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## Recovering Construction Industry: Incorporate Circular Waste Management Towards Lower Construction Waste

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### Abstract

Construction industry produces at least 40% of the world's carbon dioxide emissions as well as an estimated third of all waste worldwide in which lead to global warming. The rapid construction development is causing a serious impact from the huge amount of construction material waste in Malaysia. However, the awareness regarding management of waste is usually low, and research on current waste management is less well-documented. In Malaysia, the majority of construction waste is not recycled and typically settles up in landfills in which taking up the precious land. Thus, Malaysia has not been successful in adapting a sustainable practices effectively such as by regenerating construction waste and applying new function to the wasted construction material. A literature review was carried out using various databases. This study identified the challenges in existing construction waste management and explore the suitable design framework to integrate construction waste recycling facilities in construction site. This study contributes to the more sustainable practice in construction industry and less impactful towards the environment. Future study should consider adding more innovative and practical architectural solution such as through technology onto waste regeneration for sustainable construction practice.

**Keywords:** Construction Industry, Circular Waste Management, Lower Construction Waste

### Introduction

The Malaysian economy have been benefited significantly from the construction sector. Nowadays, due to the influencing factors such as growing populations, demands on infrastructure project, consumer behavior changes, and lifestyle improvements, the construction business is growing quickly. However, the construction industry often results in adverse impacts on the environment. Simultaneously, the amount of waste resulting from construction activities rises along with the number of projects, which causes numerous detrimental impacts on the environment and the health of the public as a whole. Proper construction waste management practices must be subsequently followed in all construction industries in order to limit the quantity of waste produced by construction projects. Waste

produced by the construction industry is often characterised as construction and demolition waste. Construction activities including building renovation, civil and building construction, clearing construction sites and demolition and excavation activity produced this waste. Each construction project needs to incorporate sustainable waste management since environmental degradation is continuing to be worsen as a result of the growing numbers in construction waste. Waste management is the process of eliminating or removing the unusable or polluted waste materials which demand for efficient and sustainable management, including "collection, reuse and recycling, handling, and waste disposal, which requires an appropriate management of disposal at construction areas.

According to the BBC in 2021, the construction sector is responsible for at least 40% of the carbon dioxide emissions which threaten to be resulting in global warming and construction waste is approximately a third of all waste produced worldwide. Construction waste are refers to debris or waste material produced during building processes that include preconstruction, construction, and postconstruction. The environmen are currently receiving negative impacts from the construction waste that was produced entirely by human activity. According to a survey conducted in 2012 by the Ministry of Housing & Local Government, construction and demolition (C&D) waste is responsible for 41% of all solid waste in Malaysia. The rapid construction development have been causing serious impact from the huge amount of construction material waste in developing countries including Malaysia. As most developing countries' development speeds are far exceeding, the production of waste from construction projects have risen dramatically. Malaysia has completed numerous construction projects, including high-rise commercial buildings, industrial buildings, schools, hospitals, and housing schemes. The population of Malaysia is expanding quickly, and the country's Malaysia Gross Domestic Product (GDP) is likewise increasing gradually, which leads to the production of an enormous amount of construction and demolition (C&D) waste. The financial foundation and fundamental of Malaysia's development includes the country's construction sector. It provided RM50.1 billion, or roughly 5% of the country's GDP, in 2016. (MyCC, 2017). The construction industry is predicted to grow by 10.3% year from 2016 to 2020, exceeding Malaysia's anticipated average economic growth of 5.0% to 6.0% each year, according to the Eleventh Malaysia Plan (MyCC, 2017). Nevertheless, the continuous massive production of building materials and the ineffective management of construction waste have had a significant negative influence on the environment. Sustainability is now becoming increasingly important and significant in Malaysia's construction industry.

