EVALUATION OF PRACTICAL STEEL WASTE DISPOSAL TECHNIQUES IN MALAYSIAN CONSTRUCTION SITES

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ABSTRACT

The construction industry is consuming substantial quantities of raw materials in processes, and it has a negative impact on the environment producing a huge amount of waste. Steel is one of the common wastes produced in the construction industry. These research paper analyses steel waste disposal techniques in the Malaysian construction sites related to environmental perspectives, and to sustain steel waste efficiently. The aim of this paper is to examine the practical disposal techniques of steel waste on construction using the 3R concept in terms of material sustainability. As many studies discussed by authors; hereby, a questionnaire methodology is effectively used and distributed randomly to evaluate the practical disposal techniques of steel waste on construction projects related to environmental indicators, in order to identify the techniques which, have the most capabilities to control and reduce waste on-site. The data has been analyzed using SPSS (statistical package for social science) software to decide whether the results meet our research objectives. The reduction technique which has the highest impact, and on the top of waste disposal hierarchy refer to the preliminary stages of a project estimating and stakeholder awareness of planning steel waste management, regarding that the results still unsatisfying. On the other hand, the results show that reusing technique in secondary stages of activities gave us a significant impact in minimizing CO_2 emissions arising from steel waste produced on-site and a preferable option for the construction stakeholders rather than recycling techniques which include certain processes rising up CO_2 emissions.

ABSTRAK

Industri pembinaan memakan kuantiti yang besar daripada bahan-bahan mentah dalam proses, dan ia mempunyai kesan negatif ke atas alam sekitar menghasilkan sejumlah besar sisa. Keluli adalah salah satu daripada bahan buangan yang biasa dihasilkan dalam industri pembinaan. Ini kertas penyelidikan menganalisis teknik pelupusan sisa keluli di tapak pembinaan Malaysia yang berkaitan dengan perspektif alam sekitar, dan untuk mengekalkan sisa keluli cekap. Objektif kajian ini adalah untuk mengkaji teknik pelupusan praktikal sisa keluli pembinaan menggunakan konsep 3R dari segi kemampanan material. Seperti banyak kajian dibincangkan oleh penulis; dengan ini, kaedah soal selidik adalah berkesan digunakan dan diedarkan secara rawak untuk menilai teknik pelupusan praktikal sisa keluli projek-projek pembinaan yang berkaitan dengan petunjuk alam sekitar, untuk mengenal pasti teknik yang, mempunyai keupayaan yang paling untuk mengawal dan mengurangkan sisa di lokasi. data telah dianalisis menggunakan SPSS (pakej statistik untuk sains sosial) perisian untuk membuat keputusan sama ada keputusan memenuhi objektif kajian. Teknik pengurangan yang mempunyai kesan yang paling tinggi, ke atas batu sisa pelupusan hierarki merujuk kepada peringkat awal projek menganggarkan dan kesedaran pihak berkepentingan pengurusan sisa keluli perancangan, mengenai bahawa keputusan masih tidak memuaskan. Sebaliknya, keputusan menunjukkan bahawa menggunakan semula teknik di peringkat menengah aktiviti memberikan kita kesan yang besar dalam mengurangkan pelepasan CO_2 timbul daripada sisa keluli yang dihasilkan di lokasi dan pilihan yang lebih baik untuk pihak berkepentingan pembinaan bukannya teknik kitar semula termasuk proses tertentu yang semakin meningkat pelepasan CO_2.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CI	-	Construction industry
CIDB	-	Construction industry development board
CITP	-	Construction industry transformation plan
SWMP	-	Site waste management plan
BREEAM	-	Building research environmental assessment method
WARM	-	Waste reduction model
UTM	-	University Technology Malaysia
Leeds	-	Leadership in Energy and Environmental Designs
GHGs	-	Greenhouse gases
GBI	-	Green building index
LCA	-	Lifecycle assessment
AISI	-	American iron and steel institute
CCPI	-	Climate change performance index
GBCA	-	Green building council of Australia
CASBEE	-	Comprehensive Assessment System for Building Environmental Efficiency
GWP	-	Global warming potential
EU	-	Eutrophication

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

The construction industry contributes to producing large amounts of unique waste materials from construction and demolition practices lead to an unbalanced state influencing environmental issues e.g. CO_2 emissions(Schütte, 2015). Management of construction waste is one of the most well-known obstacles we experience in a construction site; waste disposal became a problem due to the increasing numbers of construction projects, repetitive use of various building materials on-site, and land scarcity.

