A Critical Review of Net Zero Energy Efficient Design Strategies In Construction Sector

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ABSTRACT

As pressure grows to curb greenhouse gas emanations, construction sectors can play a critical part in dominant energy use. Since they are collectively responsible for about 33-45% of the world's carbon emissions, climate change goals will be nearly impossible to reach without construction sectors full participation. Investments in energy efficiency can offer a profit way of dropping carbon emissions levels. And with sustainability expanding on the corporate outline, property owners that offer clean, green buildings differentiate. Net-zero energy, solar buildings are emerging as a promising explanation to minimizing the environmental impression of buildings. These buildings, which curtail energy consumption and optimally use incident solar energy, both passively and actively, are usually defined as those which spread as much energy as they import, over the course of a year. The paper here presents a detailed literature review on the net zero energy building.

Keyword : - *Passive solar design, Net Zero Energy Building, PV panel, Energy efficiency*.

1. INTRODUCTION

Residential and commercial buildings account for about 40% of the total electricity used in India. Over 1.2 billion sq.m of new commercial floor space, which is about twice of what exists at present, will be added in India over the next 20 years. This will lead to a further straining on electricity demand. Given the relatively long life cycle of buildings, of 50 years or further, this implies a significant opportunity for collaborating energy efficiency measures in new and existing buildings in order to substantially lessen energy consumption in buildings for decades to come.

Reducing the impacts of the built environment is not a modest task. To solve this problem, one of the two solutions must be preserved within the building sector: either lessen building energy use or use renewable sources of energy as substitutions to fossil fuel energy. Net zero energy buildings syndicate both of the previous keys.
Zero energy constructions are not a new concept. An area of focus has been self-governing building energy options. Technologies are being directed to accomplish net zero energy intake and net zero carbon emissions. Buildings that produce an excess of energy over the year may be called 'energy-plus buildings' and buildings that consume somewhat more energy than they produce are called 'near-zero energy buildings'.

This study focuses on accomplishing NZE building goal by applying passive solar design, energy competent appliances, and application of renewable energy resource and repayment period of PV panel.

2 CRITICAL LITERATURE REVIEW

The following are the previous research review based on achieving net zero energy in the construction sector.

Bilgic et al. (2003) identified that total energy saving of 18% in annual need can be obtained by employing Passive Solar Design strategies for surviving residential buildings. The maximum saving of energy was obtained in heating energy by 61%. Other high saving of energy was obtained in lighting energy need by 40%. However, the cooling energy is increased by 34%. **[3]**

Garde et al. (2006) carried out a study on campus building on Reunion Island. From their study, they found that by using a few architectural innovations such as interior blinds, wall lights, using air fans, improved management and intelligent dimensioning of the building systems, it is possible to create a building which uses a third of the energy of a typical building with an additional cost of 2%. **[9]**

Bucking et al. (2006) studied method used in an Eco terra house in Canada and acknowledged that the method used was unable to reach NZE without changing user behavior patterns, adding more efficient PV, or increasing the roof slope to an additional optimal slope. **[5]**

Charron et al. (2007) found that 31% energy, decrease can be achieved on average by snowballing the level of insulation, and providing a more airtight building. They also stated that PV and solar collectors are included; the average reduction in energy compared to a typical home is 75%. Altering the size of the solar collectors, adding passive solar design elements, and utilizing other strategies such as ground source heat pumps could help bring the reduction to 100% to achieve a ZESH. **[6]**

Brostrom et al. (2008) conduct a study in Edmonton, Canada and they found that the chief challenge that is developing the required organizational solutions to overcome the financial, policy and training barriers for net zero energy building. **[4]**

Athienitis et al. (2008) stated that homes with low and near net-zero energy consumption can be designed in a cost-effective manner within a period of about 5 years, provided a heat pump-based system is used for heating and heat is recovered from the PV system and efficiently utilized in the house. **[1]**

Noguchi et al. (2008) carried out a case study on EcoTerra housing in Canada and he found that in low energy, housing, the building envelope needs to be equipped with high thermal presentation insulation material that reduces the fabric heat loss. He concluded that Passive solar methods are essential in maximizing the use of free clean sunlight in water- and space-heating as well as day-lighting. **[27]**

Hernandez et al. (2009) provided a model and explanation of original perception of 'net energy' to define a lifespan cycle zero energy structure, was defined as a building whose key energy use in operation plus the energy enclosed in systems over the life of the building is equal or less than the energy produced by renewable energy systems within the building. **[12]**

Hoque et al. (2010) studies have shown that one can achieve important energy savings from integrated design and that modified occupant behavior has the potential to reduce energy loads by improving NZE building design. [13]

Hui et al. (2010) stated that in the coming future, builders may go beyond energy efficiency and strive to qualify their constructions as carbon neutral or net zero energy. **[14]**

Srinivasan et al. (2011) stated that the development of approaches to determine the maximum renewable energy potential for buildings to guide building construction, it would expand conscious decision-making to make buildings more sustainable and, possibly, lead to a paradigm shift. **[30]**

