MANAGING OF SOLID WASTE ON CONSTRUCTION SITE

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ABSTRACT

Construction solid waste is a waste in solid form which is defined as useless or unwanted. It generated from building construction, demolition and refurbishment works. It has become as one of major environmental problems faced by the most municipalities. This paper based on study that has been conducted which involves types of solid wastes and factors that contribute to the waste on construction site. This study also focused on method used in managing solid waste on site. Two (2) methods have been used to achieve the objectives of this study which are questionnaire and interview. 34 respondents who are from construction company and local authorities in Pahang gave their feedback by answering the questionnaires. Data from questionnaire have been analyzed using average index (AI). Interview through site visit is carried out in Pekan, Pahang. It is done to get further information about methods used in managing waste on site. In conclusion, types of solid waste, factors contribute to waste on site and methods of managing solid waste have been identified. This study found that there are 8 types of construction waste on site such as concrete, asphalt, wood or timber, glass, plastic, metal or steel, roofing and brick or block. There are several factors contribute to waste on site such as lack of recycling facilities within the study region, mishandling, weather, inadequate storage, lack of communication between leader and worker, design changes, vandalism, ordering error, role of project manager and low quality material. The study result also shows the popular method choose by respondent to handle the solid waste which is dispose it and this is followed by reducing, recycling and reuse method.

ABSTRAK

Sisa pepejal binaan merupakan sisa yang terdiri dalam bentuk pepejal dan boleh ditakrifkan sebagai bahan yang tidak berguna atau tidak diperlukan. Ia terhasil dari kerja- kerja pembinaan, penghancuran dan pembaharuan bangunan. Sisa pepejal binaan telah menjadi satu masalah yang menyumbang kepada pencemaran alam sekitar. Kajian yang dijalankan ini berkaitan dengan jenis-jenis sisa buangan di tapak bina dan faktor yang menyumbang kepada wujudnya sisa buangan ini Kajian ini juga lebih tertumpu kepada langkah-langkah pengurusan sisa pepejal di tapak bina. Kajian hanya tertumpu kepada syarikat - syarikat pembinaan dan penguatkuasa tempatan di daerah Pahang. Dua (2) kaedah telah digunakan untuk menjayakan kajian ini iaitu melalui borang soal selidik dan temubual. Sebanyak 34 responden memberi maklum balas dan data yang diperoleh daripada kajian soal selidik telah dianalisis menggunakan indeks purata. Temubual melalui lawatan tapak dijalankan di daerah Pekan, Pahang. Ini bertujuan untuk mendapatkan maklumat dengan lebih lanjut daripada kontraktor-kontraktor yang berpengalaman di tapak bina. hasil kajian mendapati terdapat 8 jenis sisa pepejal di tapak bina iaitu konkrit, asphalt, kayu, gelas, plastik, besi, atap dan batu bata. Terdapat beberapa faktor yang menyumbang kepada berlakunya pembuangan sisa di tapak bina iaitu kurang prihatin terhadap kitar semula bahan, kecuaian pengendalian bahan, cuaca, penyimpanan bahan yang kurang sempurna, kurang komunikasi antara pekerja dan ketua, vandalisma, kesilapan dalam penempahan bahan, peranan pengurus projek dan bahan yang kurang berkualiti. Hasil kajian turut menunjukkan bahawa melupus atau membuang terus sisa merupakan langkah pengurusan sisa pepejal yang paling kerap diamalkan dan diikuti oleh pengurangan penggunaan bahan dan langkah seterusnya ialah mengamalkan kitar semula sisa buangan serta mengguna kembali sisa pepejal binaan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Construction sector is one of the main element factors that influence an economy in countries. Construction industry provide many job vacancies in many fields from professional to general workers and it giving highly profit to many parties along the construction in progress. High quality and in the same time giving profit to all parties are two important factors to ensure the improvement in construction industry. These objectives can be achieved by having the effective management system in all elements that involve in a construction project.

Material management is one of the major elements that need to give highly priority along the construction period in order to complete the project and achieve best profit margin.

Construction companies benefit by reducing the waste generation in number of ways, including reducing transportation and landfill deposition costs and the purchasing costs of virgin materials. Solid waste management is concerned with the generation, on site storage, collection, transfer, transportation, processing and recovery and disposal of solid waste (John Pitchtel, 2005).

Construction material is one of the most important elements that directly involved during design and construction phase. Therefore, if the material is not well managed, it will affect the quality of finish product (structure). In the same time it also may cause the failure to the structure.

Waste production on construction site may result from a lack of attention to the size of the products used, lack of interest of contractors and lack of knowledge about construction during design activities. Wastes on construction site can include concrete, asphalt, wood, metals, gypsum wallboard and roofing. Therefore, material management with systematic and holistic practice will maximize the revenue to the project in terms of time, human recourse and cost.