Nowadays, steel as a type of metals is one of the largest materials usages in the construction industry because of the special characteristics and the advantages of using it compared to other materials. Although steel is considered a great sustainable material compared to other materials, the intervention of steel fabrication and recycling processes make it more complicated material and not easy to manage.

Sustainability in the construction industry is a global concern, finding the most economical practices to reduce carbon footprints, conserve natural resources, and save the environment absolutely not easy. There are many progressive endeavours to decrease the depletion of natural resources, but achieving 100% use out of these resources is impossible, therefore sustainability must be considered during resource planning (Akhtar & Sarmah, 2018).

From one side, Construction industry experts are obviously knowing the need of environment, but on the other side construction industry stakeholders take in account environmental issues only if these issues come in accordance with their business benefits, and all that because construction industry does not emphasize on maintaining environment first, in spite of depending on updated pattern of construction management systems involving environment sustainability as an important dimension rather than a classic tradition of triangle components in construction management systems which is time, cost, and quality; except the limited application of this approach in developed countries.

Progressively, there are alternatives available in terms of recycling and reusing materials, reducing the amounts of the created waste in any situation, however, regardless of this, many construction wastes are still outcasted in landfills. landfill waste represents 32% which be as a result of construction and demolition activities of structures and has 13% of items that landfilled without having being used conveyed directly from construction sites (ref. Innovation Strategy Board).

As the 1996 Finance Act shows the work of waste disposal on the enlisted landfill locales in the UK which be very costly steps. To help handle this, a site waste management plan (SWMP) can be set up before construction commences, depicting the materials how it will be monitored and managed efficiently and outcasted legally through the construction processes, and illustrating how the materials recycling and re-use will be boosted. It might be conceivable to dispose of a specific amount of construction waste through cautious planning. For instance, steel formwork may be fit for being utilized for concrete work activities which would then be able to be reused somewhere else on the project instead of timber formwork which is classed as waste once it has been used.

Other sorts of construction waste might be equipped for being limited; for instance, items that are given with reduced packaging or those which are made out of recycled materials. There can likewise be chances to re-use materials and items which are in a reasonable condition (e.g. doors, windows, roof tiles, etc.), or change them for different materials with an alternate construction site. Materials and items which can't be dispensed with, minimized or reused may have to be discarded as waste. Prior to sending waste for disposal, it ought to be arranged and classified to enable waste contractors to oversee it successfully and guarantee that hazardous waste properly handled.

1.2 Background of Study

The construction industry became one of the most important sectors influences the environment by the high consumption of natural resources and extensive disposal of waste material. Moreover, it creates unbalanced ecological problems, potential sewage and the main CO_2 emissions issue which increases the risk of global warming through the extraction of materials, producing new ones and fabrication processes.

Steel is one of the materials that make a significant contribution to the solid waste construction industry; (Yahya & Boussabaine, 2016) Steel consumed in the buildings are typically subjected to various processing technologies, such as coating, heating with non-metallic substances, reacting with chemicals and doping with other metals. The production of steel is correlating to high levels of fuel consumption rates and subsequent CO_2 emissions. In recent years, this problem became wider due to the need for more urbanization, population growth, and economic activities.

This study will mainly discuss the evaluation of steel waste disposal practices to optimize CO_2 emissions to create sustainable waste management processes in the construction site.

Steel properties can be unchanged and recycled continuously. So, Steel has the ability to be one of the most recycled materials on earth. As the American iron and steel institute (AISI) stated. Other materials incorporating highly recycled properties aluminium, silver, copper, gold, brass. Because of metals characteristics, those materials are considered valuable can be recycled without losing their basic properties. So metals motivate people to collect for sale; an environmental goal with monetary incentives.

