Green Construction in India: Practices, Constraints and Opportunities for Sustainable Development

Abhijeet Shende[1]*, Dr. C. sunanda Yadav[2]

1 Research Scholar Tilak Maharashtra Vidyapeeth, Pune, Maharashtra, India

sunandayadav@yahoo.com

2 Faculty Tilak Maharashtra Vidyapeeth, Pune, Maharashtra, India

Abstract: Green construction has become an important pathway for reducing the environmental pressures associated with the expanding built environment. In India, the transition is supported by building-energy regulation, voluntary green-building rating systems and growing attention to resource efficiency, yet implementation remains uneven. This study examines green construction in India through three analytical dimensions: practices, constraints and opportunities for sustainable development. A qualitative descriptive research design based exclusively on secondary documentary evidence was adopted. Government policy and regulatory documents, Indian green-building frameworks, peer-reviewed studies and selected international evidence were purposively reviewed and thematically analysed. The analysis identifies six interconnected practice areas: energy efficiency, water conservation, sustainable materials, construction and demolition waste management, renewableenergy integration, and lifecycle-oriented design and operation. Documented constraints cluster around economic and financial conditions, regulatory implementation, organisational capability and skills, technology and material availability, and market and supply-chain conditions. The findings indicate that India's principal challenge is not the absence of sustainability frameworks but the translation of these frameworks into consistent project-level and lifecycle performance. The study identifies implementation-oriented opportunities in green finance, skills development, sustainable procurement, circular construction, supply-chain capability and performance-based assessment. The paper contributes a structured secondary-data synthesis of the Indian green-construction landscape and identifies priorities for future empirical research.

Keywords: green construction; sustainable construction; green buildings; India; construction industry; green procurement; sustainable development

INTRODUCTION

The construction sector is simultaneously an engine of economic development and a major source of environmental pressure. Buildings and construction account for around 37% of global CO_2 emissions and nearly half of global material extraction, while the sector represents approximately 11–13% of global GDP and employs about 9% of the world's workforce (UNEP & GlobalABC, 2026). These figures make the environmental performance of construction relevant not only to climate policy but also to resource security, urban development and longterm economic performance.

Green construction addresses this challenge by integrating environmental considerations into planning, design, procurement, construction, operation, renovation and end-of-life stages. Its scope therefore extends beyond installing energy-efficient equipment in completed buildings and includes passive design, energy and water efficiency, sustainable materials, waste reduction, renewable energy, healthy indoor environments and lifecycle-oriented decisionmaking.

India has developed an increasingly formal institutional architecture for sustainable buildings. The Energy Conservation and Sustainable Building Code (ECSBC) 2024 provides a framework for energy conservation and sustainable building performance in commercial and office buildings (Bureau of Energy Efficiency [BEE], 2024). GRIHA provides an Indian greenbuilding assessment system covering design, construction, post-construction and operational stages, while IGBC operates voluntary rating systems across several building categories (GRIHA Council, 2026; Indian Green Building Council [IGBC], 2026).

However, institutional development does not by itself demonstrate effective implementation. Indian research has documented economic, governmental, organisational, informational, technological and material barriers to green-building adoption (Saha et al., 2021). Research on green procurement has identified management commitment, management support and perceptions of higher cost among important barriers in Indian construction firms (Mojumder et al., 2022). More recent supply-chain research identifies green design, suppliers and green materials, certification and financial constraints within the barrier structure affecting green construction supply-chain management (Balon et al., 2024).

The research problem is therefore broader than the technical availability of green technologies: it concerns how sustainability frameworks are translated into implementable practices under economic, institutional, organisational, technological and market conditions. This study addresses that problem through a structured secondary-data synthesis rather than another stakeholder survey. Its contribution is to integrate documented practices, constraints and implementation opportunities within a single India-focused analytical framework.

OBJECTIVES OF THE STUDY

1. To examine the major green construction practices documented in the Indian context.
2. To identify the economic, financial, regulatory, institutional, organisational, technological and market-related constraints associated with green construction.
3. To examine opportunities for strengthening green construction in India in support of sustainable development.

LITERATURE REVIEW AND RESEARCH GAP

1. Green Construction and Sustainable Development - Sustainable construction has been examined as a multidimensional field in which environmental, economic and social considerations intersect across the construction lifecycle. Goel et al. (2019), in a systematic review of Indian sustainable-construction research, found that the literature had been predominantly oriented toward the environmental dimension, macro-industry level and internal stakeholders, with greater emphasis on project deliverables than project processes. Their findings support greater attention to implementation processes and broader dimensions of sustainability. The contemporary global context reinforces this need. UNEP and GlobalABC (2026) report that building energy intensity has improved and green-building certification has expanded, but sectoral progress remains insufficient for a net-zero pathway. The report emphasises policies, finance, technologies, resilience and investment as interconnected dimensions of the transition. For India, this suggests that green-construction outcomes depend on interactions between technical practices and the economic and institutional conditions under which projects are delivered.

