the best answer for generation of the electricity in our Residential Building. The establishment of the solar panels at first would be expensive, however over the long run owner of the structure would get a good deal on their energy bill. More extremely, in the shortage of normal assets we would give an independent,, energy saving, nonpolluting, Zero Energy building. The solar panels that would befitted on the back side of the building, facing towards south. This would allow for the originally most direct sunlight to be absorbed by the panels. According to us it is more efficient to install the PV Solar system in the Residential Building. We need 250 W PV Solar panels in the Building to match the current situation of Energy Consumed in the Building and 7.5 years are required to recover the installation cost of PV system.

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