IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025

DOI: 10.17148/IARJSET.2025.12744

EVALUATION AND IMPROVEMENT OF WASTE MANAGEMENT IN THE CONSTRUCTION INDUSTRY

Mohammed Hussamuddin[1], RG Nauman Khan [2]

Student of M.E (Construction Management) in Lords Institute of Engineering and Technology Hyderabad India[1]

Assistant Professor of Civil Engineering at Lords Institute of Engineering and Technology Hyderabad India[2]

Abstract: The construction industry is a major contributor to global waste generation, with construction and demolition (C&D) waste representing more than 30% of the total solid waste in urban India. Rapid urbanization, infrastructure growth, and limited enforcement of environmental regulations have exacerbated the issue, resulting in widespread material inefficiencies, environmental degradation, and increased project costs. Despite the introduction of the Construction and Demolition Waste Management Rules, 2016, the level of compliance remains low across most urban centers. This study evaluates the current waste management practices in the Indian construction industry and recommends actionable improvements aimed at promoting sustainability.

Primary data was collected through structured surveys, site inspections, and in-depth interviews with engineers, contractors, and site supervisors at various construction sites in Hyderabad. The results reveal a widespread absence of structured waste management plans. Most sites lacked designated areas for waste collection, proper signage for segregation, and partnerships with recycling agencies. Furthermore, on-site personnel often lacked awareness of waste minimization techniques, leading to the routine disposal of reusable and recyclable materials. These practices not only contribute to landfill congestion and resource depletion but also introduce financial inefficiencies into construction workflows.

To address these challenges, a multi-pronged strategy is proposed involving on-site segregation of waste, promotion of material reuse and recycling, and the establishment of partnerships with certified waste processing and recycling companies. In addition, targeted awareness programs and capacity-building workshops for construction workers and project managers are essential. The integration of digital tools such as Building Information Modeling (BIM) and site waste tracking systems can further optimize material usage and forecast waste generation. These recommendations, supported by real-time field data, aim to lay a foundation for sustainable construction practices in India aligned with national waste reduction goals and global sustainability standards.

Keywords: Construction waste, India, sustainable construction, C&D waste, BIM, urban development

I. INTRODUCTION

The construction industry in India is a vital sector that significantly contributes to national economic growth, infrastructure development, and employment. However, it is also a major generator of construction and demolition (C&D) waste. Recent estimates indicate that C&D waste constitutes over 30% of the total solid waste generated in urban India. This waste stream, consisting primarily of concrete, brick, metal, wood, plastic, and excavation debris, often ends up in unauthorized dumping sites, leading to environmental pollution, inefficient land use, and increased public health risks.

Although the Government of India introduced the Construction and Demolition Waste Management Rules in 2016, the on-ground implementation has been inadequate. Many construction sites operate without structured waste management protocols, resulting in material wastage, project cost overruns, and missed opportunities for material recovery and recycling. Key challenges include lack of segregation at the source, weak regulatory enforcement, limited recycling infrastructure, and insufficient awareness among stakeholders. The informal nature of much of the construction workforce further complicates the adoption of systematic waste handling practices.

This study aims to evaluate existing waste management practices at construction sites, with a focus on urban centers such as Hyderabad. It seeks to identify prevalent inefficiencies and propose targeted interventions to enhance sustainability.

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The objective is to provide a practical framework that supports on-site segregation, material reuse, and recycling, while integrating digital tools and training initiatives. The findings can support policy makers, contractors, and urban planners in transitioning the Indian construction sector toward a more sustainable and resource-efficient future.

II. METHODOLOGY

This study adopts a mixed-methods approach to comprehensively evaluate the waste management practices within the Indian construction sector, with a specific focus on construction sites in Hyderabad. Both qualitative and quantitative data were collected to ensure a holistic understanding of current practices and challenges.