This problem have been heavily impacting the enviroment and arises the awareness from the industry due to the huge damages made. However, there have been lack of effort being made to tackle this issue successfully. Rising illegal disposal activities as well as a lack of expertise and education regarding the proper flow of managing building waste are just a few examples of the current issues facing by construction waste management (SWCorp, 2019). Additionally, according to SWCorp, in 2019 there were approximately 1446 locations where illegal waste disposal had been discovered (CIDB, 2021). It demonstrates the fact that there are still gaps in Malaysia's construction sector's ability to handle construction waste. The director of SWCorp Malaysia, Umni Kalthum Shuib, claimed that in the federal capital, construction waste accounted for 94.6% of all illegal waste (Malaymail, 2023). According to the CIDB report, the rise in illegal dumping is a result of the rising demand for construction projects. (CIDB, 2021).

However, there is no proper guideline and framework to organize the recycling of construction waste by responsible bodies such as SWCorp and CIDB. In our country, the majority of construction and demolition debris is not recycled but instead occupies the precious land in landfills. As a result, Malaysia has struggled to adopt sustainable practises like recycling construction waste. Construction waste has grown into an emerging global ecological issue, including air pollution, global warming, climate change and acid rain that demands for immediate attention. Construction waste that has not undergone proper disposal may be harmful to the environment (Badraddin et al., 2022). The largest consumer of raw materials worldwide has been estimated to be from the construction industry. (Zimmann et al., 2016; Ghaffar et al., 2020). The construction sector nevertheless depends heavily on the "take, make, dispose" linear economic framework, which results in substantial resource consumption and minimal recovery of resources. (Anastasiades et al., 2020). There are also lack of article talks about recycling construction waste facilities that generate construction waste into new building materials. There has been lack of knowledge and skills in Malaysian construction industry towards recycling construction waste. Therefore, this study will formulate the appropriate design framework on recycling waste facilities for adaptation of renewing building material from construction waste to combat the increment of construction waste.

### **Methodology**

A comprehensive search was conducted to identify relevant studies. Electronic databases such as Google Scholar, Scopus, Science Direct, and ResearchGate were searched using keywords. such as construction industry, circular waste management, and lower construction waste. The search was limited to studies published in the English language between January 2010 and February 2023. Studies were included based on predefined criteria. Inclusion criteria encompassed empiircal studies, case studies, and literature reviews taht specifically addressed circular waste managemnet in the construction industry and its impact on reducing construction waste.

### **Results and Discussion**

The issues and difficulties with the current management of construction waste on construction sites and the space requirement for construction waste recycling facilities have been studied in several literature reviews in order to investigate the main research question. Referring to the literature review on issues and challenges with the current management of construction waste in construction site, Nawi et al (2018) found the total quantity of waste produced by the construction sector is not adequate to be accommodated by the landfill. Additionally, they noted that in Malaysia, the practice of waste incineration is now considered as one of the most effective solutions to solve the issue of disposing of building waste. Nevertheless, the detrimental effects of open burning on the environment, including air pollution driven by emissions from combustion and high temperatures, were additionally addressed. As a result, sustainability requirements are neglected in managing construction waste where these problems already cause huge impacts toward the environment where quick alternative need to be done as a solution.

The statement goes on to claim that it is necessary for improving the standards by construction industry stakeholder for managing construction waste, particularly in Malaysia, to ensure that the sector stays viable. Maniam, et al (2018) stated that construction debris in

disposal site is a major burden and an expensive challenge for solid waste management because there have been growing numerous infrastructure projects and structures created over the time. Furthermore, waste may also have a detrimental effect on the environment and the physical well-being of humans. Although with the presence of the media's long-standing interest in this issue, there have not been many actions taken to reduce the generation of waste. Construction waste was only received concern once its consequences for environmental issues became more significant.

