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PLANNING AND DESIGNING OF ZERO ENERGY RESIDENTIAL BUILDING

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Abstract *The main objective of this paper is to study and design the zero-energy residential building. Building with zero energy consumption, measure the total amount of energy used by the building on an annual basis is roughly equal to amount of renewable energy created on the site. According to the survey a major effect of building on the total worldwide energy consumption level i.e. around 40% of the total energy is used by the building.*

Key Words: Energy resources, Energy consumption, Solar energy, Zero Energy Building.

1. INTRODUCTION

The term of Net Zero Energy Residential Building is define as the building with zero net energy consumption i.e., the total amount of energy used by the building on annual basis is roughly equal to the amount of renewable energy created on site. The energy used by the building sector continues to increase, primarily because new buildings are constructed faster than old ones are retired. Currently, there are only a small number of highly efficient buildings that meet the criteria to be called "NET ZERO". As a result of advances in construction technologies, renewable energy systems, and researches, creating a Net Zero Energy Building is becoming more and more feasible.

1.1 Energy Resources

1.1.1 Non-Renewable Energy Resources

A nonrenewable resource is a resource of economic value that cannot be readily replaced by natural means on a level equal to its consumption. Most fossil fuels, such as oil, natural gas and coal are considered nonrenewable resources in that their use is not sustainable because their formation takes billions of years.

1.1.2 Renewable Energy Resources

Renewable energy is energy from energy sources that are derived from the sun, wind, or other natural processes, and that are always available.

Solar technologies tap directly into the infinite power of the sun and use that energy to produce heat, light, and power.

1.2 Connections of PV Solar Modules

There two types of connections which are given below:

1.2.1 Grid Connection

A grid connected photovoltaic power system, or grid-connected PV power system that is connected to the utility grid. A grid-connected PV system consists of solar panels, one or several inverters, a power conditioning unit and grid connection equipment.

When, conversely, on-site energy generation exceeds the building energy requirements, the surplus energy should be exported back to the utility grid, where allowed by law. The excess energy production offsets later periods of excess demand, resulting in a net energy consumption of zero. Due to current technology and cost limitations associated with energy storage, grid connection is usually necessary to enable the Net Zero Energy balance.

1.2.2 Off Grid Connection

An off grid photovoltaic is when your solar photovoltaic system is not connected to the utility grid and you are producing your own electricity via solar, wind, generator, etc. This system will generally have a battery bank in order to store the electricity for use when needed.

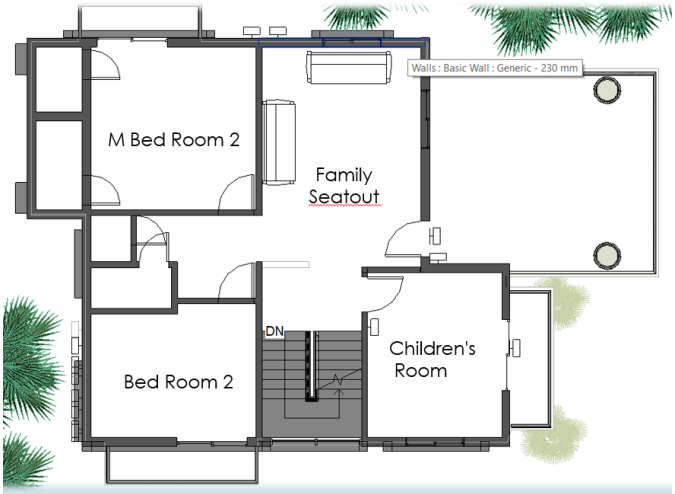
2. Proposed Residential Building

Research and Design the Zero Energy Residential Building in an affordable price.

Our main focus is to produce the electricity with the help of solar panels system for achieving the Net Zero Residential Building.

FIG 1- Proposed Residential Building (Design on REVIT)

Ground Floor Plan



First Floor Plan

FIG 2: PLAN OF RESIDENTIAL BUILDING

2.1 Characteristics of Proposed Solar PV system

Units produced by 1 kW system (1 Panel) is 5-6 kW/day

- Area Covered by 1 kW system is 10 sqm (100 sq ft Approx.)
- Total cost of 1 kW system (1 Panel) is Rs 75,000-90,000 (Grid Connected)

2.1 CALCULATION OF ELECTRIC LOAD

Particulars	Items	Units	Usage in Hr	Voltage (W)	Consumption	Invertor
HALL	LED	4	5	20	400	80
	FAN	2	5	50	500	100
	TV	1	5	80	80	80
Particulars	Items	Units	Usage in Hr	Voltage (W)	Consumption	Invertor
2-BED ROOM	LED	4	3	15	60	60
	FAN	2	10	50	100	100
2-MASTER BEDROOM	LED	4	3	15	60	60
	FAN	2	10	50	100	100
KITCHEN	LED	2	4	15	120	30
	FRIDGE	1	18	200	3600	200
	MIXER	1	1	450	450	450
TOILET, W.C, BATH	LED	10	3	6	180	60
CHILDREN ROOM	LED	2	4	15	120	30
	FAN	1	10	50	500	50
WATER PUMP		1	1	750	750	750
WASHING MACHINE		1	1	90	90	90
EXTERNAL LIGHTS		10	2	15	300	150
FAMILY SEATOUT	LED	2	2	15	60	30
	FAN	1	2	50	100	50
TOTAL LOAD					=9930W	=3370W

