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CONTRACTUAL PROVISIONS INDUCING CONSTRUCTION WASTE GENERATION: AN ANALYSIS OF SRI LANKAN STANDARD FORMS OF CONTRACT

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ABSTRACT

Construction waste remains a major challenge in the construction industry due to its environmental, economic, and resource implications. While previous studies have mainly focused on operational and site management practices as causes of construction waste, limited attention has been given to the role of contractual provisions in influencing waste generation. This study investigates how contractual clauses may contribute to construction waste during project execution. A qualitative document analysis was conducted on CIDA/SBD/02 (Section 3) to examine the potential mechanisms through which contractual clauses may lead to waste generation. The analysis identified several contractual provisions related to the priority of documents, Engineer's instructions, inspection requirements, rejection of materials or workmanship, and variations. The findings reveal that these provisions may create circumstances that lead to demolition, rework, replacement of materials, and material obsolesce during construction. Discrepancies among contract documents, late instructions, rejection of non-compliant materials, and design changes introduced through variations were identified as key contractual processes that may contribute to waste generation. The study demonstrates that contractual governance mechanisms embedded within standard forms of contract can unintentionally create conditions that lead to material waste. By revealing the relationship between contract administration processes and waste generation, the research contributes to expanding construction waste management beyond managerial and operational site practices towards governance dimensions.

Keywords: *Clauses; Construction Industry; Construction Waste; Contracts; Sri Lanka.*

1. INTRODUCTION

The construction industry forms a part of a country's economy, providing services for planning, designing, building, altering, refurbishing, maintaining, repairing, and demolishing structures (Towey, 2012). Since the countries are moving towards sustainable development, sustainable construction has become a necessity in the

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construction industry to ensure that all construction activities, from planning to completion, are carried out sustainably, considering economic, social, and environmental impacts (Ismail et al., 2012). When experts in the construction industry are working to move forward with sustainable development objectives, the management of construction waste is highly considered (Saad et al., 2022). According to Wimalarathna et al., (2023) construction waste management is the most discussed major sustainable construction practice within the construction industry. Construction waste contributes to increased construction costs, pollution, climate change, and resource depletion (Purchase et al., 2021). Therefore, both public and commercial organisations are being forced to reduce construction waste generation (Kartam et al., 2004).

It can be noticed that 'construction waste' is an integral term used in most literature without indicating its specific origins. However, Elgizawy et al., (2016) define construction as waste generated from the construction, remodelling, repairing, and demolition of buildings and other structures. This study focuses on construction waste generated from the construction of buildings or other structures, including remodelling and repairing (rework) and associated demolitions, processing and installation losses, handling and storage losses, and material obsolescence during the construction phase.

Even though construction waste materials might be considered harmless, other than the increased construction cost, they cause a lot of trouble because they are often dumped as huge masses of materials, facilitating illegal dumping of other types of waste and garbage as well (Kartam et al., 2004). Especially, developing countries poorly handle such waste through uncontrolled landfills, leading to scarce landfill space and environmental issues (Kartam et al., 2004). Construction waste management aims to minimise waste as much as possible before it is sent for final disposal, such as landfilling. The solid waste hierarchy is a widely used conceptual framework for achieving this goal, prioritising waste management in the following order: reduction, reuse, recycling, recovery, and, as a last option, disposal. Reduction is the most preferred, while disposal remains the least attractive option on the hierarchy (Gillespie, 2015). Accordingly, this study focuses on reducing construction waste.

Construction waste originates directly or indirectly from activities of different stages of the construction project life cycle, such as design, construction, maintenance, and demolition (Lu & Yuan, 2011). The most prevalent waste management strategies in the construction sector primarily address problems with construction waste, where waste is already generated (Jahan et al., 2022). However, according to Saad et al., (2022) 33% of construction waste is attributable to deficiencies in the design process. The same author identified that one of the major causes of waste generated by deficiencies in the design process is communication, clarity, and understanding-related issues. Ambiguous communication, e.g. failing to specify exactly what, when, and how a task is to be completed, can lead to rework later, which generates waste (Love et al., 2009). According to Muneer et al., (2022) communication problems arise when project drawings, documentation, contract paperwork, and instructions contain ambiguous information. Contract clauses stated in the bid or contract agreements serve as a means of communicating the owner's ideas to contractors, specifying their responsibilities (Jergeas, Hartman, 1996 as cited in Mendis et al., 2015). The parties that draft the contract documents transfer greater risk to the other parties through contract clauses concerning construction waste management (Sawant et al., 2021). Thus, Mendis et al., (2015) had

identified several instances of waste generation influenced by certain contractual clauses in standard construction contracts.

