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Designing Green Architecture Building that Blend with the Nature

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Abstract

The urbanized built environment is expanding rapidly in developing nations, and there is an urgent need to implement green building principles to make design and construction methods there more sustainable. Cities have seen an increase in built-up areas, and new construction projects that use the green building idea can undoubtedly lessen the environmental impact of buildings. However, the region surrounding urban settlements was likely occupied prior to the second millennium BC, and there is proof that people have lived there continuously from at least the sixth century B.C. Therefore, in addition to new construction, there is a significant chance that existing structures could have a negative environmental impact if their maintenance and operation practices are not examined. Government regulations pertaining to energy and water use as well as CO2 emissions will need to include mandatory limitations. The performance of existing buildings can be enhanced by a number of important sustainability improvements, in addition to energy and water efficiency, such as structural evaluation, resource use, disaster resilience, waste reduction through recycling programs, sustainable procurement and purchasing practices, and continuing operations and maintenance practices. Employee comfort and indoor environmental quality are two "intangible" benefits of green buildings that are difficult to measure but just as crucial to consider as the tangible ones. "Indoor Environmental Quality (IEQ)" includes things like views, air quality, natural lighting, thermal and physical comfort, and the ability to manage one's surroundings, all of which have beneficial psychological and physical benefits and help make residents happier and healthier.

Keywords

Green architecture, Building, Sustainable development, Environment, Indoor Environmental Quality (IEQ).

1. Introduction

"A comprehensive process beginning with the extraction of raw materials, integrated planning, design, and construction of buildings, along with their demolition and management of the resultant waste" (Elshafei et al. 2021) is what is meant by sustainable construction. The six sustainable construction principles—"minimize resource consumption; maximize resource reuse; use renewable or recyclable resources; protect the natural environment; create a healthy, nontoxic environment; and pursue quality in creating the built environment"—were used to encourage the adoption of civil engineering practices (Kibert, 2016). The AEC industry frequently uses the terms "Sustainability" and "Green" interchangeably, but adopting the term "Green" sets it apart from "Sustainability" because it conceptually balances precariously on one leg of the sustainability tripod—economic vitality, environmental health, and social equity (Mooraki et al. 2021).

The environmental activist can concentrate on a more limited agenda for change by using the language of "greenness," putting aside the more politically delicate and distressing issues of social justice and economic viability. Following the UN declaration of 1990-2000 as International Decade for Natural Disaster Reduction and the mid-term review at Yokohama in 1994, stakeholders emphasized a paradigm shift to disaster prevention, mitigation and preparedness than disaster response (Adewale et al. 2024). The AEC sector is working to address the sustainability "triple bottom line" by creating guidelines for the design and construction of green buildings that go beyond resource efficiency, which validates economic and environmental factors, to include disaster resilience, which has social ramifications as well. The debates and discussions of sustainable development and green building concepts at the international level have created the thought to know the scenario and extent of the subject at the national level in India (Karimov et al. 2024).

By examining the nation's green building situation, which has not yet been explored, this thesis expands on previous research and offers a unique addition. It has delved deeply into the topics of sustainability and green construction to comprehend their meaning and development, and it has advanced the investigation into their interdependencies and relationships shown in Figure 1 (Gowrishankar, 2015).

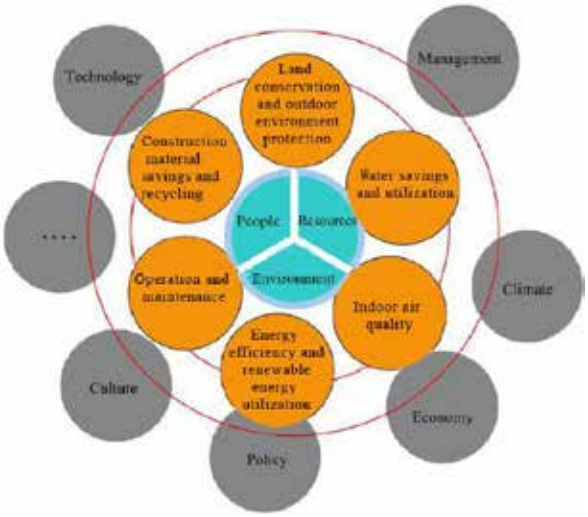

Figure 1. Green Building Design

There are published standards for existing buildings that only address operations and maintenance that are sensitive to the environment (Ramya & Hemalatha, 2015). As building owners and managers demonstrate their environmental responsibilities and look to set their spaces apart from those of their rivals, certification for a variety of building types is growing in popularity (Kellert, 2012).