1.2 Problem Statement

In Malaysia, 16,000 tones of solid waste produced in the country everyday. There are about 230 landfills in Malaysia and an estimated three (3) times as many illegal dumps. 80% of the landfills have an estimated remaining lifetime of only two (2) years (Agamuthu, 2003).

Based on article obtained from seminar on construction waste management that was held at Renaissance Palm Garden Hotel, Putrajaya on 26th March 2003, "Around the world, construction and demolition (C&D) debris frequently make up 10% - 30% of the waste received at many landfill sites. In Malaysia, solid waste as one of the three major environmental problems faced by the most municipalities. As the construction industry builds, it generates lot of construction waste which contributes a greater portion of solid waste in Malaysia. The construction industry has a substantial impact on the environment. This industry is responsible for producing a whole variety of different wastes, the amount and type of which depends on factors such as the stage of construction, type of construction work and practices on site. In Malaysia, the data and study on construction waste is still lacking".

Basically, in construction project, contractor will give full attention to make sure the construction will finish before the end date without any delay to earn profit. However, to those who are careless in managing waste or did not know how to choose a suitable method in handling waste can causes material wasting. Therefore, construction company or contractor should be able to identify a preferable and suitable method in handling waste to prevent a waste material.

1.3 Objective

There are three (3) objectives have been discussed and determined in order to realize the purpose of this study. The objectives are:

1.3.1 To identify types of construction solid waste on site.

1.3.2 To identify factors contribute to the waste on site.

1.3.3 To analyses the method used in managing solid waste on construction site.

1.4 Scope of Study

The scopes of study have been determined in order to facilitate the literature study by focusing on certain field and specific. This study is focused on managing of solid waste management on construction site.

This study covered road and building construction project. A set of questionnaire have been prepared and interview session have been conducted with people from construction companies and local authorities in Pahang area. Site study has been carried out in area of Pekan, Pahang.

