Overview Of Net Zero Energy Structures

ARHAM F.A. MOMIN[1], R.D. SHINDE[2]
[1] *ME Student, Department of Civil Engineering, RMD Sinhgad School of Engineering, Warje, Pune-411058, India.*
[2] *Asst. Professor, Department of Civil Engineering, RMD Sinhgad School of Engineering, Warje, Pune-411058, India.*

Abstract— This report consists of an overview of case studies of Net Zero Energy Buildings and related articles. The Zero Energy Building is a complex concept described with the wide range of terms and expressions. Buildings consume approximately 40% of the world's primary energy use. Considering the total energy consumption throughout the whole life cycle of a building, the energy performance and supply is an important issue in the context of climate change, scarcity of energy resources and reduction of global energy consumption.

Index Terms— Zero Energy Building, Global energy consumption

I. INTRODUCTION

The worldwide CO2 emission mitigation efforts, the growing energy resource shortage and the fact that buildings are responsible for a large share of the world's primary energy use drives research towards new building concepts, in particular Zero Energy/Emission Buildings (ZEBs). Unfortunately, the lack of a common understanding for this new type of building results in misunderstandings, endless discussions and moreover number of unique approaches often applicable for a single ZEB project.
The ZEB concept is not a new idea. Literature exists from 1970's, 80's and 90's which describes zero energy/emission buildings; Esbensen and Korsgaard (1977), Gilijamse (1995). It was the time when the consequences of the oil crisis became noticeable and the issue of fossil fuels sources and energy use started to be broadly discussed. Over the decades, in many articles and research projects number of ZEB's were described and evaluated; however, almost for each case the ZEB was defined differently or no exact definition was adopted. Moreover, often the path for achieving the 'zero goal' affected significantly the ZEB definition. Yet, just a few years ago this concept attracted the attention of a wide international audience and a worldwide discussion began.

1.1 Definitions

- "A zero-energy building, also known as Net Zero Energy Building, is a Building with Zero net energy consumption, meaning the total amount of Energy use by the building on an annual basis is a roughly equal to amount of renewable energy created on the site." (S. Baden et. al. 2009)
- "In concept, a net ZEB is a building with greatly reduce energy needs through efficiency gains such that balance of the energy needs can be supplied by renewable technologies." (D. Crawley et. al. 2006)

1.2 Objectives

- Do researches to discover the most efficient possible route to attain net zero energy.
- Study the different findings done by different authors related to NZEB.
- Find the efficient way to reduce the power consumptions of buildings.

II. LITERATURE REVIEWS

Sr. No.	Topic	Name of Authors	Findings
1	A Study on Conceptual Approach to Zero Energy Building in Modern Era	Bhavin K. Kashiyani, Jayeshkumar Pitrod, Dr. Bhavnaben K. Shah	It includes the heating needs of the building, Energy consumption, Construction and ZEB renewable energy supply option hierarchy. Heating and Cooling loads are lowered by using high efficiency equipment, added insulation, high efficiency windows, natural ventilation and other technologies.
2	Role of Net Zero Energy Building in energy security.	Santosh D Jadhav	Used Natural daylight tube for optimizing the energy needs during the daytime. Building mounted Renewable Energy such as PV and solar thermal panels are preferred so that the collection area can be guaranteed to be available throughout the life of the building.
3	Net Zero Energy Buildings, Concerted Action Energy Performance Of Buildings, Detailed Report	Hans Erhorn and Heike Erhorn-Kluttig	The buildings in the catalogue are in average 74% more energy efficient than buildings designed according to the national requirements. Photovoltaic systems and solar thermal panels proved to be the most useful technique.
4	Towards fully functional Net Zero Energy Buildings.	Boggarm S. Setty, James E. Woods	Operational definitions of NZEB must comply with the First and Second Laws of Thermodynamics. Comparisons of available data from operational buildings to baselines and targets reveal significant challenges in measurably reducing the use of depleteable resources in commercial buildings, such as educational facilities and office buildings, through means and methods that are thermodynamically achievable and cost-effective. A stepwise approach has been described that complies with the operational definition with the intent to “meet the needs and aspirations of the present without compromising the ability to meet those of the future”
5	Concept Project of Zero Energy Building	Elena Perlova, Mariia Platonova, Alexandr Gorshkov, Xenyiya Rakova	The optimal building orientation to the side of light with the prevailing wind direction during the winter in order to neutralize the negative impact of climate change on the building and thermal balance Maximum glazing northwestern facades and blank walls on the low-light scenes sides of the light (according to the results of measurements) The form of the building is characterized by a reduced coefficient of compactness. This goal has been achieved by reducing the area of external walling by eliminating irregularity facade projections, the West and other "architectural openings."

