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# A Review Paper on Green Building Research

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***Abstract:*** ***Green building technology is one of the most trending topics all over the world which is been put forward to reduce the significant impact of the construction industry on the environment, society and economy. The globe is in an urgent need of sustainable and a smart development as the problem of pollution and global warming is rapidly increasing all over the world. A drastic climatic changes also been noticed and being experienced all over the world due to increase in the Green House Gases (GHG's). In the developed countries like United States of America, Russia, Australia, United Kingdom, there are already strict measures been taken to achieve a sustainable development and also rules and regulations are been made by their respective governments to support and achieve a sustainable and an eco-friendly development of their nations. However, in the developing countries like India, China, Srilanka, Pakistan, etc., they are far behind in achieving a sustainable development and eco-friendly constructions. Also, there is a lack of awareness amongst the people about this global issue in these developing countries. The studies and the research work in these countries is also way far behind as compared to the developed nations in the world. This paper presents the need of sustainable development all over the globe especially in the developing countries like India and China which have a huge land mass and also developing rapidly and heading towards becoming the new super powers of the world soon in the future. Also, it includes the sustainable and economic studies with references to the Indian contexts with a supporting live recent case study of a newly designed and constructed luxurious residential bungalow in a small town in India. The case study is specially selected as a residential bungalow which is designed and constructed as a sustainable and a green structure in a small town in the state of Maharashtra in India as India is also known as a country of villages with a second largest population in the world. According 20 the 2011 census of India, 68.84% of Indians i.e. around 833.1 million people live in 6,40,867 different villages. This paper will help Indian villages and their residential buildings develop sustainable and green by implementing easy, simple and economic techniques.***

***Keywords: GRIHA (Green ratings for integrated habitat assessment); IEQ (indoor environmental quality, LEED (Leadership in energy & environmental design)***

## I. INTRODUCTION

There are many definitions of a Green building as per different researchers. It is also worth noting that the term green building is now days used as an interchangeable word with the high performance buildings or a sustainable buildings or structures. The concept of Green Building basically stands on four main points which are

*1)* Reduction of the effects or rather the side effects of the structure on the environment.
*2)* Improving and enhancing the health conditions of the occupants in a structure.
*3)* Savings and returns on investments to the investors and the community.
*4)* Life cycle considerations during the planning and development process.
*5)* Construction industry is one of the most rapidly developing industries all around the world.

At the same time the construction industry has significant economic, environmental and social impacts on the society. These impacts are largely seen during the lifecycle of the constructed structures. Also, there are positive as well as negative impacts of construction activities on the society. Some of the positive impacts include providing buildings and habitats along with the facilities to satisfy the human requirements, providing employment to the people of the nation and finally, contribute towards the economy of the nation. Also, the negative impacts include waste disposal during the construction activities, dust, noise pollution, water pollution, traffic congestion, etc. Also, the negative impacts continue throughout their life cycle. A building block accounts for 40% of total energy consumption according to the world business council for sustainable development. Apart from the energy consumption, the buildings produce Green House Gas emissions (GHG's) which are responsible for the global warming. According to the researchers, the carbon emission of buildings across the world will reach 42.4 billion tonnes in 2035, adding 43% on the levels of 2007. Also, these activities will include the consumption of natural resources and energy, noise and other types of pollutions and also associated with the waste production post building demolition poses a new challenge to all those countries having an issue of limited land.

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There have been a lot of research works carried out on the aspects of the green building in different contexts but they all lack in systematic reviews of the existing material of knowledge. The systematic research is very important to identify the common research problems and also highlight the future research methodology. This study will play a critical role to highlight the state of art and future need in this topic for our country India and also for other developing countries interested in developing green construction. This research paper will help developing green buildings and eco-friendly homes in India as it includes easy and simple ways to be implemented for achieving green homes and also the importance and long term profits involving green homes.

