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An Analytical Study on Green Buildings

Ebin S.B[1], Dr. T. R. Sethuraman[2]
[1]*PG Student, Department of Civil Engineering, Sivaji College of Engineering and Technology, ,*
[2]*Professor, Department of Civil Engineering, Sivaji College of Engineering and Technology,*

Abstract— The conference of parties-28 has reiterated the importance to reach the goals of reducing global temperature to the pre-industrial levels by the end of 2030 by cutting carbon footprint of every nation and also moving towards cleaner and efficient fuels and practices. According to the United Nations Environment Program, the construction industry consumes up to 50% of the planet's natural resources. Emissions and Air Quality: Manufacturing construction materials, especially cement, is energy-intensive and contributes significantly to greenhouse gas emissions. Therefore it is imperative to adopt more environmentally feasible construction practices so as to cause the least impact to the environment and also not stalling development. Green building practices are a set of new codes practiced worldwide for the past decade towards fulfilling these goals. Green building encompasses innovative technologies and design methods which utilizes the available resources more efficiently and reduces consumption of limited natural resources. This study analyses the various aspects related to green buildings, how they are beneficial worldwide and also study the implications of execution. The study is conducted by descriptive analysis from a pool of data obtained from case study papers. The themes observed in the study are selected and the general criterions to be analyzed are finalized such as air quality, sustainable materials, renewable energy integration etc.

Key Words: Green Building (GB), Renewable Energy (RE).

I. INTRODUCTION

Green buildings incorporate measures that are environmentally friendly and resource-efficient across the building lifecycle. The green buildings concept aims to comprehensively minimize the negative impact and maximize the positive impact a building has on its natural environment and human occupants. As a holistic approach to their planning, design, construction, operation, and maintenance, green buildings successfully maximize the natural efficiencies of a building site and integrate them with renewable and low-carbon technologies to support the building's energy needs and create a healthy built environment. Areas of priority in green buildings include the efficient use of energy, water, and other resources; quality of the indoor environment; and impacts to the natural environment. Buildings and the supply chain that supports them are responsible for an enormous share of worldwide carbon dioxide emissions also referred to as greenhouse gases and energy, water, and materials consumption. The global building sector also represents the largest opportunity for significant, cost-effective improvements in these areas, making it a broad and robust focus of research and development efforts. Green buildings combine a variety of approaches to practices, technologies, and materials across all stages of a building's lifecycle.

II. LITERATURE REVIEW

Ezanee M. Eliasa, Chong Khai Lin (2014) [1], Focuses on the cost factor to be considered for implementing green buildings and how the buyers respond to the idea of green building in the housing sector. It also dicusses the importance of practicing green building practices in the residential building sector.

Avinash Shivajirao Pawar (2012) [2], Studies about the importance of reducing consumption of energy and ways to incorporate renewable energy harvesting technologies into the core of green buildings. It also says that not just the use of renewable sources contribute to a green building but also formulating methods to reduce the consumption of energy. The effective utilization of natural lighting and ventilation are also discussed.

Zhonghua Gou , Xiaohuan Xie (2015) [3], Discusses about the evolving trends in green building technology across the globe and how they are critically analyzed for better innovation in the field. The importance of providing thermal insulation and solar dissipation are discussed.

Ankit Yadav, Adarsh Singh, Arun Kumar Verma, Ashok Kumar Verma, Ashutosh Kumar, Er. Shubhendu Mishra, Er. Om Prakash Pal (2022) [4], Studies the energy efficiency and ecological nature of green buildings. The use of new technologies in the construction industry that led to more efficient construction with an environmental assessment. In the present scenario.

Mohd Yasir Laeeq, Dr. Syed khursheed Ahmad, Khubaib Altamash (2017) [5], Discusses the extent to which green building concepts are practiced in the commercial building industry. It discusses the challenges involved in implementing green strategies in the real world the present building practices.

Ngakan Ketut Acwin Dwijendra, Kadek Diana Harmayani, Dewa Gede Agung Diasana Putra, Ida Bagus Putu Adnyana, Desak Ayu Krystina Winastri K (2023) [6], Conducted a study on Indonesia which revealed the extent to which the traditional building practices contribute to the overall pollution of the country and the need to incorporate sustainable building practices into the construction methods.

Lerato Aghimien, Douglas Aghimien, Olugbenga Oladinrin, Clinton Aigbavboa, and Lerato Mokwena (2023) [7], Studies the sustainable building practices adopted in South Africa and how such practices are made useful in repair and retrofitting in the existing buildings. The awareness about the technology was analyzed through a questionnaire survey from construction contractors.

Yuntao Yang , Bin Zhao, Qingli Liu (2024) [8], Discusses the integration of BIM into green building concepts to integrate the control of all the factors which contribute to make the building more energy efficient.it focuses on the role of BIM in the automation process of green buildings.

Ashraf Balabel, Wageeh El-Askary, Ahmad Alahmadi, Ali Alzaed (2023) [9], Studies the impact green roofs has to play in reducing the indoor temperature in the buildings in Saudi Arabia and how this will reduce the load on the air conditioning system.

Yun Tang (2023) [10], Analyzes the factors which led to the success of Shanghai Tower. The study analyzes the foundational, structural and sustainability aspect of green building and the role of BIM in the automation process of the building.

