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Zero Energy Building – A Passive Approach

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Abstract -
A 'ZERO ENERGY BUILDING (ZEB) is a building with annual net energy consumption nearly equal to zero. With recent advances in building technology ZEB has gained a worldwide attention and it is expected to be delivered and adapted in urban areas on larger scales all around the world by 2025. The reduction in green house gas emission is vital due to exponentially rising global climatic change, hence it is necessary to incorporate passive house designs and renewable energy resources constituting zero energy building. In addition to energy saving, the ZEB also gives comfortable indoor environment to the residents. The basic concept in ZEB is that the heat can be maximum or minimum inside the building envelope based on the outer climatic conditions and this can be achieved by keeping the house airtight and insulated. The basic principle in passive houses is not incorporate heating and cooling systems. ZEB principle is based on the high energy efficiency level and renewable energy systems causing the remaining energy needs of the building seem negligible. This report concentrates on ZEB definitions and various options available in ZEB envelope components such as walls, roofs, glazing, ventilation and also different types of materials that can adopted for thermal comfort and energy efficiency purposes. This review paper emphasizes better ZEB construction, maintenance and adoption in the future..

Keywords: Net Zero Energy Building, Solar energy , wind energy , Green Feature , Economic etc.

1. Introduction

A ZEB design should be a passive sustainable design and this consists of two major steps viz., to reduce building energy demand and to generate electricity at desired standards to achieve energy balance i.e., net zero energy. Thermal insulation is of top priority in maintaining energy efficient building and hence low thermal conductivity materials are developed and existing products are being improvised. ZEB have gained significant attention post 2010 and by 2020 it is expected that majority of the buildings in the major cities of the world would have adopted alternative renewable energy resources, stepping towards net zero energy. The Green building market worth is expected to be around 364.6 billion dollars by 2022 world-wide [8];

Hence it is a driving concept in both residential and non residential sector. In India, the net market status of green buildings is estimated to be between 30 – 50 billion dollars by 2022 [1].

The energy used by the building sector continues to increase, primarily because the new buildings are constructed faster than the old ones being retired. Recent years have seen a renewed interest in environmental-friendly passive building energy efficiency strategies. They are being envisioned as a viable solution to the problems of energy crisis and environmental pollution. Therefore ZEB should become a core concept that needs to be followed by all construction sectors, especially housing stock. Residential building is a simple model to create awareness among the public about new technologies and its benefits. This project provides the review on various passive energy efficient options available for different building components such as walls, roofs, glazing etc [2].

Fig.1. Zero Energy Building (ZEB)

2. Problem Identification

The acute problem of carbon dioxide emissions reduction into the atmosphere becomes more important due to the fact of the global climate change. Housing stock consumes 30 to 40% of all energy resources, according to various estimates. As the result, it is possible to get carbon dioxide atmosphere emissions reduction due to energy consumption reduction. The problem of housing stock energy efficiency improvement becomes very important. Transition to low energy consumption buildings construction becomes a trend which in the nearest future will transform to the task of Applied Research in the field of design and construction. Such exploration object is to design buildings with zero energy consumption or close, which is planned

construct on the site of the Polytechnic University. The novelty of the project consists in an integrated approach of the house design, which will be entirely autonomous and independent from the urban networks.

3. Objective

- ZEB principle is based on the high energy efficiency level.
- Use of renewable energy systems like solar , wind Hydro for causing the remaining energy needs of the building seem negligible or zero.
- To concentrates on ZEB definitions and various options available in ZEB envelope components such as walls, roofs, glazing, ventilation.
- To emphasizes better ZEB construction, maintenance and adoption in the future.

4. Literature Survey

The reviewed literature has indicated that there is wide diversity among ZEB definitions. Thus the definitions are divided into a number of groups in order to spotlight the most important topics for the discussion before formulating a ZEB definition. In the report, written in 2006 by Torcellini et al., authors use the general definition for ZEB given by The U.S. Department of Energy (DOE) Building Technologies Program:"A net zero energy building (ZEB) is a residential or commercial building with greatly reduced energy needs through efficiency gains such that the balance of energy needs can be supplied with renewable technologies." However they also point out clearly undefined "zero": "Despite the excitement over the phrase "zero energy," we lack a common definition, or even a common understanding of what it means." Considering different definitions of Zero Energy Building Torcellini, et al. (2006), distinguish and point out four most commonly used definitions:

