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A REVIEW PAPER ON ZERO ENERGY BUILDING

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ABSTRACT

A Zero Energy Building (ZEB), also known as a Net Zero Energy (NZE) building, or a Zero Net Energy (ZNE) building, is a building with net zero energy consumption, meaning the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site.

In early October 2021, a sudden, major energy crisis shocked India. Coal producers, distribution companies, state governments as well as the Union coal and power ministry and the Prime Minister's Office were consumed by the crisis alike.

As we know that the concept of zero energy building has gained almost the wide attention in last few decades and now, we can see that the future for the design of zero energy building. In recent year the concept of zero energy building has attracted international interested.

This paper discusses the descriptive case study investigating an existing building towards a pathway for NZEB. The attempt has been made to evaluate the concept and technologies demonstrated in the existing residential building located in Ichalkaranji City.

Keywords: *Zero energy Building, energy crisis*

1. INTRODUCTION

It is difficult to find a building, which can be named the first Zero Energy/Emission Building (ZEB). One of the reasons could be that maybe ZEB is not a new concept for a building, it is just a modern name for buildings, from times before district heating and electricity, heatedwith wood or straw and lighted with candles and domestic animals?

Nevertheless, in the late seventies and early eighties appeared few articles, in which phrases 'a zero- energy house', 'a neutral energy autonomous house' or 'an energy-independent house' were used.

In light of climate change, we are anticipating more extreme weather, such as severe storms, drought, forestwildfire, which could seriouslyaffectthe reliability of our grid and cause disasters by loss of power.

Many families or organizations prepare redundant electricity backup systems, such as uninterruptible power system (UPS), gas-electric generator, or batteries, in case that thegrid stops work. As the existing power infrastructure is often overly loaded in response to the increasing energy demands, the centralized power supply becomes more fragile and vulnerable to all problems causedby climate change. While we try to slow climate change, we need to adapt to the new "normal lifestyle.

Zero Net Energy (ZNE) building, isabuilding with net zero energy consumption, meaning the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site or in other definitions by renewable energy sources offsite, using technology such as heat pumps, high efficiency windows and insulation, and solar panels. The goal is that these buildings contribute less overall greenhouse gas to the atmosphere during operations than similar non- ZNE buildings. They do at times consume non-renewable energy and produce greenhouse gases, but at other times reduce energy consumption and greenhouse gas production elsewhere by the same amount.

2. LITERATURE REVIEW

1. **Developing a Net Zero Energy Building: ACase Study of an InstitutionalLibrary:** This paper says that the net-zero-energybuilding concept drives to link energy efficiency and renewable energy generation to achieve sustainable development. It's difficult to achieve but possible in case of large institutional campuses. Institute library buildings arelarge public buildings, and due to its complexity in occupancy level, they require a continuous and uninterrupted power supply.

2. **Zero Energy Building- AnEnergy Efficient Approach:** This paper has stated that with increasing degradation of the environment because ofincreased energy consumption, environment conscious building design hasbecome urgent. The benefits of green design to society in general, and building owners and users in particular, are manifold.

3. **Design of Zero EnergyResidential Building:** This paper has stated that In this project the design of the Conventional building byusing modular bricks and Net Zero EnergyResidential Building by using Hollow Brick The Comparison of the ConventionalBuilding and NZERB was completed by using the parameters such as the temperature by using instrument infrared thermometer which was found to be 4℃ less in NZERB compared to conventional building under same condition.

4. **International Journal of Applied Engineering Research ISSN 0973- 4562Volume 13, Number 1 (2018):** This paper says that the specialty of thezero energy building, Prana project, is thatthe whole building is made keepingsustainability and green building in mind. Every aspect of the building wasplanned with 'green' approach, showcasing the latest in HVAC technology alongside recycled materials.

5. **Case Study: India's First Net-ZeroEnergy Building- Indira Paryavaran Bhavan:** This paper says that the case study saysthat Indira Paryavarn Bhawan firstgovt. building in the country to achievethe landmark of net zero energy building to reduce emissions.

3. METHODOLOGY

This entire project is an planning and design in nature and the methodology followedin this project is listed as below.

1. Preparing plans.
2. Electrification plans with respect to developed plans.
3. Preparation of energy calculations.
4. Preparation of energy variation calculations for different seasons.
5. Market information of solar panels.
6. Preparations of solar panels requirement.
7. ROI [Return on Investment].

