

Exploring Barriers and Opportunities for Sustainable Construction Practices: A Review

Shivam Ajay Kushwaha

Final Year Student, M.Tech. (Civil) Construction Engineering & Management,
Birla Vishvakarma Mahavidyalaya Engineering College, Vallabh Vidyanagar.

Kushwaha.7487@gmail.com

Prof. (Dr.) J. R. Pitroda

Professor, PG Coordinator (Civil) Construction Engineering & Management, Civil Engineering Department,
Birla Vishvakarma Mahavidyalaya Engineering College, Vallabh Vidyanagar.

jayesh.pitroda@bvmengineering.ac.in

Gargi Ray

Assistant Professor, Civil Engineering Department, Chandubhai S Patel Institute of Technology, Charotar
University of Science and Technology, Changa.

gargisojitra.cv@charusat.ac.in

Abstract- Over the past ten years, there has been a notable increase in the construction of environmentally friendly buildings. Sustainable construction is a major shift in the design, construction, and upkeep of buildings due to the growing concerns about climate change, resources, and urban resilience. Even though awareness has grown, adoption is still constrained by supply-chain problems, poor stakeholder knowledge, fragmented policies, expensive upfront costs, and skill gaps. Opportunities for expansion, however, include corporate demand, cutting-edge technology, creative funding, government incentives, and model initiatives. Fast urban growth, forward-thinking municipal policies, and robust institutional backing put both cities in a great position to spearhead India's sustainable building movement. In order to do this and make a substantial contribution to environmental objectives and sustainable urban development, it will be necessary to implement policies in concert with industry cooperation and public-private partnerships.

Keywords- Barriers, Construction Industry, Environmental policy, Green building, Opportunities, Sustainable Construction

1. Introduction

The construction industry has a significant opportunity to mitigate the harmful effects construction has on the natural environment [1]. However, the worldwide construction industry is changing from being a resource-intensive, ecologically harmful business to one that promotes innovation and sustainability. Buildings and construction are essential to the global climate issue because they are responsible for over 30% of raw material consumption and approximately 40% of worldwide energy-related CO₂ emissions. It is more important than ever to reconsider the planning, construction, and operation of buildings. It is now believed that sustainable construction, an integrated approach that prioritizes resource efficiency, social well-being, economic viability, and environmental performance, is crucial to reaching the Sustainable Development Goals (SDG).

India's population is expected to exceed 600 million by 2036, and this fast urbanization is creating a huge demand for infrastructure and housing, which is causing resource depletion, air pollution, and greenhouse gas emissions to escalate.

1.1 Sustainable Construction

The process of creating and preserving a healthy built environment with ecological and resource-efficient techniques is known as sustainable building. It includes all phases of a building's life cycle, including design and planning, construction, use, maintenance, and eventual demolition or reuse. As green building is growing

worldwide, it is necessary to ensure that projects are delivered more effectively and efficient [2]. For that, the objectives of sustainable buildings are to consume less resources, have less of an adverse effect on the environment, improve the comfort and health of tenants, and benefit society and the economy.

The following are the essential components of sustainable building (Refer Figure 1, 2, 3):



Figure 1: Sustainable Design



Figure 2: Eco-friendly Materials



Figure 3: Energy Efficient

1.2 Evolution of green building practice in India

Environmentally sustainable building construction has experienced significant growth during the past 10 years [3]. In India, the idea of "green building" is not new. Many instances of sustainable methods may be found in traditional Indian architecture, which is based on local material utilization and climate adaptability. Nonetheless, the Confederation of Indian Industry (CII)-sponsored Indian Green construction Council (IGBC) (Refer Figure 4) was established in 2001, which greatly accelerated the current green construction movement. The development of a domestic green building ecosystem was accelerated by IGBC's introduction of foreign standards and certification programs to the Indian setting.

Further institutionalizing sustainability in building design was the Green Rating for Integrated Habitat Assessment (GRIHA), created by The Energy and Resources Institute (TERI) in partnership with the Government of India. The Energy Conservation Building Code (ECBC) and National Building Code (NBC) of India have also changed to include sustainability concepts. For that, a systematic way to identify and quantify

uncertainty in the green construction process based on the LEED rating system adopted by the Indian Green Building Council (IGBC)[4].



