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Conversion of conventional building to Net Zero Energy Building

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Abstract
The main objective of this paper is to study and analysis the existing building and also to give an overview on an existing building to make it a perfect Net Zero Energy Building. It is much difficult to understand the overall concept of a net zero energy building. As all we know that the building has significant impact on the energy use and the environment which is turn effect on the development of the present era. In present the lack of conventional energy sources encourages in developing the NZEBs.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 consumed by only buildings and becoming a major primary energy consumptive part of the worldwide structure. The ZEB definition can be describing significantly the demand and fuel supply strategies and conversion accounting are appropriate to meet a ZEB goal.

Keywords: *Energy Consumption, Energy Resources, Non-Renewable Energy Resources, Renewable Energy Resources, PV Solar Module.*

I. Introduction

Globally, building consumes about 40% of the total energy use and generate 33% of the total emissions. In India, the construction industry also consumes about 24% of the total CO_2 emissions. There is dire need to change the process of construction by using maximum utilization of renewable energy sources. A zero-energy building (ZE), also known as a zero net energy (ZNE) building is a building with zero net 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.

Recent concerns regarding sustainable building design and environmental protection have resulted in an increase demand for renewable energy system (RES) integration in buildings. The promotion of net zero energy building (NZEB) is therefore becoming one promising way to solve the increasing energy and environmental problems. Under the great support from the government and energy departments, various NZEB demonstration programs have been developed and established in different countries. Four aspects of evaluation criteria are mainly considered for evaluating the selected RES:

- Technological factors (e.g., Feasibility and reliability)
- Economic factors (e.g., implementation cost)
- Environmental factors (e.g., pollutant emission)
- Socio-political factors (e.g., political acceptance and social acceptance)

To improve energy efficiency of the existing buildings is essential, not only for achieving national objectives ofenergy efficiency in the medium term, but also to meet long-term objectives of the strategyon climate change andthe transition to a competitive economy with a low carbon dioxide emission by 2050.

ENERGY RESOURCES

- **Non-Renewable Energy Resources**

A non-renewable resource (also called a finite resource) is a resource that does not renew itself at a sufficient rate. Fossil Fuels such as Coal, Petroleum, Natural Gas are all considered as Nonrenewable Energy Resources.

- **Renewable Energy Resources**

The source of energy which can be used again and again without threatening the nature so much is known asRenewable Energy Resources**.** Sunlight, wind, rain, tidal energy and geothermal heat are some examples of Renewable Energy Resources.

The aim of this Research Paper is to focusing on the building to create it a Net Zero by using a Renewable Energy Resources instead of Non-Renewable Resources. We can use Solar Energy, Wind Energy, Tidal Energy etc to make the building net zero. We cannot use Geothermal source of energy at a level due to lack of technology.

We can use the Wind Energy when the velocity of air is very high. It works only in the open areas. The widely use Renewable Source of energy is Solar Energy. Solar Panel can be used as Solar Photovoltaic cell, solar thermal heater, etc.

Connections of PV Solar Modules
There two types of connections which are given below:

- **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.

- **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.

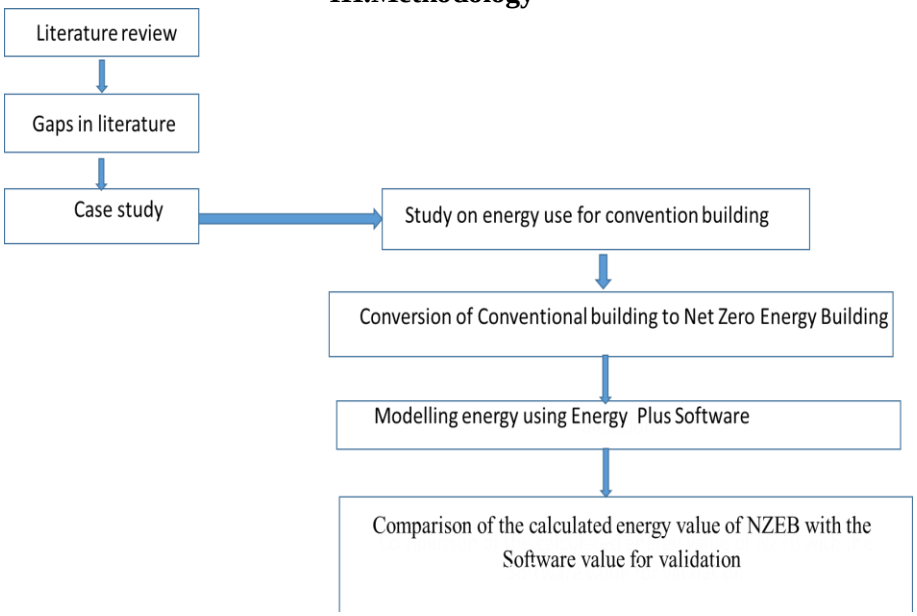
NEED OF THE STUDY

Many studies have been carried out to understand the different types of energy use during the building life cycle. So, many studies focus on reducing operating energy as 80% of the total energy use is during the operational phase. Transferring of one phase to another phase of energy does not represents a true picture of sustainability. So, there is a need to study on overall reduction of energy use by designing a net zero energy building.