- ***Kilkis, (2007)*** in his work refers to Torcellini, et al. (2006) however, in the discussion on ZEB definitions, he takes slightly another direction. Kilkis indicates that in balancing the "zero" both quantity and quality (energy) of energy should be taken into consideration, since only by using energy we are able to assess the complete impact of the building on the environment. Therefore ,author proposes a new definition for the ZEB a Net-Zero Energy Building and defines it as " a building, which has a total annual sum of zero energy transfer across the building-district boundary in a district energy system, during all electric and any other transfer that is taking place in a certain period of time".
- ***Saitoh, (1984) and Saitoh, et al. (1985)*** in their Studies present a Natural Energy Autonomous House in Japan. According to authors: ". A Multi-purpose natural energy autonomous house will meet almost all the energy demands for space heating and cooling as well as supply of hot water for standard Japanese house in 10-15 years. For this purpose, solar energy, the natural underground coldness and sky radiation cooling are utilized."
- ***Iqbal, (2003):*** "Zero energy home is the term used for a home that optimally combines Commercially available renewable energy technology with the state of the art energy Efficiency construction techniques. In a zero energy home no fossil fuels are consumed and its annual electricity consumption equals annual electricity production. A zero energy home may or may not be grid connected"
- ***Lausten, (2008),*** "Zero Net Energy Buildings are buildings that over a year are neutral, meaning that they deliver as much energy to the supply grids as they use from the grids. Seen in these terms they do not need any fossil fuel for heating, cooling, lighting or other energy uses although they sometimes draw energy from the grid."

5. Design and Implementation of ZEB

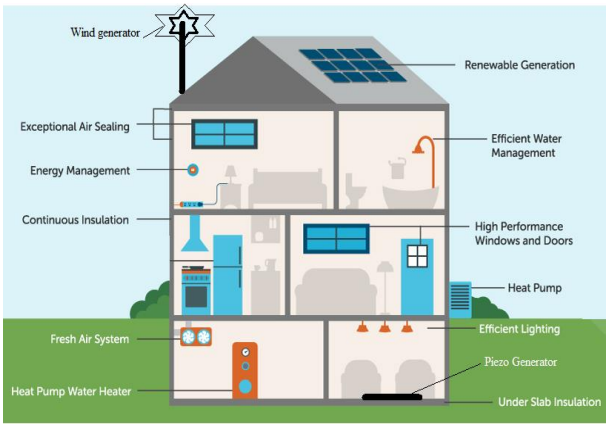

Fig. 2. Features of ZEB

6. Working Principle

The most cost-effective steps toward a reduction in a building's energy consumption usually occur during the design process. To achieve efficient energy use, zero energy design departs significantly from conventional construction practice. Successful zero energy building designers typically combine time tested passive solar, or artificial fake conditioning, principles that work with the on-site assets. Sunlight and solar heat, prevailing breezes, and the cool of the earth below a building, can provide daylighting and stable indoor temperatures with minimum mechanical means. ZEBs are normally optimized to use passive solar heat gain and shading, combined with thermal mass to stabilize diurnal temperature variations throughout the day, and in most climates are superinsulated.

All the technologies needed to create zero energy buildings are available off-the-shelf today.Sophisticated 3-D building energy simulation tools are available to model how a building will perform with a range of design variables such as building orientation (relative to the daily and seasonal position of the

sun), window and door type and placement, overhang depth, insulation type and values of the building elements, air tightness (weatherization), the efficiency of heating, cooling, lighting and other equipment, as well as local climate. These simulations help the designers predict how the building will perform before it is built, and enable them to model the economic and financial implications on building cost benefit analysis, or even more appropriate – life cycle assessment.

Zero-energy buildings are built with significant energy-saving features. The heating and cooling loads are lowered by using high-efficiency equipment, added insulation, high-efficiency windows, natural ventilation, and other techniques. These features vary depending on climate zones in which the construction occurs. Water heating loads can be lowered by using water conservation fixtures, heat recovery units on waste water, and by using solar water heating, and high-efficiency water heating equipment. In addition, daylighting with skylights or solartubes can provide 100% of daytime illumination within the home.

Nighttime illumination is typically done with fluorescent and LED lighting that use 1/3 or less power than incandescent lights, without adding unwanted heat. And miscellaneous electric loads can be lessened by choosing efficient appliances and minimizing phantom loads or standby power. Other techniques to reach net zero (dependent on climate) are Earth sheltered buildingprinciples; superinsulation walls using straw-bale construction, Vitruvianbuilt pre-fabricated building panels and roof elements plus exterior landscaping for seasonal shading.

