CONSTRUCTION WASTE INDEX FOR BUNGALOW PROJECTS IN MALAYSIA

BY

NUR AMALINA BINTI OMAR

A thesis submitted in fulfilment of the requirement for the degree of Master of Science (Built Environment)

Kulliyyah of Architecture and Environmental Design
International Islamic University Malaysia

SEPTEMBER 2022

ABSTRACT

In Malaysia, the 3R approach is still in the stage of infant and ineffective, as not all the initiatives are implemented by the construction stakeholders and some of them are unaware of it. The increasing allocation of landfills has proved that an increasing amount of unmanaged waste generated, and the allocation of funding and skills for waste management has been insufficient due to lack of attention. Malaysia is one of countries which have not familiar with the quantification for construction waste index since the information and data for construction waste quantification in Malaysia is still considered as restricted. The aim of the study is to develop a construction waste index for bungalow construction project as a construction waste management to be practiced on site for a better management of construction site. The objectives of the study are to identify the level of application of 3R concept practiced in bungalow construction project, to identify the concept of construction waste quantification and its current practice, to analyse the amount of construction waste generated in bungalow construction project, and to develop the index for construction waste for bungalow construction project. This research focuses on four bungalow construction project sites where are located in Malaysia, the level of application of 3R approach, the concept of construction waste quantification and its method as well as the types, in order to develop a construction waste index. The study is to develop a waste index as one of the waste management method as well as promotes better waste management in terms of the 3R concept as well as construction wastage storage allocation on construction site. The study includes elaboration on the sustainability and sustainable development, the sustainability in construction industry, the construction waste overview, the definition of waste, the type of waste, the construction waste management and approaches, the quantification and estimation of construction waste, the construction waste index, and the calculation of construction waste index. Literature review, case study and content analysis are used as the methodology of research. The study finds that all four bungalow project sites, did apply the concept of reduce, reuse and recycle, and none of all four sites did apply the construction waste quantification concept. The construction waste index for bungalow project is calculated and developed as 18.62 kg/m^2. This index can be used by contractor on construction site, with the aim to estimate the total wastage to be generated, minimize the order of construction material, as well as to prepare a proper and sufficient waste storage size on site, as well as helps with the wastage management for recyclable products. This study focusses on the construction wastage in four site of bungalow construction projects and does not cover other types of buildings and other types of industry, and the bungalow included in the research is limited to one to three storeys building only.

خلاصة البحث

في ماليزيا، لا يزال نهج R3 في مرحلة مبكرة وغير فعالة، حيث لا يتم تنفيذ جميع المبادرات من قبل أصحاب المصلحة في البناء وبعضهم غير مدركين لذلك. لقد أثبت التخصيص المتزايد لمدافن النفايات أن زيادة كمية النفايات غير المدارة المتولدة، وتخصيص التمويل والمهارات لإدارة النفايات لم يكن كافياً بسبب نقص الاهتمام. ماليزيا هي واحدة من البلدان التي لم تكن على دراية بالتقدير الكمي لمؤشر نفايات البناء حيث إن المعلومات والبيانات الخاصة بتقدير كمية نفايات البناء في ماليزيا لا تزال مقيدة. الهدف من الدراسة هو تطوير مؤشر نفايات البناء لمشروع بناء طابق واحد كإدارة لمخلفات البناء ليتم ممارستها في الموقع من أجل إدارة أفضل لموقع البناء. تتمثل أهداف الدراسة في تحديد مستوى تطبيق مفهوم R3 الذي يمارس في مشروع بناء طابق واحد، لتحديد مفهوم تقدير كمية نفايات البناء وممارسته الحالية، لتحليل كمية نفايات البناء الناتجة في مشروع إنشاء طابق واحد، وتطوير مؤشر مخلفات البناء لمشروع بناء طابق واحد. يركز هذا البحث على أربعة مواقع لمشاريع بناء طابق واحد تقع في ماليزيا، ومستوى تطبيق نهج R3، ومفهوم تقدير كمية نفايات البناء وطريقتها وكذلك الأنواع، من أجل تطوير مؤشر نفايات البناء. تهدف الدراسة إلى تطوير مؤشر النفايات كإحدى طرق إدارة النفايات بالإضافة إلى تعزيز إدارة النفايات بشكل أفضل من حيث مفهوم R3 بالإضافة إلى تخصيص تخزين مخلفات البناء في موقع البناء. تتضمن الدراسة شرحاً مفصلاً عن الاستدامة والتنمية المستدامة، والاستدامة في صناعة البناء، ونظرة عامة على نفايات البناء، وتعريف النفايات، ونوع النفايات، وإدارة ومقاربات مخلفات البناء، وتقدير وتقدير نفايات البناء، ومخلفات البناء. الفهرس وحساب مؤشر نفايات البناء. يتم استخدام مراجعة الأدبيات ودراسة الحالة وتحليل المحتوى كمنهجية للبحث. توصلت الدراسة إلى أن جميع مواقع مشروع البيوت المنفردة الأربعة، كما طبقت مفهوم التخفيض وإعادة الاستخدام وإعادة التدوير، ولم يطبق أي من المواقع الأربعة مفهوم تقدير كمية نفايات البناء. تم حساب وتطوير مؤشر نفايات البناء لمشروع البيوت المنفردة على أنه 18.62 كجم / متر مربع. يمكن استخدام هذا المؤشر من قبل المقاول في موقع البناء، وذلك بهدف تقدير إجمالي الهدر

