IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DESIGN OF ZERO ENERGY BUILDING FOR SUSTAINABLE CONSTRUCTION: A REVIEW

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ABSTRACT

In the future, to reduce carbon dioxide emission in the atmosphere of the earth and protecting the earth environment, mankind will be forced to do a lot less energy for heating than it uses it still. If we add to this that the stocks of non-renewable energy resources are finite, it should be recognized that the main characteristic of the future buildings is ultra-low energy consumption and even energy consumption close to zero. And many countries have established similar standards of energy consumption. ZEBs have the promising to reduce the significant energy use and as well to increase the overall share of renewable energy. However, in order not to fall short of expectation, there is a need for commonly agreed ZEB definition framework and a robust 'zero' calculation methodology. This framework should allow for a variety of solution sets and not focus only on PV based solution sets, as this strategy is mainly addressing small and new buildings.

Key words- Net Zero-Energy Buildings; Sustainable building; Ecofriendly buildings.

INTRODUCTION

Increasing public and political awareness and concern regarding climate change and global environmental degradation is translating into a greater demand for demonstrated environmental responsibility across all sectors of society. Within the building industry this is manifest in the demand for higher environmental performance requirements of buildings. Moreover, this development is occurring concurrently with a host of other significant shifts: greater interest in systems approaches and associated synergies between strategies, acknowledging relationships between buildings and infrastructure rather than a sole focus on individual buildings, and the recognition and engagement in local/community initiatives as a powerful means to effect positive change. Energy consumption and requirment of residential buildings has grown fast in recently years, thus raising a challenge on zero energy residential building (ZERB) systems, the main aim at substantially reducing energy consumption of residential buildings. Thus, how to facilitate ZERB has become a hot but difficult topic. In the paper, we put forward the overall design principle of ZERB based on analysis of the systems' energy demand. In particular, the architecture

for both schematic design and passive technology is optimized and both energy simulation analysis and energy balancing analysis are implemented, followed by committing the selection of high-efficiency appliance and renewable energy sources for ZERB residential building.

AIM

1. To Achieve important criteria for sustainable building.
2. Net zero energy building be achieve in climate zone of Pune.
3. The aim of this research is assessing the net zero energy building requirement for sustainable construction. For achieving this goal, a comprehensive research of the relevant literature is done as well some cases are employed for better illustration of the topic.

LITERATURE REVIEW

1) Liping Wang, Julie Gwilliam, Phil Jones (2009) "Case study of zero energy house design in UK" -Possible solutions for zero energy building design in UK are discussed in this paper. Simulation software (Energy Plus and TRNSYS 16) are employed in this study, where Energy Plus simulations are applied to enable facade design studies considering building materials, window sizes and orientations and TRNSYS is used for the investigation of the feasibility of zero energy houses with renewable electricity, solar hot water system and energy efficient heating systems under Cardiff weather conditions. Various design methods are compared and optimal design strategies for typical homes and energy systems are provided.

2) A.M.S. Kashkooli (2013) "Clarifying Net Energy Positive Design"- This paper is directed at clarifying the notion of net energy positive design with particular focus on what constitutes appropriate boundaries, baseline conditions and associated timeframes. Over the past decade, numerous building projects have been presented as "net zero" energy or carbon "neutral." Such claims have been made through using a variety of different approaches – onsite renewable energy technologies, carbon sequestration, purchasing green energy credits, etc. Efforts have subsequently been directed at formulating clear definitions of net zero and carbon neutral and these have provided some degree of clarity and theoretical framing of these notions. The emerging notion of "net positive energy" which, rather than simply being considered an extension of net-zero energy, raises a host of new theoretical and practical issues.

3) Ion Visa, Macedon D. Moldovan* , Mihai Comsit, Anca Duta (2013) "Improving the renewable energy mix in a building toward the nearly zero energy status"- Developing Nearly Zero Energy Buildings (NyZEB) represents a path toward sustainable communities and is required by international regulations, starting with 2018. Combined measures for reducing the energy demand and increasing the share of renewable energy systems in buildings are very much

investigated for different types of buildings. One specific case is represented by the buildings where – as result of the green energy policies – renewables are already installed, but the NyZEB status is not reached yet. These buildings are main candidates in getting this status as the initial investment required is significantly lower.

