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Green Buildings and Sustainable Construction

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ABSTRACT

Green building technology is one of the most popular issues around the world, with the goal of reducing the construction industry's considerable influence on the environment, society, and economy. As pollution and global warming become more prevalent over the planet, the world urgently requires sustainable and intelligent development. Due to a rise in Green House Gases (GHGs), dramatic climatic changes have also been noted and are being experienced all over the world. In industrialised countries such as the United States of America, Russia, Australia, and the United Kingdom, severe steps have already been taken, as well as rules and regulations enacted by their respective governments to support and promote sustainable development. In addition, there is a lack of public knowledge about this worldwide issue in these developing countries. In comparison to the wealthy nations of the world, these countries' studies and research activities lag considerably behind. This paper discusses the importance of sustainable development around the world, particularly in developing countries such as India and China, which have large landmasses and are fast developing, with the potential to become new world superpowers soon. It also covers sustainability and economic research with connections to Indian contexts, as well as a case study of a newly designed and built magnificent residential bungalow in a small town in India. The case study is a residential bungalow that was designed and built as a sustainable and green structure in a tiny town in the Indian state of Maharashtra, as India is recognised as a land of villages with the world's second-highest population. According to India's 2011 census, 68.84 per cent

of the population, or approximately 833.1 million people, live in 6,40,867 distinct villages. By using straightforward, simple, and cost-effective strategies, this study will assist Indian communities and residential buildings in becoming more sustainable and greener.

Keywords- GRIHA (Green ratings for integrated habitat assessment), Building, India, Climate, Sustainable, Construction, Green Roof & Greenhouse etc.

INTRODUCTION

The construction sector has substantial-good and negative environmental, economic, and social implications in any part of the world. Construction sector activities provide job possibilities to a huge number of individuals in addition to supplying the requisite number of buildings and facilities to human beings. Noise, traffic congestion, dust, fumes, water pollution, and garbage disposal are all detrimental effects of building activity. The need for considerable infrastructure expansion was felt as a result of developing technology and expanding population. To accommodate the growing population, a growing number of structures are necessary, necessitating the identification of effective solutions for reducing environmental impacts.

In India, challenges of sustainable construction techniques are becoming more prevalent. The growing worry about the negative consequences of construction-related activities, as well as the need to resolve them, has been featured in newspaper headlines daily. Considering this, India's government has already taken proactive measures to promote the green building as a means of improving environmental and social protection. Developers should remodel their existing construction techniques and implement sustainable construction procedures in their future projects, given the growing concern about environmental degradation. The rate at which all involved developers and builders accept this component of construction, on the other hand, is determined by the amount of awareness, knowledge, and comprehension of the repercussions of each individual activity. This goal is aligned with this goal. According to various experts, there are a variety of definitions of a green building. It's also worth mentioning that the term "green building" is increasingly synonymous with "high-performance buildings" or "sustainable buildings or structures." The concept of green building is based on four main points: reduction of the structure's effects, or rather a side effects, on the environment; reduction of the structure's impact on the environment; reduction of the structure's impact on the environment; reduction of the structure's impact on the environment; and reduction of the structure's impact. Improving and increasing the health of a structure's occupants. Savings and returns on investment for investors and the community.
During the planning and development process, consider the life cycle. Construction is one of the world's fastest-growing sectors.

In 2001, the Confederation of Indian Industries (CII) established the International Green Building Council (IGBC) in collaboration with the USGBC and the World Green Building Council. When the first green building, the Sohrabji Godrej Green Business Centre, was launched, it was a watershed moment for the country. The Indian green construction market is expected to be worth $40 billion by 2020, and it is expected to continue to develop. Buildings utilise a significant number of natural resources. With the rising demand for housing, it is crucial for the building sector to develop alternatives that will meet the demands of future generations while also preserving the environment. Even though the notion of sustainability has gained traction, a large portion of the population is still sceptical of the concept and its accompanying benefits. Few developers' actions in the area of sustainability will not have a positive impact on the industry. As a result, a

concerted effort by developers is required to transition from a traditional construction method to a more sustainable one. The developers' awareness and knowledge are crucial in this regard. The greater the number of developers who are aware of the notion, the more likely it is to be adopted. The current study aims to determine the extent of developer awareness of sustainable construction in India.