2.2 CALCULATION OF ELECTRIC LOAD

- Appliances total power draw=3370W
- To provide a small buffer or margin your minimum size inverter choice should be around 3500 w
- Divide the total daily power requirement by the number of charge hours for that geographic region e.g(Pune) =(9930x1.2)/6
  =1986 W
- 250 Watt Solar Panel
  Total Watt/250Watt solar panel =1986/250
  = 8 No. of Panels

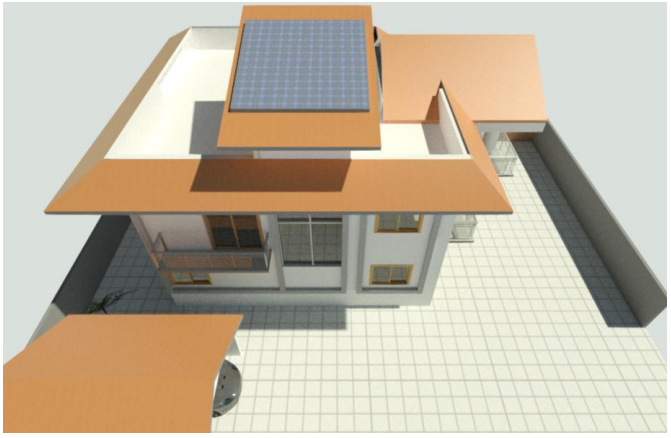


FIG 3: Solar Panels on the Roof of the Residential Building

- Number of Batteries
  250W panels produce 4.8 Amps per hour,
  = 8x4.8 amp
  =38.4 A

For 6 Hr = 38.4 A x 6
= 230.4 Ah

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

No. of batteries = 231 /50
= 4.67=5

5 Batteries of 105Ah are required

2.3 Rate Analysis

- Solar pannels = Rs 8000 per 250W Pannel
- Regulator = Rs 1800
- Batteries = Rs 8000/Series
- Inverter =Rs 4800

TOTAL COST

- Solar Pannels = 8 x 8000= Rs 64000.
- Regulator = Rs 1800.
- Batteries = 6400x5 = Rs 32000.
- Invertor = Rs 4800

Total Cost=Rs(64000+1800+32000+4800)
= Rs 1,02600

Total Cost of Solar system are Rs 1,02,600 or One Lakh Two Thousand Six Hundred

(Excluding Installation Cost)

2.4 Recovery of Cost of Installed System

In the table below,you can find pricing for our solar solution,Please note that these number are based on the 25 years of life.

System capacity	2.0 KW
Required roof space	150 Sq. feet
Average required annual output	995 Units
Expected annual Output	3214 Units
Average Required Monthly Output	83 unit
Expected Monthly Output	268 Units
Lifetime value of electricity generated	Rs 4.63Lakh(25 Years)
First year value of electricity generated	Rs 22,175
Net investment	Rs 1.07 Lakh
Cost/unit without Solar	Rs 4.98
Cost/unit with Solar	Rs 1.56
Number of Years to Payback	5.5

3. NZEBs In India

- A living Laboratory CEPT, Ahmedabad.
- Indira Paryavaran Bhawan Moef, New Delhi.
- Akshay Urja Bhawan Hareda, Panchkula.
- Eco Commercial Building Bayer Material Sciences, Greater NOIDA
- Malankara Tea Plantation, Kottayam.
- Office Complex GRIDCO, Bhubaneswar
- Net Zero Energy Building SunCarrier Omega, Bhopal

3. Advantages

- Reduces the menace of destruction of the non-renewable conventional energy resources.
- The cost of energy of a NZEB does not increase with time relative to the similar non- renewable energy building.
- Future legislative restrictions and carbon emission taxes/penalties may force expensive retrofits to inefficient buildings.
- It is an area contractionary technique which requires a less area for the installation of setup.
- By improving the energy efficiency, it reduces the total cost of ownership as well as the total cost of living.

4. Disadvanteges

- Initial cost is much higher i.e. a money blockage technique which recovers after a few years.
- Variation of weather plays a vital role for that the PV solar system is not sufficient for all type of weather.
- High skilled labour is required of having necessary information for the installation of setup.
- Solar energy system using the house envelope only works in locations unobstructed from the South. The solar energy capture cannot be optimized in facing shade or wooded surroundings.

5. Conclusion

In conclusion, we decided that for our Zero Energy Project using solar energy is the best energy source in regards to saving energy and cost efficiency. After brainstorming and researching we came to an agreement that photovoltaic solar panels are the best solution for generation of the electricity in our Residential Building. The installation of the solar panels initially would be costly, but in the long run the owner of the building would save money on their energy bill. More importantly, in the scarcity of natural resources we would be providing a self-sufficient, energy saving, non-polluting, Zero Energy building. The solar panels that would be installed would be on the back side of the building, which would be facing south. This would allow for the most direct sunlight to be absorbed by the panels. So, according to us it is most efficient to install the PV Solar system in the Residential Building. We need 250 W PV Solar panels in the Building to equalize the present scenario of Energy Consumed in the Building and 5.15 years are required to recover the installation cost of PV system.

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