WASTE MINIMIZATION BY RECYCLING OF CONSTRUCTION WASTE

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ABSTRACT

Growth in construction activities generates construction waste which is fast becoming a serious environmental problem with deadly consequences. Most of the construction and demolition waste in our country are not recycled but end up in landfills occupying valuable land not to mention the cost incurred in landfilling. In line with this, a study on the benefits of waste minimization, the materials which could be recycled, methods used to dispose waste materials and the factors as to why recycling is not popular was carried out. The scope of study covers construction companies which are registered with either CIDB or PKK (Pusat Khidmat Kontraktor) the building construction industry. The study will be carry out by an interview and also series of questionnaire. Data will be analyzed using average index. From this study, the benefits of waste minimization are conservation of natural resources, increase profit, improve company image and achieve a cleaner and safer construction site. The material which could be recycled are ferrous metal, non-ferrous metal, asphalt, brick, concrete, timber, glass, masonry, paper and cardboard, plastic and fibre-reinforced polymer(FRP). The methods of waste disposal are landfill, dumping, open air burning, recycling, reuse and incineration.

ABSTRAK

Peningkatan industri pembangunan memberi kesan yang ketara terhadap penjanaan sisa pembinaan yang merupakan suatu masalah serius pencemaran alam sekitar yang bakal membawa impak teruk Kebanyakan sisa peja industri pembangunan dan perobohan di negara tidak dikitar semula tetapi dilupus di kambus tanah(landfill). Kaedah kambus tanah bukan sahaja menyumbang kos tetapi menggunakan kawasan tanah yang bernilai. Sehubungan dengan itu, satu kajian tentang faedah meminimumkan sisa pejal, bahan-bahan yang dapat dikitar semula, kaedah-kaedah pelupusan bahan sisa dan faktor-faktor kaedah kitar semula tidak popular telah dijalankan. Kajian tersebut difokuskan hanya untuk syarikat-syarikat pembinaan yang berdaftar di bawah CIDB(Construction Industry Development Board) dan PKK(Pusat Khidmat Kontraktor) di Malaysia. Dua kaedah yang akan dijalankan untuk menjayakan kajian dipilih iaitu temubual dan borang soal selidik. Data akan dianalisis menggunakan index purata. Daripada kajian, faedah meminimumkan sisa binaan ialah seperti pemuliharaan alam, meningkatkan keuntungan dan imej syarikat, tapak pembinaan yang bersih dan selamat. Bahan yang dapat dikitar semula ialah logam ferus, logam bukan ferus, asfalt, bata, konkrit, kayu, gelas, masonri, kertas dan kadbod, plastik dan polimer gentian bertetulang(FRP). Bahan binaan dapat dilupuskan dengan cara kambus tanah, 'dumping', pembakaran terbuka, kitar semula dan incinerator.

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CHAPTER 1

INTRODUCTION

1.1 PREFACE

Under the 9th Malaysian Plan, our Malaysian government has given a much needed boost to the flagging construction industry. A total of 880 projects worth RM 15 billion will be tendered under the first rollout of the 9th Malaysian Plan. Among the projects are 450 primary and secondary schools, roads, bridges, water supply projects in Terengganu, and the Integrated Transportation Terminal in Gombak. (The Star, 19 July 2006)