## II. RESEARCH BACKGROUND

1). Mr.JiauZuo and Mr. Zhen Yu Zhao carried out their research work on the green building technology and alsostated the current status and also the future agendas for the same. They presented a report on a critical review of the existing body of knowledge of researches related to green building. They identified the common research themes and methodologies and then further carried out their research works. They focused on the common research themes such as the definition and the scope of green building,quantification of benefits of green buildings compared to conventional buildings,various approaches to achieve green building [1]. In their research work they also found that the existing studies played predominantly flows on the environmental aspects of the green building. They state in their research work, the future opportunities such as effect of climatic conditions on the effectiveness of green building assessments tools, validation and real performance of green buildings unique demands of specific population and future proofing.

The author reported a critical review of existing studies related to green buildings worldwide in their research. Their research showed that these studies can generally be classified into three categories namely the definition and scope of green buildings; benefits and costs of green buildings and the ways to achieve green buildings. Also the authors concluded that special population such as aged people, student and teacher could be made moreattention with respect to indoor environmental quality, alsoteachers. Shape the attitude and behaviours of the future practitioners and students will soon become the practitioners of green construction concept [1].

2).IgnacioZabalzaBribian;Antonio VelvoCapilla; Alfonso ArandaUson had published the paper on building and environment in which they presented the results of an lifecycle assumed study comparing the most commonly used building materials with same eco materials by using three different impact categories .the basic aim of authors by publishing this paper is to deeper the knowledge of energy and environmental specifications of the building materials. Also they encouraged the study and analysing their possibilities for improvement and providing guidelines for materials selection in the eco design of new building and also in rehabilitation of existing buildings [2].

The researchers concluded that in order to avoid the production of materials affecting the natural resources, it is necessary to promote the best use of these techniques available and innovation in production. Plants and replace as far as possible the use of finite natural resources with the waste generated in different production processes, closing the cycle of the products[2].Also this involves the commitment to reuse and recycle and always minimizing the transport of the starting materials and products which would promote the use of resources easily available in local areas.

3). Ries; Robert Bilec; Melissa M Gokhen; Nurvi Mehmet Needy and Kim Lascola had published a paper on the economic benefits of green buildings which was a comprehensive study which was supported with a case study

.they stated that in building design and constructions both the green building and standard construction techniques are considered for many building project[3].their final decision also well routinely made based solelyon schedules and budgets and also on the long term effects are often overlooked their assumption effects is that the benefits largely exceeding any added cost of the green building [3].their research investigated the relationship between the composite conventional and green building features which would contribute to the development of the green building metrics.

Their results comprised of four sections:-

- Productivity,health and safety including absenteeism, energy and IEQ[3].
- They also specified that pre and post move surely responses were analysed with paired t-tests to understandwhether there is any static significant change in the mean values of the variables.
- They also concluded the increase in productivity with the help of green building in their published paper[3]. 4). T.rameshravi&Prakash k.k Shukla had published in which he basically their life cycle energy analysis of thebuildings in which he basically stated that buildings demands energy in their life cycle right from its construction to demolition[4].also, their studies includes both the residential and office buildings in which theresults showed operating (80-90%) and embedded (10-

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20%) phases of energy use which are significantcontributors to building life cycle energy demand.as per the research the life cycle energy primary requirement of conventional residential buildings falls in the range of 150-400 kw/hrs per year and that of office buildings in the range of 250-550 kwh/m2 per year. Building lifecycles energy demand can be reduced by reducing its operating energy significantly through the use of active and passive technologies even if it leads to a slight increase in embodied energy.[4]as per the researchers, an excessive of active and passive technologies can even be counterproductive. Theresearchers concluded that the analysis of cases found in literature showed that life cycle energy use of buildings depends on the operating (80-90%) and embodied (10-20%) energy of the buildings. Normalised life cycle energy use of conventional residential buildings falls in the range of 150-400 kwh/m2 per year and office buildings in the range of 250-550 kwh/m2 per year [4].Also their research stated that most of the case studies found in literature are from cold countries where oil or gas is used for large part of the operational phase, that is for space heating. However, according to the researchers in non-cold developing countries like India, Thailand etc., electricity is derived mostly from fossil fuels is been used in operation phase for space cooling, lightning and other purposes[4]

5). Omer Tatari, Murat Kucukvar published a paper on cost premium prediction of certified buildings stated in itthat the built environment has a substantial impact on the economy, society and the environment. Along with the increasing environmental consideration of the building impacts, the environmental assessment of buildings has gained substantial importance in the construction industry. In their study, an artificial technique model is built topredict cost premium of LEED based certified green buildings based on LEED categories. The researchers concluded that the planned future work included utilization of the expanded data sets and the closer study of the interdependence of LEED points and its effect in prediction.