ENERGY CALCULATIONS

G+1 Residential Building

Sr.no	Name of appliance	Watts (W)	No.of units	Total Hours	Total no of Watts	Energy W/hr
1	Ceiling Fan	70	8	10	560	5600
2	Exhaust Fan	70	2	2	140	280
3	Door Bell	2	1	2	2	4
4	Water Heater	1000	2	1	2000	2000
5	T.V	70	2	7	140	980
6	AC	1000	6	5	6000	30000
7	Bulb	35	11	5.5	385	2117.5
8	Bulb	4.5	2	2	9	18
9	Refrigerator	200	2	8	400	3200
10	Mixer	400	2	0.5	800	400
11	Oven	1500	2	0.5	3000	1500
12	Laptop	50	2	2	100	200
13	Washing Machine	500	2	1	1000	1000

Total energy generated per day 47300 wattsEnergy generated per month 1419 kW/hr.

G+2 Residential Building

	Name of appliance	Watts (W)	No.of units	Total Hours	Total no of	Energy W/hr

Sr.no					Watts	
1	Ceiling Fan	70	12	10	840	8400
2	Exhaust Fan	70	3	2	210	420
3	Door Bell	2	1	2	2	4
4	Water Heater	1000	3	1	3000	3000
5	T.V	70	3	7	210	1470
6	AC	1000	9	5	9000	45000
7	Bulb	35	36	5.5	1260	6930
8	Bulb	5	6	1.5	30	45
9	Refrigerator	200	3	8	600	4800
10	Mixer	400	3	0.5	1200	600
11	Oven	1500	3	0.5	4500	2250
12	Laptop	50	3	2	150	300
13	Washing Machine	500	3	1	1500	1500

Total energy generated per day 74719 wattsEnergy generated per month 2242 kW/hr.

SOLAR PANEL DATA ANALYSIS

Seasonal variation of Residential and Public Buildings
G+1 School Building

Sr.no	Name of appliance	Watts (W)	No.of units	Total Hours	Total no of Watts	Energy W/hr
1	LED Bulb	18	26	4	468	1872
2	Ceiling Fan	55	44	3	2420	7260
3	Tube Light	28	32	4	896	3584
4	Exhaust Fan	12	4	6	48	288

5	Computers	450	25	3	11250	33750
6	Projectors	8	3	3	24	72
7	AC	1000	1	3	1000	3000
8	Door Bell	2	1	6	2	12
9	Internet Router	15	2	6	30	180
10	Printer	30	6	2	180	360

Total energy generated per day 50378 wattsEnergy generated per month 1512 kW/hr.

Seasonal variation of Residential and Public Buildings
G+1 Residential Building

Sr.no	**Name of appliance**	**Watts (W)**	**No.of units**	**Total Hours**	**Total no of Watts**	**Energy W/hr**
1	Ceiling Fan	70	8	10	560	5600
2	Exhaust Fan	70	2	2	140	280
3	Door Bell	2	1	2	2	4
4	Water Heater	1000	2	1	2000	2000
5	T.V	70	2	7	140	980
6	AC	1000	6	5	6000	30000
7	Bulb	35	11	5.5	385	2117.5
8	Bulb	4.5	2	2	9	18
9	Refrigerator	200	2	8	400	3200
10	Mixer	400	2	0.5	800	400
11	Oven	1500	2	0.5	3000	1500
12	Laptop	50	2	2	100	200
	Washing					

13	Machine	500	2	1	1000	1000

Solar panels required is kW/hr÷ **380** =2109/380=6

For G+1 Building 6 no of solar panels arerequired

G+2 Residential Building

Sr.no	Name of appliance	Watts (W)	No.of units	Total Hours	Total no of Watts	Energy W/hr
1	Ceiling Fan	70	12	10	840	8400
2	Exhaust Fan	70	3	2	210	420
3	Door Bell	2	1	2	2	4
4	Water Heater	1000	3	1	3000	3000
5	T.V	70	3	7	210	1470
6	AC	1000	9	5	9000	45000
7	Bulb	35	36	5.5	1260	6930
8	Bulb	5	6	1.5	30	45
9	Refrigerator	200	3	8	600	4800
10	Mixer	400	3	0.5	1200	600
11	Oven	1500	3	0.5	4500	2250
12	Laptop	50	3	2	150	300
13	Washing Machine	500	3	1	1500	1500

Solar panels required is kW/hr÷ **380** =3281/380=9

For G+2 Building 9 no of solar panels arerequired.