Figure 4: IGBC logo

The performance of green building and its trend in India shows that the percentage rise in both the original cost and the payback period has decreased with the introduction of new building techniques and materials (Refer Table 1 & 2).

Table 1: Green building performance in India [5]

Name of the Project	Location	Built-up Area (Sq. ft)	Rating Achieved	Increase in cost (%)	Payback Period (Years)
CII-Sorabji Godrej GBC	Hyderabad	20000	Platinum	18	7
ITC Green Centre	Gurgaon	170000	Platinum	15	6
Wipro	Gurgaon	175000	Platinum	8	5
Technopolis	Kolkata	72000	Gold	6	3
HITAM	Hyderabad	78000	Silver	2	3

Table 2: Energy savings from green buildings

Building	Sq. ft	Normal Building (KWH)	Actual Building (KWH)	% Reduction	Annual Energy Savings (Rs in lakhs)
Wipro, Gurgaon	175000	4800000	3100000	40%	102
ITC, Gurgaon	170000	3500000	2000000	45%	90
CII-Sorabji Godrej, Hyderabad	20000	350000	130000	63%	9

2. Literature Review

The following are the previous research review based on barriers and opportunities for sustainable construction practices:

Clarke-Hagan et al. (2014) studied how organizational, contractual, and stakeholder constraints had prevented the construction sector from embracing green advances despite being resource-intensive and harmful to the environment. Green innovation has been described as a process that aims to minimize environmental deterioration and maximize performance. According to the literature, obstacles to green innovation included high prices, risk aversion, low demand, and disparate stakeholder goals. Corporate culture, adaptable organizational structures, and managerial traits were found to be important facilitators of innovation uptake. Effective management, transparent communication, and the development of green contracts outlining risk ownership were proposed as ways to get beyond these obstacles. In the end, effective green innovation

management relied on teamwork, leadership dedication, and ongoing practice review to strike a balance between cost, quality, and environmental performance.

Dod et al. (2015) explored those buildings have been important energy consumers, accounting for about 40–45% of total energy use and significant greenhouse gas emissions. It has been noted that India's quick industrialization and urbanization have raised energy consumption, making sustainable building more urgent. According to the study, green buildings improved efficiency and occupant well-being by using 40–50% less energy and 20–30% less water. Green activities have been greatly aided by the GRIHA rating systems and the Indian Green Building Council (IGBC). However, high upfront costs, little knowledge, a lack of incentives, and a shortage of environmentally suitable materials have all impeded adoption. The study came to the conclusion that in order to mainstream green building and attain environmental sustainability in India, government laws, awareness campaigns, and incentives were crucial.

Akhani et al. (2018) explored the market potential and difficulties related to green buildings in the Indian construction industry. Adoption was found to be severely hampered by developers' and clients' continued lack of awareness of sustainability. Top issues such high implementation costs, poor communication, inadequate benefit studies, and low customer interest were noted in the literature. The applicability of rating systems such as LEED, BREEAM, GRIHA, and GREEN STAR in the Indian setting has been compared. Additionally, the study revealed that certified green buildings had payback periods ranging from two to seven years, highlighting long-term advantages. The study came to the conclusion that in order to overcome market barriers and encourage widespread adoption of green construction practices, government incentives, the availability of local resources, expert supervision, and awareness campaigns were crucial.

Sobti et al. (2023) studied the implementation of green construction principles was required due to the depletion of natural resources and the rise in pollution. Green buildings are environmentally conscious structures that are made to use as few resources as possible throughout the course of their lives. The use of sustainable materials, water-efficient systems, renewable energy sources, and the 3Rs Reduce, Reuse, and Recycle were all emphasized in the report as essential elements. It has been said that rating systems such as LEED and GRIHA are instruments for assessing environmental performance. Green buildings were proven to provide long-term savings through energy efficiency and lower maintenance, even though their initial prices were slightly higher. The study came to the conclusion that in order to achieve sustainable development and promote the widespread use of green building in India, awareness, government policies, and the acceptance of renewable technologies were crucial.

Reeva et al. (2025) studied that high beginning expenses, ignorance, inadequate incentives, and unpleasant social judgments were frequently mentioned as major obstacles in previous research. Studies also shown that implementation was hampered by stakeholder resistance and a lack of technical expertise. The analysis came to the conclusion that strengthening sustainable construction in small-scale projects required increasing awareness, policy consistency, and training in addition to implementing financial incentives and cutting-edge materials.