Hasmori et al (2020) also found that the most popular method for managing construction waste is eliminating the waste materials directly in landfills. This method has been commonly used because Malaysian contractors believe that the waste materials have a very little value for influencing them to favour this method of disposal. Nevertheless, the practises won't be viable in the long run because the construction industry has produced a large amount of waste and that amount is growing annually, continuously added to the disposal sites which already overloaded in capacity. Due to this, attempts to reduce, reuse, and recycle wastes created by construction waste management are now required to overcome these issues. Kupusamy. et al (2019) mentioned that illegal dumping is a prevalent problem where it has been used as a quick fix for many Malaysian building project contractors. Furthermore, there are also inadequate laws and regulations for regulating the production of construction and demolition debris. In Malaysia, there are not adequate statistics or details on construction waste. Besides, Malaysia still lacks on research for the regeneration of construction waste for sustainable construction practice.

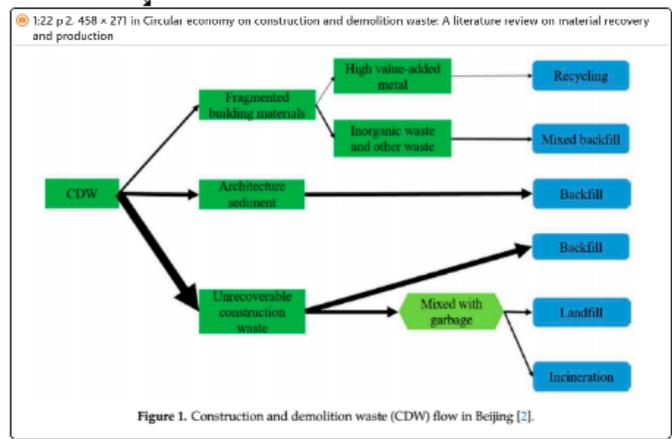
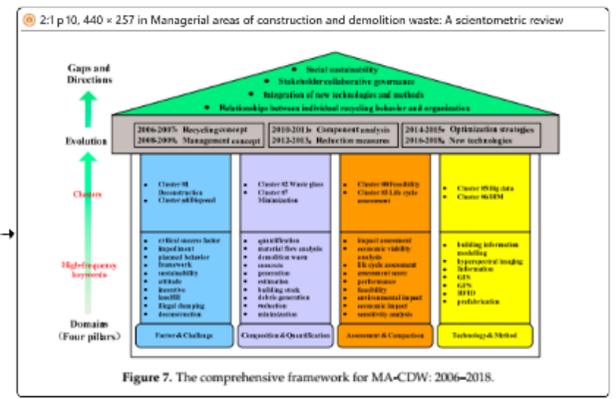
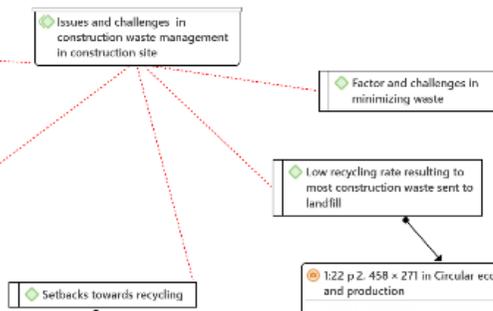
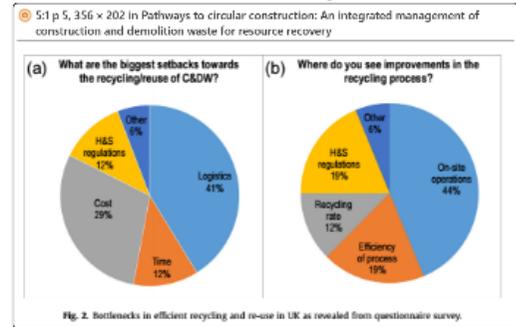
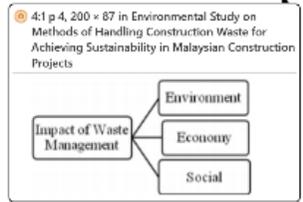
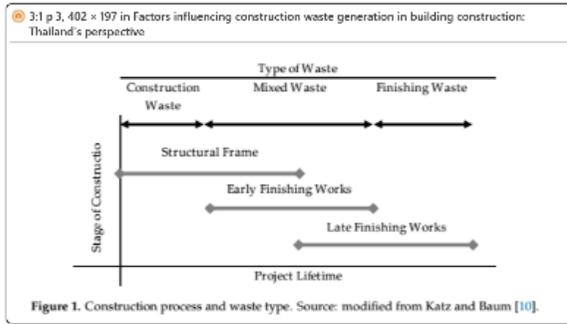