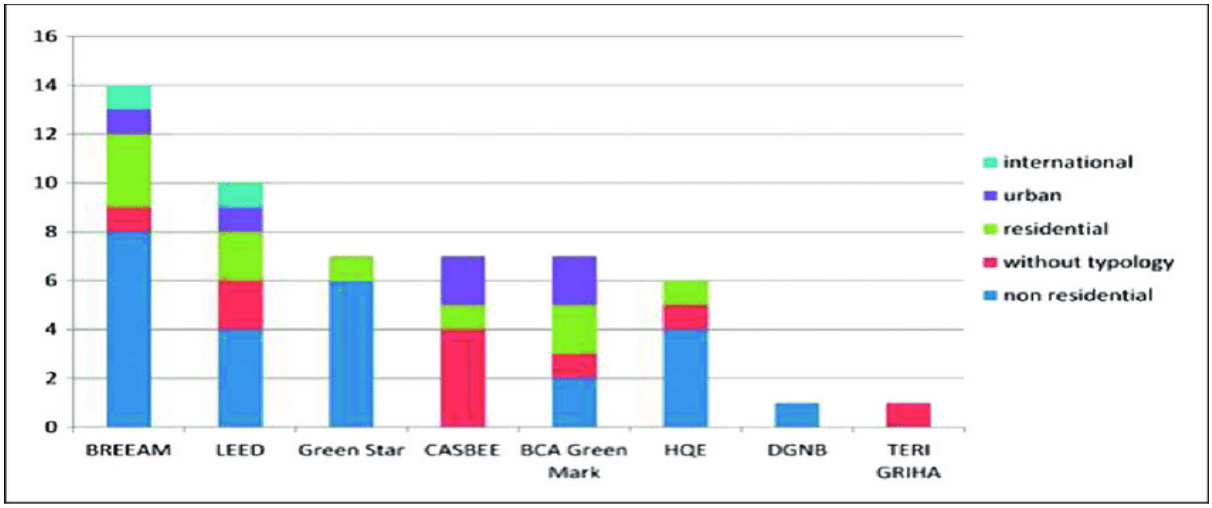
The objectives of the study are as follows:

- To identify the Sustainable Construction initiatives been organized in India.
- To assess developers' Awareness of Sustainable Construction in India.
- To assess the economic benefits of sustainable construction in terms of cost of construction and sale of products.

NEED OF GREEN BUILDING AND SUSTAINABLE CONSTRUCTION

Sustainable buildings are increasingly being shown to give financial benefits to building owners, operators, and occupants. Energy, water, maintenance/repair, churn (reconfiguring space due to changing needs), and other running costs are often cheaper in sustainable buildings. These cost savings don't have to come at the expense of larger upfront expenses. The initial cost of a sustainable building can be the same as, or lower than, that of a regular building, thanks to integrated design and innovative use of environmentally friendly materials and equipment. Although some sustainable design features have greater initial costs, the payback period for the added investment is often short, and the lifecycle cost is typically lower than that of more traditional structures.

In addition to direct cost savings, eco- friendly buildings can provide indirect economic benefits to both the building owner and society. For instance, eco- friendly sustainable building features can promote better health, comfort, well-being, and productivity of building occupants, which can reduce levels of absenteeism and increase productivity. These features can offer owners economic benefits from lower risks, longer building lifetimes, improved ability to attract new employees, reduced expenses for dealing with complaints, less time and lower costs for project, resulting from community acceptance and support for sustainable projects, and increased asset value. Eco-friendly buildings also offer society, economic benefits such as reduced costs from air pollution damage and lower infrastructural costs, e.g., for avoided landfills, wastewater treatment plants, power plants, and transmission/distribution lines.



THE AIM OF THIS STUDY is to know the importance and significance of the various factors, involved in construction of the eco-friendly housing, the requirements of which can be listed as below: -

- To upgrade the construction of sustainable house.
- To introduce roof gardening.
- To upgrade the house in maintaining a good thermal comfort inside the building.
- To demonstrate and popularize the technology of roof gardening and insulated cavity wall.
- Use of energy efficient materials which consume less energy.

