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NET- Zero Energy Building

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Abstract— "A Zero Energy Building (ZEB) offers an excellent solution to the problem of Green Buildings. A ZEB is concerned only with the energy aspect of any built environment. Such buildings have a net zero energy consumption and the net carbon emissions generated annually are also zero. A ZEB can be autonomous and independent from the energy grid supply. The energy required can be harvested on-site; usually through a combination of renewable sources like Solar, Wind and Bio-mass. The overall use of energy can also be minimized by the use of extremely efficient Heating Ventilation and Air Conditioning (HVAC) and Lighting technologies. While a green building focuses on all the aspects such as waste reduction, use of recycled building materials, site sustainability etc. On the other hand ZEB focus only on one key green-building aspect i.e. significant reduction in the energy use and greenhouse emissions of a building.

Keywords—*ZEB, HVAC, PV, GHP, CEA*

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I. INTRODUCTION

A zero-energy building, also known as a zero net energy (ZNE) building, net-zero energy building (NZEB), or net zero building, is a with zero net energy consumption and zero carbon emissions annually. Buildings that produce a surplus of energy over the year may be called "energy-plus buildings" and buildings that consume slightly more energy than they produce are called "near-zero energy buildings" or "ultra-low energy houses".

Traditional buildings consume 40% of the total fossil fuel energy in the India, China, US and European Union and are significant contributors of greenhouse gases. The zero net energy consumption principle is viewed as a means to reduce carbon emissions and reduce dependence on fossil fuels and although zero energy buildings remain uncommon even in developed countries, they are gaining importance and popularity.

Most zero energy buildings use the electrical grid for energy storage but some are independent of grid. Energy is usually harvested on-site through a combination of energy producing technologies like solar and wind, while reducing the overall use of energy with highly efficient HVAC and lighting technologies. The zero-energy goal is becoming more practical as the costs of alternative energy technologies decrease and the costs of traditional fossil fuels increase.

The zero-energy concept allows for a wide range of approaches due to the many options for producing and conserving energy combined with the many ways of measuring energy (relating to cost, energy, or carbon emissions).

II. BACKGROUND AND IMPORTANCE OF NET-ZERO ENERGY BUILDIG

India is confronting impressive difficulties in meeting its vitality needs. According to the Planning Commission's Integrated Energy Policy Report (Planning Commission 20006),if India drives forward with supported development rate by 3 to 4 times, and power era limit of 800,000 MW would be required as against the introduced limit of 160,000 MW comprehensive of all hostage plants in 2006-07.Central Electricity Authority (CEA) has assessed that the region is as of now confronting power deficiency of 9.9% and crest request lack of 16.6% (CEA 2009).Figure 1 indicates consistent enlarging hole between power request and real accomplishments.

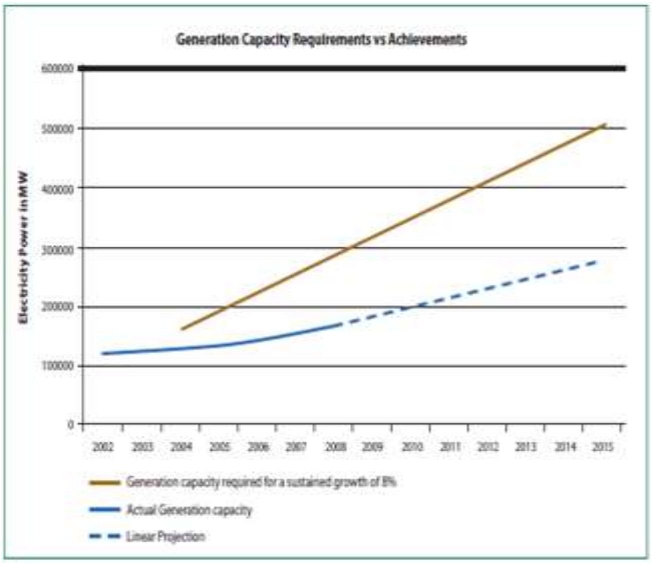

Figure 1 Electricity Generation Capacity And Achievements in India

While it is vital to add new power era ability to meet the country's developing vitality prerequisites, it is similarly essential to pay special mind to choices that will help in lessening vitality interest for end-use segments. Figure 2 indicates power utilization in different parts in India. Household and business areas represent roughly 33% of aggregate power utilization and these divisions are prone to expend around 37% of power in 2020-2021.It is accordingly,

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important that arrangement intercessions are placed set up to enhance vitality effectiveness in both and in addition leaving working in these parts.