Delisle et al. (2011) carried out a case study in Canada and found that PV still required to provide at least 30% of the energy supplies to achieve net-zero energy ingesting. They also concluded that optimal level of energy savings was between 26% and 50%, it is more likely that the net-zero option could be the optimal solution in 2030. **[8]**

Lenoir et al. (2011) conducted a survey on the building during two summer seasons, they found the difficulty of assessing thermal comfort in tropical climates. **[23]**

Torcellini et al. (2011) identified that cost ZEB is the most difficult ZEB goal to reach. To reach a cost ZEB goal, the credit received for export power would have to counterbalance energy, distribution, peak demand, taxes, and metering charges for both electricity and gas use. **[33]**

Marszal et al. (2012) study has shown that life cycle cost of 1 kWh-e for the off-site systems, such as, a private windmill or a share of a windmill farm, is lower than the price of 1 kWh bought from the power grid, the requirement of grid transfer for the off-site generated electricity hampers this cost advantage. **[25]**

Thiel et al. (2013) found life cycle assessment is an essential aspect of net-zero energy buildings to understand how the embodied energy of materials is allocated during a building's use phase. **[31]**

Sadeghsaberi et al. (2013) survey was carried out for considerate of how design tools are currently being applied to the design of NZESB in Canada and found the "Net Zero" target strongly influences the entire design process. To meet the energy target, a tight communication between various disciplines is needed already from the very early stages of the conceptual design. **[15]**

Mistry et al. (2013) in his research stated that the zero energy building initial cost is high, but overall it is most suitable for the safe future. **[26]**

Li et al. (2013) stated that ZEBs will play an increasingly important role in sustainable development. Also conclude that to enhance, more works in these areas are required life-cycle cost and conservation impact analysis, climate change, and social policy issues. **[24]**

Banerjee et al. (2014) suggest that wide acceptance of zero energy building technology may require more government incentives or building code regulations, the development of recognized standards, or significant increases in the cost of conventional energy. **[2]**

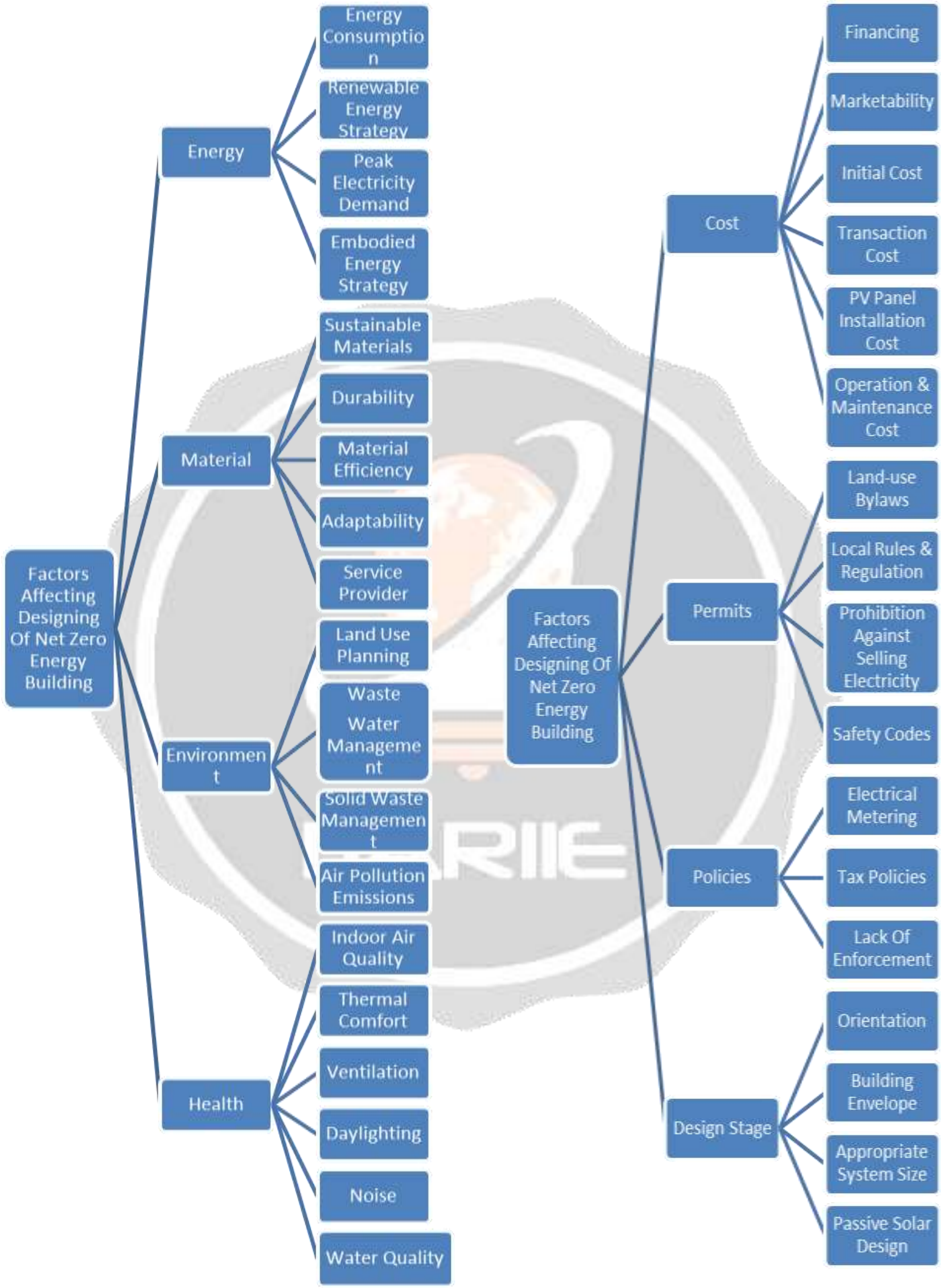
Kahoorzadeh (2014) carried out the interview with three architects and specialist in the solar energy field at Eastern Mediterranean University. And found that the passive solar energy techniques should be incorporated in a specific building altogether to take best consequences. A building cannot be sustained by just having insulations. **[20]**