RESEARCH METHODOLOGY

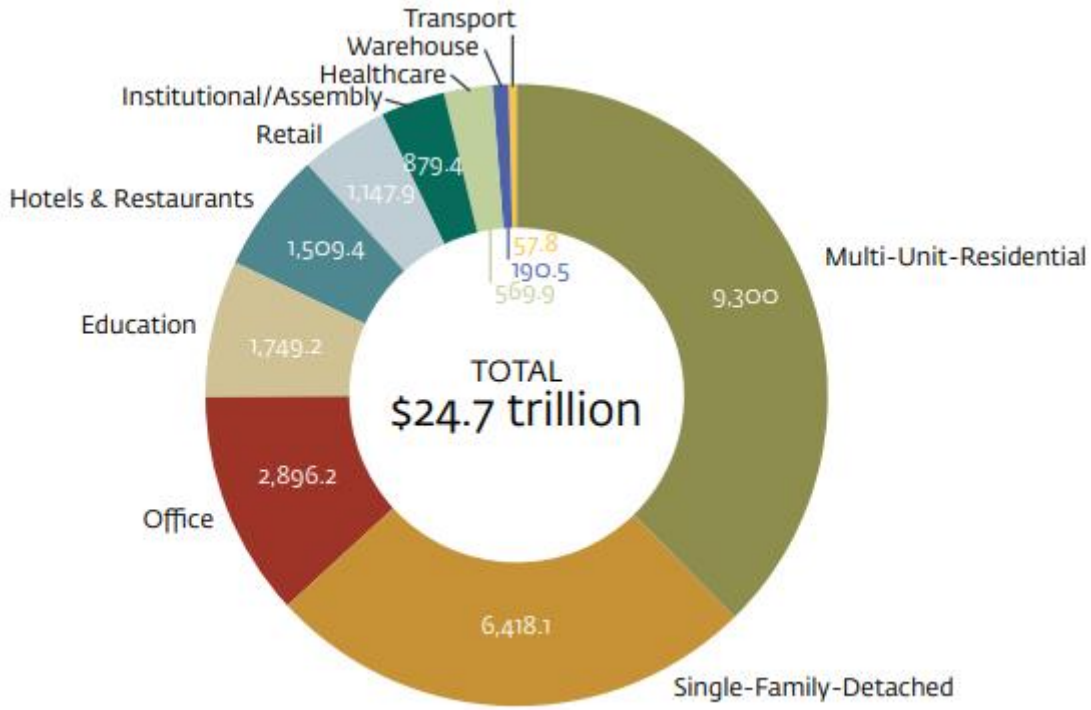
This research aims to investigate, study, and develop green building construction approaches in order to protect our planet from pollution and global warming. It also strives to raise awareness among people all around the world about the benefits of green buildings, as well as the long-term cost savings. A descriptive study was conducted in the Delhi-National Capital Region (NCR) region to determine the extent of developer awareness of the green building concept. For the study, data from the civil works registration department was used to randomly choose 50 civil engineers and 50 real estate marketing agents involved in green construction projects. The developers' perceptions of the motivations and economic benefits of green buildings were assessed through semi-structured interviews. As a result, this study is both qualitative and quantitative. To capture the required information, a five-point awareness scale (Likert Scale-Strongly Agree–Strongly Disagree) was created, authorised, and used. The questions in the survey were aimed to learn about developers' knowledge of the subject and whether they have included this component into their current and previous projects. The extent of knowledge of sustainable construction principles was measured in terms of the financial, social, and environmental benefits of becoming green. It was also calculated the level of awareness and willingness to Act by Making Necessary Changes to Implement Green Building Practices. Furthermore, the government's involvement in promoting green building construction methods is evaluated. The information gathered was examined both quantitatively and qualitatively. There was also a structured and unstructured video interview. Finally, relevant recommendations are given based on present attitudes and awareness.

LITERATURE REVIEW

Environmental preservation, social well-being, and economic prosperity are the three main pillars that guide the notion of sustainable construction. In the literature, energy and water savings, decreased maintenance costs, enhanced property value, higher tenant satisfaction, improved productivity, health advantages, and lower CO2 and waste emission are all mentioned as benefits of green buildings. Green construction is becoming increasingly popular among building professionals throughout the world. Any emerging country's growth can only be sustained if its infrastructure capacity expands. With the growing worldwide interest in sustainability, there is a growing need for the Indian construction industry to create sustainable construction processes to compete.