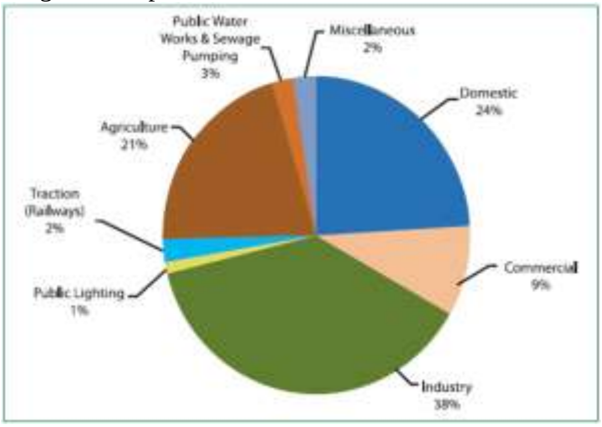

Figure 1 Electricity Consumption in Various Sectors in India

Around the globe, there are numerous activities to enhance vitality execution of working with names, for example, "net zero vitality", "zero net vitality" or "net zero carbon" structures. In spite of the fact that these terms have diverse implications, a few nations have received this expansive vision as a long haul objective for creating vitality arrangements and projects identified with the working as one of the segments in its battle against environmental change. Notwithstanding, a long haul arrangement activity that empowers the improvement of bleeding edge research and financially savvy advancements can acquire step changes the vitality use in structures.

III. ZERO ENERGY BILDING VERSUS GREEN BUILDING

- The objective of green building and economical engineering is to utilize assets all the more effectively and diminish a building's negative effect on the earth. Zero vitality structures accomplish one key green-building objective of totally or altogether decreasing vitality use and nursery gas outflows for the life of the building. Zero vitality structures might possibly be viewed as "green" in all zones, for example, decreasing waste, utilizing reused assembling materials, and so on. In any case, zero vitality, or net-zero structures do have a tendency to have a much lower natural effect over the life of the building contrasted and other "green" structures that require imported vitality and/or fossil fuel to be livable and address the issues of inhabitants.
- Because of the configuration difficulties and affectability to a site that are required to effectively meet the vitality needs of a building and tenants with renewable vitality (sun powered, wind, geothermal, and so on.), planners must apply all-encompassing outline standards, and exploit the free normally happening resources accessible, for example, inactive sun oriented introduction, characteristic ventilation, day lighting, warm mass, and evening time cooling.

IV. COMPONENTS AND DESIGN CONSIDERATIONS

A) Design and Construction

The most practical strides toward a lessening in a building's vitality utilization generally happens amid the outline process. To accomplish effective vitality utilize, zero vitality plan leaves fundamentally from ordinary development hone. Fruitful zero vitality building planners ordinarily consolidate time tried uninvolved sun oriented, or characteristic molding, rule that work with the on location resources. Daylight and sun powered warmth, winning breeze and the cool of the earth beneath a building, can give day lighting and stable indoor temperatures with least mechanical means. ZEBs are ordinarily streamlined to utilize detached sun based warmth pick up and shading, consolidated with warm mass to settle e diurnal temperature varieties for the duration of the day, and in many atmospheres are super protected.. Every one of the advances expected to make zero vitality structures are accessible off-the-rack today.

B)Foundation

While constructing a Zero Energy Building, following points need to be considered for an appropriate foundation.

i. Select a site suited to take advantage of mass transit.

ii. Protect and retain existing landscaping and natural features. Select plants that have low water and pesticide needs, and generate minimum plant trimmings. Use compost and mulches. This will save water and time.

iii. Recycled content paving materials, furnishings, and mulches help close the recycling loop.

