

Assessment of Waste Minimization Strategies in Urban Residential Building Construction Projects in Ede, Osun State, Nigeria

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Abstract

Construction waste remains a major challenge in urban residential building projects, particularly in developing countries where weak regulatory enforcement, informal site management, and limited site space increase waste generation. This study assessed waste minimisation strategies adopted in residential construction projects in Ede, Osun State, Nigeria, focusing on major waste types and sources, strategies employed at different project stages, their effectiveness, and factors influencing implementation. A qualitative approach was adopted using semi-structured interviews with fifteen stakeholders comprising five architects, three builders, three quantity surveyors, two site engineers, and two site supervisors. Data were analysed thematically. Findings revealed that construction waste in Ede is mainly associated with design modifications, inaccurate material estimation, procurement delays, poor material handling, and unskilled labour. Concrete remnants, timber off-cuts, mortar residues, and damaged blocks were the most frequently generated waste materials. Accurate quantity take-offs, modular design, and material standardisation were identified as effective minimisation strategies during design and procurement. However, implementation during construction was inconsistent due to financial constraints, limited technical expertise, inadequate storage space, and weak regulatory enforcement. The study concludes that effective waste minimisation requires improved project planning, stakeholder coordination, professional involvement in material estimation, worker training, and stronger institutional enforcement. The findings provide context-specific insights for improving sustainable residential construction and waste management practices in Nigeria.

Keywords: *Construction waste, waste minimisation, residential buildings, sustainable construction, qualitative study, Ede, Osun State.*

1.0 Introduction

The construction industry plays a critical role in economic development, infrastructure provision, and employment generation in many developing countries, including Nigeria. Rapid urbanisation and population growth in urban centres have led to increased demand for residential buildings, resulting in intensified construction activities. Despite its socio-economic benefits, the construction sector is widely recognised as one of the largest generators of solid waste globally (Alotaibi et al., 2024).

Construction waste refers to materials generated during construction, renovation, and demolition activities that are not incorporated into the final structure and therefore require reuse, recycling, or disposal. Construction waste generally includes surplus, damaged, or discarded materials arising from construction activities. According to the Waste and Resources Action Programme WRAP (2008), these materials commonly include concrete, masonry, timber, metals, tiles, plaster, packaging materials, and excavated soil. In densely populated urban environments, limited space and high construction intensity amplify both the volume of waste generated and the environmental impacts associated with improper disposal, making effective waste minimisation essential for sustainable urban development. Major causes of waste generation include poor planning, frequent design changes, inaccurate material estimation, inadequate storage facilities, and weak site supervision. In recent years, sustainable construction has gained prominence as a response to increasing environmental concerns and the need to optimise resource utilisation within the built environment. Sustainable construction promotes efficient material and energy use, minimisation of waste generation, and reduction of environmental impacts across the entire building life cycle, from design and construction to operation and demolition (Alghamdi et al., 2025). Poor construction waste management contributes to excessive consumption of natural resources, increased landfill use, environmental pollution, and rising project costs associated with waste handling and disposal. Historically, construction waste management practices in Nigeria have focused primarily on waste disposal rather than prevention. However, recent studies emphasise the importance of waste minimisation approaches that target waste reduction at the source, particularly during planning, design, procurement, and on-site handling stages (Ajayi et al., 2017). These approaches include effective design coordination, material standardisation, accurate quantity estimation, efficient procurement systems, and structured site management practices. While construction waste minimisation has been studied extensively in major Nigerian cities such as Lagos and Abuja, medium-sized towns such as Ede, Osun State, remain under-researched. Yet, these towns are experiencing increasing residential development accompanied by indiscriminate disposal of construction waste along roadsides, open spaces, and drainage channels. The limited attention given to waste minimisation practices in such urban centres creates a knowledge gap regarding the effectiveness of existing strategies and the challenges affecting their implementation. This situation highlights the need for a focused assessment of waste minimisation strategies within the local context of Ede, Osun State. Therefore, this study aims to assess waste minimisation strategies adopted in residential construction projects in Ede, Osun State, Nigeria.

