

**CONSTRUCTION WASTE INDEX FOR BUNGALOW
PROJECTS IN MALAYSIA**

BY

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

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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/m². 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 لمداخن 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.



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Khairusy Syakirin Has-Yun Hashim
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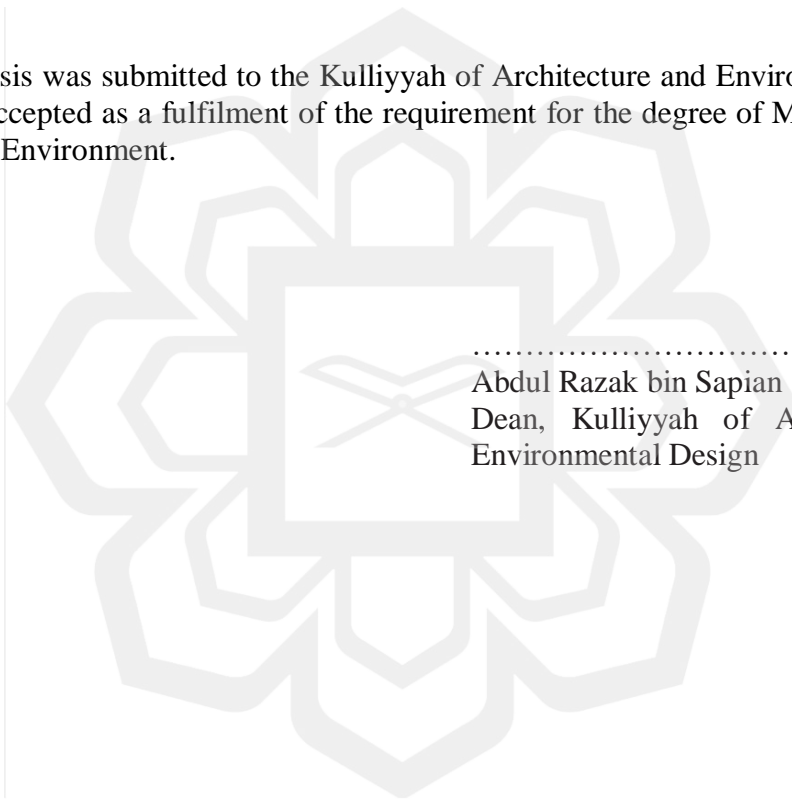
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DECLARATION