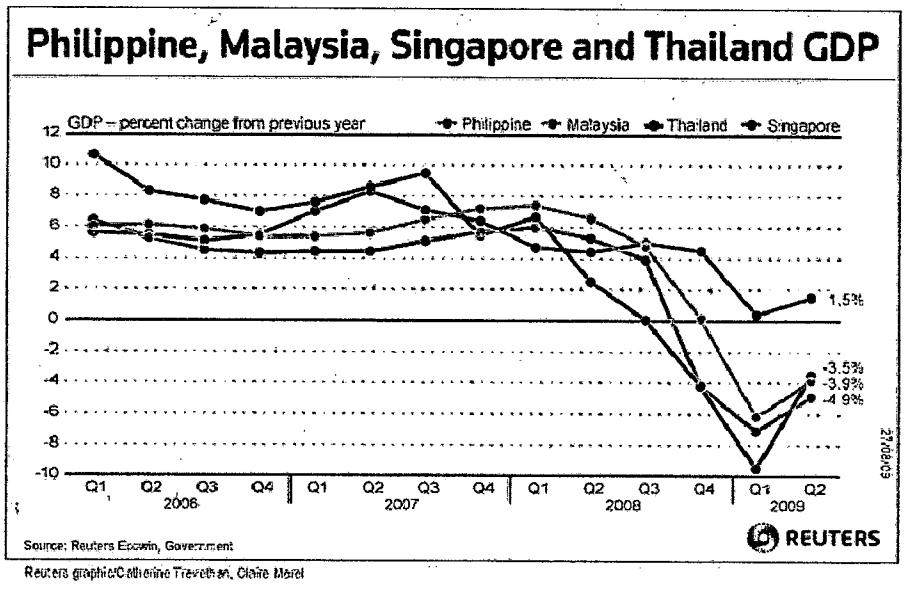

Figure 1.1: National GDP and Construction GDP of 2006 to 2009

As can be seen in Figure 1.1, construction projects are needed to give momentum the economy, increase the standard of living and provide jobs, construction by nature is not an environmentally-friendly industry. Air, water, noise and land pollution can all be linked to the construction industry. Natural disasters such as landslides and flooding could be caused by inappropriate construction management. Construction industry could also cause adverse health problems in humans. Lack of concern for the environmental consequences of large development projects has proved costly in developed countries.

In the United States construction industry alone, the EPA (USA's Environment Protection Agency) estimates that 136 million tones of construction and demolition waste are produced yearly. (Recycling Today, 16 March 2004) The construction industry in our country is fast becoming a big waste generator. The extensive building and infrastructure development projects have led to a huge increase of construction and demolition waste recently. With that in mind, the government introduced EIA (Environmental Impact Assessment) in 1987 within the framework of the Environmental Quality Act (EQA). Environmental impact assessment (EIA) is a legal measure to curb environmental pollution and ecological destruction at the source. Environmental review of projects prevents not only environmental degradation, but also construction errors and faulty economic analysis.

Waste management is now no longer an option but a necessity. Recycling has been identified as one of the best option to convert the waste materials into recycled contents. Sadly though, our national domestic recycling rate still hovers around a mere five percent. (Bernama, 9 February 2006).

Wastages affect not only our environment but also incur extra costs to the contractors and developers. Many countries especially the developed countries have started to aggressively recycle the construction materials due to its many benefits. In Malaysia, there is a huge potential in recycling of construction waste and if implemented correctly, will only bring about a construction resurgence.

1.2 BACKGROUND OF STUDY

Construction waste is defined as the by-product generated and removed from construction, demolition and renovation workplaces or sites of building and civil engineering structure. (Cheung, 1993).

As concerns grow over the amount of wastes generated in the construction industry, recycling has been identified as one of the most feasible way to overcome construction wastes. In many cases, up to 90 percent of construction wastes are recyclable. Recycling of construction materials can be defined as the separation and recycling of recoverable waste materials generated during construction and remodeling. Packaging, new material scraps and old materials and debris all constitute potentially recoverable materials. In renovation, appliances, masonry materials, doors and windows are recyclable.

1.3 PROBLEM STATEMENT

The construction and demolition industries generate a lot of debris that can be reused and recycled. Most construction waste goes into landfills, increasing the burden on landfill loading and operation. Waste from sources such as solvents or chemically treated wood can result in soil and water pollution. With concerns over scarce landfills, construction waste has been identified as a potential source of waste reduction. (Environmental Protection Agency, 2001).

In recent years, the construction industry has depleted our natural resources and this is naturally followed by environmental degradation. Without environmental awareness, contractors have caused irreversible damage to the environment by disposing of waste materials blatantly. For instance the Sipadan coral reefs were damaged by the construction of a RM4.5 million clubhouse project on Pulau Sipadan. (The Star, 28 July 2006) Besides this, our air and water sources are also being polluted and this will lead to health complications in humans in the later future.

It is then obvious that waste management should be implemented. Reducing, reusing and recycling appear to be profitable alternatives that will increase the lifetime of landfills and reduce exploration of natural resources. (Woolley, 2000) Most importantly, our environment will not face more deterioration. In addition to the environmental benefits in reducing the demand on land for disposing the waste, the recycling of construction wastes can also help to conserve natural materials and to reduce the cost of waste treatment prior to disposal (Poon, 2002).

The most important step for recycling of construction waste is on-site separation. Construction personnel must be trained in material sorting policy, and bins must be monitored periodically to prevent waste mixing. The waste materials can then be sent to relevant companies which recycle construction wastes.

The public, businesses, developers, contractors, architects and engineers has to be educated on how to minimize waste and the importance of recycling construction wastes. Our authorities could play a part too by introducing adequate legislation, enforcing the laws and prosecute the guilty parties who do not follow the law. With the expansion of urban areas, all relevant parties should ensure that waste is minimized and there is a full implementation of recycling waste materials to steer the construction industry in the right direction.

