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FROM WASTE TO USE: PLYWOOD USAGE AND WASTAGE IN SLAB AND BEAM CONSTRUCTION

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ABSTRACT

Plywood formwork is widely used in reinforced concrete slabs and beams construction due to its flexibility, availability, and ability to produce smooth finishes. Nonetheless, a considerable amount of plywood is usually wasted on the construction sites due to inefficient operations such as cutting, recurring reuses, improper stripping, and improper handling. This results in increased material consumption, higher project costs, and greater construction waste, particularly in large-scale projects. Despite its widespread application, limited research has examined plywood usage and wastage in real construction settings, especially in developing countries such as Sri Lanka. This paper presents plywood usage practices and associated wastage in slab and beam formwork in projects undertaken by major contractors in Sri Lanka. A case study strategy was adopted, involving five case studies of large-scale construction projects. Data were collected through semi-structured interviews, site observations, and document reviews, and analysed using cross-case analysis. The results show that plywood is primarily used for slab soffits and beam sides formwork, with an average reuse life of three to five cycles, depending on material quality, level of supervision, and labour handling practices. Offcuts generated during the cutting processes were identified as the major source of plywood waste, while damaged sheets mainly occur during stripping and repeated use. The paper explains the improved supervision, the planning of cutting layout, and better material handling practices to enhance reuse cycles and minimise waste. These findings provide practical guidance for contractors and policymakers to improve resource efficiency and promote more sustainable construction practices in large-scale projects.

Keywords: *Construction Waste; Material Reuse; Plywood Formwork; Reuse Cycles Slab and Beam.*

1. INTRODUCTION

The construction industry is the largest user of natural resources and the most significant producer of construction and demolition (C&D) waste on the planet, and the wood-based formwork is often regarded as one of the most popular types of waste materials that are deposited on the construction site (Kurniawan et al., 2024; Victar & Waidyasekara, 2023). According to Tighnavard et al. (2024), temporary works, such as formwork, consume a

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lot of wood and plywood and have limited reuse, with lower reuse cycles, which is resulting in monetary loss and environmental liability. Plywood concrete formwork also embodies significant embodied greenhouse gas emissions due to the energy-intensive manufacture and use of resin and coatings (Pronk et al., 2022).

In reinforced concrete construction, slab soffits and beam sides are commonly built using plywood since it has an effective strength-to-weight ratio, workability and smooth finishes, and is prevalent in formwork selections in many high-rise and large-scale construction (Rajeshkumar et al., 2021; Tighnavard et al., 2024). Nevertheless, site-level analyses and surveys indicate that timber and plywood formwork are typically reused only a few times, generally around 3 to 4 cycles, after which they are disposed of through burning or landfill and this suggests that a significant proportion of procured boards ultimately ends up as waste (Pronk et al., 2022; Victar & Waidyasekara, 2023).

The design-related and operational factors have a strong impact on the efficiency of plywood utilization (Ajayi & Oyedele, 2018). Moreover, research highlights that dimensional mismatches between structural layouts and standard material sizes are a key root cause of construction waste, and that designing to standard module sizes is one of the most effective strategies for "designing out" waste at source (Ajayi & Oyedele, 2018). On-site operational aspects, such as labour skills, supervision, and material handling practices, are repeatedly found to be driving forces behind the generation of construction waste (Salah et al., 2025).

Although construction waste management has attracted growing attention, most research examines construction waste at the aggregate level or focuses on permanent materials, with relatively few studies isolating temporary materials, such as plywood formwork, as a distinct waste stream (Albsoul et al., 2025). Broader studies on Sri Lankan C&D waste highlight numerous management issues across project life-cycle stages; however, they do not provide detailed evidence on plywood formwork use, reuse, and associated wastage in structural works (Victar & Waidyasekara, 2023). Moreover, the rapid growth of large-scale construction projects has intensified C&D waste generation in the country, while wood waste continues to be primarily managed through open dumping, landfilling, and incineration (Maduwage et al., 2025; Victar & Waidyasekara, 2023). In Sri Lanka, large-scale construction projects are defined based on Construction Industry Development Authority (CIDA) grading thresholds and public investment criteria. These typically include projects with a total estimated cost exceeding Rs. 250 million. Such projects align with contractor grades C1 to CS2, which can handle tenders ranging from Rs. 600 million to over Rs. 6,000 million (Construction Industry Development Authority, 2021; Ministry of Finance, 2025).