Joshi et al. (2014) studied two design cases, an existing building and a new building area suitable for BIPV installation in Western India. Their analysis on both cases revealed that BIPV retrofitting in existing building is expensive over designing a building with BIPV as pre-thought. The solar policy has reduced the payback period significantly and comes out to be less than 7 years for a residential and less than 10 years for an institutional building. **[18]**

Kim et al. (2015) research study results have shown that 57% of the NZEB cases use electricity for 100%of the energy demands for heating, cooling. The rest of the NZEB cases fulfill an estimated 50% of their energy demands with electricity. **[21]**

Chhetri et al. (2015) conducted a study on ways of reducing energy consumption in the context of the residential building of Kathmandu Valley. They used energy efficient fans, LED lights, and LED TV and identified those savings worth NRs 2836 annually, against an investment of NRs 37,000 and offer an overall simple payback period of 13.5 years. **[7]**

3.MAJOR FINDINGS OF THIS LITERATURE REVIEW


Factors Affecting Designing Of Net Zero Energy Building
Energy
Energy Consumption
Renewable Energy Strategy
Peak Electricity Demand
Embodied Energy Strategy
Material
Sustainable Materials
Durability
Material Efficiency
Adaptability
Service Provider
Environment
Land Use Planning
Waste Water Management
Solid Waste Management
Air Pollution Emissions
Health
Indoor Air Quality
Thermal Comfort
Ventilation
Daylighting
Noise
Water Quality
Factors Affecting Designing Of Net Zero Energy Building
Cost
Financing
Marketability
Initial Cost
Transaction Cost
PV Panel Installation Cost
Operation & Maintenance Cost
Permits
Land-use Bylaws
Local Rules & Regulation
Prohibition Against Selling Electricity
Safety Codes
Policies
Electrical Metering
Tax Policies
Lack Of Enforcement
Design Stage
Orientation
Building Envelope
Appropriate System Size
Passive Solar Design

REPRESENTATIVE REFERENCES	FACTORS
Bilgic et al. (2003)	Energy consumption, peak electricity demand, initial cost, local rules & regulation, appropriate system size
Garde et al. (2006)	Renewable energy strategy
Bucking et al. (2006)	Sustainable material
Charron et al. (2007)	Embodied energy strategy
Brostrom et al. (2008)	Tax policies, electric metering, pv panel installation cost
Athienitis et al. (2008)	Adaptability, service provider
Noguchi et al. (2008)	Operation & maintenance cost
Hernandez et al. (2009)	Building envelope, passive solar design
Hoque et al. (2010)	Orientation, building envelope
Srinivasan et al. (2011)	Air pollution emissions, indoor air quality, waste water management, thermal comfort. Ventilation, daylight, noise, water quality
Delisle et al. (2011)	Initial cost, transaction cost, pv panel installation cost
Lenoir et al. (2011)	Financing, thermal comfort, building envelope
Torcellini et al. (2011)	Tax policies, electrical metering, lack of enforcement
Marszal et al. (2012) Thiel et al. (2013) Mistryet al. (2013)	Peak electricity demand, financing, marketability, land by laws, local rules & regulation, safety codes, sustainable materials, land use planning, appropriate system design, tax policies, lack of enforcement, initial cost
Sadeghsaberi et al. (2013)	Orientation, building envelope
Mistry et al. (2013)	Initial cost
Li et al. (2013)	Sustainable material
Banerjee et al. (2014)	Building envelope
Kim et al. (2015) Chhetri et al. (2015)	Material efficiency, adaptability Financing, transcation cost

4. CONCLUSIONS

The gap between energy demand and energy supply be likely to a bigger issue mainly in developing countries like India and an effective way is needed to tackle that problem, another challenging part is selecting the energy efficiency resources. Indeed, NZE has the potential for a self-energy efficient building. If it applies to construction sector energy production would be both profitable and economical which would also be according to the norms and standards of environment, health, and safety.

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