1.1. Components of Green Building

Assessing the structural and green status of your building establishes a benchmark for success against these instruments and allows you to monitor your progress. Using cutting-edge tools, the issue with the methodological approach for diagnostic structural inspections, green assessment, and related protocols has been identified for specific structures. This entails planning, much effort and expenditure, the initiative for which is seldom taken up by organizations or individuals. Even if it means lowering the assessment's level of precision, the scope and gravity of the issue, given the massive building stock, would call for quicker

and non-invasive diagnostic techniques. Finding buildings where there is an immediate risk or that are implementing unfavourable green measures, or recommending the need for additional research, should be the top priority. Therefore, even a cursory evaluation of a building's or region's state, degree of safety, and resource usage will be a noteworthy result, especially if it is completed quickly. Additionally, the fields of green, structural evaluation, hazard risk, and vulnerability have few agencies and technical specialists. Research in this area is discouraged by the lack of time planning, spatial databases on various socioeconomic, environmental, and infrastructure factors, as well as demographic statistics on open spaces and communities. Because of the vastness of information relating to various districts and building typologies considered, uncertainty in the information about fundamental factors and structural behaviour during hazards might remain shown in Figure 2 (Beatley, 2011).

Figure 2. Components of Green Building Design

Given the aforementioned concerns, it becomes a challenge for leaders and their approach to select a reasonable method for assessing hazard risks, vulnerability, and ecological activities in order to develop a suitable action plan for greenness as well as disaster readiness and moderation in a particular neighbourhood situation and need. When making decisions during the planning stage of any building project, green building standards use an integrated and thorough approach. The decisions made during the development process by a variety of stakeholders, including customers, technical experts, quantity surveyors, site managers, contractors, environmentalists, and others, determine a building's Green Quotient. The ecological outcomes of a choice often manifest long after the choice was made, and not necessarily at the same location. Also, it is hard to recognize the effect of ecological choices on nature. Issues that are not considered as issues today may well be grave issues later on, just as the present environmental issues were not expected yesterday. Structures/buildings are long haul ventures related with extensive environmental impacts over a long duration. These kinds of environmental judgments are characterized by a great deal of ambiguity at every stage of the fundamental decision-making process, such as the problem definition, potential outcomes, and likelihood of the outcomes. Uncertainty about a building's design or a material's practical qualities and performance changes over the course of the building's life are frequently the cause of physical dangers. Additionally, in addition to depending only on the facts at hand, one must take into account the expertise and experience of professionals regarding the use of a specific building material throughout the design phase. Among these choices, the most cost-effective building among the likely possibilities, the preferred building materials, and the construction process should all be chosen with an eye toward the environment. Simplified ways to take these multicriteria decisions incorporating the opinion of all the stakeholders needs to be devised for rapid and sufficiently reliable implementation.

2. Review of Literature

There was a strong argument that how quickly and effectively the globe responds to problems like population growth and environmental degradation will determine how human society develops in the future. Though the term sustainability was not a core terminology in "The Limits to Growth", the subject of sustainability was deliberated in depth (Samer, 2013;

Kibert, 2016; Well and Ludwig, 2022; Shams and Rahman, 2017; Guy and Osborn, 2016).

The Brundtland Report "Our common future" gave the term "Sustainability" prominence in environment and policy debate. In the Rio Earth Summit 1992, the concept of sustainability has been recognized as International Law. Numerous international treaties and agreements have made it their primary goal, including the Paris Agreement to combat climate change, the Framework Convention on Climate, the Convention on Biological Diversity, the Maastricht Treaty on the European Union, the Rio Declaration: Agenda 21 and Transforming our World: The 2030 Agenda for Sustainable Development, etc. SD has become a buzzword widely debated at different policy forums, in conferences environmental policy researches and policy debates of government organizations, international organizations and non-governmental organizations (Kashanian et al. 2014; Dorostkar and Panahi, 2016).