Zero-energy buildings are often designed to make dual use of energy including white goods; for example, using refrigerator exhaust to heat domestic water, ventilation air and shower drain heat exchangers, office machines and computer servers, and body heat to heat the building. These buildings make use of heat energy that conventional buildings may exhaust outside. They may use heat recovery ventilation, hot water heat recycling, combined heat and power, and absorption chiller units.

7. Benefits of Net Zero Energy Buildings

- **Increased Value:**

NZEBs can improve or maintain your competitive advantage against other buildings, improve the value of your property, mitigate market risk, while also promoting the health and wellbeing of the building occupants.

- **Saves Money:**

The buildings are 60-90 percent over energy efficiency baselines. This means that a project will save money in the long-run over the entire lifecycle of its equipment, as well as in energy and maintenance costs.

- **Educational:**

NZEBs serve as a great way to show the benefits of energy-efficiency to the world. Everyone who is involved during the design, construction, and operations, as well as the occupants working inside the facility, gain valuable knowledge and understanding about energy-efficiencies and the technology used. Also, occupants can make connections and will learn how to limit their own energy use in their personal lives.

- **Reduces greenhouse gases:**

By limiting building's dependence on fossil fuels, or even eliminating any need for them, NZEBs are creating a more resilient future that benefits us, younger generations, and the world.

8. Conclusion

The main goal of this concept is to give guidance used to build a Zero Energy building, different strategies in selecting materials and equipment for building envelope, Electrical system, Mechanical system and designing software to analyze load in a building.

Not only this strategy can be used in new construction but also for retrofitting old buildings which can reduce the energy consumption of the existing building.

So as buildings are one of the major factor for consumption of electricity, it is viable to built a house that can generate its own electricity.

References

[1]. Shanti Pless and Paul Torcellini, Net-Zero Energy Buildings: A Classification System Based on Renewable Energy Supply Options, *Technical Report NREL/TP-550-44586 June 2010, prepared under Task Nos.* BEC7.1210, BEC7.1123, http://www.osti.gov/bridge.

[2]. M. Gonzalez, R. Machado, J. Gonzalez, Fatigue analysis of PE-100 pipe under axial loading, American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP 6 (PARTS A AND B) (2011) pp. 905-911.

[3]. N.I. Vatin, D.V. Nemova, P.P. Rymkevich, A.S. Gorshkov, Influence of level of thermal protection walling on the value of heat losses in a building, Magazine of Civil Engineering (8) (34) (2012) pp. 4-14.

[4]. M. Tenpieric, W. Van der Spoel, H. Cauberg, An analytical model for calculating thermal bridge effects in high performance building enclosure, Journal of Building Physics 31 (2008) pp. 361-387.

[5]. Paul A. Torcellini, Drury B. Crawley, Understanding Zero-Energy Buildings, ASHRAE Journal, September 2006.

[6] Wei Li, Jinzhong Zhu, Zhimin Zhu, The Energy-saving Benefit Evaluation Methods of the Grid Construction Project Based on Life Cycle Cost Theory, Energy Procedia 17(A) (2012) pp. 227–232.

[7] I. Gabriel, Kh. Ladner., Rekonstruktsiya zdaniy po standartam energoeffektivnogo doma: Per. s nem. (Reconstruction of buildings on energy efficiency standards at home),SPb.: BKhV-Peterburg, (2011) p. 480.

[8] A.S. Gorshkov, S.A. Baykova, A.S. Kryanev, Normativnoye i zakonodatelnoye obespecheniye gosudarstvennoy programmy ob energosberezhenii i povyshenii energeticheskoy effektivnosti i primer yeye realizatsii na regionalnom urovne (Normative and in legislative provision of the state program on energy conservation and energy efficiency and an example of its implementation at the regional level), Inzhenernyye sistemy. AVOK Severo-Zapad 3 (2012) p. 24.
[9] V. Serra, F. Zanghirella, M. Perino, Experimental evaluation of a climate facade: energy efficiency and thermal comfort performance, Energy and Buildings 42(1) (2010) pp. 50-62.
[10] K. Gertis, Zdaniya XXI veka -zdaniya s nulevym potrebleniyem energii (Buildings of the 21st century - building zero-energy), Energosberezheniye 3 (2007) pp. 36-47.

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