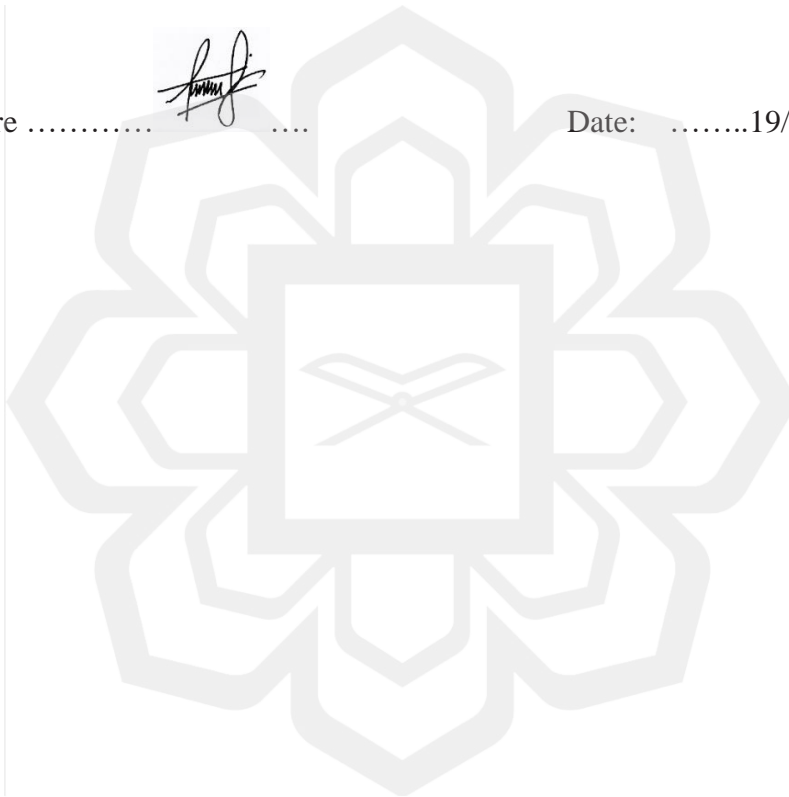
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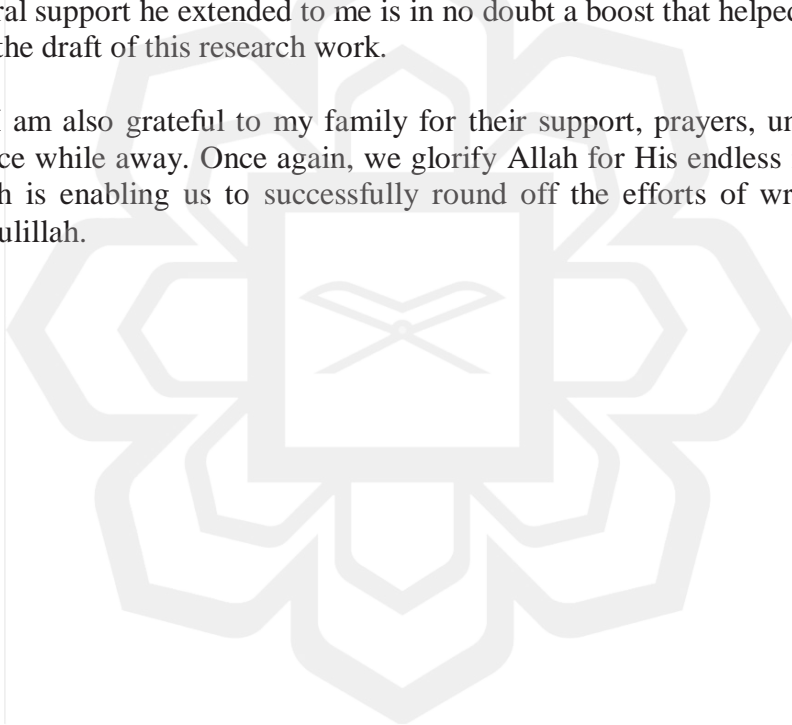


TABLE OF CONTENTS

Abstract.....	ii
Abstract in Arabic.....	iii
Approval Page.....	v
Declaration.....	vii
Copyright.....	viii
Acknowledgements.....	ix
List of Tables.....	xii
List of Figures.....	xiv
List of Appendices.....	xv
CHAPTER ONE: INTRODUCTION.....	1
1.1 Introduction.....	1
1.2 Background of Study.....	1
1.3 Statement of The Problem.....	2
1.4 Research Questions.....	5
1.5 Aim of The Study.....	6
1.6 Research Objectives.....	6
1.7 Scope of The Study.....	7
1.8 Limitations of The Study.....	7
1.9 Significance of The Study.....	8
1.10 Structure of Research.....	8
1.10.1 Chapter One: Introduction.....	8
1.10.2 Chapter Two: Literature Review.....	9
1.10.3 Chapter Three: Research Methodology.....	9
1.10.4 Chapter Four: Data Analysis and Discussion.....	9
1.10.5 Chapter Five: Conclusion and Recommendation.....	10
1.11 Conclusion.....	10
CHAPTER TWO: LITERATURE REVIEW.....	11
2.1 Introduction.....	11
2.2 Sustainability and Sustainable Development.....	11
2.3 Sustainability in Construction Industry.....	20
2.4 Definition of Waste.....	26
2.5 Type of Waste.....	28
2.6 Waste Management.....	33
2.7 Waste Management Hierarchy.....	34
2.7.1 Reduce.....	40
2.7.2 Reuse.....	42
2.7.3 Recycle.....	43
2.7.4 Dispose.....	45
2.8 Construction Waste.....	47
2.9 Construction Waste Management.....	51
2.10 Construction Waste Quantification.....	58
2.11 Construction Waste Index.....	66
2.11.1 Calculation of Construction Waste Index.....	72
2.12 Review on Similar Research in Malaysia.....	78