Numerous factors have been identified as contributing to the growth of the green construction movement, according to studies. Rapid adoption of the LED green building rating system, supportive legislative policies, executive orders, rules, regulations, and policy interventions by the government, advancement in green building technology, environmental impact followed by tenant demand, financial benefits, corporate social

responsibility, land use regulations and urban planning policies, resource depletion and degradation, re-engineering the design process, and product innovation are just a few of the factors. As a result, green building projects are motivated by either the need for environmental sustainability or the desire to minimise building operating costs. Intensifying the sustainability movement requires increased awareness and expertise. Green building approaches are becoming more popular as people become more aware of the negative effects of construction-related activities.



An Estimated $24.7 Trillion Investment Potential in Green Buildings by 2030, Says IFC Report

The principles of green construction should be followed at every stage of a green building's life cycle, from planning to destruction. Reduce, reuse, recycle, protect nature, eliminate pollutants, life-cycle costs, and quality are some of these ideas (Kibert, 2016). Furthermore, the resources needed to carry out building activities, such as land, water, energy, and materials, should be in line with construction industry principles. The Confederation of Indian Sector (CII) is an organisation dedicated to developing and expanding the Indian construction industry without jeopardising the society's environmental well-being. It is a non-profit organisation that contributes significantly to the growth of the Indian construction industry.

Since developers have been identified as major participants in implementing the objective of sustainable construction, several seminars, professional presentations, and conferences on the subject have been arranged to raise their awareness and knowledge. A growing number of developers are joining the green movement in

the hopes of gaining financial benefits by meeting the needs of green consumers. The study's goal was to determine the amount of public awareness regarding green buildings, their characteristics, and financial benefits.

HYPOTHESIS

H0 - There are no significant connections between building design procedures and the Green Building implementation framework.

H1 - There are significant connections between building design procedures and the Green Building implementation framework.

ANALYSIS

1. Respondent's PROFILE

Civil engineers and market brokers involved in green building projects received the questionnaire survey. The majority of those who took part in the survey were men, according to the results (89 percent). Only a small percentage of females (11%) contributed to the survey. The largest number of participants have completed their graduation (60%) followed by (40%) of respondents who have completed their post-graduation.

2. Description

Most respondents had a better grasp and awareness of sustainable construction's environmental, economic, and social benefits. When it comes to implementation, however, it appears that respondents are unsure or have not examined whether or not they have included sustainable components in their housing.

The following procedures were used in the current investigation, which are listed below with their beneficial effects and observations: -