الناتج، وتقليل ترتيب مواد البناء، بالإضافة إلى إعداد حجم تخزين نفايات مناسب وكاف في الموقع، فضلاً عن المساعدة في إدارة الفاقد للمنتجات القابلة لإعادة التدوير. تركز هذه الدراسة على الهدر الإنشائي في أربعة مواقع لمشاريع تشييد طابق واحد ولا تغطي أنواع أخرى من المباني وأنواع الصناعة الأخرى، وتقتصر البيوت المنفردة المتضمنة في البحث على مبنى من طابق إلى ثلاثة طوابق فقط.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science of Built Environment.

……
Khairusy Syakirin Has-Yun Hashim
Supervisor

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science of Built Environment.

……..
Azrin bin Mohd Din
Internal Examiner

……..
Izran Sarrazin bin Mohammad
External Examiner

This thesis was submitted to the Department of Quantity Surveying and is accepted as a fulfilment of the requirement for the degree of Master of Science of Built Environment.

……..
Sharifah Mazlina Binti Syed Khuzzan
Head, Department of Quantity Surveying

This thesis was submitted to the Kulliyyah of Architecture and Environmental Design and is accepted as a fulfilment of the requirement for the degree of Master of Science of Built Environment.

……..
Abdul Razak bin Sapian
Dean, Kulliyyah of Architecture and Environmental Design

DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Nur Amalina binti Omar

Signature ……  …. Date: ……..19/9/2022……..

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

DECLARATION OF COPYRIGHT AND AFFIRMATION OF FAIR USE OF UNPUBLISHED RESEARCH

CONSTRUCTION WASTE INDEX FOR BUNGALOW PROJECTS IN MALAYSIA

I declare that the copyright holder of this thesis are jointly owned by the student and IIUM.

By signing this form, I acknowledged that I have read and understand the IIUM Intellectual Property Right and Commercialization policy.

Affirmed by Nur Amalina binti Omar

19/9/2022

…… ……..……

Signature Date

ACKNOWLEDGEMENTS

All glory is due to Allah, the Almighty, whose Grace and Mercies have been with me throughout the duration of my programme. Although, it has been tasking, His Mercies and Blessings on me ease the herculean task of completing this thesis.

I am most indebted to by supervisor, Asst. Prof. Dr Khairusy Syakirin Has-Yun Hashim, whose enduring disposition, kindness, promptitude, thoroughness and friendship have facilitated the successful completion of my work. I put on record and appreciate his detailed comments, useful suggestions and inspiring queries which have considerably improved this thesis. His brilliant grasp of the aim and content of this work led to his insightful comments, suggestions and queries which helped me a great deal. Despite his commitments, he took time to listen and attend to me whenever requested. The moral support he extended to me is in no doubt a boost that helped in building and writing the draft of this research work.