Although previous studies have discussed construction waste management, timber reuse, and CLT applications, limited research has specifically examined plywood formwork waste as a distinct waste stream within the Sri Lankan construction industry. Given the heavy reliance on plywood formwork in Sri Lankan concrete construction and the absence of systematic project-scale data on its utilisation and wastage, a clear research gap exists (Maduwage et al., 2025; Victar & Waidyasekara, 2023). Therefore, this study aims to investigate plywood usage practices and wastage patterns in slab and beam formwork within large-scale construction projects undertaken by major contractors in Sri Lanka using a cross-case study analysis, while contributing towards sustainable construction and circular economy practices.

2. LITERATURE REVIEW

Construction and demolition (C&D) waste is a major global waste stream that drives project cost overruns, excessive raw material consumption, environmental degradation, and public-health risks (Lee et al., 2024; Tafesse et al., 2022). Moreover, international reviews and scient metric analyses confirm that C&D waste has significant environmental impacts across the project life cycle and is now a central focus of sustainable construction policy and research (Chen et al., 2021; Islam et al., 2024). Furthermore, Mohammad (2025) stated that in developing countries, weak waste governance and limited monitoring further exacerbate these impacts at the project level.

In this broader context, formwork is a serious temporary system in reinforced concrete construction, which directly affects structural elements and considers a significant portion of the construction cost and consumption of materials (Devi & Yadav, 2023). According to Setiawan et al. (2025), conventional practice uses timber and plywood formwork to erect slabs and beams, which are assembled, stripped and moved around in the construction cycle. Moreover, case-based assessments indicate that variance between cost budget plans, unit rate analysis and actual purchases of timber and plywood tend to reflect excessive ordering, under-recorded reuse, and concealed wastage in column and beam formwork (Sidiq et al., 2025; Setiawan et al., 2025).

Plywood has been widely used as a sheathing material since it provides a good strength-to-weight ratio, handling, and concrete surface finish (Devi & Yadav, 2023). Nevertheless, the life cycle studies and the circular economy studies have shown that concrete formwork with plywood has significant embodied greenhouse gas emissions due to manufacturing energy and the consumption of resin, which implies that wastage increases the environmental and economic costs (Papamichael et al., 2023; Tighnavard et al., 2024). Additionally, comparative Life Cycle Assessment (LCA) of reusable formwork materials demonstrates that under high reuse cycles, plastic and steel formwork can be better than plywood in a combination of environmental and cost indicators, but findings are highly sensitive to the real reuse rates and wear-out behaviour at the site (Baskaran et al., 2025; Tighnavard et al., 2024).

At the technical level, experimental work on plywood for concrete formwork has examined how repeated use affects material properties and concrete surface quality (Aramaki et al., 2021; Papamichael et al., 2023). Aramaki et al. (2021) further stated that, with increasing reuse (up to about four cycles), bending strength and stiffness decline, while surface roughness rises, which in turn affects gloss, colour uniformity, and water absorption of the resulting concrete surface. According to Papamichael et al. (2023), softwood plywood is commonly used across foundations, walls, slabs, and columns, often without systematic optimisation of panel thickness, grade, or reuse planning for different elements. Furthermore, these patterns suggest that the inherent reuse potential of plywood is not fully realised, and that many panels are discarded earlier than technically necessary, becoming a notable component of structural wood waste (Aramaki et al., 2021; Setiawan et al., 2025).

Overall, literature indicates that although plywood formwork has a wide range of applications in the reinforcement of concrete constructions because of its convenient benefits, the reuse potential of this material is not always met in real-life situations (Devi & Yadav, 2023). Increased reuse cycles with inefficient practices in site management, handling, and storage are also associated with high material waste and environmental and economic negative effects (Kothalawala et al., 2025). This shows that plywood formwork is still a significant waste of construction in large-scale projects, especially when there is no effective waste management and reuse policies need to be implemented.

3. RESEARCH METHODOLOGY

The case study strategy was selected as it allows an in-depth investigation of real construction practices within their practical project environments while enabling comparisons across multiple projects (Sanda et al., 2021). Five large-scale building construction projects (C1–C5) were purposively selected from ongoing building construction projects in Sri Lanka to represent different project types, including commercial, residential, and infrastructure-related developments. All of the selected building projects were contracted under the CIDA CS2 grading category. The projects were selected based on their high usage of plywood in slab and beam formwork operations, accessibility for data collection, and relevance to the research objectives. The selected projects were actively under construction during the data collection period, enabling the observation of real-time plywood usage, handling, reuse, and wastage practices across different construction environments. The selection of five case studies was considered adequate as repetitive patterns and consistent findings related to plywood usage and wastage practices were observed across the projects, indicating data saturation (Guest et al., 2006). The key characteristics of the selected case study projects are presented in Table 1.