1.4 OBJECTIVES

The purpose of my study is to minimize wastages at construction sites by recycling of construction wastes. In order to ensure this study meets its purpose, the objectives are:

a. To study the benefits of waste minimization
b. To identify materials that could be recycled
c. To identify the methods used to dispose of the waste materials in Malaysia
d. To identify the factors why recycling is not a popular choice.

1.5 SCOPE OF STUDY

The study covers construction companies which are registered with either CIDB(Construction Industry Development Board) or PKK (Pusat Khidmat Kontraktor).

1.6 JUSTIFICATION

This study is done due to many valid reasons. The main reason is better environmental awareness is truly needed in lieu of the numerous developments going on in our country. Once there is awareness, the contractors could be trained properly on environmental management and the benefits of wastes minimization on construction sites.

Other than that, this research hopes to convince the contractors, developers and everyone who is involved in the construction industry that recycling is the best option to dispose of the waste materials.

With recycling, the waste materials will not be dumped indiscriminately, sent to incinerators or burnt on-site or sent to landfill sites. Contractors could just send the materials to recycling centers. This way, our country can cut down on landfill sites and protect our natural surroundings from further degradation.

Recycling is an economically viable option. From recycling of construction wastes, contractors could recoup their losses and make a healthy profit out of it. In the United States, there is a big market for recycled construction wastes. In Malaysia, recycling is still in its infancy and there is much potential still untapped in the recycling industry.

