CHAPTER 40

Construction and Demolition Waste Management

Onkar Sanjay Sonavale[1], Omkar Babasaheb Kukade[1], Manjushree Anand Pagare[1] and Dipesh Rajendra Salunkhe[2]

ABSTRACT

Urbanization has resulted in accelerated construction activities, which stimulate economic growth while also increasing environmental stress, especially by creating Construction and Demolition (C&D) waste. The sources, amount, and management processes of C&D waste are analyzed in this study with a focus on the hindrances in effective recycling and the influence of policy, technology, and budget allocation on increasing sustainability. Using a mixed- method research strategy, the study gathered primary data using a questionnaire survey of 100 stakeholders, namely municipal officials, construction professionals, and environmental experts, and secondary data from literature reviews, case studies, and policy reports. A visit to the PCMC C&D Waste Management Plant in Moshi offered first-hand insights into waste recycling and processing operations. The surveys point out that plastic waste forms 33 percent and concrete debris 27 percent of C&D waste and shows wide variations in recycling figures of different projects. The major and most frequently cited and severe hindrances were scarcity of recycling facilities (36 percent), regulation barriers (23 percent), and high recycling costs (16 percent). The study gives evidence toward better and efficient waste management and strategies such as enhanced stakeholders' awareness, technology adaptation, and policy and regulatory interventions. By filling the gap between conceptual frameworks and reality on the ground, this study provides practical advice to foster sustainable urban development, minimize environmental footprint, and enhance regulatory compliance for C&D waste management.

Keywords: Construction and demolition waste; Recycling; Sustainability; Urbanization; Waste management.

1.0 Introduction

Urbanization drives rapid construction activity, leading to significant economic growth but also posing environmental and infrastructural challenges. Construction and Demolition (C&D) waste, a major component of urban solid waste, exacerbates issues like resource depletion, pollution, and landfill overflow.

[1]*School of Construction, NICMAR University, Pune, Maharashtra, India*
[2]*Corresponding author; School of Construction, NICMAR University, Pune, Maharashtra, India (E-mail: P2370512@student.nicmar.ac.in)*

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Despite existing regulations, inefficient waste management practices persist due to poor recycling rates, outdated infrastructure, and limited adoption of advanced technologies like AI and IoT. This study aims to identify key factors influencing C&D waste generation, evaluate current waste management strategies, and explore how policy, cost control, and technology can enhance sustainability in urban construction projects. The research addresses critical questions regarding the sources and volume of C&D waste, challenges in recycling, and the impact of budgets, regulations, and technology on waste management. By bridging the gap between theoretical models and practical implementation, this study provides data-driven insights and recommendations to improve waste management practices. Ultimately, the findings aim to reduce environmental impact, enhance regulatory compliance, and promote sustainable urban development.

1.1 Objectives

The research objectives of this study are to analyze the volume and sources of Construction and Demolition (C&D) waste generation across various project types, evaluate current recycling and waste management practices while identifying barriers and cost-effective strategies, and assess the impact of regulatory compliance, budget allocation, and technological adoption on sustainable C&D waste management. By addressing these objectives, the study aims to provide actionable insights and recommendations to enhance waste management practices, promote sustainability, and support the development of environmentally responsible urban construction projects.

2.0 Literature Reviews

The literature review highlights the growing focus on Construction and Demolition (C&D) waste management, driven by urbanization and sustainability concerns. Elshaboury *et al.* (2022) conducted a bibliometric analysis of C&D waste management research, identifying key trends and gaps, such as estimation techniques, environmental impacts, and emerging technologies. Similarly, Islam *et al.* (2024) reviewed sustainable C&D waste management challenges, emphasizing the need for integrated frameworks, stakeholder engagement, and technology adoption.