I am also grateful to my family for their support, prayers, understanding and endurance while away. Once again, we glorify Allah for His endless mercy on us one of which is enabling us to successfully round off the efforts of writing this thesis. Alhamdulillah.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

The title of this research is "Construction Waste Index for Bungalow Project". The intention of this chapter is to deliver a general idea of the research carried out. In this chapter, the points which to be reviewed and go into detail are the statement of research problem, aim and objectives of the research, scope of research, limitation of the research, research methodology outlines and the structure of the research.

1.2 BACKGROUND OF STUDY

Construction is one of the prevalent businesses in both emerging and established countries, in term of investment, occupation and also contribution to the gross domestic product as this sector is necessary for human living, work and also their social need (Uher, 1999; Medineckiene, Turskis, & Zavadskas, 2010). Asian countries with the 30 million population and rapid development such as Malaysia, China and South Korea are demanded to focus more on the organisation and reduction of construction waste as the generation of the wastage is increasing annually (Lau V. , 2004). The total volume of wastage produces hinge on the construction phase and construction practice methods used on site (Foo, Ismail, Ade, Nagapan, & Khairul, 2013).

Some major aspects which be the factor for the increasing of construction waste generation are poor construction material storage and processing of construction material design variations and changes on site (Muhammad, Mansor, & Rafikul, 2012). The estimation of construction waste process should be done through reasonable and scientific technique for a more well-organized management of construction waste. Most studies on construction waste management are focusing on the basic concept of 3R (reduce, reuse, recycle), contractor's attitude, level of awareness, and waste disposal yet less attention and studies have been carried out on the effectiveness of the 3R application in site and the construction waste quantification and index as a recommendation for a better construction waste management technique on site and perhaps on design stage as well for the industry to grow in a sustainable way.

1.3 STATEMENT OF THE PROBLEM

Problem statement 1

The 3R approach is still in the stage of infant and ineffective waste management as not all the initiatives are implemented by the construction stakeholders and some of them are unaware of it.

The 3R approach which has been promoted by Malaysia government was considered still in the stage of infant (Manaf, Samah, & Zukki, 2009). This is supported by other study which stated that the 3R programme had been considered as an ineffective waste management as not all the initiatives are implemented by the construction stakeholders (Saadi, Ismail, & Alias, 2016). Most of the construction pratitioners are found to be not executing the 3R concept on their construction sites

besides a few of them are unmindful of it. A study by Mydin, Khor and Sani (2014) stated that an increasing allocation of landfills has proved that an increasing amount of unmanaged waste generated, and the allocation of funding and skills for waste management has been insufficient due to lack of attention. The policies carried out by the government also yet still not sufficient as only few are completely practiced by the waste management participant (Sin, Chen, Long, Goh, & Hwang, 2012).

Problem statement 2

Increasing allocation of landfills has proved that an increasing amount of unmanaged waste generated, and the allocation of funding and skills for waste management has been insufficient due to lack of attention.

In some construction projects, the developers and contractors had taken less waste management strategy as they both are more focusing on exploiting economic interests. A lot of illegal dumping produced by the unconcerned generation of construction waste will cost the government to spend more on the treatment of the wastages (Li & Wang, 2010). Construction waste produced on site requires high cost for the transportation and large space area for its disposal (Liu & Wang, 2013). The usual practice of construction waste disposal in most countries such as Malaysia, Australia, Germany and Finland, is by discarding at landfills (Nagapan, Ismail, & Ade, 2012; Faniran & Caban, 1998).

Problem statement 3

Malaysia is one of countries which have not familiar with the quantification for construction waste index since the information and data for construction waste quantification in Malaysia is still considered as restricted.

The calculation of the total amount of wastage generated from construction projects have been a challenging process due to the vigorous and fast track period of construction activity and also the lack of amount and type of data on construction waste generated (Siti & Wan, 2013; Jalali, 2007). A precise estimation of construction waste can be obtained by developing a model specifically for waste quantification in construction industry (Ahmad, Che, Noor, Siti, & Nik, 2012). This method is available in some studies and has been practiced in some countries. However, Malaysia is one of countries which have not familiar with the quantification for construction waste index since the information and data for construction waste quantification in Malaysia is still considered as restricted (Siti & Wan, 2013).