Some authors, such as Lele (1991), made a different argument, saying: "Sustainable development is a meta fix that will unite everybody from the profit-minded industrialist and risk-minimizing subsistence farmers to the equity-seeking social workers, the growth-maximizing policymaker, the goal-oriented bureaucrat, and therefore the vote-counting politician." Some authors (e.g., Viederman, 1993) favoured the argument that sustainability is an ethical guiding principle. There is debate and a plethora of arguments about the definition and breadth of SD definition.

Brooks (1992) made a compelling case for the necessity of an operational definition of SD in order to make decisions about alternative policies, technologies, and developmental strategies. The concept of SD needs to be practical, with goals and decision criteria, in order to be relevant. There is no rationale for the delay since actions, policy decisions and investments made today will have consequences far into the future since damages caused to the environment may be physically or economically irreversible.

According to Yudelson (2009), a Green Building is a high-performance building that "considers and reduces its impact on the environment and human health: A Green Building has a higher level of indoor air quality, uses significantly less energy and water than conventional buildings, and has minimal site impacts". The author further argued that any building designed and planned as Green Building should be tested on the scale of sustainability by some recognised Green Rating System. Kibert, (2016) suggested that green building idea was founded on the key principles of nature and could be characterized as "Creating healthy built environment: planning, design, construction, operation, renovation and retrofit based on ecologically 22 sound principles. When a building is constructed, the artificially created ecosystem replaces the natural ecosystem. The human-made build environment which is nonproductive replaces produced natural systems. The built environment emits solid, liquid, and gas pollutants and uses energy, water, and materials over its 50–100-year life cycle. Over the course of its lifetime, a building releases enormous amounts of garbage into the environment—between 0.4 and 0.5 tons per person year.

2.1. Objective of the Study

i) To study sustainability, its original concept and relevance with the construction industry.

ii) Whether the Green Building movement accomplished its objective and at the necessary pace in the roughly 20 years since the Green Building Concept was introduced in India, or if additional work needs to be done.

iii) Identify the challenges in the path of propagation of Green Building Concept in India,

iv) To study and analyse, whether the institutional framework and policy framework has supported to the extent required or something more to be done?

v) To study and find, whether Green Building Concept is useful and capable to tackle the environmental challenges arising out of the building industry?

vi) To study and find, whether the Green Building Rating System developed and introduced in India need some more R & D and diversification to meet the challenges posed by the society and climate?

According to the survey, the green building movement is far more prevalent in the South and Western regions of the country than it is in the Northern and Eastern regions. It serves as a gauge of the regions' awareness and adaptation. The adoption of the Green Building Concept is significantly influenced by economic growth, the existence of international and multinational corporations, and incentives from regional urban authorities.

3. Methodology

Buildings are a major source of resource and energy use worldwide; in the US, they account for 39% of primary greenhouse gas emissions, 40% of total energy consumption, and 72% of all electricity (Amer, 2019). Moreover, buildings are responsible for over 10% of the world's freshwater withdrawals and 25% of wood harvest globally (Kibert, 2016). These findings justify the pressing and timely engagement of the AEC industry in efforts towards sustainable construction preserving world's resources and promoting quality life across the globe. According to sustainable construction is "a holistic process starting with the extraction of raw materials, integrated planning, design, and construction of buildings, along with their demolition and management of the resultant waste." The six sustainable construction principles—"minimize resource consumption; maximize resource reuse; use renewable or recyclable resources; protect the natural environment; create a healthy, nontoxic environment; and pursue quality in creating the built environment"—were used to encourage the adoption of civil engineering practices (Kibert, 2016). Going green differs from sustainability in because it theoretically rests dangerously on one leg of the sustainability tripod's environmental health, even though the phrases "green" and "sustainability" are frequently used interchangeably in the AEC sector. Social justice, environmental health, and economic vitality. According to Sustainability: An International Perspective (1998), sustainability is firmly based on the "triple bottom line" of economic, environmental, and social factors. Social justice and economic vitality, which are more politically sensitive and unpleasant, are put on hold while the environmental activist concentrates on a more limited agenda for change thanks to the language of greenness. However, the AEC industry's paradigm change in thinking aims to meet the sustainability "triple bottom line" by creating standards for the design and construction of green buildings. Several key elements of the green industry.