In Sri Lanka, the Construction Industry Development Authority (CIDA) was established to implement standards for construction work, practices, procedures, processes, and documentation relating to the construction industry (Construction Industry Development Act, No. 33 of 2014). Sri Lanka has its own standard forms of contract published by CIDA. Although these have been prepared primarily using international standard contract formats, such as the World Bank Conditions of Contract and FIDIC, there are some deviations from these standards (Dilshani & Disaratna, 2014). Among the standard forms of contract published by CIDA, the standard bidding document procurement of works of major contracts (CIDA/SBD/02) is recommended for use on works contracts over Rs. 100 million, and for contracts of lesser value, which are of a complex nature.

Even though this study is based on the Sri Lankan CIDA/SBD/02, the contractual mechanisms identified are not unique to the specific standard form of contract or Sri Lanka. Priority of documents, Engineer's instructions, inspection, rejection, and variation procedures are governance functions that also appear in other standard forms of contract, including FIDIC-based forms. Therefore, the findings are context-specific for the selected form of contract, yet the underlying mechanism by which contract administration can generate waste has broader international relevance.

Although extensive research has examined operational and managerial causes of construction waste, there has been no published research on contractual clauses and their impact on waste generation in Sri Lanka. Therefore, this study aims to fill the existing research gap by identifying contractual clauses in CIDA/SBD/02 (Section 3–Conditions of Contract) that have the potential to contribute to construction waste generation through their implementation and contractual administration during project execution.

2. CONSTRUCTION WASTE AND CONTRACTUAL GOVERNANCE

2.1 CONSTRUCTION WASTE IN THE CONSTRUCTION INDUSTRY

Construction waste is among the fastest-growing waste streams in Sri Lanka. As a developing country, construction waste generation is higher than in developed countries (Medawala & Dassanayake, 2024).

Construction activities in Sri Lanka generate various types of waste, including concrete, brick, ceramic tile, and wood waste (Chathury et al., 2025). According to Medawala and Dassanayake, (2024), the industry generates a higher proportion of concrete as construction waste but generated concrete waste is not much reused or recycled in the construction industry. They are transported and illegally dumped or end up in landfills.

According to Victar and Waidyasekara, (2023), in Sri Lanka, secondary material markets for construction waste are hindered by a lack of government support. This includes insufficient funding, regulations, and infrastructure, leading to challenges in managing and disposing of construction waste. Many areas in Sri Lanka lack designated waste disposal sites, and there is a shortage of vehicles and equipment for waste collection and transportation. As an insufficient regulatory measure, it is identified that the lack of financial penalties or disincentives for individuals or organisations that fail to manage their waste properly. This means there is no cost for improper disposal of waste, and as a

result, waste management practices may be neglectful or inadequate (Victar & Waidyasekara, 2023). Therefore, understanding the underlying causes of construction waste generation is essential for developing effective strategies aimed at reducing waste at its source.

2.2 CAUSES OF CONSTRUCTION WASTE

Various researchers identified different causes of construction material waste. According to Fadiya et al., (2014) construction material waste can be generated in any stage of the construction life cycle and arises from design, logistics, and physical construction processes. However, this study is limited to the physical construction process. Therefore, the causes of material waste were categorised as rework (associated with demolition), processing and installation losses, handling and storage losses, and material obsolescence for ease of study.

Rework (Associated with Demolition)

Rework is defined as the unnecessary effort of redoing a process or activity that was incorrectly implemented the first time (Mahamid, 2022). It frequently requires the demolition of already completed work (Karunasena et al., 2025).

Frequent design changes and modifications during construction often necessitate rework, which consumes additional materials and generates considerable waste, and if the design change is made during construction, it can lead to the demolition of already completed work, resulting in waste of both labour and material (Alotaibi et al., 2025; Karunasena et al., 2025). Lack of labour skills and untrained laborers leads to workers' mistakes, which necessitate remedial works, and then rework is required (Mahamid, 2022). According to Alotaibi et al., (2025) design and planning errors and omissions could adversely affect project progress and lead to rework on construction sites. Moreover, the same author has identified that the lack of site supervision allows errors to go unnoticed until they are finished, which leads to remedial work involving demolition and rework of the faulty elements.

Processing and Installation Losses

Operational errors, including faults in construction execution, and potential inefficiencies in material installation practices, emerge as a notable cause of waste across all components, with an exceptionally high impact observed in finishes, as decorative features are easily damaged during placement (Rathnayake et al., 2024). According to the authors, the high percentages reported were mainly due to cutting waste resulting in different sizes and uneconomical shapes, due to incorrect decision-making, and the lack of supervision (Karunasena et al., 2023).