Table 1 : Summary of selected case study projects

Case Study	Project Duration	Project Cost (Mn)	Contract Type	Location	Type of project
C1	36 Months	23000	Measure and pay	Kandy, Sri Lanka	Building projects within the civil construction
C2	24 Months	1700	Measure and pay	Colombo 03, Sri Lanka	Commercial Building
C3	18 Months	850	Measure and pay	Colombo 06, Sri Lanka	Commercial Building
C4	24 Months	13600	Measure and pay	Colombo 08, Sri Lanka	Government Administrative Building
C5	36 Months	1300	Lump sum	Wadduwa, Sri Lanka	Apartment Building Project

Data collection for the study was primarily carried out through semi-structured interviews with construction professionals and site personnel directly involved in formwork operations. In addition, site observations and document reviews were conducted to collect information related to plywood usage, handling practices, reuse methods, and wastage generation on construction sites. The interview participants included Project Managers (PM), Quantity Surveyors (QS), Site Engineers (EN), Technical Officers (TO), Quality Assurance personnel (QA), Operation Engineers (OE), and Formwork Carpenters or Gang Leaders (F). The interviewees were selected from each case study to capture both managerial-level and operational-level perspectives related to plywood usage practices and associated wastage onsite. Moreover, QSs were included as participants because they are involved in material quantity assessment, wastage evaluation, cost monitoring, and verification of plywood usage related to formwork operations on construction sites. The interview guideline for the interviews are mainly focused on plywood usage practices, procurement methods, reuse cycles, treatment practices, wastage generation, storage conditions, disposal methods, and waste reduction strategies related to slab and beam formwork. The distribution of interview respondents across the five case studies is summarised in Table 2.

Table 2: Distribution of interviewees across case study projects

Case Study Interviews	Case 1	Case 2	Case 3	Case 4	Case 5
Project Manager (PM)	PM1-C1/ PM2-C1	_	_	_	_
Quantity Surveyor (QS)	QS-C1	QS-C2	QS-C3	QS-C4	QS-C5
Site Engineer (EN)	_	EN-C2	EN-C3	EN1-C4/EN2-C4	EN1-C5 / EN2-C5
Technical Officer (TO)	_	TO-C2	_	_	_
Quality Assurance (QA)	_	_	QA-C3	_	_
Operation Engineer (OE)	_	_	_	OE-C4	_
Formwork Carpenter / Gang Leader (F)	F1-C1/ F2-C1	F1-C2 / F2-C2	F1-C3 / F2-C3	F1-C4 / F2-C4	F1-C5 / F2-C5

The collected interview data were analysed using cross-case analysis, which allows comparison of plywood usage practices, operational challenges, and waste generation patterns across different construction projects. Through this comparative analysis, the study was able to identify recurring operational factors influencing plywood wastage in slab and beam formwork within large-scale construction projects in Sri Lanka.

4. DATA ANALYSIS AND FINDINGS

As per the main themes identified through the case study interviews, this section analyses the key practices and factors influencing plywood usage and associated wastage in slab and beam formwork, and challenges using cross-case comparison.

4.1 PLYWOOD USAGE PRACTICES

Across five case studies, plywood usage is also largely concentrated on slab and beam formwork, particularly for slab soffits and beam sides during structural works. PM1-C1 explained, *"Plywood is primarily used in structural formwork, with significant application in slab and beam construction."* Similarly, TO-C2 mentioned that plywood is used especially for basement slabs to transfer floors, including lift walls and lintels. In case 4, EN1-C4 and F1-C3 mentioned that plywood was also observed in secondary applications such as temporary site huts, retaining works, site protection elements, and temporary coverings. However, slab and beam formwork remained the primary source of plywood usage and wastage considered in these projects as per the interviewees.