2.1 Necessity of Green Building

To accomplish the sustainability objectives, a slow paradigm change toward green buildings is necessary:

1. Building design and the construction sector have a big impact on the environment.
2. Natural biologically diverse habitats are deprived of land usage due to normal building.
3. Buildings consume more than 20% of electricity used in India [6].
4. Green building techniques can improve current unsustainable construction and operation methods while significantly reducing or eliminating adverse environmental effects [7].
5. Green design practices provide the benefit of lowering operating expenses and addressing issues with indoor air quality.

2.2 Comparative Analysis of Reviewed Studies

Author(s) / Year	Study Location	Key Barriers Identified	Opportunities / Recommendations
Tan et al. (2010)	Singapore	Lack of management and time [8], high cost, limited investment.	Develop green PM frameworks; expand government incentives
Djokoto et al. (2014)	Ghana	Lack of awareness; high initial cost; limited government support.	public awareness campaigns [9]; strategic policy integration
Akhani et al. (2018)	India	Lack of Skilled supervision [10]; low demand; fragmented market.	Government incentives; local training programs

2.3 Common Barriers

The following barriers are given below:

1. **Cost Concerns:** Adoption of sustainable construction practices by developers, contractors, and builders is significantly hampered by financial considerations. As compared to conventional projects, green projects tend to cost more to construct [11]. Sustainable building materials, technology, and methods can initially cost more than their conventional counterparts. Even though sustainable buildings may result in large long-term savings through energy efficiency and lower operating expenses, many industry stakeholders desire short-term financial advantages, making it difficult to justify the higher initial expenditures [12].
2. **Limited Awareness to Sustainability Education:** A lack of skilled labour and inadequate access to advanced green building technologies hinder the implementation of sustainable practices [13]. It's possible that experts are unaware of the latest advancements in green building certifications, materials, and technology. The adoption of sustainable building practices may be hampered by a lack of knowledge, as contractors and builders often opt for tried-and-true traditional methods.
3. **Inadequate Access to Sustainable Materials:** There can be wide regional variations in the accessibility and availability of sustainable construction methods and materials. There may not be a well-established eco-friendly material supply chain in some places, which makes it challenging for developers and builders to obtain and incorporate these components into their projects. Therefore, conventional materials that are easily obtainable still rule construction methods.
4. **Resistance to Change:** Since the building business has long-standing customs and habits, adopting sustainable construction techniques necessitates a departure from accepted wisdom. This reluctance to change may be ascribed to a number of things, such as a lack of trust in unproven sustainable alternatives, worries about unfamiliarity, or perceived hazards.
5. **Complexity and Integration Challenges:** To obtain the best environmental performance, sustainable building approaches frequently include the integration of several parts and technologies. For professionals who lack the necessary skills to smoothly integrate green building features into their plans and projects, putting these ideas into practice can be challenging.
6. **Regulatory Barriers:** One of the biggest obstacles to the broad adoption of sustainable construction methods might be outdated or conflicting building standards and regulations. Insufficient incentives and enforcement of green building standards may not be sufficient to motivate industry participants to give sustainability top priority in their projects.
7. **Perceived Performance Issues:** The broad adoption of eco-friendly materials and technology may be hampered by doubts about their efficacy and longevity. Professionals in the industry may be hesitant to embrace sustainable alternatives because of doubts about their resilience and long-term performance.

2.4 Opportunities of Green Building

The following are the opportunities of the green building given below:

1. **Energy Efficient:** Significant reduction in energy consumption through renewable energy and efficient systems. We can use a solar energy system converting solar energy into electricity which is used to operate the building [14] [15].
2. **Water Conservation:** Use of rainwater harvesting and greywater recycling techniques [16].

3. Waste Reduction: Promotes recycling and reuse of construction materials [17].
4. Improved Indoor Air Quality: Use of non-toxic, low-Voc materials enhances occupant health [18].
5. Environmental Protection: Reduces carbon footprint and conserves natural resources.
6. Government Incentives: Incentives such as tax reduction [19], subsidies and certification advantages.
7. Innovation and Technological Progress: Promote the adoption of sustainable and intelligent technologies.
8. A Rise in Property Value: Buildings with green certification have greater occupancy rates and market value.