2.1 Data Collection

Primary data was gathered using three core methods:

1. **Structured Surveys**: Standardized questionnaires were administered to over 50 respondents, including site engineers, supervisors, project managers, and laborers. The surveys focused on awareness levels, waste handling protocols, segregation practices, and material reuse initiatives.

2. **Site Inspections**: Field visits were conducted at ten active construction sites representing various project scales (residential, commercial, and infrastructure). Observations were documented on parameters such as presence of waste bins, signage for segregation, storage areas for reusable materials, and waste disposal methods.

3. **In-depth Interviews**: Semi-structured interviews were held with 15 key stakeholders—including contractors, municipal waste officials, and recycling agency representatives—to gain deeper insights into institutional challenges, regulatory compliance, and logistical constraints.

2.2 Data Analysis

Quantitative data from surveys were analyzed using descriptive statistical techniques to identify trends, frequencies, and percentages. Qualitative data from interviews and field notes were coded and thematically analyzed to uncover recurring issues and stakeholder perspectives on barriers to effective waste management.

2.3 Benchmarking and Validation

The observed practices were benchmarked against national guidelines such as the Construction and Demolition Waste Management Rules, 2016, and international best practices for sustainable construction. Findings were cross-validated through triangulation across multiple data sources to ensure reliability and accuracy.

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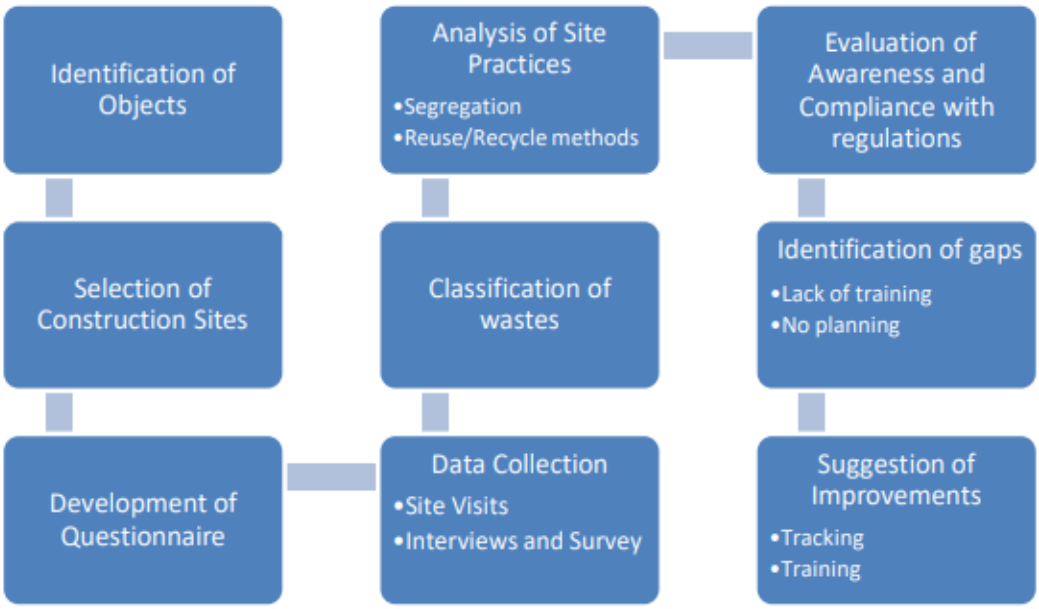
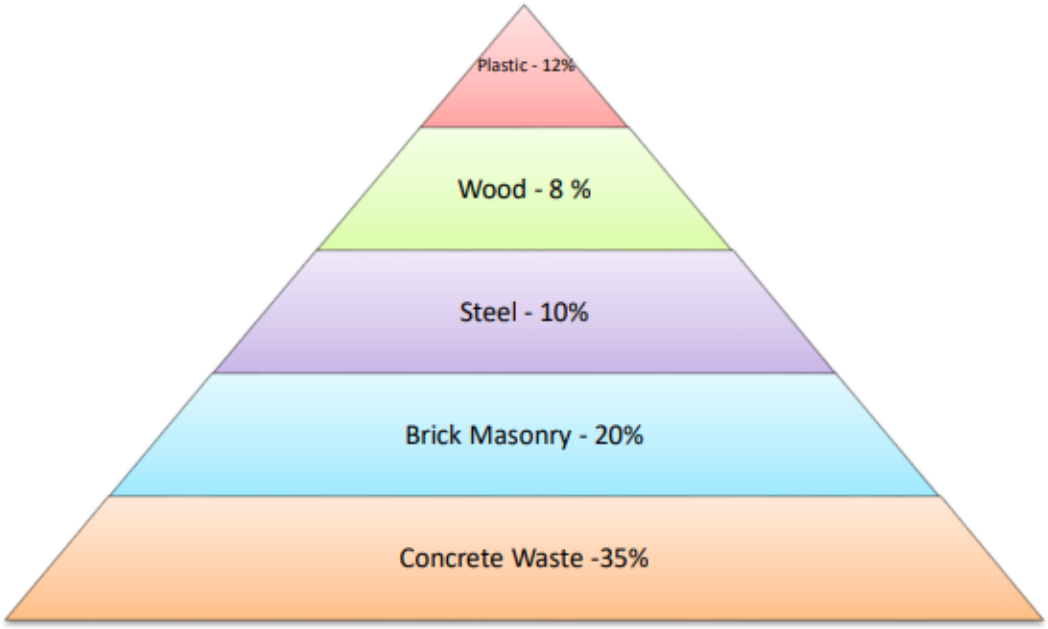