A proper and sustainable foundation will yield best results.

C) Material Efficiency

Materials used in the formation of Zero Energy Building have a huge contribution in its overall efficiency. Hence material efficiency has to be taken into account.

Strategies to increase material efficiency:-

i. Select sustainable construction material and products by evaluating several characteristics such as reused and recycled content, zero or low off gassing of harmful air emissions, zero or low toxicity, sustainable harvested materials recyclables, durability, longevity, and local production. Such products promote resource conservation and efficiency. Using recycled-content products also helps develop markets for recycled materials.

ii. Use dimensional planning and other material efficiency strategies.

iii. These strategies reduce the amount of building materials needed and cut construction costs. For example, design rooms on 4-foot multiples to conform to standard-sized wallboard and plywood sheets.

iv. Reuse and recycle construction and demolition materials. For example, using inert demolition materials as a base course for a parking lot keeps materials out of landfills and costs less.

v. Require plans for managing materials through deconstruction, demolition, and construction

D) Energy Generation Technologies

There are several energy generation technologies which are being used to displace the use of fossil fuels on the supply side. These technologies are used to produce electricity, hot water, and heat in buildings.

E) Photovoltaic Systems

Photovoltaic (PV) systems convert sunlight directly into electricity. The semiconductor materials interact with the sunlight to free the electrons and produce electricity. The major raw material is silicon. Silicon is primarily used for its high light to electricity conversion properties and its abundance. A system is composed of individual PV cells that are wired together to form a module. PV modules provide from 10 to 300 Watts of power.

Power production from PV cells is intermittent due to their dependence on the sun. In addition, the quantity of electricity generated is proportional to the light intensity and the angle of light incidence on the PV cells. As a result, a well designed system needs unobstructed sunlight access for most of the day, year-round.

The drawback with PV systems is their inability to effectively store energy. Batteries can be used for backup, however, they are expensive and do not have high efficiencies. A new measure called net metering alleviates this problem by tying PV systems to the utility grid. In these circumstances, the PV modules are connected to an inverter that changes the system's direct-current (DC) electricity to alternating current (AC), which is compatible with the utility grid. When the PV cells are producing more energy than needed by the building, the utility meter runs backwards and supplies electricity to the grid. This results in an even swap for grid power used by the building at other times. Net metering allows consumers to pay for their "net" electricity consumption from the utility.

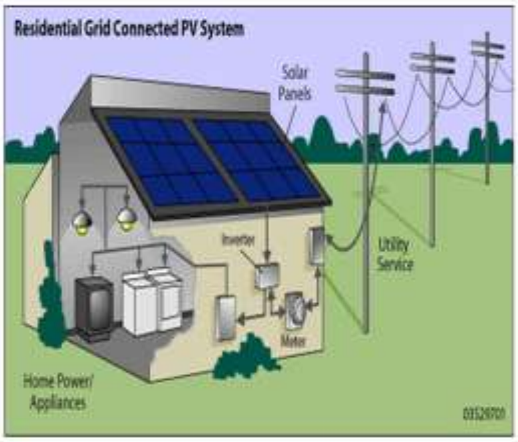

Figure 3. Layout of PV and Utility Grid Connection

Solar Water Heating

Sun based water radiators utilize the sun to warm either water or a warmth move liquid in the sun based authorities. The water is then put away for use as required. A run of the mill sun based water warmer gives around 66% of private boiling hot water needs. Subsequently, an ordinary fuel is required for reinforcement. There are two principle classes of frameworks: dynamic and inactive. Dynamic frameworks use electric pumps, valves, and different controllers to circle the liquid through the gatherers. The three sorts of dynamic frameworks are immediate, aberrant, and channel back frameworks. Direct frameworks circle the water straightforwardly through the sun oriented gatherers. These sorts of frameworks are most proper in regions that don't solidify for drawn out stretches of time. Also, these frameworks perform the best when the water is not hard or acidic. Roundabout frameworks flow heat exchange liquids through the gatherers. The warmth from these liquids is then exchanged to the water put away in the tanks through a warmth exchanger. The last dynamic framework is a channel back framework.