3.1. Urbanization, Energy Demand and CO_2 Emissions

This research was focused on sustainability issues in the construction sector. Therefore, the energy demand and CO_2 emissions from the construction sector have been discussed and deliberated. Industrialization and urbanization are two important elements of development and are interrelated and interdependent.

3.2. Sustainable Construction / Green Building a Subset of Sustainability

The industrialization, technological advancement and urbanization pushed the building sector beyond the boundary of basic need, and it entered the arena of aspirations where the human living standard and style have made the built environment one of the biggest consumers of primary energy produced globally and biggest consumer of extracted natural minerals. The experts started a discussion on methods and means of construction to reduce or eliminate adverse impacts on the environment and make the building sector more sustainable. This gave birth to the "Green Building Concept". In general, a "green building" is one that is designed and constructed with resource-efficient techniques and materials that won't negatively impact the environment or the health of its tenants, construction workers, or the general public (Mohammadi et al. 2016).

3.3. Green Building Scenario in India

In developing countries like India where the government has a dominant role and being a role model for society, institutional and regulatory support is key for the propagation of any such movement. In India, the building sector is still controlled by rules, regulations, specifications, and codes framed by the Government. The land and its development are a state subject controlled by different State governments under the federal structure of the country. Through the

Ministry of Housing and Urban Affairs, the Central Government provides advice on town planning and urban development nationwide. The respective State Government frames its own rules and regulations for urban development. With certain autonomy to frame the rules and regulations for the development of their urban areas. Primarily, rules and regulations for urban development and town planning called building bylaws 11 are framed by the State Government with a certain degree of flexibility to the local city authorities for changes according to the local need. But by and large, the building bylaws framed by the State Government are followed by the local authorities shown in Figure 3.

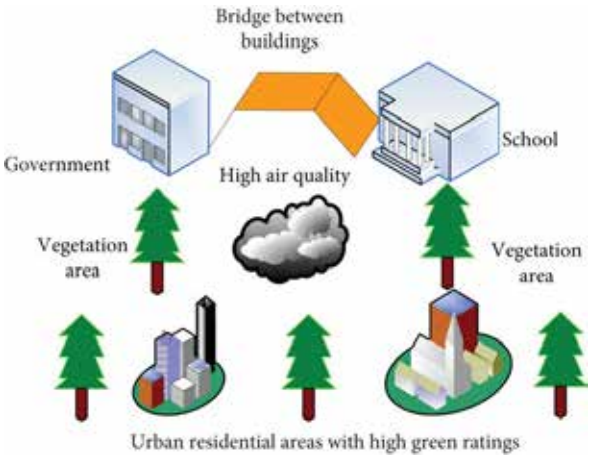

Figure 3. Schematic Diagram of Green Building Grades

3.4. Green Building Rating Scenario

The existing and traditional building codes favours traditional buildings in place of sustainable buildings. The responsibility of updating and modifying the codes mostly rests with government agencies. The new, innovative and alternate green building materials are less used or discouraged due to non-modification of codes. The users prefer time tested with market history products. The new products, technologies and materials get less response due to the above factor. The proper analysis, studies and labelling need to be done for these products in the beginning for good response. There is a general perception in the mind of users that the green product and technologies are having a high cost and taking more time. The life cycle analysis is not done. The builders and developers are more interested to minimise initial cost and time. Lack of knowledge or awareness of the fact that the traditional products or technologies are causing many environmental problems and green building mitigates these environmental problems.

3.5. India and Green Building Concept

In 2001, the LEED India green rating system was launched. The Indian Green Building Council is in charge of overseeing it in India. It is a private, voluntary organization. Despite having its roots in the US LEED rating system, the LEED India rating system has been adjusted to take into account local conditions.