2. Green Construction Practices - Indian green-building frameworks provide a basis for identifying the principal dimensions of green construction. GRIHA covers measures implemented during design, construction, post-construction and operation and describes its approach as process-driven and performance-oriented (GRIHA Council, 2026). IGBC Green Homes addresses site planning, water conservation, energy efficiency, materials and resources, indoor environmental quality, and innovation and design (IGBC, 2026). These frameworks indicate that green construction is a bundle of interrelated practices rather than a single technology. Energy practices include passive design, building-envelope performance, efficient lighting and cooling, monitoring and renewable-energy integration. Water practices include

efficient fixtures, rainwater harvesting, wastewater treatment and reuse. Material practices concern resource-efficient selection, recycled or locally sourced materials, durability and embodied impacts. Construction and demolition waste management addresses segregation, reuse and recycling. Lifecycle approaches connect design and procurement decisions with construction, operation, maintenance and end-of-life outcomes (IGBC, 2026; Ministry of Environment, Forest and Climate Change [MoEFCC], 2016).

3. Constraints on Green Construction - The Indian literature identifies recurring constraint categories. Saha et al. (2021) classify barriers under economic, governmental, organisational and social-perception, information, technology and material dimensions. Mojumder et al. (2022), using empirical evidence from Indian construction firms, identify reduced senior-management commitment, lack of management support and perceptions of higher cost among critical barriers to green procurement. Balon et al. (2024) identify financial constraints, suppliers and green materials, green design and certification within the barrier structure affecting green construction supply-chain management.These studies suggest that implementation is shaped by both project economics and organisational capability. Upfront cost may be more visible than lifecycle savings; fragmented procurement can constrain access to sustainable materials; and insufficient skills can limit translation of codes or rating criteria into project decisions. Regulatory existence is therefore distinct from regulatory implementation, while certification availability is distinct from actual operational performance.

RESEARCH GAP

Existing Indian research provides important but specialised evidence: Goel et al. (2019) synthesise sustainable-construction research; Saha et al. (2021) focus on commercial greenbuilding barriers; Mojumder et al. (2022) examine green-procurement barriers using firm-level empirical methods; and Balon et al. (2024) examine green construction supply-chain barriers using manager-level evidence. The present study does not claim novelty from identifying these individual factors. Instead, it addresses a synthesis gap by integrating documented greenconstruction practices with cross-cutting constraints and implementation opportunities within one India-focused descriptive framework, while distinguishing policy prescriptions from empirical evidence on implementation.

METHODOLOGY

- **Research Design** - The study adopts a qualitative descriptive research design based exclusively on secondary documentary evidence. The design is appropriate because the research questions concern the documented nature of green construction, recurring implementation constraints and development opportunities rather than measurement of stakeholder perceptions or statistical relationships.

- **Source Selection and Inclusion Criteria -** Sources were purposively selected from four categories: (1) Government of India policy, regulatory and technical documents; (2) Indian green-building rating and guidance documents; (3) peer-reviewed academic studies on sustainable construction, green-building adoption, procurement and construction supply chains in India; and (4) current international sector evidence used to establish broader context. Documents were included when they contained substantive information on green-construction practices, implementation constraints, institutional mechanisms or development opportunities relevant to India. General sustainability documents without a clear construction or builtenvironment connection were excluded.

- **Analytical Procedure -** Selected documents were examined through thematic document analysis. Evidence was coded under three primary categories: (i) practices—energy, water, materials, waste, renewable energy and lifecycle approaches; (ii) constraints—economic and financial, regulatory and institutional, organisational and skills, technological and material, and market and supply-chain conditions; and (iii) opportunities—policy implementation, green finance, skills, procurement, circularity, technology and performance-based assessment. No statistical weighting, causal modelling or ranking of barriers was undertaken.

SCOPE AND LIMITATIONS

The study synthesises documented evidence rather than generating primary observations. It therefore cannot estimate the prevalence of green practices across Indian construction firms, establish causal effects on adoption, or measure stakeholder perceptions. Government and industry documents may also reflect institutional priorities. Triangulation across policy documents, rating systems and peer-reviewed studies was used to reduce dependence on any single source type.

FINDINGS

Green Construction Practices - The evidence indicates that green construction in India is increasingly institutionalised through regulatory and voluntary assessment systems. ECSBC 2024 establishes an energy and sustainability framework for commercial and office buildings (BEE, 2024), while GRIHA provides a process- and performance-oriented framework covering design through operation (GRIHA Council, 2026). IGBC's residential framework combines mandatory requirements and credit-based assessment across site, water, energy, materials, indoor environmental quality and innovation (IGBC, 2026).

The practice landscape can therefore be understood as an integrated resource-efficiency system. Energy measures address envelope and system performance; water measures address conservation and monitoring; material measures address resource use and embodied impacts; waste measures address segregation, reuse and recycling; and renewable-energy measures can reduce dependence on conventional energy. The frameworks also demonstrate movement toward lifecycle and performance considerations rather than a narrow focus on construction inputs alone (GRIHA Council, 2026).