4) A.J. Marszal, P. Heiselberg, J.S. Bourrelle, E. Musall, K. Voss, I. Sartori , A. Napolitano (2010) "Zero Energy Building – A review of definitions and calculation methodologies"- The concept of Zero Energy Building (ZEB) has gained wide international attention during last few years and is now seen as the future target for the design of buildings. However, before being fully implemented in the national building codes and international standards, the ZEB concept requires clear and consistent definition and a commonly agreed energy calculation methodology.This paper focuses on the review of the most of the existing ZEB definitions and the various approaches towards possible ZEB calculation methodologies. It presents and discusses possible answers to the abovementioned issues in order to facilitate the development of a consistent ZEB definition and a robust energy calculation methodology.

5) Saravan Devraj, N Kapilan, T Nagaraja, Albert M (2018)- Studies on Zero Energy Building- It is reported that 30 to 40% of all of the primary energy used worldwide is used in buildings. This high energy use may directly or indirectly affects the environment. Also it causes climatic changes, degrades the environment and increases the air pollution. Hence it is necessary to reduce the energy consumption in the building and necessary steps to be taken to make the buildings more environmentally sustainable. In recent years, zero energy building concepts is developed to overcome this problem. The zero energy building uses natural energy sources to meet the energy requirements of the building. In this work, the authors have carried out a study to analyze the performance of a zero energy building and found that it is possible to have such building in India.

6) P. Torcellini, S. Pless, and M. Deru, D. Crawley (2006) "Zero Energy Buildings: A Critical Look at the Definition"- This study shows the design impacts of the definition used for ZEB and the large difference between definitions. It also looks at sample utility rate structures and their impact on the zero energy scenarios. The way the zero energy goal is defined affects the choices designers make to achieve this goal and whether they can claim success. The ZEB definition can emphasize demand-side or supply strategies and whether fuel switching and conversion accounting are appropriate to meet a ZEB goal. Four well-documented definitions—net-zero site energy, net-zero source energy, net-zero energy costs, and net-zero energy emissions—are studied; pluses and minuses of each are discussed. These definitions are applied to a set of low-energy buildings for which extensive energy data are available.

7) M. Kapsalaki , V. Leal, M. Santamouris (2012) "A methodology for economic efficient design of Net Zero Energy Buildings"- A methodology for assisting the choice of economically efficient NZEB solutions from the early design stage is now available. Its use in practice may be of great relevance as the results showed that the differences

between an economically efficient and economically inefficient NZEB can be over three times both in terms of initial and life cycle cost.

8) Georgios Tsalikis, Georgios Martinopoulos (2015) "Solar energy systems potential for nearly net zero energy residential buildings" - Solar energy systems are currently the most widely installed renewable energy systems in the building sector in an effort to reduce the energy consumption of buildings. This paper investigates solar potential regarding photovoltaic and solar thermal utilization in typical residential buildings in order to identify their impact towards nearly Net Zero Energy Buildings (NZEB). Different options regarding the installed capacity of photovoltaics and solar combi systems in various locations and climatic conditions are evaluated from a technical as well as from an economic point of view. The results indicate that in all cases, photovoltaics are able to cover the annual electricity demand of a residential building with a payback period of less than 7 years. In the case of solar combi systems, payback period ranges between 5.5 and 6.5 years when compared with a conventional fuel oil heating boiler and 9 years when compared with a natural gas boiler, providing at least 50% of the total heating demand of the buildings. In total, solar energy systems are able to cover at least 76% of the primary energy demand of residential buildings proving that they are a viable solution towards NZEB.

9) D. Kolokotsa a , D. Rovas , E. Kosmatopoulos, K. Kalaitzakis (2011) – "A roadmap towards intelligent net zero- and positive-energy buildings"- aim of the present paper is to present a review on the technological developments in each of the essential ingredients that may support the future integration of successful NZEB/PEB, i.e. accurate simulation models, sensors and actuators and last but not least the building optimization and control. The integration of the user is an integral part in the dynamic behavior of the system, and this role has to be taken into account. Future prospects and research trends are discussed.

10) Robert, A., & Kummert, M. (2012). "Designing net-zero energy buildings for the future climate, not for the past."- This paper investigates the use of the downscaling method known as "morphing", proposed by Belcher et al. (2005), to generate weather data files. The impact of using these weather files on the energy performance of an actual NZEB is then assessed. Morphing is applied to typical "horizon years" representative of future climate and also on a month-by-month and year-by-year basis using raw data from a selected GCM. A 50-year series of hourly weather data is obtained and analyzed for two different locations, Montréal (QC) and Massena (NY). The data are then used to simulate the performance of a netzero energy home as it was designed using historical data. The results show that the building misses the net-zero energy target for most years. The year-to-year variability of the total energy use is relatively small but the impact on the energy excess or shortage in relation to the net-zero target is significant.