1.7 Flowchart of Research Methodology

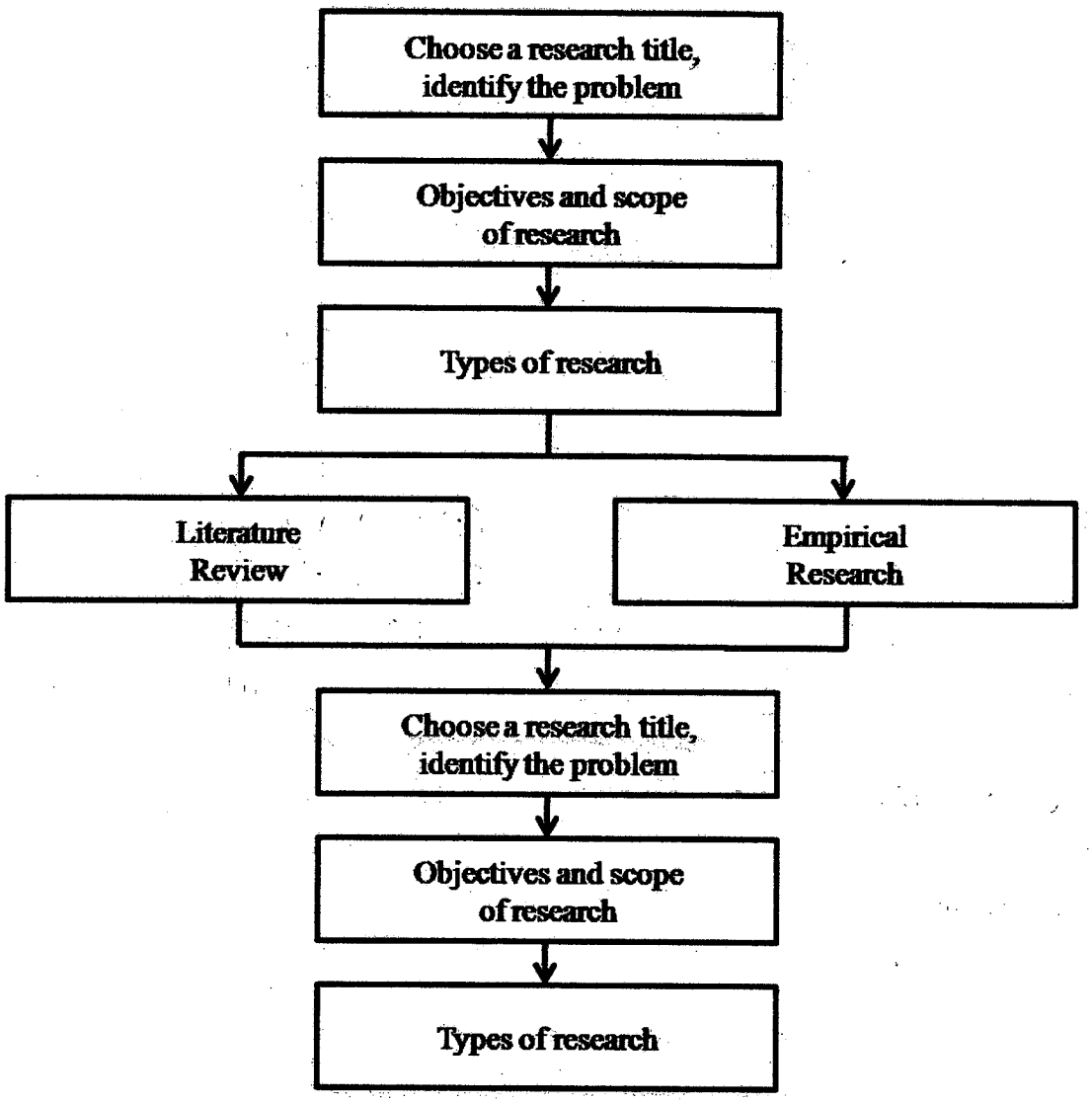

Figure 1.2: Flowchart of Research Methodology

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Construction waste is becoming a serious environmental problem in many cities around the world. (Chen *et al.*, 2002; Ferguson *et al.*, 1995; Shen *et al.*, 2000, 2002; Smallwood, 2000; Wong and Tanner, 1997). Construction and demolition (C&D) debris frequently makes up 10–30% of the waste received at many landfill sites around the world (Fishbein, 1998).

Construction and demolition (C&D) waste according to the EUWaste Strategy is considered as one of the 'priority' waste streams. According to the Sixth Environment Action Program entitled 'Environment 2010: Our future, Our choice', recommendation actions need to be taken with respect to the stream of C&D waste, (EC, 2001).

In Malaysia, the construction industry generates a lot of construction waste which may cause significant damage to our environment. Waste minimization and effective and sustainable waste management is thus a most pressing issue nowadays. However, data is not readily available on the current structure of construction waste flows by the source of generation, type of waste, intermediate and final disposal and the amount of waste reduced at source, reused or recycled on-site or off-site .

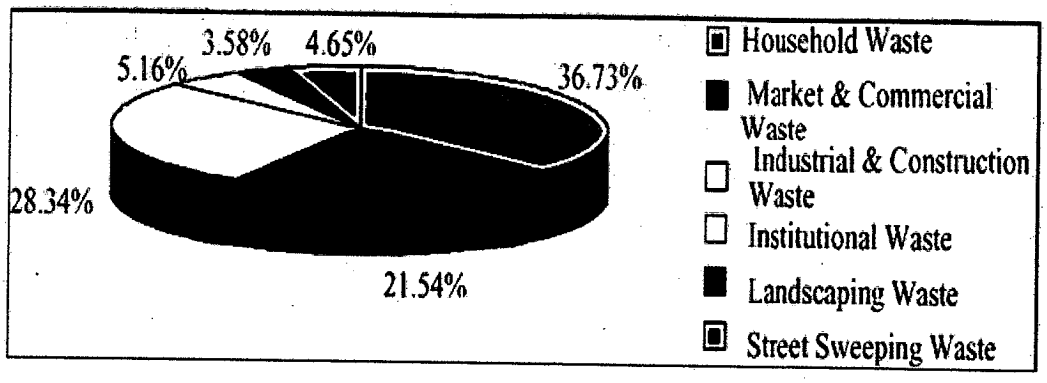

Figure 2.1 Percentage of solid waste in 1994 by Hassan *et al.* (1998)

From Figure 2.1, it can be concluded that construction waste make up a large portion of solid waste in Malaysia. Construction and demolition waste is most often disposed of in landfills; however recent recognition of the potential for diversion from the landfills of more and more waste components has led to construction and demolition waste becoming a target of interest for recycling (Peng *et al.*, 1997) (Trankler *et al.*, 1996).

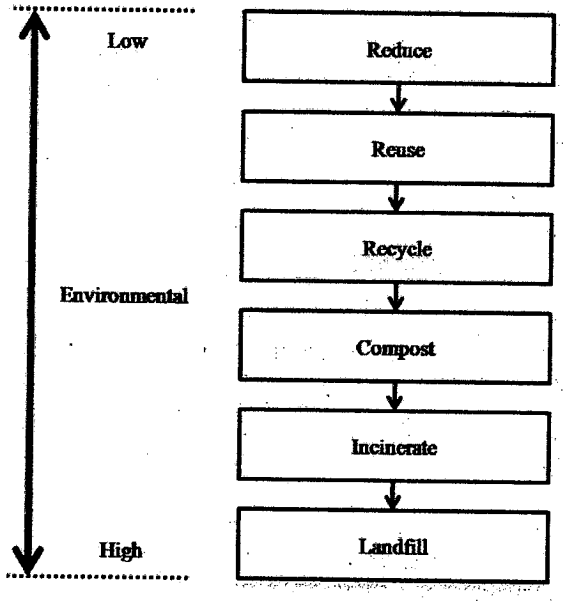

Figure 2.2: Hierarchy of construction and demolition waste (Peng *et al.*, 1997).