G+1 School Building

Sr.no	Name of appliance	Watts (W)	No.of units	Total Hours	Total no of Watts	Energy W/hr
1	LED Bulb	18	26	4	468	1872
2	Ceiling Fan	55	44	3	2420	7260
3	Tube Light	28	32	4	896	3584
4	Exhaust Fan	12	4	6	48	288
5	Computers	450	25	3	11250	33750
6	Projectors	8	3	3	24	72
7	AC	1000	1	3	1000	3000
8	Door Bell	2	1	6	2	12
9	Internet Router	15	2	6	30	180
10	Printer	30	6	2	180	360

Solar panels required is kW/hr÷ **380** =3737/380=11

For G+1 Building 11 no of solar panelsare required.

RETURN ON INVESTMENT:

DATA NEEDED:

G+1 residential building powerconsumption

1. No of panels required

= 2*1000/380

= 5 solar PV panels.

2. Shadow free Area = 2*100

= 200 sq.ft Number of units generated by 1kwsolar

PV system assuming 5 Hrs of brightsun in a day

For 2kW solar PV system

=2*5hrs=10kWh.

3. Amount of electricity saved= Assuming cost of 1 unit electricity =

9.65 Rs

Electricity bill saved/day = units generated in day x cost of 1 kwh unit

=10* 9.65

= 97Rs.

Yearly savings= Rs 34920/-

4. Pay back calculations=

If cost required for 1Kw of Solar PVsystem installation is 62000 Rs,then cost required for 2 Kw of Solar PV system installation

= 62000 * 2Kw =124000 Rs

After 40% subsidy, thetotal cost of 2Kw solar PV system installationcomes to -

= 40/100 * 124000 Rs.

= 49600 Rs (subsidy discount)Net initial cost = 12400-49600=74000/-

5. Payback period =

Net cost of system/ yearlysavings

= 74000/34920

= 2.11 years.

G+2 residential building powerconsumption

1. No of panels required

= 3*1000/380

= 8 solar PV panels.

2. Shadow free Area = 3*100

= 300 sq.ft Number of units generated by 1kwsolar

PV system assuming 5 Hrs of brightsun in a day

For 3kW solar PV system

=3*5hrs=15kWh.

3. Amount of electricity saved= Assuming cost of 1 unit electricity =

9.65 Rs

Electricity bill saved/day = units generated in day x cost of 1 kwh unit

=15* 9.65

= 146Rs.

Yearly savings= Rs 52560/-

4. Pay back calculations=

If cost required for 1Kw of Solar PVsystem installation is 62000 Rs,then cost required for 2 Kw of Solar PV system installation

= 62000 * 2Kw =124000 Rs

After 40% subsidy, the

total cost of 3Kw solar PV system installationcomes to -

= 40/100 * 186000 Rs.

= 55800 Rs (subsidy discount)Net initial cost = 18600-55800=13020/-

5. Payback period =

Net cost of system/ yearlysavings

= 13020/52560

= 2.5 years.

G+1 school building power consumption

1. No of panels required

= 4*1000/380

= 11 solar PV panels.

2. Shadow free Area = 4*100

= 400 sq.ft Number of units generated by 1kwsolar

PV system assuming 5 Hrs of brightsun in a day

For 2kW solar PV system

=4*5hrs=20kWh.

3. Amount of electricity saved= Assuming cost of 1 unit electricity =

9.65 Rs

Electricity bill saved/day = units generated in day x cost of 1 kwh unit

=20* 9.65

= 193Rs.

Yearly savings= Rs 69480/-

4. Pay back calculations=

If cost required for 1Kw of Solar PV system installation is

62000 Rs,then cost required for 2 Kw of Solar PV system installation

= 62000 * 4Kw =248000 Rs

After 40% subsidy, thetotal cost of 2Kw solar PV system installationcomes to -

= 40/100 * 248000 Rs.

= 74400 Rs (subsidy discount)Net initial cost = 248000-

74400=173600/-

5. Payback period =

Net cost of system/ yearlysavings

= 173600/69480

= 2.5 years.

4. CONCLUSION

From this project we have concluded that demand of electricity is increasing day by day and for that generation of energy we need lot of renewable sources such as electricity generation by coal , water .To minimize this use of natural sources we have installed solar panels on buildingwhich uses sun energy to generate electricity which helps to minimize the use of electricity that can be used in both residential as well in commercial we have used, on grid solar panel system by using this system the extra energy can be return to MSEB so that they can even use energy for other work purpose

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