Figure 1 : Typical use of plywood in large-scale construction projects

4.2 PROCUREMENT AND RECORDING PRACTICES

Across the five cases (C1–C5), plywood usage is recorded through store systems, material issue records, or procurement databases, while associated wastage is rarely measured separately. Moreover, the study revealed that wastage is typically managed through assumed percentages, reuse cycle estimates, or reconciliation methods. For instance, PM1-C1 stated *"we record the usage, but we don't record the wastage specifically because we already allow the wastage percentage, and it is time-consuming to calculate."* Similarly, QS-C2 explained *"we have records of the usage from stores, but wastage is not recorded because formwork is given to subcontractors."* In some cases, digital systems assist monitoring; QS-C1 mentioned *"wastage is calculated through the ERP system by deducting the issued material from the net quantity."* In Case 5, QS-C5 stated *"we use reconciliation for wastage calculations, but it is not 100% accurate because calculating wastage for formwork is not practical."* Technical respondents also highlighted the practical difficulty of measuring wastage directly, as EN1-C4 noted *"wastage is not measured separately because it is not practical to calculate physical wastage on site."* Overall, usage in large-scale projects is systematically tracked through procurement systems, while wastage is mainly managed through allowances and lifecycle considerations. In terms of procurement, projects often purchase large quantities (approximately 1000–2500 plywood boards) during the initial slab cycles, with further orders based on reuse cycles and site progress. Figure 2 shows how procurement and recording practices happen in the sites.

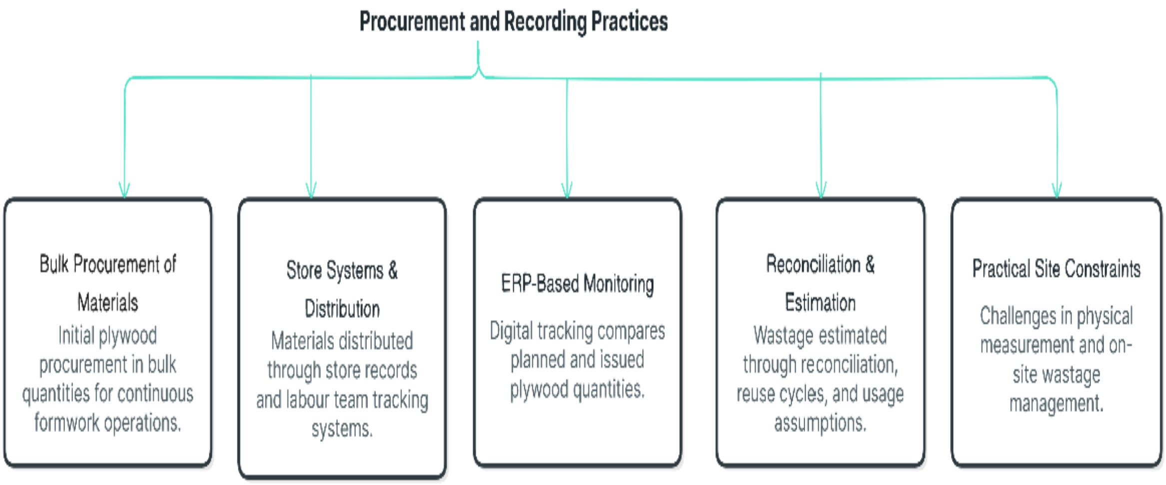

Figure 2: Procurement and recording practices of plywood

4.3 MATERIAL SPECIFICATION AND TECHNICAL SELECTION

Across the five case studies, plywood selection showed greater variation, although slab and beam formwork remained the primary application. Many respondents indicated the use of film-faced (coated) plywood because of its durability and better concrete finish. For instance, PM1-C1 mentioned, *"film-faced plywood is mainly used because it provides a good concrete finish and higher reuse cycles."* However, normal shuttering plywood was still used in some projects for cost reasons. EN-C2 emphasised, *"Sanstha shuttering boards are sometimes selected because they are more cost-effective even though coated boards perform better."* In case 4, Merbok film-faced plywood was used for its high reuse potential, although respondents noted that cut edges can be vulnerable to moisture. Generally, 15 mm-thickness boards and the standard size of 1220 × 2440 mm were commonly used. Overall, the findings indicate that material selection in large-scale projects balances durability, cost, and reuse potential, depending on project requirements and site conditions.