STRATEGIES TO A ZERO NET ENERGY BUILDING

Strategies were studied, verified, evaluated, retested and assessed. There could also be interactions amongst strategies, which mean that a notion studied in one stage might impact another notion endeavored under a dissimilar stage. Also, strategies might neutralize each other or be useless. Step 1 concentrated on costless strategies because

they produce natural resources, like daylight, or include strategies that improve the performance of the systems and envelope. Step 2 concentrated on strategies with energy efficiency which decrease energy consumption. Step 3 studied systems which produce renewable energy to power the building. Step 4 concentrated on operations of building, a key step in attaining Net Zero Energy Building. This is the point where educational outreach and policy turn into a fundamental part of keeping the behavior of low energy consumption.

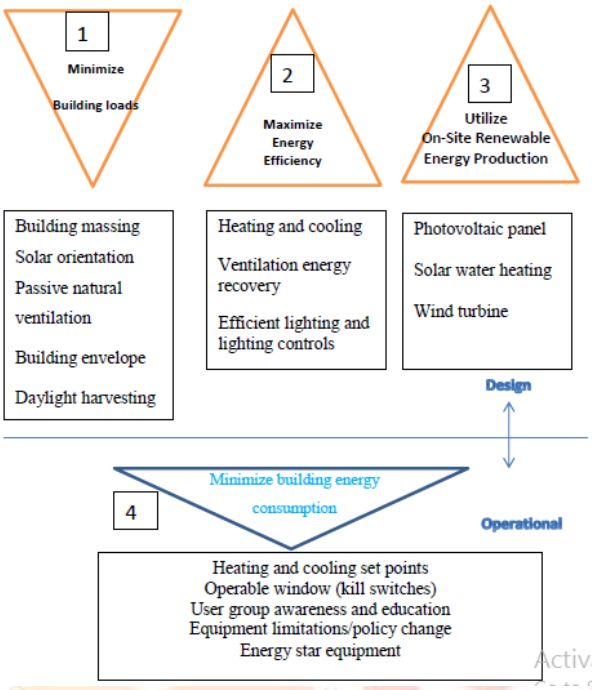
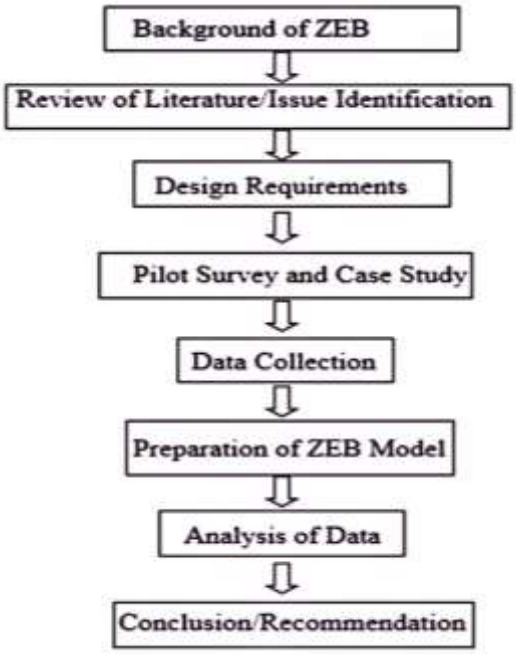


Fig: Strategies to a zero net energy building

METHODOLOGY

1. The following steps were adopted in order to achieve the objective of this study of energy efficiency of the designed building:
2. Create sustainable category definitions and background study for sustainable construction through literature surveys and study of materials through data collection
3. Evaluation of object of the research.
4. Conduct online research to find projects and project information and Conduct data analysis and thorough investigations of Feasibility of sustainable construction through available case studies.
5. Layout the problem statement concluded from the above study and provide Architectural and space solutions of energy efficient methods to be adopted for the construction maintenance and performance of sustainable buildings.
6. Perform Life Cycle Assessment of sustainable buildings
7. Perform Design/Energy Analysis and propose frameworks, grid analysis, and Temperature Test Results.
8. Propose various applications and benefit campaigns for encouragement of use of sustainable buildings in India. The study of actual problem in adoption of sustainable buildings, its Remedies and Benefits will be produced.



Flow Chart

CONCLUSION

1. What are the important criteria for achieving net zero energy building with sustainable construction?
2. And, how could a sustainable building be achieved in different climate zones?
3. What are the planning and design changes necessary for development of a sustainable building?
4. The building designed as a sustainable building and produces its own electricity, thus it can save a huge amount in electricity bill.

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