			The presence of the vestibule at the entrance, this avoids the additional heat loss.
6	A Critical Review of Net Zero Energy Efficient Design Strategies in Construction Sector.	Sunnykumar Vora, Prof Mamta Rajgor, Dr. Jayeshkumar Pitroda	Factors Affecting design of Net zero energy Buildings are: 1. Energy 2. Material 3. Environment 4. Health 5. Cost 6. Permits 7. Policies 8. Design Stage
7	A Literature Review of Zero Energy Buildings (ZEB) Definitions	Marszal, Anna Joanna; Heiselberg, Per Kvols	Reducing site energy use through low energy building technologies such as Daylighting, high-efficiency HVAC equipment, natural ventilation, evaporative cooling, etc. Using renewable energy sources available within the building's footprint PV, solar hot water, and wind located on the building. Using renewable energy sources available off site to generate energy on site such as Biomass, wood pellets, ethanol, or biodiesel that can be imported from off site, or waste streams from on-site processes that can be used on-site to generate electricity and heat.
8	Embodied Energy and Nearly Zero Energy Buildings: A Review in Residential Buildings.	P.Chastasa, T.Theodosioua, D.Bikasa, K.Kontoleona	The share of embodied energy appears to increase towards the nZEB even though an important reduction up to 50% in the total energy intensity of the building is identified. A 17% gap is identified in the share of EE between nZEB and low energy buildings with an increase up to 54% between the nZEB and conventional buildings. The increase in embodied energy indicates by the that maybe LCEA should be considered in energy efficiency regulations along with its further standardization.
9	Studies on Zero Energy Building	Saravan Devraj, N Kapilan, T Nagaraja, Albert M	Every aspect of the Prana Project building was planned with 'green' approach, showcasing the latest in HVAC technology alongside recycled materials. Conversion devices are used to optimize the usage of water. Building automation systems are used to optimize the use of energy.
10	Zero Energy Building Envelope Components: A Review	Sunil Kumar Sharma	It includes a detailed review on building envelope components in order to achieve the goal of Zero Energy Buildings. Details of envelope components such as Passive solar walls, Walls with latent heat storage, T-Mass walls, Riverdale Net zero deep wall system, Green walls, Lightweight roofs, Cool roofs, Green roofs, Photo-voltaic roofs, Roof vents, Rubber roofs, Vacuum glazing and Dynamic glazing. Several studies have been performed to find the economic feasibility of various building energy efficiency strategies.

			Cost-benefit analysis of some of these energy efficiency strategies for a cooling dominated desert climate is presented by Sadineni et al (Suresh et al., 2011).

CONCLUSION

We conclude that in modern era, zero energy building is important mainly for the increase in the energy price. We can save the non-renewable sources of energy like electricity, fuel gas etc. ZEB is also beneficial for the owner because freedom from the energy consumption bills. Zero energy building is totally environment friendly. For the zero-energy building initial cost is high but overall, it is most suitable for the safe future. Utilization of natural resources more efficiently reduces a building's negative impact on the environment. By constructing zero energy building to reduced national energy consumption and also reduced global warming effect.

REFERENCES

[1] AIA Res Corp. Energy Conservation in Building Design. Washington: American Institute of Architects, 1974.

[2] ASHRAE. (2001). ANSI/ASHRAE/IESNA Standard 90.1-2001 Energy Standard for Buildings Except Low-Rise Residential. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers.

[3] ASHRAE. ASHRAE Vision 2020: Producing Net Zero Energy Buildings. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., January 2008.

[4] Barley, C.D.; Deru, M.; Pless, S.; Torcellini, P. (2005). Procedure for Measuring and Reporting Commercial Building Energy Performance. Technical Report NREL/TP-550-38601. Golden, CO: National Renewable Energy Lab.

[5] Brundtland, GH. Our Common Future, Chapter 1: A Threatened Future. s.l.: UN Documents: Gathering a body of global agreements;- A/42/427 Annex, 1987.

[6] City of Boulder. (2006). Solar Access Guide, Building Services Center, Boulder, Colorado.

[7] Deru, M. and P. Torcellini. (2004). Improving Sustainability of Buildings through a Performance-Based Design Approach: Preprint. NREL Report No. CP-550-36276. World Renewable Energy Congress VIII, Denver, CO: August 29−September 3, 2004. Golden, CO: National Renewable Energy Laboratory, 8 pp.

[8] Deru, M. and P. Torcellini. (2006). Source Energy and Emission Factors for Energy Use in Buildings. Technical Report NREL/TP-550-38617. Golden, CO: National Renewable Energy Laboratory. EIA. (2005). Annual Energy Review 2004. Washington, DC: U.S. Department of Energy, Energy Information Administration.

[9] Mermoud, A. (1996). PVSYST Version 3.3. User's Manual. Geneva, Switzerland: University of Geneva, University Center for the Study of Energy Problems.

[10] Public Law 110-140. Energy Independence and Security Act of 2007, Title IV: Energy Savings in Buildings and Industry. Washington, DC: U.S. Government Printing Office, December 19, 2007.

[11] Standard 90-75: Energy Conservation for New Building Design. Atlanta: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1975.

[12] Torcelinni P, Pless S, Deru M, Crawley D. Zero Energy Buildings: A Critical Look at the Definition. Oak Ridge, TN: NREL/CP-550-393833, 2005. Conference Presentation.