4.4 REUSE CYCLES AND LIFECYCLE PERFORMANCE

It is noted that plywood boards were generally reused around 3–5 cycles in all cases, although the reuse rate varied depending on material quality, supervision, and handling practices. Larger slab areas required approximately 800–1500 plywood sheets per slab cycle, reflecting the scale of structural works. New plywood boards were mainly used for the first slab, while later cycles involved a combination of new and reused boards. PM1-C1 stated *"plywood can normally be reused about five times, but it depends on supervision during handling and removal."* Another observation was reported in C4, where Merbok film-faced plywood allowed significantly higher reuse cycles. QS-C4 stated *"Merbok boards can be reused around 10–15 times, while normal plywood is usually reused only about 3–4 times."* Overall, plywood lifecycle performance in large-scale projects is influenced by board quality, supervision, and reuse strategies adopted during successive slab cycles.

4.5 TREATMENT PRACTICES AND THEIR EFFECTIVENESS

The study revealed that mould oil (form oil) was the primary treatment used for plywood formwork. The oil was generally applied after installing the formwork to prevent the boards from sticking to concrete during striping. For example, PM1-C1 explained *"mould oil is applied after placing the plywood formwork so that the boards do not stick to the concrete during removal."* Similarly, QS-C2 mentioned *"the oil helps increase reusability and reduce damage to the plywood when removing the slab formwork."* Some respondents also mentioned that the treatment reduces water absorption and improves board durability during repeated reuse cycles. In one case, EN-C5 stated *"burnt oil can sometimes be used instead of mould oil, but petrol-based oil is better while diesel-based oil is not recommended."* Overall, treatment practices in large-scale projects serve as a preventive strategy to improve stripping efficiency, protect plywood surfaces, and extend reuse cycles.

4.6 WASTE GENERATION PATTERNS

Across the five cases (C1–C5), based on respondents, plywood wastage percentage of 10–15% represents the estimated proportion of plywood material wasted in relation to the total plywood quantity procured and used for formwork operations on the construction site which varied depending on slab geometry, reuse cycles, and labour handling practices. PM1-C1 explained *"for the initial slabs it is around ten to fifteen percent, but if the structure repeats, the wastage can reduce to around five to ten percent for subsequent slabs."* However, EN-C3 noted that wastage may increase after several reuse cycles as boards begin to deteriorate. Quantity Surveyors reported relatively lower wastage values based on reconciliation estimates. For instance, QS-C1 stated *"three to five percent for slabs and overall wastage is about ten percent,"* while QS-C3 indicated *"around five to ten percent."* Offcuts were consistently identified as the dominant type of plywood waste, mainly produced during cutting operations for slab edges and beam sides. Several respondents also reported damaged sheets after stripping or repeated reuse cycles, particularly when boards are reused multiple times. Overall, the findings suggest that cutting activities and repeated reuse cycles are the main contributors to plywood waste generation, with the most common waste type remaining. Figure 3 illustrates the summary of the waste generation patterns as discussed above.