Economic and Financial Constraints

Economic considerations recur across the Indian evidence. Saha et al. (2021) identify economic barriers and long-payback perceptions as constraints on commercial green-building adoption, while Mojumder et al. (2022) identify perceptions of higher cost as a critical greenprocurement barrier. Balon et al. (2024) also place financial constraints within the barrier structure affecting green construction supply chains. The recurring issue is the visibility of upfront expenditure relative to benefits that may accrue through lower operating costs over a longer period.

The evidence supports a shift from initial-cost comparison toward lifecycle economic assessment. This does not imply that green construction is always more expensive or always financially beneficial; rather, investment decisions require consideration of capital cost, operating performance, maintenance, financing conditions and project time horizon together.

Regulatory and Institutional Constraints

India's policy architecture is substantial, but implementation remains a separate issue. The existence of ECSBC 2024 and voluntary rating systems demonstrates policy and institutional development; the literature identifies enforcement, implementation and institutional coordination as continuing concerns (Saha et al., 2021). The implication is that further policy formulation alone may not resolve implementation gaps. Effective translation of requirements into project practice depends on institutional capacity, clarity of responsibilities, technical support and monitoring.

Knowledge and Organisational Capability

Green construction requires coordinated decisions by developers, architects, engineers, contractors, suppliers and facility managers. Gehlot and Shrivastava (2022) report challenges in sustainable-construction practice among Indian construction professionals, while Mojumder et al. (2022) identify senior-management commitment and management support as important barriers to green procurement. These findings indicate that organisational readiness and skills are enabling conditions for implementation, not secondary considerations.

Technology, Materials and Supply Chains

Material and technology availability creates another implementation layer. Saha et al. (2021) identify uncertain supply of green materials and technology-related concerns among Indian barriers. Balon et al. (2024) show that suppliers, green materials, green design, certification and financial constraints are embedded in the structure of green construction supply-chain barriers. A project's ability to implement green specifications therefore depends partly on upstream market capacity, making sustainable procurement inseparable from project-level design and construction decisions.

Market Conditions

Market conditions influence incentives available to developers and construction firms. Where clients primarily evaluate projects through initial price, delivery time and conventional specifications, environmental attributes may receive less weight. Evidence from Indian greenprocurement and green-building research indicates that perceived cost, organisational commitment and market-related conditions can influence implementation (Mojumder et al.,

2022; Saha et al., 2021). Market development therefore complements regulation through demand, information and credible performance evidence.

DISCUSSION

The findings reveal a consistent pattern: India's green-construction challenge is increasingly one of implementation and integration rather than the absence of concepts, technologies or assessment frameworks. This interpretation extends the research agenda identified by Goel et al. (2019), which called for broader treatment of social and economic dimensions and greater attention to construction processes. The current evidence suggests that practices, constraints and enabling mechanisms need to be considered as a connected system.

First, policy effectiveness depends on implementation capacity. ECSBC 2024 and voluntary rating systems provide formal mechanisms, but project-level outcomes depend on whether requirements are understood, financed, procured and monitored. Second, economic decisions need a lifecycle perspective. The recurring emphasis on upfront cost suggests that financial mechanisms and lifecycle-cost evidence may be important for strengthening the business case for green construction. Third, organisational capability is critical: management commitment, skills and cross-functional coordination determine whether sustainability requirements become operational decisions.

Finally, green construction cannot be isolated from the supply chain. Sustainable materials, suppliers, certification and procurement practices are interconnected. This supports a transition from a building-centric conception of green construction toward a system perspective in which developers, designers, contractors, suppliers, regulators and occupants collectively influence sustainability outcomes.

Opportunities for Sustainable Development

Six implementation-oriented opportunities emerge from the synthesis. First, policy implementation can be strengthened through clearer institutional responsibilities, technical guidance and monitoring. Second, green finance and lifecycle-based investment appraisal can reduce the emphasis on short-term capital cost. Third, professional training can address capability gaps among designers, contractors, project managers and suppliers.

Fourth, sustainable procurement can create demand for green materials and encourage supplier capability. Fifth, circular construction can build on the Construction and Demolition Waste Management Rules, 2016 by moving beyond disposal toward reuse, recycling, recovery and design for future material recovery (MoEFCC, 2016). Sixth, performance-based assessment can complement design-stage certification by examining actual energy, water, waste and operational outcomes. These opportunities are consistent with the global emphasis on policies, finance, technologies, resilience and investment in the building's transition (UNEP & GlobalABC, 2026).

CONCLUSION

This study examined green construction in India through practices, constraints and opportunities. The secondary evidence demonstrates that India's green-construction landscape includes building-energy regulation, voluntary rating systems and practices covering energy, water, materials, waste, renewable energy and lifecycle performance. At the same time, documented implementation constraints extend across economic and financial conditions, regulatory execution, organisational capability, skills, technology and material availability, supply chains and market conditions.

The principal implication is that scaling green construction requires more than adding technologies or expanding certification. The transition depends on an enabling ecosystem in which policy implementation, lifecycle finance, professional capability, sustainable procurement, supply-chain development, circularity and performance measurement reinforce one another. Because this study is documentary, it does not establish adoption rates or causal relationships. Future research should test the identified dimensions empirically among Indian developers, contractors, architects, suppliers and other construction stakeholders, with attention to differences by building type, firm size, geography and project stage.

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