Srećković *et al.* (2024) explored circular economy (CE) applications in the building life cycle, revealing gaps between theory and practice in the Architecture, Engineering, and Construction (AEC) industry. Hasibuan *et al.* (2025) investigated CE integration in C&D waste management, highlighting the potential of digital tools like Building Information Modeling (BIM) and Life Cycle Assessment (LCA) while noting challenges such as high costs and policy inconsistencies. Gherman *et al.* (2023) provided a comprehensive review of C&D waste management within the CE framework, identifying research gaps in economic and social evaluations.

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Swarnakar & Khalfan (2024) analyzed CE adoption in C&D waste management, emphasizing the lack of structured frameworks and the need for advanced technologies and decision-support systems. Purchase *et al.* (2021) identified legal, technical, and economic barriers to CE adoption, advocating for global frameworks to support sustainable practices. Zhao *et al.* (2022) examined C&D waste management in Australia, highlighting the role of design-phase interventions and cross-jurisdictional challenges. Colorado *et al.* (2022) focused on Colombia, revealing knowledge gaps and inefficiencies in C&D waste management common across developing nations.

Gayakwad *et al.* (2015) addressed India's C&D waste challenges, stressing the lack of regulatory enforcement and the need for sustainable waste hierarchies. Ray *et al.* (2024) quantified C&D waste disposal during COVID-19 using satellite imagery, offering a framework for indirect waste estimation. Abulebdah *et al.* (2024) proposed an integrative approach for optimizing C&D waste management in developing countries, demonstrating significant cost savings through GIS and optimization models. Mukherjee *et al.* (2023) reviewed C&D waste management in India, emphasizing the need for uniform regulations and sustainable practices. Alhawamdeh *et al.* (2024) used the PESTLE framework to analyze drivers for improved C&D waste management, highlighting the role of policy, technology, and stakeholder engagement.

Wei (2024) explored advanced management techniques to improve recycling efficiency and reduce carbon emissions, emphasizing government incentives and BIM. Huanyu Wu *et al.* (2019) reviewed performance assessment methods for C&D waste management, noting the underrepresentation of social factors in evaluations. Menegaki (2018) examined global C&D waste challenges, proposing a conceptual map to address systemic issues. José-Luis Gálvez-Martos *et al.* (2018) highlighted best practices in Europe, advocating for waste reduction, improved recycling, and enhanced secondary material quality. Ma *et al.* (2020) identified challenges in China's C&D waste recycling, including unstable waste sources, high costs, and poor coordination, offering policy recommendations for improvement.

3.0 Research Methodology

The research methodology combined qualitative and quantitative approaches to study Construction and Demolition (C&D) waste management. Primary data was collected through a questionnaire survey of 100 stakeholders, including municipal authorities, waste professionals, and construction experts. Secondary data was gathered from literature reviews, case studies, and policy documents. An on-site visit to the PCMC C&D Waste Management Plant in Moshi provided practical insights into waste processing and recycling. The systematic process included problem identification, literature review, survey design, data collection, analysis, and recommendations, offering a comprehensive understanding of C&D waste management challenges and solutions.

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4.0 Data Analysis

The data analysis section examines the responses collected from 100 stakeholders involved in Construction and Demolition (C&D) waste management. It highlights key trends, challenges, and opportunities in waste generation, recycling practices, and barriers to effective waste management.

Table 1: How Many Years of Experience Do You Have in the Construction Industry?

		Frequency	Percent
Valid	Less than 2 years	17	17.0
	2–5 years	32	32.0
	6–10 years	34	34.0
	More than 10 years	17	17.0
	Total	100	100.0

Source: Compiled by authors

Table 2: What Type of Construction Projects do You Primarily Work on?