Figure 1: Theoretical framework of deductive 1

Meanwhile, based on the literature review from deductive 2 which is the space requirement for construction waste recycling facilities. Construction and demolition debris typically makes up roughly a quarter of all solid waste which were sent to disposal sites in most countries (Lu et al., 2017). Practitioners and researchers have put forth less effort in handling the waste given the significant volume and its negative effects. However, different solutions have been proposed as other alternatives apart from being discarded. Reduce, reuse, and recycle, often known as "3R" method, can be used to summarize these actions. In addition, this method is encouraged compared to the conventional way of discarding construction waste such as sending them to landfill. Spaces for upcycling facilities should comprises the facilities to directly segregate the construction waste into categories of reuse and recycle and provide spaces that facilitate the process for recycling for new usage or product. Bao et al (2018) mentioned that since all procedures are carried out in a controlled setting, off-site recycling is typically more environmentally beneficial. These nevertheless come with several drawbacks, including expensive transportation cost and subsequent annoyance, huge expenditures and a substantial demand for land occupation. In addition, they also mentioned where onsite recycling can also provide numerous of advantages, including easier management, a smaller investment, fewer transportation expenses, and even reduced dust and noise pollution to the nearby neighborhoods. Required spaces need to be provided in limited amount of available land for regenerating waste on-site such as collection point, treatment and reproduction spaces. Nevertheless, it is highly desirable to have a thorough knowledge regarding the strategies for overcoming difficulties.

Ghaffar et al (2020) stated that buildings should serve as banks of valuable items and materials, where materials in the buildings should maintain their intrinsic value through. Innovative design and circular value chains may accomplish this, in which is essential for construction industry to minimizes waste and the consumption of virgin resources. Innovative on-site waste management methods for construction and demolition waste in the direction of a circular economy have become the focus of numerous research initiatives. As example, the VEEP project, which aims to create upcycling waste treatment technologies that recover aggregates and ultrafine cementitious materials for precast concrete components. Re-use often requires an insignificant amount of processing before being utilized again. Therefore, it is required to provide spaces for processing construction waste material into readily use material and spaces for producing new building material and product from treated used materials. However, there is relatively little information and experience available regarding the potential uses of construction items. Kim (2021) also stated that beginning in 2022, it will be illegal to bring building waste directly into the landfills in the metropolitan region in Korea. Therefore, only the leftover C&D garbage that has been recycled at recycling facilities may be taken in. This strategy is anticipated to lower the volume of C&D trash disposed of at landfills. As a result, creating a system of resource circulation via increasing trash recycling is a critical and pressing task for the transition towards a society that values sustainability.