CHAPTER THREE: METHODOLOGY.....	88
3.1 Introduction.....	88
3.2 Research Design.....	91
3.2.1 Case Study.....	91
3.2.2 Literature Analysis.....	92
3.2.3 Content Analysis.....	92
3.4 Sampling.....	92
3.5 Procedure.....	94
3.6 Conclusion.....	99
CHAPTER FOUR: DATA ANALYSIS AND DISCUSSION.....	100
4.1 Introduction.....	100
4.2 General Information of the Case Study.....	100
4.3 The Application of 3R Concept at Bungalow Project Site.....	101
4.4 The Application of Construction Waste Quantification at Bungalow Project Site.....	104
4.4.1 Benefit of Construction Waste Quantification.....	104
4.5 Construction Waste Generated at Bungalow Project Site.....	105
4.5.1 Calculation of Total Volume of Construction Waste Generated at Bungalow Project Site.....	105
4.5.2 Types and Composition of Construction Waste at Bungalow Project Site	107
4.5.3 Calculation of Weight of Each Type of Material Waste Generated at Bungalow Project Site.....	108
4.6 Construction Waste Index for Bungalow Project.....	113
4.6.1 Developing Construction Waste Index for Bungalow Project.....	113
4.6.2 Developing Construction Waste Index for Each Type of Material Waste for Bungalow Project.....	114
4.6.3 Benefit of Construction Waste Index.....	118
4.7 Conclusion.....	119
CHAPTER FIVE: CONCLUSION, LIMITATION AND RECOMMENDATION.....	120
5.1 Introduction.....	120
5.2 Objective One.....	121
5.3 Objective Two.....	122
5.4 Objective Three.....	123
5.5 Objective Four.....	124
5.6 Limitation.....	126
5.7 Recommendation.....	126
REFERENCES.....	127
APPENDICES.....	142

LIST OF TABLES

Table 2.1	Examples of some measurable objectives or sustainability indicators.....	15
Table 2.2	“Economy of Resources” Principle.....	23
Table 2.3	“Life Cycle Design” Principle.....	23
Table 2.4	“Humane Design” Principle.....	24
Table 2.5	Estimated construction waste generation and composition on the site.....	30
Table 2.6	Construction waste generation rate benchmarks in some countries.....	69
Table 2.7	Waste generation rate and disposal cost.....	71
Table 2.8	Waste material density.....	78
Table 2.9	Summary of Construction Waste Generation Rate at Site A, B and C.....	79
Table 2.10	Waste index and wastege level for various sites in Klang Valley...	81
Table 2.11	Sources of Waste and Contractors’ Credentials.....	84
Table 2.12	Construction waste generation rate of housing projects in Ipoh.....	85
Table 2.13	Sources and waste management facilities in housing construction sites in Ipoh.....	86
Table 3.1	The Amount of Construction Waste Generated in Four Bungalow Projects.....	97
Table 3.2	The Calculation of Construction Waste Index in Four Bungalow Project Sites and the Average Construction Waste Index.....	98
Table 3.3	The Calculation of Construction Waste Index in Four Bungalow Project Sites Categorized by Type of Materials.....	98
Table 4.1	Bungalow construction site profile.....	101
Table 4.2	Level of application of 3R concept and waste quantification practiced in bungalow project site.....	102