Recycling, being one of the strategies in minimization of waste, offers three benefits (Edwards, 1999):

a. Reduce the demand upon new resources
b. Cut down on transport and production energy costs and
c. Use waste which would otherwise be lost to landfill sites.

2.2 DEFINITION OF CONSTRUCTION WASTE

The waste building materials, packaging, and rubble resulting from construction, remodeling, repair, and demolition operations on pavements, houses, commercial buildings, and other structures.

(U.S. Environmental Protection Agency (USEPA)

Waste is defined as the by-product generated and removed from construction, renovation and demolition workplaces or sites of building and civil engineering structure.

(Cheung, 1993)

Waste is defined as any material by-product of human and industrial activity that has no residual value.

(Serpell and Alarcon, 1998)

Solid wastes can be defined as all wastes in solid form which are discarded as useless or unwanted and in general arise from human activities. Construction wastes are wastes generated from building, demolition and refurbishment works for individual housing, commercial building or other structures.

(Peavy *et al.*, 1985)

Solid waste is defined as those wastes from human and animal activities. Wastes accepted by public authorities for ultimate disposal, including hazardous waste, liquid-solid sludge from industry and water/waste water plants are within this definition. Solid

waste can be classified as municipal waste (e.g. paper, plastics, food wastes, ashes, and special wastes such as street sweepings, dead animals etc), industrial waste (e.g. timber, demolition and construction waste, treatment plant waste, hazardous waste, etc) and hazardous waste (e.g. radioactive substances, chemicals, biological waste, flammable waste, explosives etc.).

(Kiely ,1997)

2.3 DEFINITION OF MANAGEMENT

Working with and through other people to accomplish the objectives of both the organization and members.

(Patrick J Montana, Bruce H Charnov)

The art of getting things done through people.

(Mary Parker Follet)

Management is both art and science. It is the art of making people more effective than they would have been without you. The science is in how you do that. There are four basic pillars: plan, organize, direct, and monitor.

(F. John Reh)

2.4 DEFINITION OF RECYCLING OF CONSTRUCTION WASTE

Construction waste recycling is the separation and recycling of recoverable waste materials generated during construction and remodeling. Packaging, new material scraps and old materials and debris all constitute potentially recoverable materials. In renovation, appliances, masonry materials, doors and windows are recyclable.

(A Sourcebook for Green and Sustainable Building)

The waste building materials, packaging, and rubble resulting from construction, remodeling, repair, and demolition operations on pavements, houses, commercial buildings, and other structures."

(The U.S. Environmental Protection Agency (USEPA)

2.5 CONSTRUCTION WASTE GENERATION

Throughout the life cycle of a construction project, there are a number of factors leading to the production of wastes (Graham and Smithers, 1996), which are summarized as in Table 2.1. The implications of the five phases, namely, design, procurement, materials handling, construction / renovation, and demolition, to the waste generation are described by Graham and Smithers (1996) as follows.

Project Phase	Causes of Waste
Design	Plan errors Detail errors Design changes
Procurement	Shipping error Ordering error
Materials Handling	Improper storage Deterioration Improper handling (on-site or off-site)
Construction/Renovation	Human error Tradesperson Other labour Equipment error (e.g. catastrophe, accident and weather)
Demolition	Tipping

Table 2.1: Causes of waste in different project phase

2.5.1 Design

Carelessness at the design stage can lead to the excessive cutting wastes and create a shortage of materials on site. Architectural design and rare standard formwork and components can also greatly affect the constructability and assemblies of a building. Plan errors or incomplete details, as a result of time constraint, can also cause variations that require input of additional materials.

2.5.2 Procurement

Faults in taking-off, unfinished detailing and small quantity of materials required in renovation work are the main cause of over-ordering. Lack of care during transportation will also result in material damage.

2.5.3 Handling

Lack of confined space always causes storage problem of materials. Consequently, waste results from bad stacking, rusting of steel, damage and aging of formwork, etc.

2.5.4 Construction / Renovation

Construction of civil engineering works are followed after project planning and design. It is subdivided into four major phases (Abdul Hakim Muhammad, 1996):

a. Preliminary works
b. Site preparation
c. Construction of project
d. Building facilities