Channel back frameworks pump the water through the gatherers. At the point when the pump stops, the water in the gatherer channeling channels into a supply tank. Thusly, this framework is Suitable for colder atmospheres where solidifying is an issue. Uninvolved frameworks course water through the framework without pumps or valves. The nonappearance of electrical segments makes these frameworks more dependable and simpler to keep up. The two principle sorts of detached frameworks are bunch radiators and thermo siphon frameworks.

F) Wastewater Recycle:

Recycle of waste is carried by the accumulation and deposition of wastewater from building for reuse before it reaches the aquifer.

Waste water is collected from building & water collected is just redirected to a deep pit with percolation. & treatment is given to such water by the process of rainwater harvesting

Uses of recycle water include water for garden, water for livestock, water for irrigation.

G) Geothermal Heat Pump

Geothermal heat pumps (GHP), also known as GeoExchange or ground source heat pumps use the earth's natural energy to provide heating and cooling. The system consists of piping and a heat pump. While the system does not convert electricity to heat, it uses electricity to transfer the thermal energy between the building and the ground. In heat mode, the system draws heat from the ground and transfers it to the building. In cooling mode, the reverse occurs and heat from the building is extracted and transferred to the ground. A heat transfer fluid circulates through the pipes transferring heat between the earth and the ground. The earth provides a constant temperature of about 55oF and acts as a heat sink. There are two types of GHP systems, open loop and closed loop systems. An open loop system draws in ground water and circulates it through the system. The water is discharged from the GHP circuit into a discharge well. From here, the groundwater can return to the aquifer it came from.When there are concerns of groundwater contamination, a hybrid open loop is used. The groundwater is isolated from the building's water flow and is pumped through a heat exchanger where heat is transferred to the interior water flow.

V. EERGY CONSERVATION TECOLOGIES

Demand side management of energy consumption in buildings can be controlled through energy efficient construction technologies. Not only do these technologies reduce the consumption of energy, they also make the use of renewable energy sources more viable.

1) Passive Solar Design

Passive solar design uses the sun's energy for the heating and cooling of living spaces. The building design takes advantage of the basic natural processes associated with radiation, conduction, and natural convection that are created in building materials by exposure to the sun. Building materials can reflect, transmit, or absorb solar radiation from sunlight. Air warmed by the sun also moves in predictable patterns within buildings.

2) Passive Solar Heating

Passive solar heating systems capture the sun's heat within the building's elements and release that heat when the sun is not shining. While the building's materials are absorbing the heat for later, solar heat is available for maintaining a comfortable temperature. The two main elements of passive solar heating are south facing glass, also known as glazing, to pass sunlight into the building, and thermal mass for absorbing, storing, and distributing heat. There are three approaches to passive systems – direct gain, indirect gain, and isolated gain.

3) Window overhangs

One method of reducing the amount of cooling required for buildings in the summer is by adding window overhangs. Window overhangs block the sunlight in the summer when the sun is higher in the sky. The shade created by the overhang helps prevent solar gain or heat build up on the walls and windows. Conversely, in the winter, the sun is lower in the sky and more sunlight and heat can enter through the windows

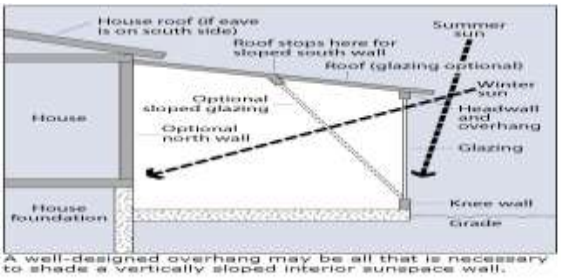

Figure 4 Cooling Effect of Window Overhang

3) Interior Space Planning

Energy can be conserved in homes by placing rooms in strategic locations. Considering how the rooms will be used in different seasons and at different times of the day can save energy and increase comfort. For example, locating the room that produces the most heat on the north side or coolest side of the house increases the heating/cooling efficiency.