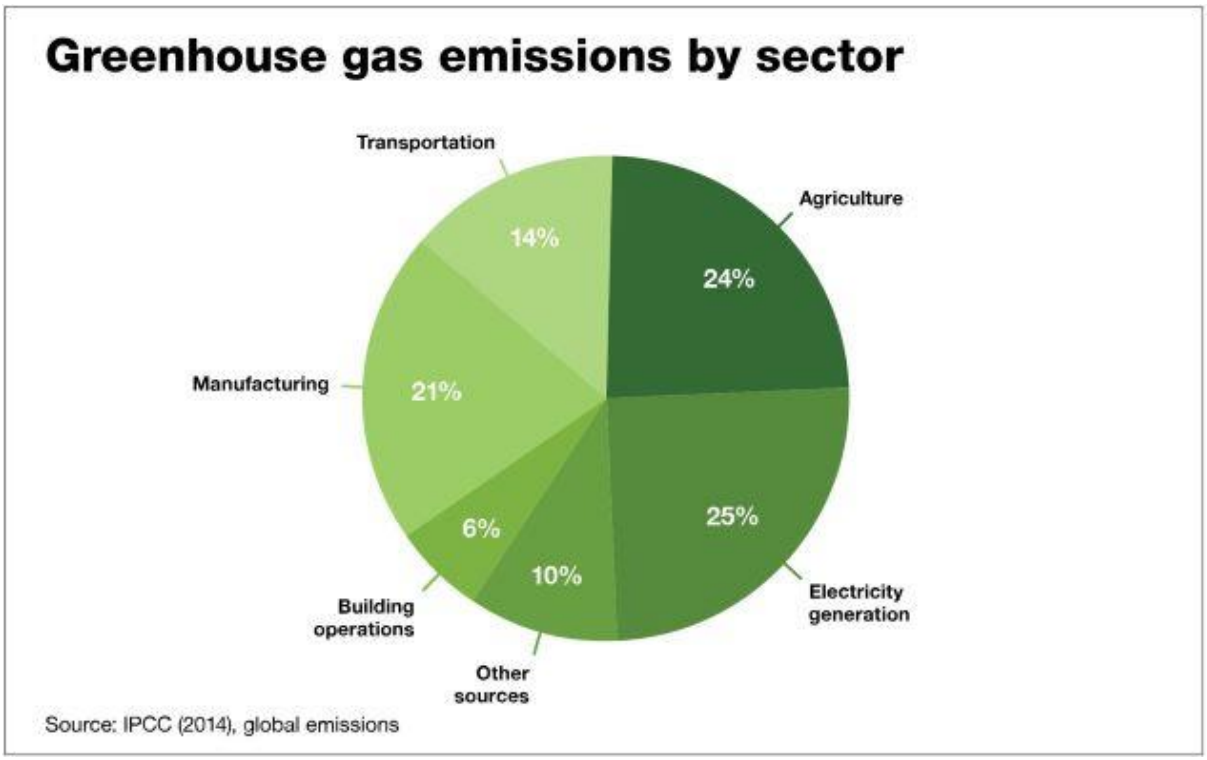
Phase I: A Sustainable Design for Eco-Friendly Wall Systems
Phase II: Inclined Green Roofs
Phase III: Water Harvesting System

Phase I: Eco-friendly Wall Systems: Sustainable Design.
The main component that had a significant impact on the room temperature was the building's walls, as they are in close touch with the surrounding environment and are subject to temperature variations owing to climate change. By employing the rat trap bond wall technology to build an eco-friendly or insulated cavity wall with the cavity in walls filled with hardwood powder, which provided thermal insulation, the room temperature was reduced, and a cooling effect was created. As a result, a significant reduction in room temperature was accomplished. Plaster finishes and environmentally friendly paints were among the eco-friendly wall treatments. These finishes and textures can make a big impact or serve as a subtle backdrop. Many of these finishes will improve with age, and all you'll need is a regular paint to get started. There are a number of finishes available that are made with natural components and emit little or no off gassing. If you require a

softer surface or have a unique application that necessitates the use of wall coverings, you have a variety of possibilities, including natural and recycled items. All of the residences outside walls were given these eco-friendly wall treatments.

Insulation Material:

The qualities of insulating materials are claimed to be as follows: Textile product made from long filament fibres that has been reprocessed. Long filament fibres are not respirable entering the lungs, according to tests. Unlike standard rotary spun fibreglass, it does not pose a cancer risk. Excellent sound absorption properties.



Phase II: Inclined Green Roofs

Extensive green roofs are light in weight and have a very thin coating of soil, with sedums and mosses as the primary drought-resistant plant species. These roofs are self-sustaining and only require a yearly inspection and a small amount of fertiliser feeding. Intensive green roofs with vegetation, roof gardens, or even parks, on the other hand, require excessive upkeep, watering, and weeding, just like regular gardens. Between these two extremes, a diverse spectrum of roof vegetation with variable soil depths and plant varieties exists. Some, such as meadows, require only occasional upkeep, while others require more attention. On top of the home, green roofs with an inclination of (200 to 300) were used. These are available in a variety of forms and sizes. The creation of a green roof benefits both the environment and the user. These roofs are appealing and might provide a better outlook and environment for city people. During all the asphalt and concrete, animals and plants take shelter on the rooftops, and these roofs can partially compensate for lost green area on the ground. Green roofs also save money since the roofing material lasts longer and the cost of heating and cooling the

structure is reduced. Increased green space and permeable surfaces in the city result in natural management of much of the precipitation, lowering drainage costs and reducing the burden on sewage treatment plants.

