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A Review on Sustainable Construction

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ABSTRACT

Building construction and operation have been associated with many environmental issues, such as contamination of the surrounding area and overuse of world resources. The world's environmental degradation issues have compelled society to reconsider its methods of development and expand the notion of sustainable development. Green building has an important impact on building design, so it should be emphasized. Growing environmental concerns have given green and sustainable buildings a lot of attention in recent years. Developed and developing nations each have their own evaluation criteria and procedures for certifying green or sustainable architecture. Green technologies encompass a broad spectrum of technological innovations aimed at reducing the adverse impacts of human activities on the environment and fostering sustainable development strategies. The purpose of this paper is to cover the significance of sustainable construction, the materials used to construct sustainable buildings, building assessment methods, the role that green technologies play in sustainable development, and the difficulties associated with applying sustainable construction techniques.

Keywords: Environmental degradation, sustainable construction practices, Green buildings, Green technologies, and Sustainable Development Goals.

INTRODUCTION

The construction industry is crucial to a country's economic success. By constructing the necessary socioeconomic infrastructure, such as schools, colleges, hospitals, roads, and other basic and enhanced facilities, the construction industry improves the quality of life for citizens. (Jamilus Md Hussin et al., 2013). Many environmental difficulties have been linked to construction, including pollution of the surrounding environment and excessive use of global resources during building development and operation (Grace K.C. Ding, 2008). The objective of sustainable construction is to create communities that uphold economic justice, respect human dignity, and maintain the balance between the built and natural environments (Du Plessis C, 2002). One tactic to address the demands of the construction industry is sustainable construction. The objective is to attain sustainable development (Abidin N. Z., 2010). In 1994, the first worldwide conference on sustainable construction was held in Tampa, Florida. Sustainable development is "the creation and responsible management of a healthy built environment based on resource efficient and ecological principles"(Kibert C., 1994).

The construction industry has been chastised for its contribution to environmental degradation, which contradicts sustainable development ideals (Pearce D, 2005). Building operations are responsible for almost half of all CO2 emissions, and the construction industry is a major user of nonrenewable resources and

waste generator. The building industry used 30–40% of natural resources, 50% of the energy used in buildings for heating and cooling, over 40% of the world's material consumption went toward creating the built environment, and 30% of energy use was for housing (Bourdeau L., 1999). The twentieth century witnessed an unprecedented increase in the use of natural resources and minerals. Global raw resource production more than doubled between 1990 and 2017, and it is expected to double again by 2060 (Bibas, R., 2021). The rising need for materials may be somewhat mitigated by structural changes and technological advancements, which would decouple material consumption from economic growth (Mohammadi Golafshani E et al., 2021; Brandao R et al., 2021). The built environment consumes roughly one-third of all raw materials on Earth. Buildings are the major energy consumers (Shooshtarian S et al., 2021; Martek I et al., 2018). In order to reduce the use of natural resources and enhance population living standards, they require the adaptation of new approaches to economic growth and development that would place a greater emphasis on other sources of growth (Vargas-Hernandez J G., 2020). The environmental implications of construction, eco-labeling building materials, recycling-friendly design, and green structures are piqueing the interest of building specialists across the globe (Johnson, 1993; Cole R J, 1998; Crawley D & Aho I, 1999; Rees, 1999).

Cities are become denser, with more high-rise buildings and narrower urban lanes. The urban environment deteriorates as housing plot sizes decrease due to increased densities and the encroachment of green spaces (Santamouris et al., 2001). As the number of buildings and associated infrastructures expands dramatically to accommodate cities' growing populations, enormous resources are required for their development, operation, and maintenance. The quality of the design of these buildings is crucial since it determines the resources needed for their operation and maintenance in the future (Macmillan S, 2005). Over the past few decades, the phrases "green" and "sustainable," which are frequently used "interchangeably," have become more widely recognized in the fields of design, engineering, and building (Korkmaz K et al., 2009). Sustainable building development can be accomplished by environmentally friendly design and construction (Krygiel E et al., 2008).

A building that employs and exemplifies resource conservation and environmental care at every stage of its life—from construction to operations, maintenance, renovation, and demolition—is considered green, according to the USGBC (USGBC, 2013). Green buildings idea makes buildings more sustainable by decreasing resource use in building development, operation, and maintenance. Structure systems like A.C and lighting are energy guzzlers, using more than 60% of the energy used in a typical commercial structure. They can also have an effect on the indoor environmental quality. As a result, the energy efficiency of the systems is critical. Material selection that reduces embodied energy and building waste is also crucial [Wong NH, 2015]. Green buildings are those that are planned, designed, built, and operated with the goal of conserving resources, reducing pollution, protecting the environment, and providing people with healthy and comfortable interiors (Aysin Sev, 2011;Yang Geng et al.,2019).