Handling and Storage Losses

Bad material storage, lack of material management on site, with careless handling and use of some goods, is another cause of material waste generation (Mahamid, 2022).

For example, cement have to be stored in a closed or shaded area to maintain its quality but construction sites store cement in open spaces under direct weather. Poor handling and storage expose materials to various environmental factors, such as moisture and high temperatures, which lead to defects and loss of initial properties (Alotaibi et al., 2025).

All materials should be unpacked and arranged properly to avoid any damage (Kaliannan et al., 2018).

Material Obsolescence

Material obsolescence refers to materials that are discarded without adding value to the project, often because they are no longer needed or do not meet requirements (Mahamid, 2022). The procurement of low-quality materials or products that do not comply with the contract specifications can render them obsolete for the intended task (Karunasena et al., 2025). Poor order of material without referring to details can result in overordering of materials, which will also end up as construction waste (Kaliannan et al., 2018). Changes in design during the project can make previously ordered or even installed materials redundant and unusable, leading to their total loss (Karunasena et al., 2025). Small quantities of leftover supplies (e.g., mortar or opened paint containers) are frequently discarded after a task is completed because they cannot be easily reused elsewhere (Alotaibi et al., 2025).

While these causes are commonly associated with management and operational inefficiencies, several of them are closely connected with contractual arrangements governing project communication, variation management, and decision-making authority.

2.3 ROLE OF CONTRACTS IN CONSTRUCTION PROJECTS

Effective governance mechanisms are necessary to ensure the timely, cost-effective, and high-quality delivery of construction projects (Yi & Nie, 2024). According to Chen et al., (2018) contracts have three main functions: control, coordination, and adaptation. The control function ensures compliance and limits the parties' opportunistic behaviour. The coordination function provides clear procedures for communication, task allocation, and information sharing. The adaptation function enables parties to respond to unforeseen changes and evolving project conditions (Yang et al., 2025).

To limit opportunistic behaviour by the parties, contracts separately stipulate their rights and obligations, thereby aligning with their interests (Chen et al., 2018). To enhance effectiveness and efficiency, the contract implements mechanisms to improve communication and clarify the objectives and the division of labour for the project's tasks. This helps to reduce task ambiguity and facilitate better understanding (Mellewigt, 2007). Contracts provide procedures to deal with adjustments to the initial agreements that are made by the parties such as variations and value engineering ideas (Wambeke et al., 2011).

Accordingly, these governance functions influence how construction activities are executed and how project decisions are implemented during the construction phase (Karunasena et al., 2025). Hence, contractual processes may unintentionally create circumstances where construction materials become redundant or unusable, leading to the generation of construction waste.

3. METHODOLOGY

A qualitative research approach was adopted for this study. Qualitative approach is a scientific method that emphasises contextual depth and individual voices in understanding social phenomena, often taking a constructive or interpretive perspective

(Lim, 2023). This approach explores the everyday routines and challenges people encounter and focuses on understanding the deeper meaning and motivations behind these experiences, which cannot be captured through numerical data (Taherdoost, 2022). It aims to unveil the “what”, “why”, “when”, “where”, “who”, and “how” (or the “5W1H”) behind social behaviors and interactions (Lim, 2024). This approach utilises various empirical sources, such as case studies, document analysis, life experiences, and narratives (Taherdoost, 2022). This study requires critically evaluating contractual clauses within the CIDA/SBD/02 document, identifying clauses that have the potential to generate construction waste. It is required to investigate the 'what' and 'how' questions that a qualitative approach values; 'What' are the clauses, and 'How' do they contribute to waste generation? Therefore, the qualitative approach was selected for the study.

The primary data source for this study was the Sri Lankan standard form of contract CIDA/SBD/02 (Section 3–Conditions of Contract). This document is widely used in major construction projects in Sri Lanka and governs the contractual relationships between project stakeholders, including the Employer, Engineer, and Contractor.

A qualitative document analysis technique was employed as the analysis technique. Document analysis is a structured procedure for reviewing or assessing documents, both electronic and printed, to extract meaning, gain understanding, and develop empirical knowledge (Bowen, 2009). In this study, document analysis is employed to systematically examine the CIDA/SBD/02 document to identify contractual clauses that have the potential to generate construction waste. Document analysis enabled the integration of literature findings, such as recognised causes of construction waste, with the content of the contract, allowing for a comprehensive interpretation of how contractual governance can contribute to or mitigate waste.