		Frequency	Percent
Valid	Residential	19	19.0
	Commercial	20	20.0
	Industrial	41	41.0
	Infrastructure (roads, bridges, etc.)	20	20.0
	Total	100	100.0

Source: Compiled by authors

The data shows construction professionals' experience levels. Many mid-career professionals work in the area, as 34% have 6–10 years of experience. This is followed by individuals with 2–5 years of experience (32%), indicating a continual migration of fresher professionals. Early-career professionals with less than 2 years of experience and highly experienced professionals with more than 10 years each make up 17% of the sample. This fair distribution shows that a combination of new and experienced personnel helps the sector thrive and survive. Industrial construction projects dominate the industry, with 41% of respondents being involved. Commercial and infrastructural projects employ 20% of the workforce, demonstrating a balanced approach to large-scale undertakings. Residential development accounts for 19% of replies, indicating a reduced housing project priority. The industry's focus on industrial development while being active in commercial, infrastructural, and residential sectors boosts economic growth and urban expansion.

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Table 3: What are the Primary Sources of waste in Your Projects?

		Frequency	Percent
Valid	Concrete and cement debris	27	27.0
	Wood and timber waste	11	11.0
	Metal scraps	9	9.0
	Plastic waste	33	33.0
	Hazardous materials (e.g., asbestos)	20	20.0
	Total	100	100.0

Source: Compiled by authors

Plastic trash accounts for 33% of construction and demolition (C&D) waste, raising concerns regarding non-biodegradable waste management. Concrete and cement waste follow at 27%, indicating major structural work material use. Waste contains 20% hazardous elements, including asbestos, posing health and environmental dangers. Timber trash is 11% and metal scraps 9%, suggesting smaller contributions. This distribution emphasises the necessity for focused plastic and concrete waste reduction efforts to enhance sustainable building.

Table 4: What Percentage of Waste from Your Projects is Recycled or Reused?

		Frequency	Percent
Valid	0–20%	14	14.0
	21–40%	23	23.0
	41–60%	35	35.0
	61–80%	14	14.0
	81–100%	14	14.0
	Total	100	100.0

Source: Compiled by authors

Construction projects recycle and reuse trash differently, according to the statistics. The majority (35%) recycle or reuse 41–60% of their garbage, showing modest sustainability efforts. trash management strategies vary, as 23% recycle 21–40% of trash and 14% each recycle 0–20% and 81–100%. A further 14% recycles 61–80% of its trash, demonstrating sustainable building. This distribution emphasises the need for better waste management to boost recycling and green building. The lack of recycling facilities, which 36% of respondents cited as a serious difficulty, is the main obstacle to construction waste recycling. For 23% of respondents, regulatory limits are important, whereas 16% worry about excessive recycling costs. Challenges include a lack of knowledge and training (14%), and inadequate incentives for sustainable activities (11%). These results show that physical, legal, financial, and educational barriers are slowing construction waste recycling programs.

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Table 5: What are the Key Barriers to Effective Waste Recycling?

		Frequency	Percent
Valid	Lack of awareness/training	14	14.0
	High recycling costs	16	16.0
	Limited availability of recycling facilities	36	36.0
	Regulatory constraints	23	23.0
	Lack of incentives for sustainable practices	11	11.0
	Total	100	100.0

Source: Compiled by authors

5.0 Conclusion

This research highlights the essential issues of Construction and Demolition (C&D) waste management, especially in light of accelerated urbanization and economic development. The results indicate that plastic and concrete waste are the predominant sources of C&D waste, with recycling processes being discouraged by a lack of facilities, regulatory limitations, and high prices. The study brings out the necessity to incorporate the use of new-age technologies like Building Information Modeling (BIM) and Internet of Things (IoT) for streamlining waste management procedures. The research also points to the necessity for tighter policy guidelines, stakeholder involvement, and financial incentives in the direction of fostering sustainable operations. The first-hand experience of the on-site visit to the PCMC C&D Waste Management Plant helped identify practical realities of obstacles and operational inefficiencies, once again emphasizing the urgency to develop practical, scalable solutions. By overcoming these obstacles and applying data-driven approaches, the construction sector can cut its environmental impact significantly, become more resource-efficient, and help promote urban sustainability. This study provides a basis for further research and policy interventions to enhance C&D waste management practices across the world.

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