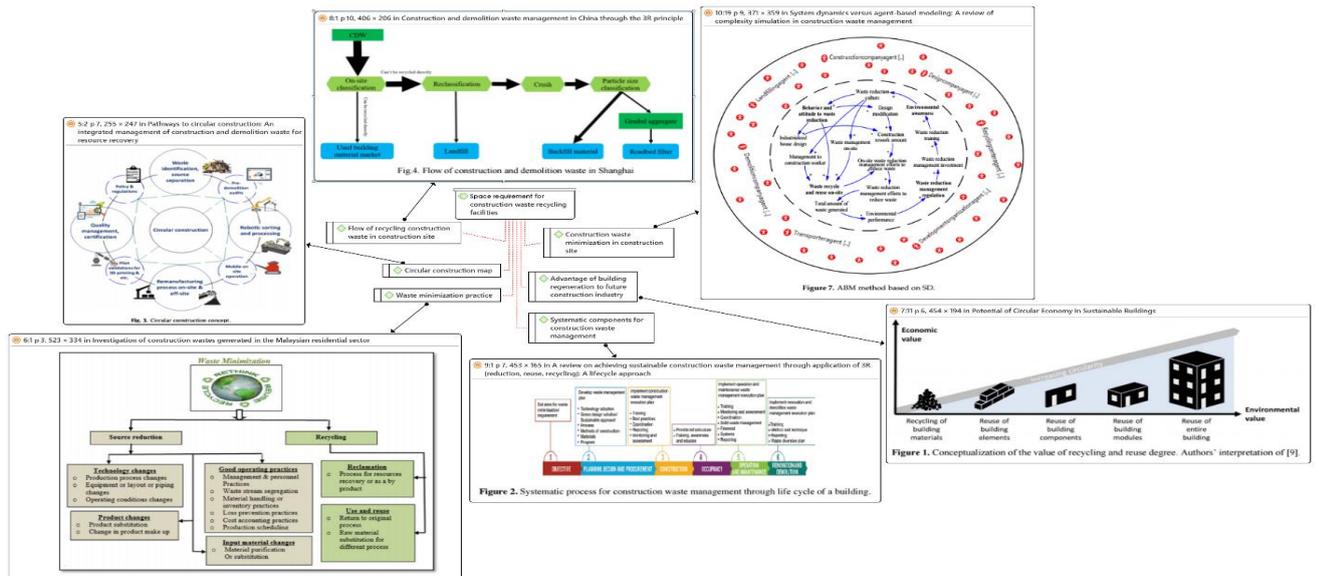


Figure 2: The theoretical framework of deductive 2

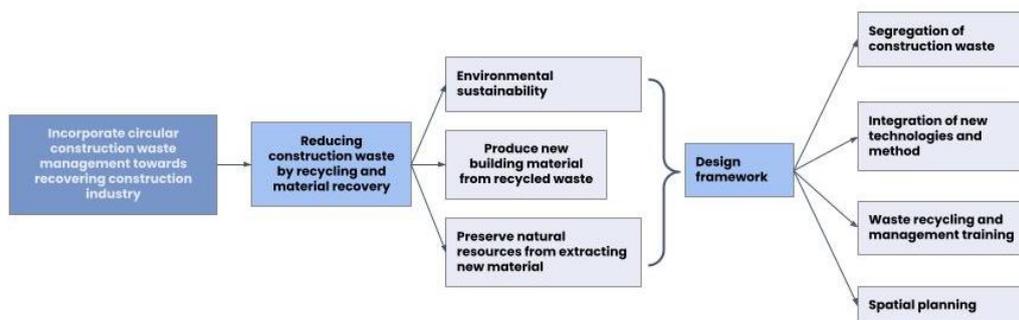


Figure 3: The conceptual framework of deductive 2

**Conclusion**

Based on the above framework, the qualitative method will be used to investigate the main research question which is what is the suitable design framework for construction waste recycling facilities for resource recovery. The results of this study will have the potential to contribute to many stakeholders in construction industry in Malaysia, including every stage of construction industry. This research is in line with efforts by World Health Association (WHO) to achieve Sustainable Development Goals 11, 12 and 13 that concentrates on improving the climates and making the cities, industries and communities more sustainable. This research will not only serve as an intervention to improve the management of construction waste through architectural approach, but it will also serve the environment and communities into more quality and sustainable way of living. This research have the limitations on finding the articles and study related to the construction waste management. The reason behind this may be because there are lack of framework for construction waste management especially in Malaysia. Next, there are also lack of case studies can be referred to that are related to construction waste management. Moreover, there are still low awareness in recycling construction waste in construction site in Malaysia, therefore, less case study can be use as reference for the design framework for construction recycling facility.

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