Steel recycling processes maintain natural resources while consuming less energy to process than the fabrication of new material using raw materials and stimulate less carbon dioxide and other harmful gases. Overall, only 30 percent of metals are recycled, 40 percent of worldwide steel production is fabricated by recycling method, crude steel forms 42 percent of steel materials recycled in the US; 400 million tons of metal are recycled worldwide every year.

1.3 Problem Statement

Steel is the second-highest material waste generated on-site(You, Be, & In, 2020). The extraction and consumption of raw materials through construction industry processes result in a final product and waste materials being continuously generated on-site. Regarding that, the construction industry contributes to the most influential environmental pollutants(Yahya & Boussabaine, 2010).

Steel waste production is one of the pollution causes(Yang & Liu, 2002). A different application of steel waste disposal practices implemented on-site, but it may not be the right choice related to environmental issues rather than an easy way to get rid of steel waste. The reduction is one of the most efficient methods to control and manage steel waste at construction and demolition stages, and it helps to reduce waste generation, transportation, cost, disposal and recycling(Poon, Yu, & Jaillon, 2004).

According to the reports by climate change performance index (CCPI) in 2018 and 2019, Malaysia came in the rank of 52 and 51 respectively of the assessment includes 60 countries related to the performance of 14 indicators on climate change categorized in four groups GHG emissions, renewable energy, energy use, and adherence to climate policy.

Wastes contain heavy metals (HMs) at low concentrations, somehow be useful in improving agricultural production, as they are essential to living organism growth. However, high concentrations of HMs have negative effects on the environment (Vongdala, 2018) The failure to handle hazardous waste, which comprises large components of toxic chemicals, heavy metals, or irradiation materials, is a considerable threat to human health and the environment (Kamaruddin & Aziz, 2017); Also, using inappropriate disposal practice exacerbate the problem of CO_2 emissions and increase the cost of ecological issues.

Two of the best environmental advantages are the protection of landfill space and a decrease in greenhouse gases. Landfills have become bigger throughout time proceed. As indicated by the Construction and Demolition Recycling Association, it has been determined that more than 4,000 sections of land could be saved every year through the recovery of mixed construction and demolition materials.

Construction and demolition recovery can likewise act to diminish greenhouse gases. At the point when materials are recycled into new materials, less energy is required than to deliver virgin materials. Recovered materials would themselves be able to be utilized as a fuel source, replacing consuming fossil fuels. The U.S. EPA has built up a Waste Reduction Model (WARM), which incorporates emission factors produced for PCC, black-top solid, wood, drywall, black-top shingles, block, and steel. For each 350 million tons recycled, more than 22 million metric huge amounts of CO_2 are kept away from annually. As far as energy saving funds, a sum of 500 trillion BTUs or what might be compared to more than 85 million barrels of oil can be saved. Likewise, we can maintain a strategic distance from the extraction, transportation, and preparing of crude materials which can damage the environment and create ecological issues. Construction & demolition waste contributes to 10-30% to the solid waste collected at many Landfills around the world(Saat, 2013).

1.4 Aim and Study Objectives

The aim of this study is to investigate the present steel waste disposal practices in the Malaysian construction industry and evaluate the practical disposal techniques in terms of optimizing CO_2 emissions. The objectives of this study are:

1. To estimate project stages that contribute to higher steel waste production.
2. To compare practical steel waste disposal techniques on construction sites.

For the first objective, the researcher will go through the construction project stages which really give an indication of higher steel waste production on site. In the second objective, an investigation will be done on reduce, reuse, recycling methods in the construction industry, and we try to identify the most used technique in the opinion of construction stakeholders to reduce steel waste amounts on-site.

1.5 Scope of Work

This research paper focuses only on the steel waste in construction sites due to the various types of construction waste exist there. Recently, steel represents a significant type of materials used in many construction sites and produce a considerable amount of waste. Focusing on steel waste allows us to assess the practices and achieve environmental sustainability. The scope of this work will cover construction sites in Malaysia. In addition, the most common types of construction projects (housing units, commercial, high residential, industrial) taken as a sample for this research.