The specific objectives are to:

1. Identify the major types and sources of construction waste generated in residential building projects in Ede;
2. Examine waste minimisation strategies adopted at different stages of residential construction projects;
3. Evaluate the effectiveness of the identified waste minimisation strategies; and
4. Determine the factors influencing the implementation of waste minimisation strategies in residential construction projects.

The study is guided by the following research questions:

1. What are the major types and sources of construction waste generated in residential building projects in Ede?

2. What waste minimisation strategies are adopted at different stages of residential construction projects?
3. How effective are the identified waste minimisation strategies?
4. What factors influence the implementation of waste minimisation strategies in residential construction projects in Ede?

Construction waste comprises excess materials generated during construction, renovation, or demolition activities that are not incorporated into completed buildings. These materials include concrete debris, masonry units, timber off-cuts, steel scraps, tiles, plaster, packaging waste, and excavated soil. It can be grouped into physical waste, which refers to actual material losses, and non-physical waste, such as time delays and increased costs caused by inefficient use of resources. Globally, construction activities contribute a large proportion of urban solid waste, accounting for about 25–40% in many cities, especially in developing countries where waste management systems are still weak (Osmani, 2012). Waste is generated at different stages of construction. At the design stage, incomplete drawings, frequent design changes, and poor coordination among professionals often lead to rework and material waste (Ajayi et al., 2020). During procurement, issues such as inaccurate quantity estimation, over-ordering, weak supplier coordination, and poor delivery planning also contribute to waste (Lin et al., 2026). On-site, waste is often increased by unskilled labour, poor supervision, improper storage of materials, and damage during handling and transportation, especially in crowded residential construction sites. In developing countries like Nigeria, construction waste management is still a major challenge due to limited funding, weak institutional control, and poor enforcement of regulations, which often leads to indiscriminate dumping of waste (Unegbu & Yawas, 2024). In this context, waste minimisation refers to efforts aimed at reducing waste at the source through better planning, improved design, and proper material management without necessarily increasing project cost (Utsev et al., 2024). Different waste minimisation strategies exist across the project stages. At the design stage, methods such as standardisation, modular design, and prefabrication help to reduce off-cuts and rework. At the procurement stage, accurate estimation, just-in-time delivery, and good supplier relationships help to avoid over-ordering and material deterioration (Ajayi et al., 2021). On-site strategies include proper storage of materials, use of skilled workers, good supervision, and proper sequencing of work activities, while operational strategies focus on reuse, sorting, and recycling of materials (Unegbu & Yawas, 2024).

However, most of the existing studies are based on large cities where construction activities are more formal, regulations are stronger, and projects are usually handled by larger contractors. Because of this, many existing waste minimisation frameworks are shaped by these urban conditions and may not fully represent what happens in medium-sized towns.

Medium-sized towns like Ede are quite different. Construction there is often dominated by small-scale residential projects, informal labour is more common, and professional coordination is usually limited. Regulatory enforcement is also weaker. These conditions may affect both the amount of waste generated and how waste minimisation strategies actually work in practice. Yet, not much attention has been given to these differences in previous studies.

Also, many previous studies tend to rely more on quantitative surveys, focusing mainly on levels of awareness or waste quantities, with less attention to the real-life experiences and practices on construction sites. This leaves a gap in understanding the practical and contextual factors that influence waste minimisation in places like Ede.

This study therefore focuses on filling this gap by examining construction waste minimisation in Ede, with attention to how local construction practices shape the use of waste reduction

strategies, and how existing frameworks can better reflect medium-sized town realities.