To enhance analytical reliability, clauses were identified by interpreting the established causes of construction waste in the literature. Clause-by-clause triangulation between the contract text, the literature on construction waste causes, and the theoretical functions of contract governance strengthened the validity of the clauses. Each identified clause was re-read to ensure that the waste pathway was supported by the clause wording and was consistent with established causes of demolition, rework, processing, and installation losses, handling and storage losses, or material obsolescence. This review process helped improve the consistency of the analysis.

4. FINDINGS AND DATA ANALYSIS

4.1 CONTRACTUAL PROVISIONS INFLUENCING CONSTRUCTION WASTE GENERATION

A clause that may directly or indirectly trigger or lead to any of the following causes of construction waste generation identified from the literature review was considered as a contractual clause that has the potential to contribute to construction waste generation through its implementation and contractual administration during project execution.

- Demolition (during construction)
- Rework (can be associated with demolition)
- Processing and Installation losses
- Handling and storage losses
- Material obsolescence

Table 1 presents the results of the document analysis conducted on CIDA/SBD/02 (Section – 3) to identify how contractual provisions may influence construction waste generation.

Table 1: Document analysis CIDA/SBD/02

Clause No.	Clause Title	Clause Extract	How waste can be generated
1.5	Priority of Documents	For the purposes of interpretation, priority of the documents shall be in accordance with the following sequence: (a) (b) …. (g) the Specifications; (h) the Drawings; and (i) the Bills of Quantities, and any other…	When there is an ambiguity or discrepancy between documents, this clause gives the right to the Contractor or obligate him to execute the work according to the highest priority document in the sequence. If the considered document's information is incorrect, it sometimes leads to demolition and/or rework, generating construction waste.
3.3	Instructions of the Engineer	The Engineer may issue to the Contractor (at any time) instructions, which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract.	Engineer's instructions can be issued 'at any time'. Late or uncoordinated instructions can lead to changes after procurement of materials and work execution, leading to waste of materials.
7.2	Inspection	If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.	If the Contractor has to uncover the work, there will be demolition and rework, which leads to construction waste
7.4	Rejection	the Engineer may reject the Plant, Materials, or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.	Rejection typically results in removal, rework, and disposal, leading to construction waste
13.1	Right to Vary	Variations may be initiated by the Engineer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by a request for the Contractor to submit a proposal	Changes after procurement of material and work execution create surplus materials, and demolition waste.

Clause No.	Clause Title	Clause Extract	How waste can be generated
13.3	Variation Procedure	The Engineer shall, as soon as practicable after receiving such proposal, respond with approval, disapproval, or comments. The Contractor shall not delay any work whilst awaiting a response.	This clause forces the Contractor to proceed under uncertainty, leading to rework if the final proposal is approved.

Table 1 is structured into four main columns, which mention the particular clause extract relevant to the case and the corresponding explanation of how the clause may lead to waste generation with respect to their clause number and title.

4.1.1 Priority of Contract Documents

Clause 1.5 establishes the order of precedence among contract documents when discrepancies arise between them. The clause specifies that documents such as the specifications, drawings, and Bills of Quantities are to be interpreted according to a defined hierarchy. While this provision provides a mechanism to resolve ambiguities, discrepancies between these documents can still lead to incorrect interpretation during the execution of works. When construction activities are carried out based on conflicting or inaccurate information contained in higher-priority documents, rectification of completed work may become necessary. Such rectification often involves demolition or rework of already completed elements, which contributes to the generation of construction waste.

4.1.2 Engineer's Instructions

Clause 3.3 grants the Engineer the authority to issue instructions to the Contractor at any time during the execution of the works. Although this clause facilitates effective project management and allows the Engineer to address issues that arise during construction, instructions issued after materials have been procured or after work has commenced can lead to modifications in the executed work. Late or uncoordinated instructions may require the removal of completed work or the replacement of installed materials. Consequently, this can result in wastage of materials and additional demolition waste generated from the altered construction elements.

4.1.3 Inspection of Work

Clause 7.2 requires the Contractor to provide notice before covering up any part of the work. If the Contractor fails to provide such notice, the Engineer may require the Contractor to uncover the work for inspection and subsequently reinstate it. This process involves the removal and reconstruction of construction elements. The uncovering and reinstatement of work can lead to demolition of previously completed portions and the generation of waste materials such as concrete fragments, finishes, or other building components that cannot be reused.

4.1.4 Rejection of Materials or Workmanship

Clause 7.4 empowers the Engineer to reject materials, plant, or workmanship that do not comply with contractual requirements. Upon rejection, the Contractor is required to remove the defective materials or work and replace them with compliant alternatives. This process often results in the disposal of rejected materials and demolition of non-

compliant work. As a result, defective materials and demolished construction elements become part of construction waste generated on site.