Data Analysis



III. RESULTS

3.1 Waste Management Practices at Hyderabad Construction Sites

The survey and field inspections conducted across ten construction sites in Hyderabad—including areas such as Gachibowli, Kondapur, Uppal, LB Nagar, and Miyapur—revealed widespread deficiencies in waste management practices. The results show:

- 78% of sites did not have a formal waste management plan.
- 90% of sites lacked designated areas for waste segregation.

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- 85% of sites disposed of mixed waste without sorting into recyclable or reusable categories.
- 0% of sites maintained a waste inventory or record-keeping system.

Most construction waste, including concrete debris, wood, packaging material, and steel scrap, was dumped into general municipal waste streams or on vacant land, often without prior treatment.

3.2 Awareness and Training Levels

The structured survey included 52 respondents:

- 28 site engineers,
- 14 contractors,
- 10 site supervisors.

The results indicate low levels of awareness regarding sustainable construction practices:

- 67% of respondents were unaware of the Construction and Demolition (C&D) Waste Management Rules, 2016.
- 81% stated that their company had never conducted training on waste minimization or segregation.
- 74% believed that reusing materials on-site would lead to increased labor or logistical costs.

These statistics underscore a serious knowledge gap, especially among small to mid-size contractors operating in Hyderabad's rapidly expanding real estate sector.

3.3 Environmental and Economic Impact on Hyderabad

The environmental consequences of poor waste management in Hyderabad are increasingly visible:

- In areas like Jeedimetla, Balanagar, and Patancheru, unauthorized dumping of C&D waste was observed within 1–2 km of residential zones.
- According to GHMC reports, Hyderabad generates an estimated 1,200 to 1,500 tons of C&D waste per day, but only about 25% is officially collected and sent to recycling centers.

Economically, sites that implemented basic segregation and reuse of materials (e.g., reusing shuttering plywood, steel bars, and bricks) reported:

- Cost savings of 8–12% on material procurement.
- Reduced disposal costs by nearly 15–20% when coordinated with recycling agencies.

However, only 2 out of 10 sites in the study had attempted any structured reuse strategy, often informally and without documentation.

D. Institutional Gaps and Infrastructure Deficiencies

Despite Hyderabad having two officially designated C&D waste processing facilities (Jeedimetla and Fathullaguda), these centers remain underutilized. Key findings include:

- None of the surveyed sites were registered with GHMC for scheduled waste pickup or delivery to these processing units.
- GHMC officials reported that less than 30% of builders comply with C&D waste disposal guidelines.
- There is no centralized digital portal for tracking C&D waste generation, collection, and recycling across Hyderabad's construction projects.