However, there is limited qualitative evidence on how these waste minimisation strategies are practically implemented within medium-sized urban centres in Nigeria, particularly in towns such as Ede, Osun State. Most existing studies focus on large metropolitan areas or adopt quantitative approaches that do not fully capture the lived experiences and practical challenges faced by construction professionals at project level. To address this gap, this study provides a qualitative investigation into the application of waste minimisation strategies in urban residential building projects in Ede and examines the contextual factors influencing their effectiveness. This study is underpinned by the Waste Hierarchy Principle (Reduce–Reuse–Recycle model), which emphasises the prioritisation of waste prevention at the source over disposal. The framework assumes that construction waste can be minimised through targeted interventions across the project lifecycle. In this study, construction waste generation is conceptualised as a function of project activities at the design, procurement, and construction stages. Waste is reduced when appropriate minimisation strategies are effectively implemented across these stages.

The framework is structured around four key components:

Sources of Construction Waste

Construction waste in urban residential building projects arises from multiple sources across the project life cycle. Key sources include design inefficiencies such as incomplete drawings, frequent changes, and the use of non-standard materials. Procurement-related challenges, including inaccurate material estimation, over-ordering, and poor supplier coordination, also contribute significantly to waste generation. Additionally, on-site practices, such as improper handling of materials, reliance on unskilled labour, and inadequate supervision, exacerbate the problem, leading to increased material losses and rework (Minunno et al., 2020).

Waste Minimisation Strategies

To address these sources of waste, construction projects employ strategies at various stages. At the design stage, approaches such as modular design, prefabrication, and standardisation of materials help reduce off-cuts and rework. During the procurement stage, accurate quantity take-offs, just-in-time delivery, and engagement of reliable suppliers prevent over-ordering and material deterioration. On-site and operational strategies focus on proper material storage, effective supervision, and the reuse and recycling of materials, thereby minimising the volume of waste generated (Ajayi et al., 2020; Lin et al., 2026).

Influencing Factors

The effectiveness of waste minimisation strategies is influenced by several moderating factors. Technical capacity, including the skills and expertise of the workforce, determines how well strategies are implemented. Economic considerations, such as the cost of adopting these strategies, may limit their use. Regulatory and institutional support, including enforcement of policies and the provision of incentives, further shapes the success of waste reduction measures. Finally, site-specific constraints, such as limited space and infrastructural challenges, can hinder the practical implementation of these strategies (Unegbu & Yawas, 2024).

Expected Outcomes

When waste minimisation strategies are effectively implemented, they lead to several positive outcomes. These include reduced construction waste, lower project costs, and improved resource

efficiency. Ultimately, such interventions contribute to the promotion of sustainable urban construction practices, supporting environmental sustainability and the efficient use of materials within the built environment (Enobie et al., 2024).