## III. METHODOLOGY

This study is aimed at research, study and development of the green building construction techniques in order to save our planet from pollution and global temperature rise. Also, it aims at spreading awareness among the people all over the world, about the advantages and also the long term cost savings from green buildings.

Further, the structural methodology is structured as below:

1. Introduction
2. Literature survey
3. Study of the research topic in detail
4. To study the research papers, articles and magazines related to the topic of study.
5. Data collection from the proposed areas of study which includes large, medium and small scale constructionprojects.
6. Collection of information with the help of web surveys.
7. Finding out new ways and techniques for development of green construction.

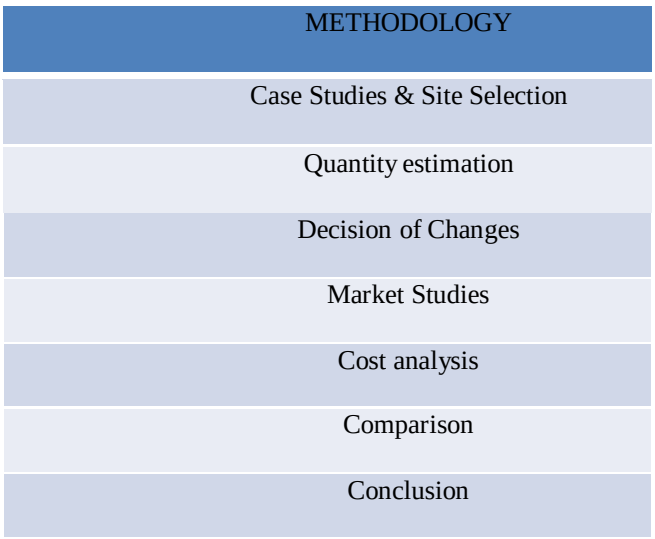



Fig.1. Flowchart of Methodology

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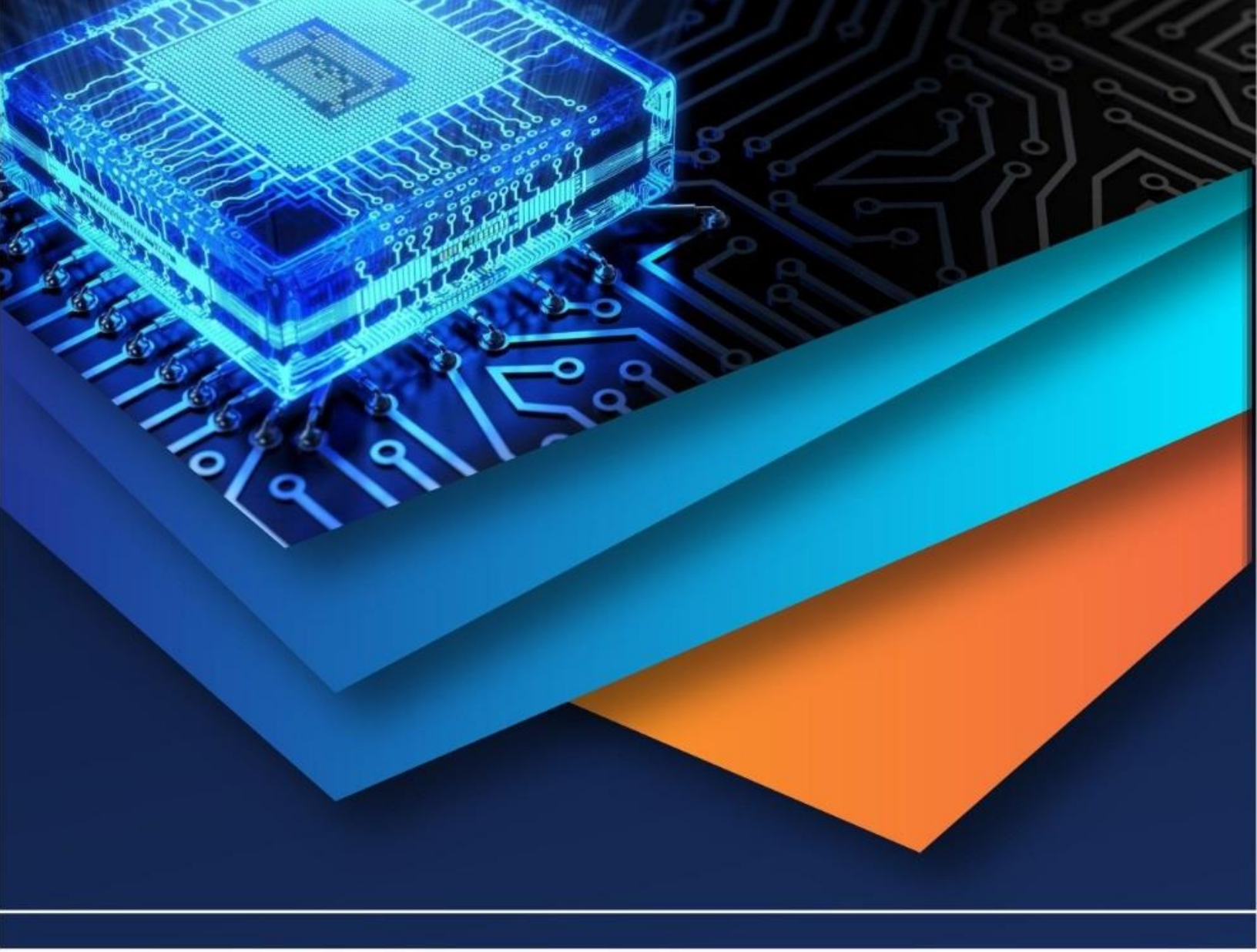
## IV. CONCLUSION