The rating system's foundation is promoting environmentally friendly building design and construction methods. It is a credit-based system, the credits are awarded based on the performance of the building on the following parameters:

i) Planning and site selection
ii) conserving water
iii) maximizing energy efficiency
iv) materials and resources
v) indoor environmental quality
vi) Innovation and design processes

3.6. GRIHA Green Rating System

In 2005, this green ranking system was created and made public. It was created by TERI with support from the Ministry of New and Renewable Energy of the Indian government. The Association for Development and Research of Sustainable Habitat, or ADaRSH, is the society in charge of overseeing it. An impartial forum for discussion on matters pertaining to India's sustainable habitats is ADaRSH. GRIHA is promoted by ADaRSH as a tool for Green Building design and assessment. Its assertion is supported by nationally recognized environmental and energy standards.

- The principle of refusing to widely adopt foreign trends, materials, technology, products, etc., particularly when there are local alternatives or equivalents.
- The idea of reducing reliance on high-energy systems, processes, products, etc.
- The idea of reusing products, materials, and

conventional technology in order to lower the expenses associated with both creating and running business operations.

- The idea that all trash produced on the construction, operation, and demolition sites should be recycled.
- The idea that engineering systems, methods, and procedures should be reinvented so that India sets a worldwide standard that other countries can emulate.

3.7. Green Building Scenario in India

Since its inception in 2001, the green construction movement has lasted for about 19 years. In this area, some research was done. The energy efficiency policies and programs for an Indian residential building were examined. According to the author, a number of nations have implemented measures to increase energy efficiency and the utilization of sustainable and renewable energy sources. Energy efficiency has been significantly impacted by standards such as the National Building standards (NBC), Energy Conversion Building Codes (ECBC), Indian Standards SP: 41, LEED India, and GRIHA rating programs.

3.8. Evolution of Sustainability

Environmental degradation was started with industrialization in the 18th century but the sustainability debate is relatively new. The study covered the literature and research works to trace the origin of sustainability which has roots in the rebirth of the modern environmental movement in the 1960s. The role of the United Nations and its associated organization is very important in this field and they have contributed a lot. The study covered the publication, reports of the commissions and data / compiled data globally, by the United Nations and its associated organizations.

3.9. Green Building Concept and its Rating System

As the concept was initially started in developed countries, much of the study and research works have been carried out in these countries. In developing countries like India, some studies have been carried out but still, very limited literature and research work is found in this field. In developed nations, the green building rating system was created and implemented. The United States and the United Kingdom are leading this project. The idea of the green building grading system was introduced in order to measure and quantify the sustainability efforts made by the building industry. Some of the most well-known and significant green building rating systems in the world are covered in the study. The research work and literature have been examined in the study. The thesis presents a detailed study on prominent green rating systems in the country i.e., LEED – India and GRIHA. Green building projects registered under these two rating systems have been examined. The annual data has been presented and analysed to understand the growth scenario since the introduction of the two systems. The green building movement in India has completed around 20 years. The work examines institutional and regulatory support extended and established in this period.

3.10. Growth of Towns /Cities

Jobs, greater prospects, and a higher standard of living are examples of economies of scale that the cities offer. People from rural areas move to cities in pursuit of greater prospects and higher incomes. Urban towns and cities have grown at an unprecedented rate as a result of this migration, particularly in the last 50 years. The smaller towns have been converted to smaller cities, smaller cities to bigger cities and big cities to metropolitan cities. In the city, large numbers of build spaces are constructed in a limited area. The concentration of buildings disrupts the ecological functioning in the area. And it creates a huge demand for energy and other natural resources.

4. Research Design

This study addresses an expert's multi-criteria decision-making challenge when choosing an appropriate green building construction strategy. It is necessary to demonstrate the modern industry's attention on the seeming benefits of precast construction over the cast-in-situ technology in the age of industrialization and sustainable development. Instead of using the conventional metrics of cost, time, and quality, holistic criteria that take into account both "hard" and "soft" elements must be used to capture the sustainable performance of construction processes. This study

used Zadeh's fuzzy synthetic evaluation technique to create an analytical tool based on the experts' collective preferences in the integrated Green Building design because there is a lack of formal and verified data on the applicability of construction methods shown in Figure 4 (Tabb and Deviren, 2017).