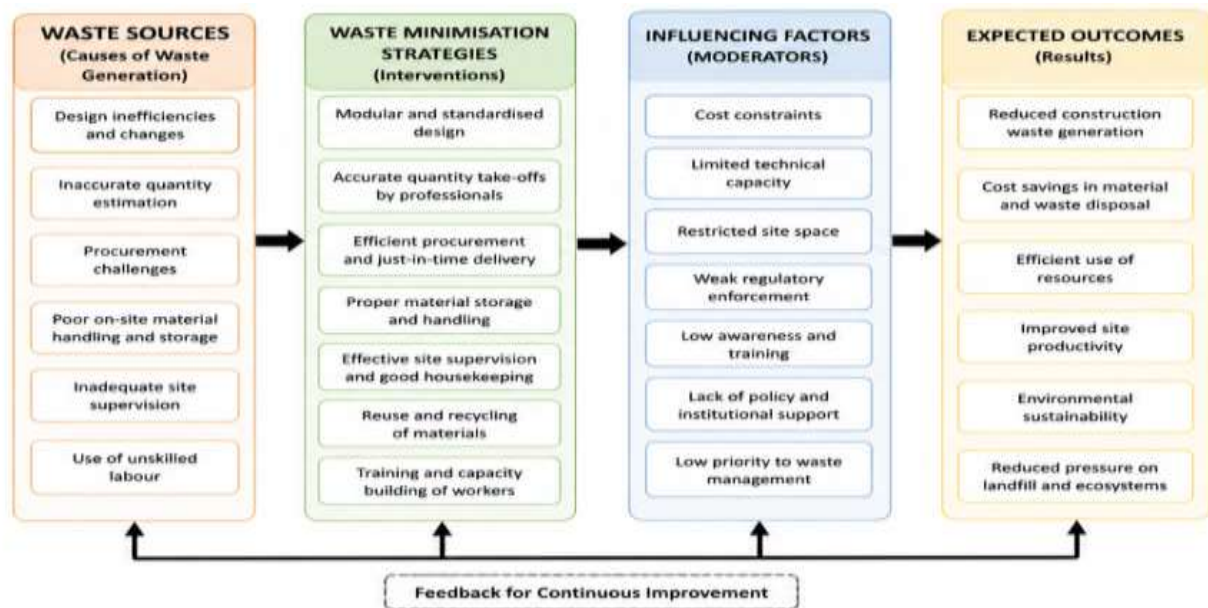


Figure 2.1: Waste Hierarchy-Based Conceptual Framework for Construction Waste Minimisation in Residential Building Projects in Ede, Osun State,
Source: Author's compilation from literature review based on Ajayi and Oyedele (2017), Osmani (2012), and waste hierarchy principles (2026).

2.0 Methodology

A qualitative research design was adopted to enable an in-depth exploration of waste minimisation practices and stakeholder experiences in urban residential construction projects in Ede, Osun State, Nigeria. This approach is appropriate because it allows for detailed understanding of processes, behaviours, and contextual factors influencing construction waste management practices. Semi-structured interviews were used as the primary data collection method, as they provide flexibility while maintaining consistency across participants (Creswell and Poth, 2018). The study area, Ede, is a rapidly growing medium-sized urban town characterised by small- to medium-scale residential developments, limited site space, informal site management practices, and weak construction waste control mechanisms. These characteristics make it suitable for examining waste minimisation strategies within a constrained urban context. The study population comprised builders, architects, quantity surveyors, site engineers, and site supervisors whose professional roles directly influence material planning, procurement, and site operations in residential construction projects in Ede, Osun State. A purposive sampling technique was adopted to select participants based on their practical experience and involvement in construction activities relevant to the study.

A total of fifteen (15) participants were selected for the study. The demographic and professional profile of the participants is presented in Table 3.1 to enhance transparency and allow for an assessment of the study context.

Table 3.1: Demographic and Professional Profile of Participants

Participant Code	Profession	Years of Experience	Project Type Involved
P1	Architect	12 years	Residential
P2	Architect	9 years	Residential/Mixed
P3	Architect	7 years	Residential
P4	Architect	15 years	Residential
P5	Architect	10 years	Residential
P6	Builder	14 years	Residential
P7	Builder	11 years	Residential
P8	Builder	8 years	Residential
P9	Quantity Surveyor	13 years	Residential
P10	Quantity Surveyor	9 years	Residential
P11	Quantity Surveyor	6 years	Residential
P12	Site Engineer	10 years	Residential
P13	Site Engineer	7 years	Residential
P14	Site Supervisor	16 years	Residential
P15	Site Supervisor	12 years	Residential

Source: Fieldwork Data, 2026.

Data Saturation

Data collection and analysis were conducted concurrently in an iterative manner. Interview transcripts were coded progressively, allowing emerging concepts to be continuously compared across participants. This process enabled the researcher to monitor the emergence of new codes throughout the data collection process.

After approximately the twelfth interview, no substantially new codes were identified, and subsequent interviews produced largely repetitive information. By the fifteenth interview, the emerging themes were well established across all participant categories, indicating that thematic saturation had been achieved at the overall study level.

However, it is acknowledged that saturation within individual professional groups may not have been fully achieved due to the limited number of participants within each category. This reflects a structural limitation of the sampling distribution rather than a weakness in the study design.