3. Case Study

India First Net-Zero Energy Building- Indira Paryavaran Bhawan

India first net-zero building **Indira Paryavaran Bhawan** is located in New Delhi, and its construction started on 25th January 2011 and completed on 31st October 2013.



Figure 5: Indira Paryavaran Bhawan

The structure was inaugurated on February 28, 2014, by Dr. Manmohan Singh, the prime minister at the time. The building has a LEED India Platinum rating from the Indian Green Building Council (IGBC) and a five-star GRIHA (Green Rating for Integrated Habitat Assessment) assessment from MNRE. The structure has a geothermal heat exchange system, a fully automated robotic multi-level automobile parking system, a sewage treatment facility, a solar power plant, and puzzle parking.

A corridor connects the two blocks that make up Indira Paryavaran Bhawan. G+7 buildings with three basements make up each block. The complex has 32,000 square meters of total floor space. There are conference rooms, meeting rooms, offices, and other areas on each floor. Situated between the two blocks, the building has a central atrium and seven elevators. The built-up cost is around 209 crore and it contain 330 Car parking.



Figure 6: Onsite installed Solar PV Panels [20]

Table 3: Solar Photovoltaic Power plant Specifications

Parameter	Quantity
Capacity of Power Generation	930 kW Peak (Largest Roof top solar)
Annual Energy Requirement	14,00,000 Unit (kWh)
Annual Energy Generation	14,00,000 Unit (kWh)
Net Energy Consumption	ZERO
Total area	6000 m ²
Total area of Solar panels	4600 m ²
Type of Photovoltaic panel	Mono Crystalline 20% efficiency [21]
Number of panels	2844
Nature of Power Generation	Grid Interactive

Achievements

1. 40% savings in energy, zero electricity billing and savings in water.
2. The building is rated as a 5-star GRIHA (Green Rating for Integrated Habitat Assistant) by MNRE (Ministry of new & Renewable) and LEED (Leadership in Energy & Environmental Design) in January 2014.
3. India Platinum rated by Indian Green Building Council (IGBC)

4. Conclusion

Based on the reviewed literature, several key insights can be drawn regarding the exploring barriers and opportunities for sustainable construction practices:

1. Sustainable building is essential to guaranteeing long-term urban resilience and reducing environmental harm.
2. The primary barriers include high upfront costs, inadequate policy enforcement, and a lack of understanding.
3. Government incentives, innovation, and the expanding demand for eco-friendly facilities all present opportunities.
4. Government, industry, and academia must work together for implementation to be successful.
5. Shifting towards green buildings can be accelerated by promoting sustainable technologies, education, and awareness.

Acknowledgement

The authors sincerely acknowledge Prof. (Dr.) Vinay Patel, Principal, Birla Vishvakarma Mahavidyalaya Engineering College (BVM), and Prof. (Dr.) Sanjay Dhiman, Head and Professor, Civil Engineering Department, BVM, Vallabh Vidyanagar, Gujarat, India, for their encouragement and valuable infrastructural support in facilitating this research.

References

- [1] J. Monahan, R. Coates, and D. Clarke-Hagan, "Overcoming the barriers of green innovation in construction projects through its successful management," *Proc. 30th Annu. Assoc. Res. Constr. Manag. Conf. ARCOM 2014*, no. September, pp. 123–132, 2014.
- [2] Y. Li, H. Song, P. Sang, P. H. Chen, and X. Liu, "Review of Critical Success Factors (CSFs) for green building projects," *Build. Environ.*, vol. 158, no. January, pp. 182–191, 2019, doi: 10.1016/j.buildenv.2019.05.020.
- [3] L. B. Robichaud and V. S. Anantatmula, "Greening Project Management Practices for Sustainable Construction," *J. Manag. Eng.*, vol. 27, no. 1, pp. 48–57, 2011, doi: 10.1061/(asce)me.1943-5479.0000030.
- [4] A. Gaurav and N. Krishna, "Cost and time overrun analysis for green construction projects Arun Chandramohan , S . Lakshmi Narayanan *," *Int. J. Green Econ.*, vol. 6, no. 2, pp. 167–177, 2012.