Phase III: Water Harvesting System

Rainwater harvesting was also used to make the project more sustainable and environmentally friendly. Water was stored in a storage area built near the residence. It was decided to recycle the treated grey water for the purpose of watering the plants.

FINDINGS

1. Foundation

Though there isn't much that can be done about this part of the construction because it all depends on the soil conditions and the structure's safety, it is recommended to use a foundation depth of 0.6 m for normal soils such as gravely soil, red soils, and other similar soils, and to use un-coursed rubble masonry with bond stones and good packing.

2. PLINTH

A plinth was built with 1:6 cement mortar at a height of 0.2 m above ground level. The traditional plinth slab of (100-150) mm was omitted, and in its stead, impervious blankets such as concrete slabs or stone slabs were supplied all around the structure to decrease soil erosion and thus eliminate foundation surface exposure and crack formation.

3. RAT- TRAP BOND WALLING

Laurie Baker, an architect, devised this technique, which has been tried and validated in India for the past 40 years. The rat-trap bond is constructed by laying bricks on their sides, with a hollow of (80-100) mm and an alternate course of stretchers and headers. To give the walls extra strength, the headers and stretchers are staggered in consecutive levels. The main advantage of this bond is that it saves money on bricks by allowing a one-brick thick wall to be built with fewer bricks than a solid bond.

4. DOORS & WINDOWS

It is recommended to use wooden doors and windows instead of concrete or steel section frames, as was done for this project, to achieve good thermal insulation, because wooden doors and windows have less effect of temperature variations or sun light as compared to concrete and steel doors and windows, and the location of these doors and windows was mostly in the northern or southern direction to avoid direct sunlight, while providing sufficient ventilation and air circulation for giving cooling effect.

5. Tiles on The Outer Face of The Wall

The cavity was filled with wooden powder in the insulated cavity wall construction, thus there was a risk of fire owing to the use of wooden materials by short-circuits or other accidental conditions, and there was also a risk of water penetration into the cavity in the event of severe rains. As a result, tiles were installed on the outside and inner faces of the walls to protect them from the damaging conditions. Tiles also protected the walls from direct contact with air heat, lowering the temperature and increasing the cooling effects.

6. Roofing & Garding

Roofing of residential structures is usually done with 12.5 cm thick RCC slabs, which can be level or inclined. A green roof, on the other hand, is a building's roof that is partially or totally covered with plants and a growing media, which is planted above a waterproofing membrane. Additional layers, such as root barriers, drainage, and irrigation systems, may be included. Additional layers, such as root barriers, drainage, and irrigation systems, may be included. Thus, the same green roof concept was employed for this experimental house, which served multiple functions for a building, including absorbing rainwater, providing insulation, and assisting in the reduction of urban air temperatures.

OBSERVATONS

Temperature observations were taken on both the houses in the project stated above, one that was built using traditional means and another that was built using green roof and eco-friendly technologies, and the following observations were made.

The following observations were made on traditional and green buildings at the time of the trial: -

Normal Temperature Outside = 32.00Celcius
Room Temperature of Traditional Building = 31.40Celcius
Room Temperature of Green Building = 29.30Celcius
Reduction in Temperature for Traditional Building = 0.60Celcius
For Green Building = 2.70Celcius

Difference between Reductions in Temperature of
Traditional and Green Building = 2.10Celcius

After the increase in temperature by the lighting effect
Temperature outside around Traditional and Green Building= 37.00Celcius
Room Temperature of Traditional Building = 34.90Celcius
Room Temperature of Green Building = 30.10Celcius

Reduction in temperature
For Traditional Building = 2.10Celcius
For Green Building = 6.90Celcius

Difference between Reductions in temperature of
Traditional and Green Building = 4.80Celcius

As a result of the results presented above, a Green building will have a lower room temperature and have a greater cooling impact than a standard building. As a result of the foregoing readings, the green house has a lower internal temperature than a house built the traditional way.

CONCLUSION

We live in an era where the globe is continually exposed to UV rays, global warming, and high pollution levels. The disaster is the unhealthiest of our living conditions. Due to the fundamental problem of global

warming, greenhouse effect, and uncertainty in climatic behaviour, which is hurting human beings greatly, the environment of Raipur city is also highly hot in summer when compared to other cities. As a result, the green building method outlined above will show to be quite advantageous in avoiding excessive heat during the summer, hence decreasing energy consumption and making the building more sustainable while still providing residents with a high level of comfort. A green building with a water harvesting system uses natural energy to reduce temperature and raise ground water levels, avoiding the added cost of using mechanical means to do so.