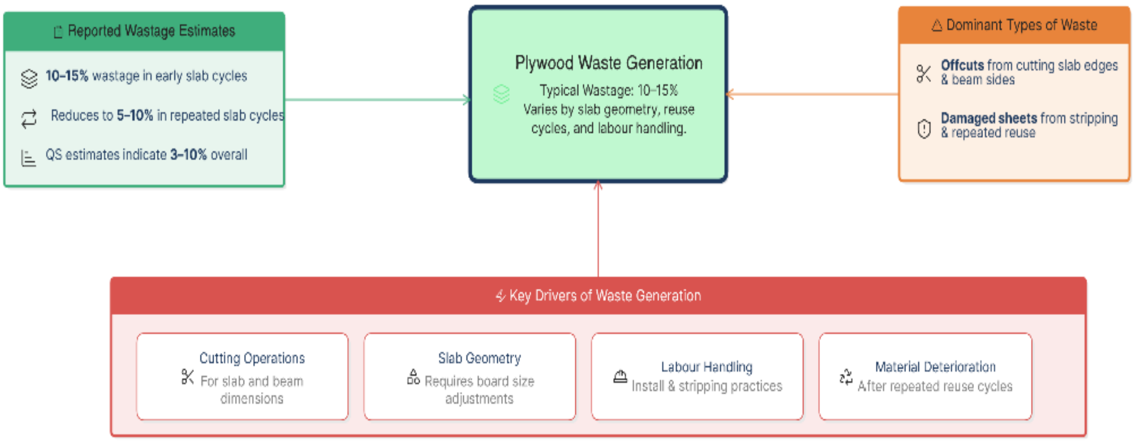

Figure 3: Plywood waste generation and key drivers

4.7 DAMAGE CLASSIFICATION AND REUSE STRATEGY

Across the five cases (C1–C5), plywood boards were also classified based on damage severity after stripping operations, generally under major and moderate damage categories. Major damage included cracking, sagging, severe layer peeling, delamination, and water-related deterioration, and such boards were usually disposed of. PM1-C1 highlighted *"major damages are like layers ripping off, cracks in the board, or sagging, and those boards are usually disposed."* In contrast, boards with minor damage, such as broken edges or surface wear were trimmed and reused for smaller elements, including beam sides, lintels, or temporary works. EN-C3 explained *"boards are assessed based on physical condition, and minor layer peeling is trimmed and reused for smaller works."* In most projects, reuse decisions were made through visual inspection by supervisors and labour teams, as highlighted by QS-C4, boards are inspected visually, and sheets with delamination or structural deformation are disposed while moderately damaged boards are trimmed and reused. Some respondents also noted material-specific behavior, where Merbok plywood can become brittle after several reuse cycles, increasing the likelihood of breakage. Overall, damage classification in large-scale projects relies mainly on visual inspection and practical reuse decisions, with an emphasis on maximizing material utilization before disposal. Figure 4 illustrates the common type of damaged plywood formwork on construction sites.

Figure 4: Damaged and discarded plywood formwork after reuse cycles

4.8 Operational Causes and Tasks of Waste

As discussed, plywood waste generation was also mainly influenced by slab geometry, labor handling practices, and operational formwork activities. Several respondents highlighted that dimensional mismatches between slab layouts and standard board sizes require frequent cutting, which produces offcuts. PM1-C1 stated *"the main cause is the changes of the design of the different slabs,"* similarly EN-C3 stated *"slab geometry and dimensional mismatch with standard board sizes require cutting adjustments."* Labour handling during stripping was also identified as a major cause of plywood damage. F1-C3 explained *"Sometimes labourers remove boards roughly with crowbars and damage the plywood."* Similarly, QS-C4 emphasized *"cutting plywood sheets to match slab and beam dimensions produces the highest amount of waste."* Overall, respondents agreed that cutting operations and formwork removal (de-shuttering) are the main tasks generating plywood waste, demonstrating that design requirements and human handling practices are key operational drivers of waste in large-scale projects. Figure 5 illustrates the key operational processes and site-level factors contributing to plywood waste generation, including cutting operations, handling practices, and de-shuttering activities.

Figure 5: Operational causes of plywood waste generation in slab and beam formwork

4.9 Storage and Site Constraints

It is noted that plywood boards were also mainly stored using covered tarpaulin protection combined with more organized storage arrangements. PM1-C1 mentioned *"plywood is mainly covered with tarpaulin without touching the ground,"* while EN-C2 explained *"the boards are stored covered with tarpaulin."* In several projects, plywood was additionally stored in designated site stores or storage areas, providing better protection from weather conditions. QA-C3 highlighted "*plywood is stored both in the store and on site, covered with tarpaulin,"* while QS-C5 mentioned that boards are often kept inside site stores. Overall, the findings show that although tarpaulin-covered storage remains the common practice, large-scale projects are more likely to use dedicated storage spaces, which helps protect material stock and maintain plywood reuse potential.

4.10 DISPOSAL PRACTICES AND END-OF-LIFE HANDLING

Across the five cases (C1–C5), plywood boards were mainly disposed of through dump yards once they reached the end of their usable life. Several respondents confirmed this approach. For instance, PM1-C1 noted that boards are *"dumped to dump yards,"* while QS-C2 also explained that damaged boards are *"disposed to dump yards."* Despite this, some reuse of smaller pieces still occurs before final disposal. F2-C1 stated that boards are *"disposed to dump yards but some cut parts are reused on the site,"* indicating that small pieces may be used for temporary works. Similarly, EN1-C5 mentioned that offcuts are sometimes reused for minor applications such as drainage or temporary formwork before disposal. Overall, the findings suggest that dumping remains the dominant disposal practice, although limited reuse of smaller pieces occurs before final disposal. Figure 6 demonstrates the common disposal practices in Sri Lankan construction industry.