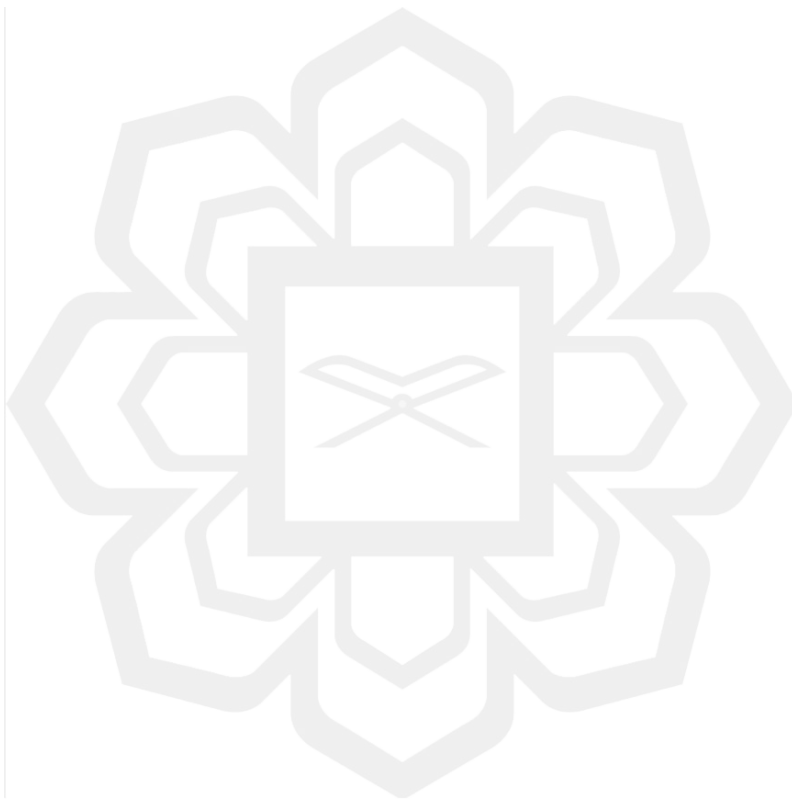
Table 4.3	Total volume of lorry and bins used at bungalow project sites.....	106
Table 4.4	Types and composition of construction waste at bungalow project sites.....	108
Table 4.5	Waste material density.....	109
Table 4.6	The calculation of total volume and weight of each material waste produced at Site 1.....	109
Table 4.7	The calculation of total volume and weight of each material waste produced at Site 2.....	110
Table 4.8	The calculation of total volume and weight of each material waste produced at Site 3.....	110
Table 4.9	The calculation of total volume and weight of each material waste produced at Site 4.....	111
Table 4.10	Total amount of each type of waste material generated at bungalow project site.....	112
Table 4.11	Construction waste index of bungalow projects for all sites and the average construction waste index.....	114
Table 4.12	Construction waste index for each material types for Site 1.....	115
Table 4.13	Construction waste index for each material types for Site 2.....	115
Table 4.14	Construction waste index for each material types for Site 3.....	115
Table 4.15	Construction waste index for each material types for Site 4.....	116
Table 4.16	Average construction waste index for each material types at bungalow project sites.....	116
Table 4.17	Construction waste index for each material for bungalow project site sorted from highest to lowest.....	117
Table 5.1	The Amount of Construction Waste Generated in Four Bungalow Construction Project Site.....	123
Table 5.2	Average Construction Waste Index and Construction Waste Index of Each Waste Material.....	124

LIST OF FIGURES

Figure 2.1	Framework for Sustainability and Sustainable Development.....	14
Figure 2.2	Sustainability.....	16
Figure 2.3	Sustainable Construction Model.....	25
Figure 2.4	Composition of generated construction waste materials on the Site.....	30
Figure 2.5	Construction site activities and types of construction waste.....	32
Figure 2.6	Construction Waste Management Hierarchy.....	35
Figure 2.7	Construction waste management life cycle.....	37
Figure 2.8	Generic flow pattern of construction material on site.....	39
Figure 2.9	Methodological framework for construction waste quantification...	63
Figure 2.10	Stockpiled waste.....	75
Figure 2.11	Gathered waste.....	76
Figure 2.12	Waste index between residential project and commercial project...	87

LIST OF APPENDICES

Appendix I	Sample of Contract Document.....	143
Appendix II	Sample of lorry used for waste transportation (picture).....	145
Appendix III	Sample of construction waste allocation at site (picture).....	147



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 practitioners 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.