The estimation process should be done through reasonable and scientific technique for a more well-organized management of construction waste. Most studies on construction waste management are focusing on the basic concept of 3R (reduce, reuse, recycle), contractor's attitude, level of awareness, and waste disposal yet less attention and studies have been carried out on the effectiveness of the 3R application in site and the construction waste quantification and index as a recommendation for a better construction waste management technique on site and perhaps on design stage as well for the industry to grow in a sustainable way.

Thereby, the research will investigate on the matters of the level of actual practice of 3R concept applied as well as the construction waste quantification, the amount of construction wastage generated, together with the construction waste index for bungalow construction project.

1.4 RESEARCH QUESTIONS

1- What is the level of application of 3R concept practiced in bungalow construction project?

2- What is the concept of construction waste quantification and its current practice in bungalow project?

3- How much is the amount of construction waste generated in bungalow construction project?

4- What is the index for construction waste for bungalow construction project?

1.5 AIM OF THE STUDY

The aim of the study is to develop a construction waste index for bungalow construction project as a construction waste management to be practiced on site for a better management of construction wastage at bungalow construction site. This index shall be used by contractor or any person in charged on construction site, with the aim to estimate the total wastage to be generated, minimize the order of construction material, as well as to prepare a proper and sufficient waste storage size on site, as well as helps with the wastage management for recyclable products.

1.6 RESEARCH OBJECTIVES

In order to achieve the intended aim, there are several research objectives that need to be fulfilled. The objectives of the research are:

1- To identify the level of application of 3R concept practiced in bungalow construction project.

2- To identify the concept of construction waste quantification and its current practice in bungalow project.

3- To analyse the amount of construction waste generated in bungalow construction project.

4- To develop the index for construction waste for bungalow construction project.

1.7 SCOPE OF THE STUDY

This research focuses on four bungalow construction project sites where are located in Malaysia, the level of application of 3R approach, the concept of construction waste quantification and its method as well as the types, in order to develop a construction waste index for overall project, besides for each type of construction wastage.

1.8 LIMITATIONS OF THE STUDY

This study only focusses on the construction wastage in four site of bungalow construction projects and does not cover other types of buildings and other types of industry, and the bungalow included in the research is limited to one to three storeys building only. The construction waste material studied in the research are focused on seven types of material waste which are dirt/soil/sand, bricks and blocks, tiles, wood, concrete and aggregate, cement and plaster and metal. Other than that, the location of the four site projects is located within Peninsula Malaysia.

1.9 SIGNIFICANCE OF THE STUDY

There are some significances of the study identified as:

1- Develop a construction waste index as one of the construction waste management method.
2- Promotes better construction waste management in terms of the 3R concept as well as construction wastage storage allocation on construction site for future construction project
3- Guidelines for professionals, students and practitioners in construction industry in the context of construction waste management.

1.10 STRUCTURE OF RESEARCH

1.10.1 Chapter One: Introduction

The chapter describes the overview of the research, which are the introduction, problem statement, research aim and objectives, research questions, significant of research, limitation of research, research methodology and structure of research.

1.10.2 Chapter Two: Literature Review

The chapter consists of literature study of the research. It includes elaboration on the sustainability and sustainable development, the sustainability in construction industry, the construction waste overview, the definition of waste, the type of waste, the construction waste management and approaches, the quantification and estimation of construction waste, the construction waste index, and the calculation of construction waste index.

1.10.3 Chapter Three: Research Methodology

Under this chapter, the research design and methodology is explained and detailed out. Literature review, case study and content analysis are used as the methodology of research. The sampling and the procedure of the research will be explained.

1.10.4 Chapter Four: Data Analysis and Discussion

The chapter elaborates the data and findings that have been obtained for the research. The data is analyzed and evaluated, and all the calculation will be explained in a detailed discussion in order to achieve the aim and objectives of the research and explains the process of data analysis for the case study conducted.