4.1.5 Variation and changes in Design

Clause 13.1 provides the Engineer with the right to initiate variations to the works at any time before the issuance of the Taking-Over Certificate. Variations may involve changes to the design, quantities, or specifications of the work. When such variations are introduced after materials have already been procured or construction activities have been executed, previously completed work may need to be modified or demolished. Additionally, materials that were procured based on the original design may become surplus or obsolete. These circumstances contribute significantly to construction waste generation.

4.1.6 Variation Procedure and Continuation of Work

Clause 13.3 outlines the procedure for variations and requires the Contractor to proceed with the execution of work without delaying ongoing activities while awaiting responses to variation proposals. This requirement may result in situations where construction activities continue despite uncertainty regarding approval of the variation. If the variation proposal is approved, completed portions may need to be altered or reconstructed. Consequently, rework and demolition may occur, leading to additional construction waste.

5. DISCUSSION

The findings of the document analysis do not deny that the management and operational problems lead to waste generation. Rather, they show contractual governance and other causes are complementary. Contractual clauses shape project information flows, decision authority, and timing, influencing on-site behaviours that produce operational waste. For example, late design changes may occur due to poor management, yet contractual governance supports issuing late variation instructions. Moreover, ambiguous document precedence (priority of documents) as contractual governance raises the likelihood of executing work from high-priority documents with errors, which then results in an operational problem that triggers rework.

This integrative perspective advances the literature by moving beyond the causal perspective of waste generation, which highlights contractual design, administrative practice, construction sequencing, and the material outcome. The chain highlights intervention points at different stages, such as contract drafting, contract administration, and on-site supervision thus broadening the focus of waste mitigation.

Theoretically, this study contributes to contract governance literature by showing that contract functions (control, coordination, adaptation) have consequences beyond traditional economic performance metrics. Whereas most contract theory evaluates contracts in terms of cost, time, and dispute management, the present analysis focuses on environmental and resource outcomes, specifically material waste as legitimate contract performance indicators. This positions waste reduction as a governance objective, and it invites future work to treat sustainability as an explicit contractual function alongside traditional goals.

Moreover, the findings of the study create opportunities for the development of testable hypotheses. For instance, whether contractual provisions requiring obtaining

clarifications for ambiguities in documents can reduce resulting rework and demolition works. In doing so, the study facilitates the empirical measurement of governance-related waste drivers and contributes to advancing the field from primarily descriptive case-based observations toward a more systematic and testable theoretical understanding.

Even though the present document analysis demonstrates probable contract provisions that have the potential to waste generation, it does not provide implications to mitigate them. Future studies should assess the viability of amending the identified contract provisions to address the potential waste generation risk. Comparative research across different standard forms of contracts would also provide different mechanisms they have incorporated to address the identified issues. Finally, further studies should be conducted to suggest amendments to the identified contractual clauses to reduce the generation of construction waste. These studies will provide a solid foundation when the CIDA/SBD/02 is going to be revised with more consideration towards sustainable considerations.

6. CONCLUSIONS

This study examined how contractual provisions within the CIDA/SBD/02 may influence the generation of construction waste during project execution. Through document analysis, the study identified several contractual clauses that can create conditions leading to demolition, rework, processing, and installation losses, handling and storage losses and material obsolescence. The analysis revealed that clauses related to the priority of contract documents, the Engineer's instructions, inspection requirements, rejection of materials or workmanship, and variations can influence construction activities in ways that may result in material wastage.

The findings indicate that discrepancies between contract documents may lead to incorrect execution of work, which subsequently requires rectification and generates demolition waste. Similarly, the authority granted to the Engineer to issue instructions and initiate variations during the construction phase can result in modifications to completed works or previously procured materials. Inspection requirements and the rejection of non-compliant materials or workmanship may also necessitate removal and replacement of construction elements, further contributing to waste generation.

These findings demonstrate that construction waste generation is not solely a consequence of site-level inefficiencies or poor material management yet can originate from contractual processes that govern the execution of construction projects. The contractual framework establishes procedures and decision-making authority that may unintentionally create situations where waste can be generated. Overall, the study highlights the importance of considering contractual governance when addressing construction waste management. By recognising the potential influence of contractual provisions on construction practices, project stakeholders can better understand the broader institutional factors that contribute to waste generation. Such understanding is essential for developing more comprehensive strategies aimed at minimising construction waste and improving resource efficiency within the construction industry.

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