Additionally, limited enforcement staff and lack of regular inspections were cited as major limitations during interviews with municipal officials.

3.4 Opportunities and Strategic Recommendations

Based on the data collected, the following improvement strategies are recommended for Hyderabad:

Strategic Area	Recommended Action	Expected Benefit
On-site Waste Segregation	Mandatory color-coded bins and signage	Improved sorting, increased recycling
Digital Waste Tracking	Implement QR-code based material logs and BIM-integrated tools	Real-time waste forecasting and accountability
Capacity Building	GHMC-mandated training for engineers and laborers	Awareness improvement and policy compliance
Policy Incentives	Fast-track approvals for sites with green waste plans	Encourage sustainable practices
Public–Private Partnerships	Link developers with local recycling vendors	Improve collection logistics and reduce illegal dumping

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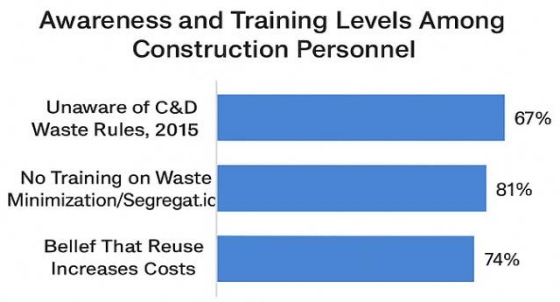

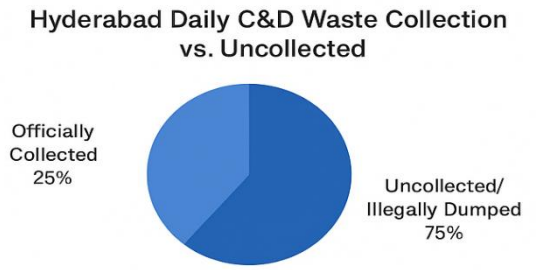

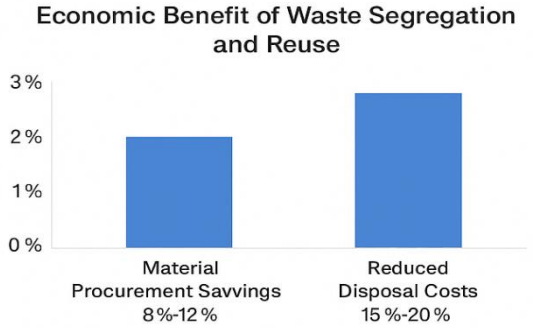

IV. CONCLUSION

The findings from this study clearly highlight a significant gap in the adoption of sustainable construction waste management practices in Hyderabad. A majority of construction sites lack basic infrastructure and planning for waste segregation, record-keeping, or compliance with national regulations such as the C&D Waste Management Rules, 2016. Unregulated dumping and improper disposal continue to burden municipal systems, while valuable recyclable materials are wasted due to the absence of structured segregation and reuse strategies.

Furthermore, the data reveals a critical lack of awareness and training among stakeholders, including engineers, contractors, and supervisors. This knowledge gap hinders the implementation of efficient waste management practices, especially among small to mid-scale developers. Many stakeholders perceive waste reduction initiatives as cost-intensive, despite evidence of economic benefits from reuse and material savings. This perception must be addressed through targeted capacity-building programs and policy-driven incentives.

To move towards a more sustainable future, it is essential to strengthen institutional frameworks, enforce compliance through regular inspections, and promote public-private partnerships. Integration of digital tools for tracking waste, along with mandatory on-site segregation and government-backed training programs, can significantly improve the current scenario. By bridging policy, practice, and awareness, Hyderabad's construction sector can lead the way in setting new benchmarks for environmentally responsible urban development.

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