Similarly, low occupancy areas such as storage rooms and bathrooms can be placed in the north side of the building. These rooms don't need as much heat, and would not benefit as much from the warmth brought by a southern exposure. Accordingly, interior spaces that need the most light and heating/cooling should be along the south face of the building. Grouping baths, kitchens and laundry rooms near the water heater will also save the heat that would be lost from longer water lines.

4) Landscaping

Well designed landscaping can leverage different greenery to enhance the energy efficiency of homes. Trees that provide shade placed on the east and west side of the building help keep the interior cool in the summer. In the winter, shrubbery and trees can protect the house from cold winds. Low shrubs and plans placed on the south side of the house increase the exposure to the sun during the winter.

5) High Efficiency Lighting

The use of compact fluorescent lights can reduce a building's lighting electricity load by 75%. These lights provide almost equivalent light (lumens) and are indistinguishable from traditional incandescent bulbs. They also last 10,000 hours versus the 2,000 hour are operating life of standard incandescent lamps. In warm weather, a secondary benefit is the reduced heat emitted by the lamp. This reduces building cooling loads.

6) High Efficiency Appliances

Although high efficiency appliances have higher upfront purchase costs, they can significantly reduce energy consumption resulting in long term operating savings. Many high efficiency appliances are commercially available. Among these are refrigerators, washer dryers, and HVAC systems.

FRAMING

Our framing is a little different. We've constructed it to allow for a higher standard of insulation, one of the key elements in eliminating the need for heating. The change we've made is to remove the nogs from between the studs and replace them with supporting battens that run along the inside of the wall. The same approach is taken in the ceiling. This achieves two key improvements over a standard approach: Key design areas for designing a building to be as energy efficient as possible are in the following table.

Design Area	**Strategy**
Lighting	Install the most efficient lighting you can afford
	for the best lighting design you can afford.
Day lighting	Ensure the building form, orientation, and its openings
	are designed to maximize natural light in the
	building without dramatically increasing the
	Cooling requirement. Install lighting controls to

	turn off lights when there is sufficient natural
	light.
Equipment	Though not regulated today, specify the most
	Energy efficient equipment (computers, elevators,
	vending machines, etc.) Available.
Glazing	Select glazing that maximizes visible light
	transmission minimizes solar heat gain and
	conduction, while balancing the beneficial
	passive solar effects.
Opaque Constructions	Optimize the construction assembly to minimize
	energy use while balancing HVAC operation
	schemes (night ventilation, etc.).
Natural Ventilation	If the local climate and neighbourhood permits,
	design the building to maximize cross ventilation
	and stack effect.
HVAC System	If all of the above are done correctly and
	depending on the climate, some or all portions
	of the HVAC may be able to be eliminated.

CONCLUSION

The report so far presented suggested that the concept of Zero Energy Building will play a pivotal role to combat &compensate the negative impact of the reckless industrialization and commercialization on the environment. Indian have always nurtured the idea of eco friendliness, thanks to the raddiwallas who recycle waste.

Zero Energy Building has tremendous benefits both environmentally and financially. Environmentally Zero Energy Building provides efficient use of water, energy and material. Green work spaces have proven to be viable, in terms of cost effectiveness. Although, the initial costs may be higher green work spaces save a lot of money in long run, with increased productivity from the employees and lower maintenance costs.

Zero Net Energy buildings are a technically feasible method of reducing energy demand. The combination of demand side management with renewable energy sources provides a technically attractive way of constructing buildings with no demand on the utility grid. Viable renewable energy sources consist of photovoltaic cells, solar water heaters, and geothermal heat pumps. On the demand side, passive solar design techniques reduce the energy demand of buildings. The use of high efficiency lighting and appliances also contributes to energy efficiency.

The Shunya prototype home demonstrates one way these different technologies can be combined to build a zero net energy home. However, the study serves to demonstrate that zero net energy is more than just a long term vision. It is a current reality.

A Net Zero Energy Home works on the principle of utilizing maximum renewable energy from sun & is independent of any electricity grid. The emphasis in a net zero home is to take a radical approach towards attaining maximum sustainability by utilizing resource efficiency.

Zero energy Building can not only mitigate environmental damage but also provide return on investment and improve working condition for its inhabitant.

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