1.5 Methodology

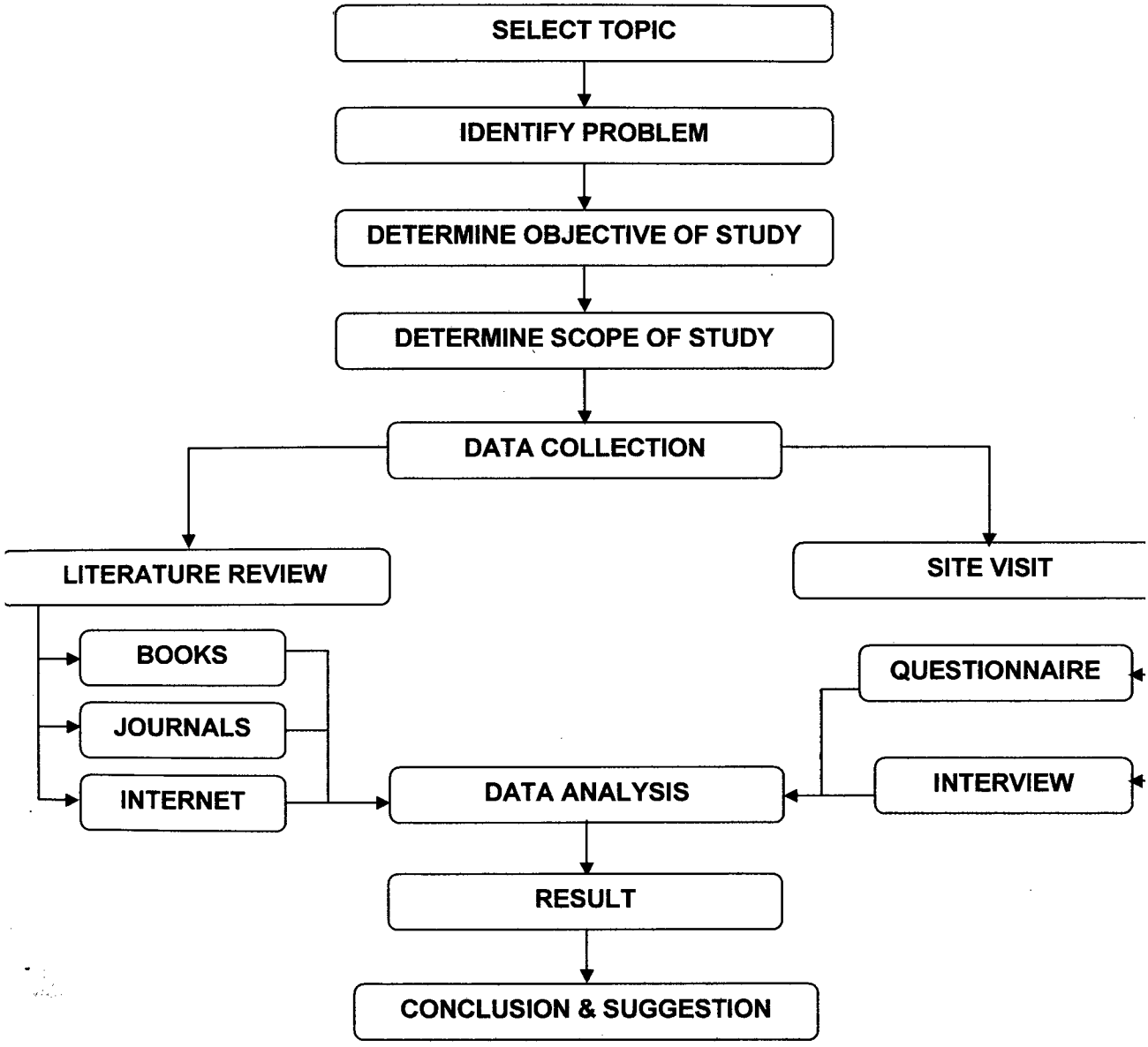

Figure 1 Study Methodology

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Construction materials have usually been obtained from primary sources, but there are many millions of tones of waste material and industrial by products that are potentially capable of satisfying a substantial proportion of industry's demands for aggregates, fill materials and other construction materials.

Solid waste includes all waste material incidentals to the construction or building also demolition industries. As well as waste materials, it can include dredging materials, tree stumps and rubble including pavements

2.2 Definition

2.2.1 Waste

Definition of waste comes from the EC (European Council) Framework Directive which implies that waste is any material where the holder has an intention to discard the material as no longer part of the normal commercial cycle or chain of utility. The Environmental Protection Act 1990 (EPA 90) Section 75 defines waste as:

a) Any substance which constitutes a scrap material or an effluent, or other unwanted surplus substance arising from the application of any process

b) Any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled, but does not include a substance which is an explosive within the meaning of explosive act 1875

c) Anything which is discard or otherwise dealt with as if it were waste, shall be presumed to be waste unless the country is proved

Construction and demolition waste are the most prolific sources of fly –tipped waste, so any exemptions in a definition of waste must be safely distinguished to stop uncontrolled fly-tipping.

2.2.2 Solid Waste

Solid waste 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 (Peavey *et al.*, 1985).

Solid waste is a solid material possessing a negative economic value, which suggests that it is cheaper to discard than use. Volume 40 of the U.S Code of Federation Regulations (40 CFR 240.101) defines a solid waste as garbage, refuse, sludge, and other discarded solid materials resulting from industrial and commercial operation and from community activities. It does not include solids or dissolved material in domestic sewage or other significant pollutant in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluents, dissolved material in irrigation return flows or other common water pollutant (John, 2005).

2.2.3 Solid Waste Management

Proper solid waste management addresses the collection, handling, and disposal of trash at the construction site. Solid waste is as varied as its many names, and before one can properly manage solid waste one must be able to identify trash and its sources.

Solid waste management is concerned with the generation, on site storage, collection, transfer, transportation, possessing and recovery, and ultimate disposal of solid waste (John, 2005).

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to storm water from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors (John, 2005).

2.2.4 Waste Minimization

Waste minimization is the process and the policy of reducing the amount of waste produced by a person or a society. It is part of the wider aim of waste reduction which is often described as a component of the waste hierarchy.

In the waste hierarchy, the most effective policies and processes are at the top. Waste minimization is also strongly related to efforts to minimize resource and energy use. For the same commercial output, usually the fewer materials are used, the less waste is produced. Waste minimization usually requires knowledge of the production process, cradle-to-grave analysis (the tracking of materials from their extraction to their

return to earth) and detailed knowledge of the composition of the waste (Velma I. Grover et al, 2000)

2.3 Types of Construction Wastes

Components of solid waste in construction can include concrete, bricks, tiles, ceramics, asphalt, wood, glass, plastic, metals, gypsum board, roofing, and mixed construction and demolition waste (Paul, 2005).

The importance of the construction waste management is illustrated by the data. Identification of the composition of waste is also relevant for an efficient waste management process due to the amount of waste that is reusable or recyclable. Examinations of construction waste composition in Europe and the United States have yielded data summarized in Table 1 (Hettiaratchi et al., 1997).