Green Technology

Green technology should be defined as any procedure, products or service that lessens adverse environmental effects while preserving ecosystem quality and human health. Cleaner or environmental technology can sometimes be referred to as "green" technologies. Addressing several important concerns, including the mitigation and adaptation of climate change, the growing demand for energy and resources, and sustainable waste management, can be achieved through the development and

implementation of green technology. Green technology may help reduce carbon emissions, increase resource and energy efficiency, and prevent significant environmental deterioration. In addition to lowering the possibility of resource shortages, this would advance the Sustainable Development Goals (SDGs) and improve social quality, human welfare, and environmental quality (UN SDG, 2015).

Green technology refers to technology that is used in a way that minimizes its negative environmental impact while at the same time allowing for continued progress that is a result of globalization. The government offers numerous tax breaks that produce electricity from renewable sources and takes steps to promote green technology. Equipment for solar heating systems that is purchased from local manufacturers is exempt from sales tax and import duties. The Ministry of Energy has also instituted a national awareness campaign for renewable energy and green technology every year (Gangadhar B and Ramakrishna Naidu G, 2017).

Green Building or Sustainable Construction Materials

Air, water, and soil are contaminated by the heavy use of thermal and electrical energy in traditional building materials like steel, cement, and bricks. One of the biggest problems in growing nations like India is how to dispose of the solid waste that comes from industrial and agricultural activity. Reusing wastes as an environmentally friendly building material appears to be a key potential answer to the problems of land-filling, pollution, and the high cost of building materials (Pappu Asokan, et al., 2007).

Green building materials use less energy and resources during production, produce little to no pollution, and don't harm people's health. Natural materials with minimal energy and maintenance costs ease of disassembly, and recyclable after destruction are often used in green construction materials (Wills S, 2009). Because less raw materials need to be extracted, processed, and transported over great distances to construction sites, salvaging and reusing building materials can save energy and lower greenhouse gas emissions and also lessens the impact of waste management on the economy and environment (Torgal F and Jalali S, 2011).

BUILDING PERFOMRMANCE METHODS

The building environmental evaluation methodologies highlight environmental aspects of sustainability through criteria (Parvesh Kumar, 2023). Environmental building evaluation techniques are especially helpful in the design phase, since they allow for the analysis and implementation of any impairment for the pre-design criteria as the design progresses. It is possible to reduce environmental damage throughout the design process by incorporating environmental factors (Cole R J, 1999; Crawley D and Aho I, 1999). The diverse interests of persons engaged in building development influence how well a building performs. For instance, a building owner might be more focused on the financial success of his establishment than residents, who might be more concerned with interior air quality, comfort, health, and safety. Analyzing a building's environmental performance and satisfying every user need with a single approach is difficult. Therefore, the perfect environmental building evaluation would include every need of the different parties involved in the project (Cole 1998).

A method to evaluating environmentally friendly buildings emphasizes the importance of sustainability when it comes to building design and the on-site construction that follows. Giving a thorough evaluation of a building's environmental aspects using a standardized and verifiable set of criteria and targets to help building owners and designers meet higher environmental standards is the main goal of an environmental building assessment technique. Additionally, it creates the

fundamental framework for the building industry's efforts to preserve the environment and achieve sustainability, as well as increasing awareness of environmental issues in construction processes. It offers an objective way to evaluate building performance, an approach to organizing environmental data, and a gauge of how far we've come toward sustainability (Cole, 1999).

Building's environmental performance systems were designed to evaluate how well a development balances ecology, energy, and the environment while also considering the social and technological aspects of initiatives (Clements-Croome D, 2004). Construction environmental evaluation techniques use to highlight the environmental aspects of sustainability. An approach for evaluating sustainability is required at the early stages of design, when choices made in this area have a significant influence on the built environment's overall performance. To develop techniques for implementing net positive design, anthropocentric and ecological/biocentric perspectives must further converge (Parvesh Kumar et al., 2023).

BREEAM and LEED are the most widely used instruments for evaluating green buildings. There are three reasons why these two plans are the best. The first is because of how many topics it covers, particularly the environment. Secondly, the extensive range of buildings that are covered, and thirdly, the significant variations in the criteria and scope of assessment between the plans (Lee W L& Burnett J, 2008).

