

Materials and Practices for Sustainable Planning & Design : A Literature Study

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Abstract: This literature study explores the essential materials and practices for achieving sustainability in urban planning and architectural design. It emphasizes the importance of sustainable material choices, energy-efficient design, and green building certifications. The study also examines successful case studies and policy frameworks promoting sustainability. In summary, it provides valuable insights for professionals, policymakers, and researchers working towards a more sustainable built environment.

Keywords: Sustainability, Green Building, Sustainable Construction.

1. Introduction

Sustainability refers to the efforts made to maintain or support a process continuously over time. It is a broad and multifaceted concept that revolves around the responsible management of resources to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainability is generally divided into three core concepts: economic, environmental and social which is often described as the "triple bottom line" approach.

Sustainability in construction is often

referred to as "green building" or "sustainable construction," which is a critical approach to designing, constructing, and operating buildings and infrastructure in a way that minimizes their environmental impact, maximizes resource efficiency, and promotes long-term economic and social benefits. Sustainable construction practices and technologies aim to reduce energy consumption, minimize waste, and create healthier, more environmentally responsible structures.

2. Scope

The scope in sustainable construction is vast and promising, with increasing global awareness of environmental concerns and the need for eco-friendlier building practices. In India, in particular, the scope for sustainable construction is significant,

given the country's rapid urbanization and growing population.

3. Objective of Work

The objective of this study is to analyze the materials and practices in construction to minimize the environmental impact of buildings, reduce resource consumption, and enhance the quality of life for occupants;

- Environmental Conservation
- Resource Efficiency
- Energy Efficiency
- Water Conservation
- Improved Indoor Environmental Quality
- Economic Viability.

4. Historical Background

India has rich traditions and history in holistic strategies for buildings and construction. Despite this the sustainable buildings agenda currently receives limited attention in India. While there are some local initiatives promoting sustainable buildings which include research, pilot or advocacy projects, there is no coordinated approach to address the wider sustainable buildings agenda in India.

Sustainable construction in India is deeply intertwined with the country's rich architectural and cultural heritage. India has a long history of sustainable building practices that can be traced back thousands of years. Ancient Indian architecture emphasized the use of locally sourced and renewable materials, such as mud, bamboo, thatch, and stone, to construct structures that were well-suited to the local climate and environment.

In the modern era, the concept of sustainable construction gained momentum with the Indian

government's initiatives to promote green building practices. Organizations like the Indian Green Building Council (IGBC) introduced rating systems such as LEED-India to certify environmentally responsible buildings. These initiatives spurred the adoption of sustainable construction practices, promoting energy efficiency, water conservation, and the use of renewable resources.

5. Present Study

The construction industry in India is a major employer, contributing to economic growth, but it also has negative impacts on the environment and society, such as environmental degradation, climate change, and poor working conditions for unskilled workers. A recent study shows a triple-bottom-line (TBL) centric review and assessment of construction practices in India that has been conducted using qualitative, inductive content analysis of 68 research papers. The data used in this paper consists of 68 research papers that were selected for their relevance to the assessment of construction practices in India from a sustainability perspective.

The research papers were subjected to qualitative, inductive content analysis to identify and analyze the relevant information related to sustainable construction practices in India. The content analysis involved identifying and labeling categories based on the semantic essence of the information found in the research papers. The aim was to provide a comprehensive assessment of the current state of construction practices in India and identify areas for improvement in terms of sustainability. This research paper's approach is limited to the triple-bottom-line (TBL) dimensions of sustainability, and it may not cover all aspects of sustainability in construction practices in India. The paper acknowledges the need for further research in multiple areas, indicating that there may be limitations in the current understanding of sustainable construction practices in India.

6. Literature Review

- 1) *ESCAPE Simplified Approach Designed to Evaluate Materials Sustainability: The Case of New Adsorbent Materials For Activated Carbon Substitution (2023)*

This paper discusses the increasing global demand for raw materials, the need to achieve climate objectives, and the importance of securing the availability of raw materials in Europe. It emphasizes the concept of the circular economy and the importance of closing the loop in industrial value chains to enhance resource efficiency. The paper aims to introduce the ESCAPE (Evaluation of Sustainability of material substitution using CARbon footPrint by a simplifiEd approach) approach as a tool to evaluate the sustainability of new secondary raw materials and support the circular economy and

Critical Raw Materials Act strategies.

It discusses the increasing global demand for raw materials, the need to achieve climate objectives, and the importance of securing the availability of raw materials in Europe. It emphasizes the concept of the circular economy and the importance of closing the loop in industrial value chains to enhance resource efficiency.

- 2) *Smart materials and technologies for sustainable concrete construction (2023)*

The paper reviews sustainable concrete construction practices, including the use of eco-friendly materials and technologies like green concrete, self-healing concrete, and 3D-printed concrete, to mitigate environmental impact. It emphasizes the importance of interdisciplinary collaboration, research, and emerging trends like digitalization and circular economy principles in driving the transition towards sustainable concrete construction.

It provides a comprehensive review of current trends and opportunities for sustainable concrete construction, emphasizing the importance of adopting eco-friendly practices to mitigate the industry's environmental impact and examines the roles of governments, industry, and academia in promoting sustainable concrete construction, emphasizing the need for interdisciplinary collaboration and research.