III. RESEARCH METHODOLOGY

Case study

The case study method is a research approach that involves an in-depth and detailed examination of a specific individual, group, event or phenomenon. It is a qualitative research method, the aim of which is to gain a comprehensive understanding of the researched subject. Case studies are commonly used in various fields such as psychology, sociology, anthropology, business, medicine, and education.

Here are some key characteristics and steps involved in the case study method:

- Case selection: Researchers select a specific case or a small number of cases that are considered relevant and informative to the research question in hand.
- Data Collection: Researchers collect data through a variety of methods, including interviews, documents, archival records, and sometimes surveys. Multiple sources of information are used to ensure a comprehensive understanding.
- Longitudinal perspective: Case studies often involve a longitudinal perspective, where researchers study a subject over an extended period of time to capture changes and developments.
- In-depth analysis: Researchers conduct detailed analysis of the collected data, examining patterns, themes, and unique aspects of the case. This analysis may include categorizing and interpreting information.
- Contextual Understanding: Emphasis is placed on understanding the context in which the case is situated. This includes examining the social, cultural, historical and environmental factors that may influence the subject.
- Holistic approach: Case studies aim to provide a holistic view of a subject that takes into account multiple dimensions and perspectives. This helps capture the complexity of real-life situations.
- Developing or testing a theory: Case studies can be used to develop new theories or test existing theories. Researchers can derive broader insights from a specific case and apply them to a broader context.

- Generalization: While case studies are often criticized for their limited generalizability due to the focus on a specific case, researchers can attempt to generalize findings to broader populations or situations.
- Ethical considerations: Researchers must adhere to ethical standards and ensure the confidentiality and privacy of individuals or groups involved in the case study.

The findings are usually presented in a detailed report, including a description of the case, research methods used, data analysis and conclusions drawn. The report may also include direct quotations, excerpts from interviews and relevant documents.

The case study method provides a rich and nuanced understanding of complex phenomena, allowing researchers to explore real situations in depth. However, it is important to note that findings from case studies cannot be easily generalized to other contexts, and researchers must be careful when making broad claims based on individual cases.

IV. FINDINGS

Criterion to be fulfilled in order to maintain green building standards are identified from the comprehensive analysis of the case studies and they are enumerated as follows:

1. Sustainable materials: sustainable materials are those which contributes the least impact to the environment and are available within the allocated budget. Use of sustainable materials over traditional materials in construction industry helps to cultivate the habit of recycling and effectively reduces cost for production of virgin raw materials.
2. Energy efficiency: This aspect is one of the most important theme in green buildings. Technologies adopted to improve the energy use efficiency of the building are analyzed. Popular methods like use of LED lighting instead of conventional lighting, proper use of the environmental factors like natural light and wind whenever the weather is right, use of regenerative technologies in vertical transportation systems, start stop escalators, double glazed façade glass etc. contribute in reducing the ;load on the energy grid of the building.
3. Water conservation: Water conservation is a key aspect of green buildings. Water conservation includes collection of naturally available water in the form of rain water with the help of underground storage tanks and also minimizing the usage of water through the use of efficient pipe fittings which limits the amount of water discharged from the fittings.
4. Site selection and land use: Selection of the site for green building and how the surrounding space is utilized also takes a major part in the green performance of the green building. The orientation should be aligned so that the sunlight can be utilized during the day time. The surrounding land can be converted into woodlands with plantation of native trees which help to reduce the urban heat island effect caused by the building.
5. Indoor air quality: Green buildings ensures that the indoor air quality is optimum and is comfortable to the occupants. Technologies like carbon dioxide sensors, wind towers, screw chillers are used to supply the interiors with fresh air with the consumption of least energy. The supply can be modified based on the demand of oxygen by the number of occupants in a building at a time.
6. Waste reduction: the waste generated by a green building is neutralized within the premises of the building itself and later discharged which causes the least effect on the environment. A paper recycling facility, grey water treatment plant, root zone treatment technique can be incorporated with green buildings to meet the waste reduction targets.
7. Green roofs and green walls: these methods are now widely used in buildings not just because of the sustainability aspect but also the aesthetic appeal of the practice. Green roofs reduces the heat radiated from the upper roof on to the lower floors and also provides an excellent space for recreation an convention activities. The green walls reduces the amount of heat circulating in the floors hence reducing the load on the HVAC system.
8. Renewable energy integration: Rather than depending on external sources for the energy needs of the building it is more effective to generate the energy required to function the building from within the building itself. Various techniques like photovoltaic cells, wind power

and also hybrid generators can be used to produce energy and also the excess energy can be distributed into the grid.

9. Building management system: building management system is not just a single unit but is a group of advanced systems which help to integrate the controls of a green building in a centralized system. The control of internal air quality, remotely controlling the ventilation, adjusting the HVAC load based on the occupancy of the building etc. can be achieved by integration with building management systems.

V. CONCLUSION

Green buildings is a field of construction engineering that should be popularized more and that should be incorporated into the contemporary construction practices. Green buildings reduce the dependency on the traditional energy intensive operational costs and also reduces then carbon footprint that the construction industry can cause on the environment. More advancements are under way in this discipline of engineering which will help to discover more sustainable practices to reduce the impact of construction industry in the environment.

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