Figure 6: Disposal practices of plywood formwork at the end-of-life in the construction site

4.11 CHALLENGES IN MANAGING PLYWOOD WASTE

Across the five cases (C1–C5), it is revealed that plywood waste management challenges were mainly related to labour handling practices, time pressure, and supervision difficulties. Several respondents noted that labour behaviour during stripping operations significantly affects plywood damage. PM1-C1 stated *"labourers are likely to work with new plywood, and some labourers are careless about the materials."* Similarly, QS-C2 mentioned that labourers often focus on completing tasks rather than minimizing wastage. Time pressure during construction activities was also identified as a contributing factor. EN1-C4 explained *"when the schedule is tight, boards are sometimes cut quickly without checking properly, and workers remove plywood roughly using tools."* Design-related factors were also reported as a source of waste generation. QS-C3 emphasized, *"when slab geometry does not align with standard board dimensions, cutting adjustments create more offcuts."* Additionally, supervision and coordination challenges were observed, particularly when subcontractors manage formwork work. EN-C2 explained that controlling plywood wastage becomes difficult when subcontractors handle formwork operations. Finally, site constraints such as limited storage space and weather exposure were also identified as factors affecting reuse cycles.

4.12 PERCEPTION TOWARD WASTE REDUCTION IMPROVEMENT

Across the large-scale projects (C1–C5), most respondents agreed that better waste reduction practices are beneficial, particularly through improved supervision and labour management. Several interviewees emphasized that supervision plays a critical role in controlling material handling and reuse. QS-C1 mentioned, *"even skilled labourers may not care about the materials without proper supervision."* Similarly, EN-C3 explained, *"monitoring labour is important because workers often prefer using new plywood rather than reusing existing boards."* Other respondents highlighted that improved supervision during stripping and handling operations could extend reuse cycles. F1-C2 stated *"if supervision is increased and workers are properly instructed, plywood can be reused more times."* However, some participants also emphasized the need to balance waste reduction with project productivity. QS-C3 indicated *"although improving supervision and planning can increase reuse cycles, excessive effort to reduce small offcuts may affect productivity."* Overall, the findings suggest that stronger supervision, better labour awareness, and improved coordination during cutting and removal activities are key strategies for reducing plywood waste in large-scale construction projects. Figure 7 illustrates the interaction between operational drivers, waste generation processes, and key strategies for reducing plywood waste in construction activities.

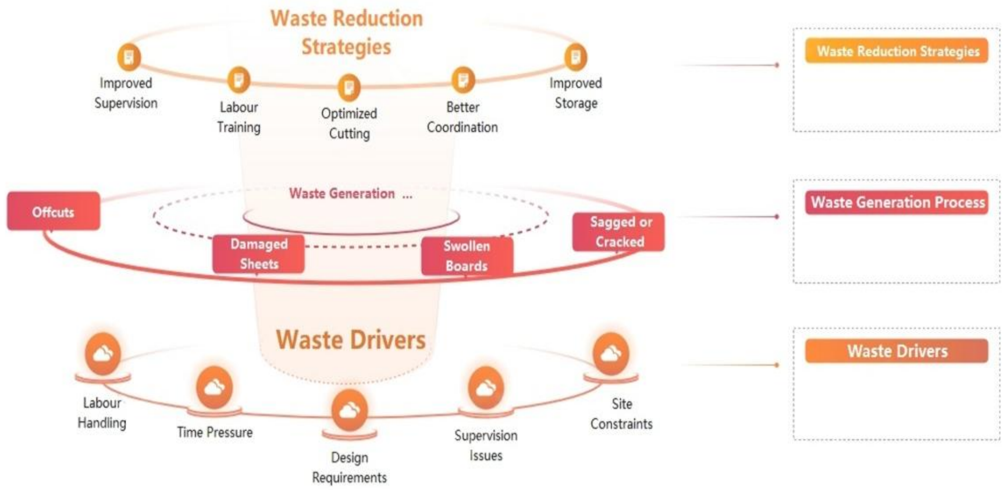

Figure 7: Relationship between waste drivers and generation, and reduction strategies

According to Bandara et al. (2025), adopting circular solutions, such as utilising plywood waste as value-added products, including its potential reprocessing into engineered panels offers significant opportunities to enhance resource efficiency in the construction sector. This indicates a strong potential for applying a waste-to-use approach to formwork materials in construction projects.