The decision to conclude data collection at fifteen participants was therefore based on thematic sufficiency and repetition of responses, consistent with qualitative research practice where sample adequacy is determined by data richness rather than statistical representation (Guest et al., 2020).

Data Collection

Data were collected through face-to-face semi-structured interviews conducted at construction sites and professional offices in Ede. Each interview lasted approximately 20–25 minutes. The duration was sufficient to obtain in-depth responses due to the participants' professional experience and familiarity with construction practices.

Where necessary, follow-up probing questions were used to clarify responses and deepen understanding. With participants' consent, interviews were audio-recorded, while in cases where recording was not permitted, detailed field notes were taken.

Ethical Considerations

Ethical standards were observed throughout the study. Informed consent was obtained from all participants prior to data collection. Participants were assured of confidentiality, anonymity through coding (P1–P15), voluntary participation, and secure storage of all data. The study adhered to established ethical principles guiding qualitative research in the built environment. Data were analysed using thematic analysis following Braun and Clarke (2021). This involved six systematic phases:

Table 3.2: Phases of Thematic Analysis Applied in the Study

Phase	Description of Process	Application in This Study
Phase 1	Familiarisation with data	Interview recordings and field notes were transcribed and read repeatedly to gain understanding of participants' responses.
Phase 2	Generating initial codes	Meaningful statements related to waste minimisation practices were identified and coded, resulting in approximately 25 initial codes.
Phase 3	Searching for themes	Similar codes were grouped together into broader categories and potential themes.
Phase 4	Reviewing themes	Emerging themes were examined and refined to ensure consistency, relevance, and distinctiveness.
Phase 5	Defining and naming themes	Final themes were clearly defined and appropriately labelled based on their meanings and relevance to the study objectives.
Phase 6	Producing the report	Themes were interpreted and discussed in relation to the research objectives and existing literature on construction waste minimisation.

Source: Adapted from Braun and Clarke (2021) and modified by the author (2026).

Trustworthiness of the study was ensured through several strategies. Member checking was conducted by sharing summaries of interpreted responses with selected participants to confirm accuracy. Peer review of the interview guide and emerging themes was carried out by two experienced qualitative researchers in construction management to enhance methodological rigour. Instead of methodological triangulation, findings were compared with existing literature to strengthen interpretation through literature corroboration.

3.0 Results

The findings revealed that the major types of construction waste generated in residential building projects in Ede include concrete and masonry off-cuts, timber and steel scraps, broken tiles, plaster remnants, packaging materials, and excavated soil. Participants attributed the generation of these wastes to factors such as frequent design modifications, inaccurate quantity estimation, poor material handling, and inadequate site supervision. Several respondents emphasised that excessive ordering of materials often occurs due to uncertainty during quantity estimation, while poor coordination between design professionals and site personnel was identified as a major source of rework and material wastage. A quantity surveyor explained that:

“Sometimes materials supplied to site exceed what is actually needed because measurements are not properly checked before ordering.” (P9, Quantity Surveyor)

Similarly, an architect noted that:

“Design modifications during construction usually lead to demolition and replacement of already completed work, especially in residential projects.” (P2, Architect)

Participants further identified several waste minimisation strategies adopted during the design and procurement stages of construction projects. Common approaches mentioned include the use of modular design layouts, standardisation of building components, accurate quantity take-offs, phased material procurement, and reliance on trusted suppliers. Respondents indicated that these measures help minimise material off-cuts, over-ordering, and material deterioration. However, interviewees also acknowledged that the implementation of such strategies is often constrained by financial limitations and project time pressures. One builder stated:

“When proper measurements and material scheduling are done before construction starts, waste on site reduces significantly.” (P7, Builder)

In the same vein, a site engineer remarked that:

“Just-in-time delivery helps reduce material damage because items are not stored on site for too long.” (P12, Site Engineer) With respect to on-site waste minimisation practices, participants identified proper material storage, improved supervision, planned sequencing of construction activities, and the engagement of skilled labour as important strategies for reducing waste generation. Despite the recognised benefits of these measures, respondents explained that their implementation remains relatively weak in Ede due to limited site space, informal management structures, insufficient supervision, and cost-related constraints. A site supervisor explained that:

“Most residential sites in Ede are too small, so materials are kept outside where they can easily get damaged.” (P14, Site Supervisor)

Likewise, another respondent observed that:

“Some contractors avoid hiring skilled workers because they want to reduce labour costs, but this often leads to mistakes and rework.” (P8, Builder)

Although participants acknowledged the potential benefits of reuse and recycling practices in reducing construction waste, their implementation was found to be minimal within the study area. Respondents attributed this challenge to inadequate awareness, limited access to recycling facilities, transportation difficulties, and weak institutional support. One site engineer stated that:

“Most contractors simply dispose of waste because recycling facilities are not easily accessible around Ede.” (P13, Site Engineer)

Similarly, an architect explained that:

“Waste sorting is difficult on small residential sites because there is not enough space for separation.” (P3, Architect)

4.0 Discussion

These findings indicate that a substantial proportion of construction waste generated in Ede is avoidable and largely associated with deficiencies in planning and project execution practices. This observation supports previous studies which identified early-stage project decisions as significant contributors to construction waste generation (Ajayi et al., 2017).

The findings suggest that preventive measures introduced during the planning and procurement stages are generally more effective than reactive waste management measures implemented during construction. Participants consistently emphasised that waste prevention at the early stages of projects reduces the likelihood of material losses before construction activities commence. This aligns with previous studies which found that proactive interventions introduced during project planning are more effective than corrective site-based approaches (Akinade et al.,

2018; Lin et al., 2026).

These findings demonstrate that the limited effectiveness of on-site waste minimisation practices in Ede is influenced not only by physical site constraints, but also by weak management practices, inadequate supervision, and cost-saving behaviours among construction stakeholders. This finding corroborates earlier studies which identified site management quality and labour competence as critical determinants of effective construction waste minimisation (Enobie et al., 2024). These barriers are consistent with findings from previous studies conducted in developing countries, where inadequate institutional frameworks and weak regulatory systems have been identified as major obstacles to sustainable construction waste management practices (Unegbu & Yawas, 2024). Overall, the findings highlight the importance of adopting integrated waste minimisation approaches that combine effective planning, accurate procurement practices, improved on-site management, and stronger institutional support systems. The study further demonstrates that reducing construction waste in medium-sized urban centres such as Ede requires not only technical interventions, but also improved stakeholder awareness, stronger enforcement mechanisms, and greater investment in sustainable construction practices.

5.0 Conclusion

This study assessed waste minimisation strategies in urban residential building construction projects in Ede, Osun State, Nigeria. The study identified key construction waste types, examined the strategies adopted across project stages, evaluated their effectiveness, and explored factors influencing their implementation.

Findings show that construction waste in the study area mainly comprises concrete and masonry off-cuts, timber and steel scraps, broken tiles, plaster residues, packaging materials, and excavated soil. These wastes are largely driven by design changes, inaccurate quantity estimation, procurement inefficiencies, poor material handling, and inadequate site supervision.

Although several waste minimisation strategies are available at the design, procurement, and construction stages, their implementation remains inconsistent. Early-stage strategies such as standardisation, modular design, accurate quantity take-offs, and just-in-time delivery were found to be more effective than on-site measures. However, their application is constrained by financial limitations, weak coordination, informal site practices, and limited regulatory enforcement. The study further reveals that reuse and recycling practices are poorly implemented due to inadequate infrastructure, low awareness, and weak institutional support. Overall, the study concludes that construction waste minimisation in Ede is limited less by lack of knowledge and more by implementation challenges and contextual constraints within small-scale residential construction settings.

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