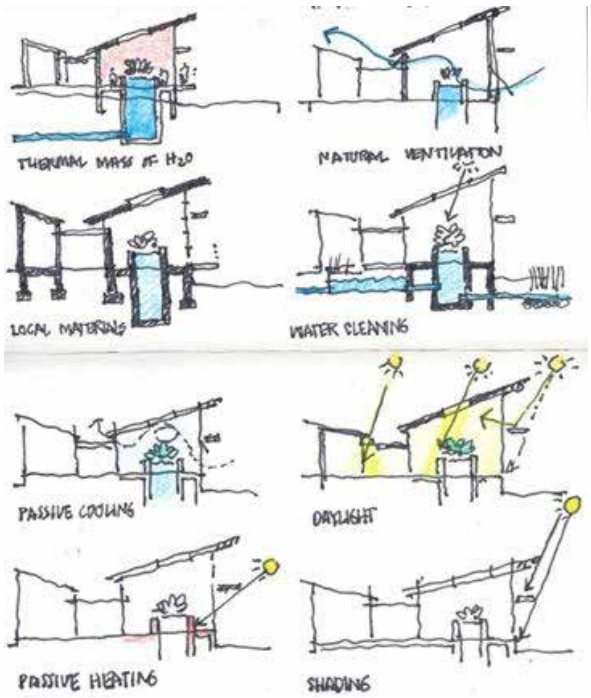

Figure 4. Green Architecture & Building

It has been attempted to strike a suitable balance between the ecological, social, and economic aspects of sustainable building, reflecting the worries of different experts and venture stakeholders. Pairwise comparisons were used to determine the weights allocated to each metric, which were then verified by calculating the consistency ratio. The best construction method will satisfy stakeholders' preferences, and the evaluation criteria also call for negligible data that was typically accessible during the early stages of conceptualization (Talas, 2022).

Decisions can be made with careful consideration of social, economic, or environmental perspectives based on project constraints because the results provide new scores for different combinations of criteria. This study creates the foundation for automated tools that facilitate project-level choices and methods for a well-built space. If additional criteria are obtained and the experts' findings shift in accordance with their requirements and point of view, the same systematic model may be connected. To increase knowledge of the near-term market potential for the industrialization of construction, more research should be conducted on a variety of projects. Multi-hazard assessments are diverse and necessitate a vast database from multiple offices, specific programming initiatives, computerized maps, satellite imagery, and the ability to analyse the scenario. The suggested expert opinion method may be especially helpful in India, where there is a dearth of housing data and virtually no empirical evidence of damage from previous risks. This technique can be used to determine the vulnerability of any building type by assembling a group of experts that are knowledgeable about building construction technology.

5. Conclusion

The green building concept is a very structured, scientifically designed program to address these issues in a systematic and organised way. The green building certification programs need to be propagated in all parts of the country from metropolitan to small urban towns. This has created a very high demand for energy, water and other Natural resources which entails huge extraction of natural resources and minerals. People move to cities from rural areas in search of greater opportunities, a higher standard of living, more money, and improved health and education. This trend is more or less the same in all parts of the globe. Industrialisation, urbanisation and modern development have succeeded in fulfilling many of these aspirations of society. But it has failed on many other fronts. It has posed many challenges for the planet. The environmentalists and thinkers do not agree with the methods and means of development during the industrialisation era. They are of the view that modern development or the current pattern of development is not sustainable. It has / will lead to many environmental problems and climate changes which will threaten the life carrying and lively hood capability of the planet. These environmental, ecological and climate changes are now

visible in the form of natural disasters, polar ice melting, global warming, change in rainfall patterns, extinction of species, loss of natural habitats, desertification, etc. This is also crucial for lowering the nation's carbon impact and achieving its sustainable development objectives. For this, more intense involvement of state governments is required by the way of making or amending building bylaws incorporating green building provisions.

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