- 3) *Are there any gains in green-tech adoption? Unearthing the beneficial outcomes of smart-sustainable practices in Nigeria and Hong Kong built environment (2023)*

This study explores the key benefits of implementing smart-sustainable practices (SSP) in the built environment of Hong Kong and Nigeria, including better design products with low environmental impact and enhancement of project quality and productivity. This study aims to explore and examine the beneficial outcomes of SSP in the built environment of Hong Kong and Nigeria, providing insights for policymakers, clients, and contractors. The paper explores and establishes the key beneficial outcomes of smart-sustainable practices (SSP) in the built environment of Hong Kong and Nigeria, including better design products with low environmental impact and enhancement of project quality and productivity.

The findings provide practical and objective means to predict and assess the impacts of SSP implementation, offering pragmatic tools and effective recommendations for promoting the delivery of smart, sustainable projects worldwide.

- 4) *A critical analysis of LEED, BREEAM and*

DGNB as sustainability assessment methods for retail buildings (2023)

The paper critically analyzes LEED, BREEAM, and DGNB as sustainability assessment methods for retail buildings. It highlights the significant environmental impact of retail buildings, particularly in terms of energy consumption, water usage, waste generation, and greenhouse gas emissions. It emphasizes the importance of integrating sustainability principles into retail stores and the role of Building Sustainability Assessment (BSA) methods in achieving this objective.

The paper critically analyzes LEED, BREEAM, and DGNB as sustainability assessment methods for retail buildings. It compares the applicability of these assessment methods to retail buildings, addressing the gap in knowledge regarding their suitability for specific non-residential buildings like food retail stores. The paper provides a breakdown of how categories, indicators, and weights are assessed in each of the analyzed BSA methods for new buildings, including retail buildings.

5) *High rise office building makeovers—Exploiting architectural and engineering factors in designing sustainable buildings in different climate zones (2022)*

This study investigates the impact of architectural and engineering elements on the energy performance of high-rise office buildings in different climate zones. It focuses on high-rise office buildings, considering meteorological parameters such as temperature, solar radiation, and wind profile, as well as architectural and engineering conditions, to understand the influence of climate on building design and energy conserving measures.

The study identifies that a rectangular building plan with a 1:1.44 plan ratio, split-core position, and central atrium presents the best performance in the warm-summer-cold- winter (WSCW) climate zone, while a square building plan with a split core and no atrium displays the best performance in the hot-summer-mild-winter (HSMW) climate zone.

6) *Climate adaptation of design scheme for energy-conserving high-rise buildings—Comparative study of achieving building sustainability in different climate scenarios (2022)*

The study focuses on the impact of design parameters on the energy performance of high-rise office buildings in different climate environments. It identifies and compares the major sensitive design parameters and establishes the most applicable passive strategies for achieving building sustainability criteria. The results show that design characteristics such as plan ratio, core position, and

atrium effect significantly affect energy performance in different climate contexts. In a cold climate, a rectangular building plan with a vertical split-core and no atrium, along with double-glass curtain walls, achieves the best energy performance. In a hot climate, a square building plan with a vertical split-core and no atrium, along with double-glass curtain walls and renewable energy systems, achieves the best energy performance.

7) *Investigating the drivers and acceptance of sustainable materials in Kuwait: A case study of CEB (2022)*

This study investigates the drivers of sustainable construction in Kuwait, focusing on Compressed Earth Blocks (CEBs) as an alternative material. It also explores the level of awareness and acceptance of sustainable materials among different stakeholders. The research was conducted in three phases: identifying drivers from literature, designing and implementing a questionnaire-based survey, and performing statistical analyses to compare the influence of drivers on stakeholders' choices. The results show that the most influential drivers for practitioners are energy efficiency, availability and accessibility to resources, environmental impact, enhancement of health and safety, and knowledge and skill of personnel. For clients, cost savings and enhancement of health and safety are the most important drivers. Despite a poor level of awareness, the survey indicates a positive level of acceptance of sustainable materials, highlighting the need for knowledge dissemination among stakeholders.

It conducts a literature review to identify factors influencing sustainability in the construction industry, considering the local context of Kuwait and identifies the most influential drivers for practitioners and clients, such as energy efficiency, availability and accessibility to resources, environmental impact, enhancement of health and safety, and cost savings.

8) *Critical components of Environmentally Sustainable Buildings Design Practices of office buildings in Ghana (2019)*

This study examines the critical components of environmentally sustainable building practices at the design stage for office buildings in the tropical built environment, specifically in Ghana. It uses a quantitative research method and a structured questionnaire to gather the views of 250 professionals in the building industry. The findings suggest that energy efficiency and conservation, water efficiency and conservation, material conservation, waste reduction, reuse and recycling, and humane adaptation are the major components that positively influence sustainable design practices of office

buildings in tropical regions. These findings can be useful for professionals during the design stage of projects to preserve the environment and its resources.

7. CONCLUSION

Sustainability in construction can be quite hard to achieve while considering the economic and environmental factors. However, there are some efforts to make it achievable as the times are changing. This paper gives the brief review about;

- Smart Materials and Technologies
- High Rise Buildings
- LEED, BREEM, and DGNB methods
- Energy Conservation

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