II. Literature Riview

In the concept of NZEB, the fundamental idea is to make buildings meet all their energy requirements by usinglow-cost, locally available, nonpolluting, renewable sources [3]. For those buildings with electric grid connection,when the energy balance between energy sold and energy used turns out to be zero, they can be qualified as NZEBs[4]. Net-Zero Site Energy, Net-Zero Source Energy, Net-Zero Energy Costs, and Net-Zero Energy Emissions arefour accounting methods that are commonly used [3]. For Net-Zero Site Energy, renewable energy, which isaccounted for at the site, can offset the annual energy consumption of the building. A Net-ZeroSource Energybuilding is able to provide enough renewable energy to support its annual usage. The energy that is utilized toextract, process, generate, and deliver the energy to the site is considered as source energy in the calculation. Net-Zero Energy costs means that the amount that the building owner gets paid by exporting renewable energy from thebuilding should be equal to or more than the amount of the purchase that the owner made with external energyservice utilities. And in Net-Zero Emissions building, emissions from its annual energy consumption should beequal to the emissions-free renewable energy that the building produces or purchases. Even though there is a generalunderstanding towards the NZEB idea, a widely agreed definition that can be consistent with the principles behindthe practice of designing and constructing NZEBs internationally is still lacking [5]. Recent research towards thedefinition of NZEB extends its concept to include the consideration of the building's embodied energy andcomponents, thus integrating life cycle energy balance into "net energy" concept [6]. In this way, it is possible toacquire the true environmental influence that the building has exerted based on the evaluation of both its operatingenergy use and the energy which is embodied in its structure, materials, and technical installations [7]. The life cycleenergy balance calculation method can be widely applied to preservation and retrofits projects. In the existingresearch projects, most NZEB cases use annual balance to support their applied methodologies [8], so the presentedresearch in this paper also uses a balanced annual energy budget to study the achievement of net-zero energy use incommercial retrofits. Net-Zero Source Energy definition is applied in this exploration to investigate the effectiveways to generate as much renewable energy as the building needs in a year, thus reducing the electricityconsumption of the building to zero.

III.Methodology



Study on Energy use for Conventional building

Most of the energy used in buildings is used to maintain a comfortable indoor environment in terms of thermal comfort (heating or cooling) and air quality (ventilation). Other energy uses are electric light, domestic hot water and household appliances or other electrical equipment (refrigerators, computers, TVs etc.).

Energy-related CO2 emissions from buildings have risen in recent years after flattening between 2013 and 2016. Direct and indirect emissions from electricity and commercial heat used in buildings rose to 10 GtCO2 in 2019, the highest level ever recorded. Several factors have contributed to this rise, including growing energy demand for heating and cooling with rising air-conditioner ownership and extreme weather events. Enormous emissions reduction potential remains untapped due to the continued use of fossil fuel-based assets, a lack of effective energy-efficiency policies and insufficient investment in sustainable buildings.

Based on different energy consumption in the building, the energy is calculated by using different appliances used in the building or by different energy simulation software like Revit, E-Quest, Green building studio, Design builder, Energy Plus etc... which gives real time data. The energy consumption varies time to time based on climate and weather conditions.

Conversion of conventional building into Net zero energy building

The energy consumption by the building should be converted into renewable energy. This can be done using Solar energy and wind energy in the buildings. Based on the energy demand the amount of solar pv panels or wind turbines are calculated before installation. The study on weather and climate plays a very important role in energy generation, this can be analysed by using energy modelling sotwares and also by studying the weather data of building surroundings.

Solar energy

Solar panels placed on the rooftop absorbing as much of the energy from the sunlight.The energy can be used for cooking, heating, etc.…One solar Unit produces 1 kW system (1 Panel) is 4-5 kW/day. Area required by 1 kW system is 10 sq.m (100 sq. ft). Total cost of 1 kW system (1 Panel) is Rs 75,000-90,000 (Grid Connected) in India at present.

Wind energy

Wind is very useful when it is converted to energy. We can see the large wind turbines at hilly areas where wind and energy generation is more. In some areas where wind energy is abundant and high, small windmills can be used to generate electricity. A windmill of 1kw system can produce a daily output of 5 kWh at mean wind speeds of 5.5 m/s.

Internet of Things(IOT)

The Internet of things (IoT) describes the network of physical objects, thingsthat are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.In Energy reduction and modelling different hardware electronic equipment required such as “Raspberry pi Module”, “IEEE Module etc.The appliances and energy generation are

connected with IOT which enables in careful utilization of energy and resources. The IOT also helps in Realtime energy monitoring by using smart gadgets with the help of Wireless network.

IV. Summary

This research explored potentials for achieving net-zero energy goals in adaptive reuse and retrofit on an existingcommercial building. The study considered passive design strategies and energy-efficient building systems toimprove building performance and reduce energy consumption. Also, the objective was to investigate how tomaximize energy savings and reach net zero energy goals by utilizing renewable energy sources. Based on extensiveenergy modeling and simulations, multiple design considerations were investigated, such asmaterial selection,improvements to building envelope, retrofitting of HVAC and lighting systems, occupancy loads, as well asapplication of renewable energy sources. The results show that this commercial building is able to meet net-zeroenergy use after appropriate design manipulations and use of several renewable energy sources. The economic potential of the project can be decreased by investigating economic aspects and costs associated with regenerative design strategies andimplementation of renewable energy sources.

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