1.6 Significance of Research

The importance of this study is to estimate the steel waste for different stages and the practices of disposing construction steel waste on-site related to environmental issues in Malaysia and to assess the performance of these techniques toward environmental sustainability and waste produced on-site.

1.7 Organization of Thesis

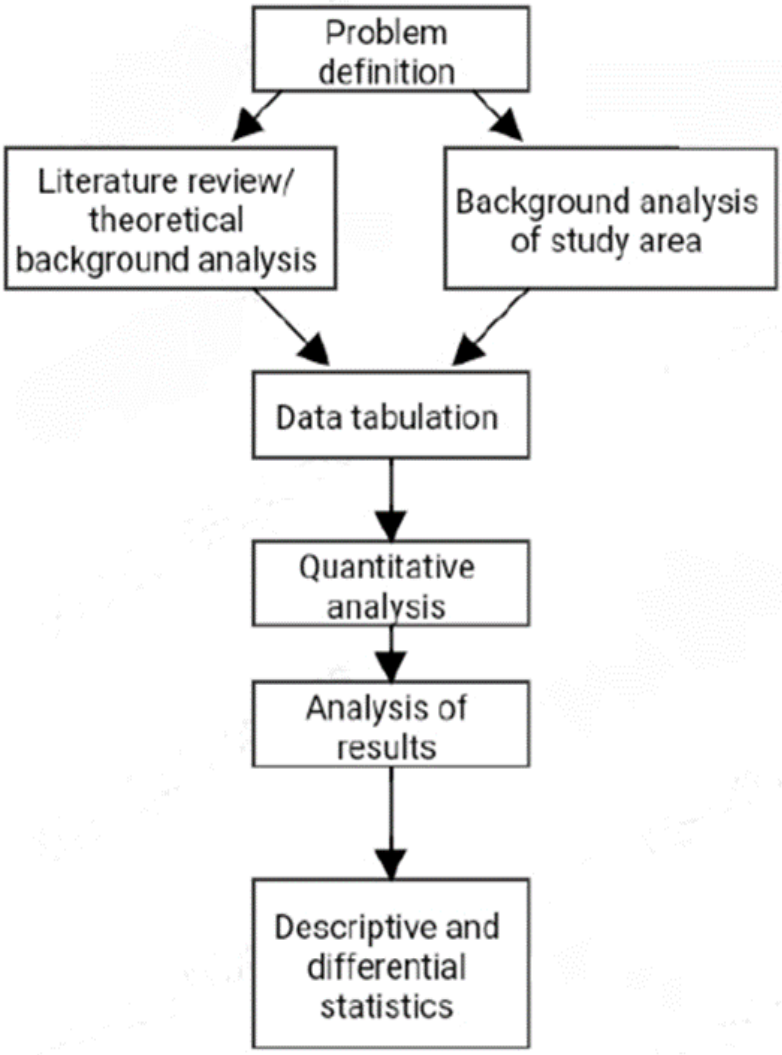

Figure 1.1 Work schedule/ approach of the study

Based on Figure1.1 the thesis begins with statements of the purpose and objective of the study in chapter 1, together with the problems followed and studied in the importance of the study. Chapter 2 illustrates the literature review related to the waste management system and deal specifically with metal waste, and sustainable waste management systems. Secondary data of existing management and institutional situation in the country before focusing on the scope of the study; while

the primary data collected and related to this study are explained in chapter 3, along with methodology and approach of the study; the methodology part also explains statistical analysis used. Chapter 5 covers the analysis of the results, conclusion, and recommendation on future research findings.

1.8 Expected Outcomes

The expected result is to identify the practical disposal techniques and assess waste produced on-site from various stages, and whether if there are any exertion efforts in making sustainable construction steel waste disposal in Malaysian construction projects, the practices, rules, and regulations which followed there related to environmental issues, and carbon dioxide emissions. we found that reduce technique still hard to achieve in some companies due to conventional method processes compared to advanced companies which conduct its work through developed technologies, then the reuse technique takes a high impact in consuming steel waste when using the steel waste effectively in secondary activities, in companies dealing with construction buildings, they tend to reuse steel waste rather than recycle it, and this technique optimize and reduce the amount of waste transported out of the site.

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