The first comprehensive building performance evaluation approach was the Establishment Environmental Assessment Method (BREEAM), which was developed in 1990. BREEAM was the first and is now the most extensively used environmental building assessment system (Larsson N, 1998). The Building Research Establishment in the United Kingdom collaborated with private developers to establish the system in 1990. A certificate of assessment result based on a single rating scheme—fair, good, very good, or exceptional—is given to the specific building. Establishing a set of environmental criteria by which building performance is assessed and graded is the aim of this approach. This evaluation can be carried out even in the project's planning phases. The investigation's conclusions can be incorporated into the building design and development phase, and modifications can be made to satisfy predefined standards (Johnson S, 1993).

Numerous alternative assessment techniques have been created globally to conduct environmental building assessments since the introduction of BREEAM in the UK. Based on some type of life cycle assessment database, the majority of environmental building assessment technologies address the building level (Seo S et al., 2006). Although new construction has been the primary application of environmental assessment methodologies, renovation and upkeep of existing structures are equally crucial components of a sustainable future (Grace K.C. Ding). The majority of building assessment techniques focus on just one criterion, such as indoor comfort, energy use, or air quality, to show a building's overall performance (Cooper, 1999; Kohler, 1999).

U.S.GBC in 2000 developed LEED. LEED India green building assessment methodology was developed by IGBC in 2006. The LEED evaluation method has been designed for use in core and shell construction, new construction, schools, housing, community development, retail establishments, and existing structures. Buildings are assessed using this tool and given certification, platinum, gold, or silver ratings.

CHALLENGES IN APPLICATION OF SUSTAINABLE CONSTRUCTION

Traditional design and construction's focus on cost, performance, and quality, sustainable design and construction also aims to reduce resource depletion, minimize environmental degradation, and provide a

healthy built environment (C. J. Kibert, 1994). Sustainable goals are now part of the architectural design and construction sector, marking the beginning of a new paradigm in sustainability (J. Vanegas et al., 1996).

The main obstacle to the use of sustainable construction is the general client perception that it would be more expensive and risky. Client's perception that employing green materials and modern technologies will result in higher costs. However, additional design elements may result in a charge increase for the consultant (Johnson S D, 2000; Hydes K and Creech L, 2000). Cost advisors for the client provide an additional obstacle. According to quantity surveyors, the initial construction costs of environmentally friendly and highly energy-efficient buildings might range from 5% to 15% more (Barlett E and Howard H, 2000).

Customers are worried about more than just rising costs; sustainable building also attracts more risks, such as using novel methods, lacking prior construction experience, conducting extra testing and inspections, receiving insufficient support from suppliers and manufacturers, not receiving performance data, etc. (Hydes and Creech, 2000; Larsson N and Clark J, 2000). Because our financial system's discounting mechanism actually discourages long-term investment, innovators were pressured to think more about their actions' immediate financial gains than their long-term implications (Smith M et al, 1998).

CONCLUSION

Construction industry has been criticised for its contribution to environmental degradation which conflicts with the principles of sustainable development. Enhancing the environmental performance of buildings will in fact promote more environmental responsibility and raise the importance of future generations' welfare. The goal of green building is to reduce carbon dioxide emissions, create an eco-friendly environment, use more renewable resources, save energy and water, reduce waste and recycle on-site materials, and design buildings with more visually appealing exteriors.

Undoubtedly, environmental building evaluation techniques play a major role in accomplishing the objective of sustainable growth in the construction industry. The long-term implications on living standards for both current and future generations are also of importance to society, in addition to economic growth and development. Without a doubt, project decisions must take sustainable development into account. It is no longer sufficient to support decision-making using a traditional single-dimension evaluation technique.

Building industry concerns in both developed and developing nations are centered around creating a more sustainable built environment. To track green growth and sustainable development, nations require action plans and metrics that are well-defined. Adopted policies and laws by nations must adhere to established international norms and understand sustainable development within the framework of the green economy. It is imperative for nations to keep refining their national plans in order to establish a distinct vision, well-defined objectives, a methodical approach, and means of carrying out their pledges. It has been and continues to be the target of concentrated efforts in developed nations. Policies, legislation, and the development of several sustainable structures are the products of these efforts. All parties involved in sustainable construction must put forth enormous effort, but they must overcome internal and external barriers. It is the responsibility of construction experts to make sure that their methods incorporate sustainable development initiatives.

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