- [5] D. Tathagat and R. D. Dod, "Role of Green Buildings in Sustainable Construction-Need, Challenges and Scope in the Indian Scenario," *IOSR J. Mech. Civ. Eng. Ver. II*, vol. 12, no. 2, pp. 2320–334, 2015, doi: 10.9790/1684-12220109.
- [6] J. Sobti, "Role of Green Buildings in Sustainable Construction Practices," *Int. J. Eng. Res. Technol. ISSN 2278-0181*, vol. 12, no. 11, pp. 1–4, 2023.
- [7] S. Vora, M. Rajgor, and J. Pitroda, "A Critical Review of Net Zero Energy Efficient Design Strategies In Construction Sector," *Int. J. Adv. Res. Innov. Ideas Educ.*, vol. 3, no. 1, pp. 1187–1194, 2017.
- [8] B. G. Hwang and J. S. Tan, "Green building project management: Obstacles and solutions for sustainable development," *Sustain. Dev.*, vol. 20, no. 5, pp. 335–349, 2012, doi: 10.1002/sd.492.
- [9] S. D. Djokoto, J. Dadzie, and E. Ohemeng-Ababio, "Barriers to sustainable construction in the ghanaian construction industry: Consultants perspectives," *J. Sustain. Dev.*, vol. 7, no. 1, pp. 134–143, 2014, doi: 10.5539/jsd.v7n1p134.
- [10] D. A. Akhani and J. R. Pitroda, "To Identify and Analyse Market Opportunities and Challenges for Green Building," *Int. J. Innov. Res. Technol. (IJIRT)*, ISSN 2349-6002, vol. 4, no. 12, pp. 247–251, 2018.
- [11] B.-G. Hwang and J. S. Tan, "Sustainable Project Management for Green Construction," *Challenges, Impact Solut.*, no. June, p. 9, 2012.
- [12] A. Dingat and J. Pitroda, "A Study on Green building: Market opportunities and challenges," *Int. J. Creat. Res. Thoughts (IJCRT)*, ISSN 2320-2882, vol. 5, no. 4, pp. 1291–1297, 2017.
- [13] R. Charles, "Barriers and Strategies for Sustainable Building Practices in Small-scale Construction: Insights from Literature and Industry Stakeholders," no. February, 2025.
- [14] Balramdas, P. Meher, S. Behera, B. Rath, S. Dash, and P. Choudhary, "A comparison between Normal buildings and Green buildings-A case study approach," *Int. Res. J. Eng. Technol.*, pp. 51–54, 2016.
- [15] J. Pitroda, L. Biraj, N. Dhiraj, and N. Jay, "A Critical Literature Review on Benefits Due to Passive Solar Energy System in Educational Building," *Int. J. Constr. Res. Civ. Eng.*, vol. 2, no. 5, pp. 16–20, 2016, doi: 10.20431/2454-8693.0205003.
- [16] A. R. Phanse and J. R. Pitroda, "Water Efficiency and Management in Green Building: A Review," *ADBU-Journal Eng. Technol.*, vol. 10, no. 2, pp. 0100200134(8PP) 1–8, 2021.
- [17] D. Belani, A. H. Makwana, J. Pitroda, and C. M. Vyas, "Intelligent building new era of today's world," *Trends Challenges Civ. Eng. Today's Transform. World*, no. March, pp. 1–16, 2014.
- [18] R. Gandhi, J. Pitroda, and B. Bhatt, "Factors Affecting Green Building Based Smart City," *Int. J. Adv. Res. Eng. Sci. Technol.*, vol. 4, no. 2, pp. 38–44, 2017, [Online]. Available: <https://www.researchgate.net/publication/314229574>
- [19] A. Karji, M. Namian, and M. Tafazzoli, "Identifying the key barriers to promote sustainable construction in the United States: A principal component analysis," *Sustain.*, vol. 12, no. 12, 2020, doi: 10.3390/su12125088.
- [20] R. Khandelwal, R. Jain, and M. Gupta, "Case Study: India's First Net-Zero Energy Building-Indira Paryavaran Bhavan," *Int. J. Sci. Technol. Res.*, vol. 9, no. 11, pp. 353–357, 2020.
- [21] G. P. Selvan, D. D. Jayganes, D. S. R. Ravi, and A. Professor, "Case Study on Zero Energy Building (Indira Paryavaran)," *Int. J. Creat. Res. Thoughts*, vol. 10, no. 6, pp. 2320–2882, 2022.