5. DISCUSSION

The findings of this study both align with and extend the existing literature related to plywood usage and wastage in reinforced concrete construction. Similar to the previous studies, all the five large-scale case studies confirmed that plywood is mainly used for the slab soffits and beam side formwork because of its workability, lightweight and smooth surface for concrete finishes (Rajeshkumar et al., 2021; Tighnavard et al., 2024). While the projects selected covered different building types (commercial, residential, institutional and infrastructure related), the pattern of usage of plywood was fairly similar for all cases. The cross-case consistency confirms that the two most common uses of plywood, slab and beam formwork, are still the most prevalent uses regardless of project, while other uses such as temporary site huts, retaining works and site protection were less consistent and depended on project-specific requirements.

The study is also in line with previous studies which report that plywood generally has short re-use cycles before it is considered waste, because of material deterioration and repeated handling (Aramaki et al., 2021; Pronk et al., 2022; Victar & Waidyasekara, 2023) . The main reasons for using plywood boards in the five cases were, in most instances, delamination, moisture conditions, and damage during stripping operations, with boards typically reused 3-5 times. But there are some differences in the results from what is currently being published. The reuse cycles of coated Merbok film-faced plywood were found to be about 10-15 times (Case 4), which is much better than the typical 2-4 times reuse that is usually reported for plywood. In the same way, the previous studies focused on plywood waste in general, but in this study, offcuts created in the process of slab and beam cutting were identified as the most abundant type of waste in all the cases. The results further corroborate earlier studies that noted that dimensional mismatches, slab geometry, labour handling operations, and cutting operations were identified as significant operation factors that create waste in production (Ajayi & Oyedele, 2018; Salah et al., 2025).

The results of the waste recording and management practices findings support and challenge the previous studies. As found in previous studies, in the selected projects, the measurement of the actual wastage rate in plywood was not usually conducted, and wastage was predominantly managed by way of wastage allowances, wastage re-use assumptions, wastage reconciliation methods, and procurement estimates (Sidiq et al., 2025; Setiawan et al., 2025). This is in line with the observation that construction waste monitoring practices are weak in many developing countries (Mohammad, 2025). However, were some projects in this study that showcased more systematic procurement and tracking methods using ERP systems and store-based documentation, suggesting that there is a gradual improvement towards better material tracking systems in large-scale projects in Sri Lanka. However, due to practical considerations on site, labour constraints and time constraints, none of the projects undertook physical measurements of the waste generated from the plywood.

The study also makes several contributions to the existing body of knowledge in a practical and theoretical manner. From a practical perspective, the results indicate that redesigning the projects, organising the storage and supervision, raising labour awareness and careful planning of cutting can have a substantial impact on minimising plywood waste production and increasing the number of times it can be reused, depending on the type of project. Theoretically, this research makes a contribution by identifying plywood formwork as a separate waste stream of temporary construction material waste, rather than under the general categories of Sri Lankan C&D waste studies, which has been absent in some of the previous studies. The cross-case analysis further revealed that although the projects varied in terms of their characteristics and building functions, the patterns of wastage of plywood, operational causes, re-use practices and disposal methods were generally similar for the projects. This helps in establishing the reliability of the results and the potential of the observed problems of waste management in large scale construction projects in Sri Lanka. In addition, the study contributes to the existing literature by highlighting the potential for plywood waste to be diverted to more circular economy applications, such as value-added engineered wood products and systems based on the CLT paradigm, which goes beyond the traditional concept of a linear waste management stream that focuses on disposal.

6. CONCLUSIONS AND WAY FORWARD

This paper examines the use of plywood and the associated wastage in slab and beam formwork in large-scale construction projects undertaken by major contractors in Sri Lanka. A cross-case study approach was adopted. The findings show that plywood is mainly used in slab soffits and beam sides. On average, plywood is reused 3-5 times, depending on material quality, level of supervision, and labour handling. The main types of waste identified are offcuts generated during cutting damaged boards during the stripping process. These are influenced by factors such as slab geometry, time pressure and inadequate supervision and handling practices. The overall wastage level is estimated to be approximately 10-15%. The study highlights the importance of improved supervision, proper cutting layouts, and better material handling practices to increase reuse cycles and reduce waste. Plywood waste was also identified as having potential value. The findings further demonstrate important practical implications for the Sri Lankan construction industry by highlighting opportunities to improve resource efficiency, minimise material wastage, and support circular economy practices through better plywood reuse and waste management strategies. As a next step, this ongoing research will investigate the feasibility of repurposing plywood waste into a sustainable partition wall system by adopting a cross-laminated timber (CLT)-inspired approach, offering a sustainable solution for partition wall applications in Sri Lanka.

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