The rainwater collection system will raise groundwater levels, which will be used during peak demand periods. A green building with a water harvesting system uses natural energy to reduce temperature and raise ground water levels, saving money on the added costs of mechanical cooling systems. The tiles on the outside of the wall will reflect the sun's rays, lowering the building's internal temperature. The installation of tiles on the wall will lower the cost of painting or distempering the wall on a yearly basis. During heavy rains, tiles protect the wall from seepage. Though the concept of Green Homes is new in India, it will assist us in taking the first step toward conserving the earth's natural resources and reducing energy usage and costs.

The research' conclusions can be divided into three groups: definitions and scope of green building, advantages and costs of green building, and methods for achieving green building. Most literature evaluations, it has been discovered, focus on environmental aspects of sustainability, such as energy consumption, water efficiency, and greenhouse gas emissions, as well as technical solutions. Furthermore, the life cycle assessment method, which is widely used in the environmental elements of green building, might be a beneficial tool for social sustainability. Also, provisions for educating and training individuals or tenants will aid in regulating their behaviour when utilising a green building, which may have a substantial impact on the building's performance. Also notable is the issue of the cost and benefits of green building. It's also worth noting that all of the leading green building assessment systems are tailored to the specific climatic and geographic characterises of their respective regions. As a result, while assessing the effectiveness of these green building rating methods, this point must be considered when setting global benchmarks with references to green construction. In a country like India, where the bulk of the population lives in villages and towns rather than cities, it is critical to raise awareness among the inhabitants of rural and towns. As a result, the above-mentioned challenges will be on the future agenda for green building research, as well as supporting a greater proportion of green and sustainable development.

REFERENCES

[1] ASHRAE, USGBC, CISBE. (2008). Performance Measurement Protocols for Commercial Buildings [2] Beall, Frank C., University of California, letter report to Joel Tranmer (May 1994) [3] Cathy E. Creswell and Linda M. Wheaton Green Building & Sustainability Resources California Department of Housing and Community Development Housing Policy Division

[4] The School of Renewable Natural Resources

[5] N.K. Naik. —Mechanical and Physical-Chemical Properties of Bamboos carried Out by Aerospace —Engineering Dept., IIT – Bombay

[6] Practical Action Walls using the _rat – trap bond ‘technology

[7] Wilkes, K., Proceedings of the International Symposium on Roofing Technology (1991)

[8] Yarbrough, D., "Thermal Decomposition of Ammonium Sulphate at Low Temperatures" letter report to the Cellulose Marketing Council (September 1991)

[9] Zane Satterfield, P. E., NESC Engineering Scientist Green Building

[10] Bowman, R. and Wills, J., 2008. Valuing green: how green buildings affect property values and getting the valuation method right. Green Building Council of Australia, Sydney
[11] Hydes, K.R. and Creech, L., 2000. Reducing mechanical equipment cost: the economics of green design. Building Research & Information, 28(5-6), pp.403-407.
[12] Kibert, C.J., 2016. Sustainable construction: green building design and delivery. John Wiley & Sons.
[13] Lombardi, P., 2001. Responsibilities toward the coming generation forming a new creed. Urban Design Studies, 7, pp.89-102.
[14] Addis, B. and Talbot, R., 2001. Sustainable construction procurement: a guide to delivering environmentally responsible projects (Vol. 571). London: Ciria.
[15] The economic benefits of green building-yearbook 2009-10, Australia Bureau of statics, Canberra, Australia; 2010
[16] Life cycle energy analysis of buildings; T. Ramesh, Ravi Prakash, KK Shukla
[17] Jian Zuo and Zhen Yu Zhao (2013), Renewable and sustainable energy reviews-ELSEVIER
[18] Life cycle assessment of the building materials outlook 2010. US energy information administration
[19] The economic benefits of a green building; Ries, Robert Bilee, Melissa Gokhan
[20] Sustainability assessment and rating of buildings; Ricardo Mateus, University of Minho