Table 1: Composition of Construction and Demolition Waste (Hettiaratchi et al., 1997)

Construction and Demolition (C&D) Waste Category	Composition (by weight) Percentage %			
	Spencer (1991)	Bossink & Brouwers (1996)	AEP (1995)	CH2M Hill (1992)
Asphalt	46			
Concrete	14	13		70
Metal	5		7	6
Wood	26		35	13
Clay stone tablets		29		
Concrete and wood piles		17		6
Clay bricks		14		
Clay roof tiles		10		
Cement mortar		8		
Paper / cardboard packing material		7	8	
Rubble, aggregate and ceramics including concrete			24	
Building materials including gypsum board			17	2
Glass			3	
Plastic			2	
Other mixed C&D waste	9	2	4	3
Total	100	100	100	100

2.3.1 Concrete

Concrete is the most widely used material for building structures. Concrete wastage mainly results from excess quantity of ready mix concrete. There are variations and errors in calculating the quantity of needed concrete because of improper planning or poor communication, which results in over-ordering. A certain amount of concrete

wastage also occurs during transportation, in which it may settle over a long period and cannot be used for construction activities. Because of the congested traffic in Hong Kong, one of the interviewed project managers explained that their concrete wastage due to the settlement of long transportation time affected around 1.5% of the total mixed concrete materials, which is a quite significant issue; however, it is difficult and nearly impossible to control the transportation system in Hong Kong. Furthermore, significant concrete wastes involve difficult waste handling processes, which request significant labors hours and time. Poor formwork may also cause wastage of concrete (Vivian *et al.*, 2005).

Concreting is a major building process and most of the work was made from ready mixed concrete. Dry wall is generated by light weight concrete. Concrete material loss attributed to excessive material ordering, broken formwork and redoing due to poor concrete placement quality. An investigation on the material wastage level in Netherlands, 13% of the concrete material was wasted and most of it was lost through scraping off and through transportation (Bossink and Brouwers, 1996)

80.6% of waste concrete which formed 6.7% of the waste stream after raining was recycled at a concrete crushing plant and used for road base (McDonald and Smithers, 1996)

2.3.2 Asphalt

Old asphalt materials are crushed for recycling as asphalt aggregate, mixed with sand binder. The binder can be either cement or liquid in the form of a bituminous emulsion; a combine of cement and a liquid binder are used as well. Asphalt aggregate can also be stabilized with blast furnace slag or fine slag. Only a limited proportion of asphalt can be reused in highly pervious road surface, as the composition of these mixtures is highly critical. Asphalt shingles are shredded and reduced in size with hammer mill and nails and other ferrous material are removed magnetically. The final material is screened. Several recycling technologies in recycling asphalt material (Hendricks and Pietersen, 2000).

2.3.3 Wood / Timber

Another major building material used is timber board. The main causes of timber wastage include the natural deterioration resulting from usage and cutting waste, and both are difficult to avoid. Timber wastage can be significant without proper management. According to the survey by Shen et al.2003, the wastage of timber materials can be as high as 20% of the total materials during foundation works (Vivian *et al.*, 2005)

Wood or timber waste makes up 40 to 50 percent of what comes off a residential jobsite. Ground-up wood can be used for mulch, composting, animal bedding, landfill cover, as an industrial fuel source, and in "new" building products (Skoyles and Skoyles, 1987).

Majority of timber waste was generated from formwork with a smaller quantity resulted from cutting timber for internal finishing and fittings. In the case of formwork, most of the timber materials delivered to site would eventually be discarded as waste after several reuses (Jaillon and Poon, 2003).

2.3.4 Glass

In 1997, the glass industry recycled 425 tones of glass in the United Kingdom. Glass can be reused in the construction industry for number of application like window, glass fibre, filling material, tile, paving block, asphalt in road, and aggregate in concrete (Coventry,1999).

2.3.5 Plastic

Almost every material and product delivered to site is protected by plastic material. Minimize waste of vinyl siding, flooring and countertop materials by ordering only quantity needed.

2.3.6 Metals / Steels

Metal formwork and reinforcement are formed by steel material. Off-cuts from steel reinforcement and metal studs were recycled easily and formed 8.5% of the waste stream of which 100% was recycled. More management attention was given to the steel material that have a significant impact on the project cost because steel is relatively expensive compared to other construction materials (Federle, 1993).

Steel reinforcement bars are commonly used materials in building construction. The main cause of steel wastage is cutting. Damages and rusting during storage also form a major part of steel wastage (Vivian *et al.*, 2005).

2.3.7 Roofing

Roof tiles are normally wasted in a non-consequent process, affected by different stages of construction sequences. The sizes of the materials may not match what is specified in the design due to poor coordination and communication. Sometimes, wastes occur in the application to these specific sized areas. Furthermore, during transportation, tiles can be easily cracked, thus more attention should be paid in delivering these materials (Vivian *et al.,* 2005).

2.3.8 Bricks and Blocks

Brick and block are the most common walling materials. The main cause of these wastes is by cutting. In the case of unpacked supply, wastage can also be induced due to damages to these fragile materials. On the other hand, unused bricks left on site may end up in the trash skip ultimately, and such wastes can be significant in those projects where a material planning is poor (Vivian *et al.,* 2005).