This paper study reported all the technical and also the economic aspects related to green buildings worldwide. Also, through this live case study of a small residential bungalow in a small town of India it is expected to attract at least the researchers all over the world especially in India and also to all the readers towards planning of their new homes or retrofitting their old ones by simple modifications and converting it into a green or a sustainable building for future long term savings (economic aspects) and also for saving our environment (environmental aspects). The conclusion for the studies can be classified into three different categories i.e. definitions and scope of green building, benefits and costs of green building and ways to achieve green building. It has been observed that in most of the literature reviews, the focuses are on environmental aspects of sustainability such as energy consumption, water efficiency and greenhouse gas emissions and also with their technical solutions. Also, the life cycle assessment approach, which is extensively applied in the environmental aspects of green building can be a useful tool for social sustainability. New rating tools are developing rapidly worldwide. But more studies in these fields are required to support these new rating tools and also help in assisting the decision-making for the investors and the developers. Also, awareness amongst the people should be spread about the green building concepts and its long term profits. Current scenario is that people in countrieslike India are ignorant about this concept and also lack of awareness can be observed. Government initiative willhelp largely in spreading awareness.

Also, provisions of educating and training people or the occupants will help to regulate their behaviour of using the green building which may affect the building performance significantly. Also, the discussion on cost and benefits of the green building are quite noticeable. It is also worth noticing that all the leading green building assessment tools are designed according to their local climatic and geographic conditions. Thus to set benchmarks for the world with references to green building, this point needs to be taken into considerations when comparing the effectiveness of these green building rating tools. The case study considered into this research paper is specially selected, designed, and constructed keeping in mind the green building concepts and its necessity to the environment and also to our pockets in the long term considerations. Also, this case study will help in studying awareness about the green building concepts amongst the people of towns and villages of India and help them develop their own green home and promote them to after building it. It is important to spread awareness amongst the people of the villages and towns in a country like India as the majority populationof India lives in villages and towns and not in cities. Also, special population such as aged people, students, and teachers could be paid more attention. Aged people tend to be more vulnerable to the overheating and the indoor environmental quality. Students will become practitioners in the future, also leaders in various sectors. Teachers play a critical role to shape the attitude and behaviour of students towards the sustainability related issues such as the matter of using buildings. Thus, the above mentioned issues serve as items of future agenda for green building related research and also promoting amount of green and sustainable development.

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