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CASE STUDY: WASTE MATERIAL MANAGEMENT FOR HOUSING PROJECTS AT PORT DICKSON

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Abstract

Waste material management is very important at the construction site. This waste material management study was conducted around the housing construction projects at Port Dickson. The purposes of this study are to identify the types of waste materials commonly found in housing construction project, identify problems encountered in the management of waste materials in housing construction project and proposed methods of improving waste management of waste material in housing construction projects. All information and data for this study were obtained from the distribution of questionnaires and interviews with respondents. Statistical analysis methods i.e. average index and frequency are used to analysed and obtain results. Based on the results of the study finding that the waste of construction materials generated and often disposed of, especially in the construction site area is concrete, brick, wood, soil and mortar. The next method of improvement that shows the highest frequency is the method of controlling material stock to avoid ordering of excess material and improving knowledge about waste management. This shown that the waste management system of waste materials is very important in controlling the occurrence of waste and can avoid the problem of loss on the housing construction project. The conclusion of this study shows that there are five types of waste building materials that are often generated at the housing construction site. This study also shows the contractors were practice the best way in disposing of construction waste.

Key-word: -Waste Management, Waste Category, Waste Management Method

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1. Introduction

The construction industry sector is now rapidly developing in line with the success achieved in Malaysia. The construction sector is one of the important sectors and can influence the economic development of a country because of its ability to provide employment opportunities in various fields and the involvement of various parties involved in construction-based transactions which will generate the national economy. The Malaysian Construction Industry Development Board (CIDB) is of the view that the construction industry will continue to grow rapidly.

This statement was made based on the increasing demand for housing, transportation, education, water supply and so on. Therefore, construction waste and waste such as mortar, wood, cement, bricks and other waste products are also the result of housing construction activities which are increasing in demand. Along with the growth of this industry, the rate of waste materials is also increasing. Although construction is gaining momentum, the management of waste materials is very weak. Indirectly the problem of waste materials is the concern of the government and society. However, without realizing it, the construction sector is one of the sectors that contribute to environmental pollution when the construction waste is not managed properly such as being dumped everywhere illegally. This is due to unsystematic management, impractical and not emphasized by the contractors involved. The contractor must meet the regulations of the local authority which involves construction work, especially the management of building material waste. Contractor organizations in particular must also be skilled and trained to manage building material waste.

Significant growth in the construction industry is a serious problem for most developing countries. Construction material waste is due to the material handling stage, design work, operation and procurement (Sakawi, 2017). Waste building materials have a direct impact on productivity, loss of time and materials (Mastura, 2011). Physical waste contributes to most landfills and studies show that almost 26% of landfills are filled with construction waste. According to Tahir, (2019) emphasis should be given to minimizing construction waste where the construction industry produces a large amount of waste of building materials which is about four times more than what is produced at home and more than 50% dumped at landfills.

Therefore, to avoid this waste disposal culture, construction practitioners and researchers need to know the causes and factors of the construction waste. The factors that contribute to generate of construction waste are various. Khairulzan Yahya, 2006 stated that building waste refers to building materials from construction sites that have been used or not used for any reason. According to JPSPN (2013), states that construction waste is diverse where it depends on the size of the construction project and geological form as well as contains unwanted materials that can affect the environment. Examples of building materials waste include ferrous or non-ferrous metal, soil, stone, sand, cement, brick, concrete, asphalt, bitumen, wood, plaster, plastic, paper and hazardous materials such as paints and lacquers.

In Malaysia, most contractors pay less attention to waste management and construction waste for example for housing projects, construction waste such as concrete and excess land dumped on the side of the road and in the built area. In fact, there are a few who often take the easy way out by throwing the waste in a remote place and away from the public view. This is an unethical act and can harm all parties, especially for the community around the construction area, especially the locals.

This waste and construction waste if not managed properly will not only cause environmental pollution but will also make it difficult for the construction management itself. For example, building materials such as excess cement and concrete if discarded and left alone will cause serious problems because the building materials are easily hardened. In addition, without good and systematic management, construction costs will increase because the contractor suffers losses such as over-ordering the number of materials used at the construction site and causes an increase in accidents that occur at the construction site due to negligence in handling construction waste materials. Therefore, if the management of waste and construction waste for this housing construction project is not taken seriously by all parties, then it is feared that it will create a culture and negative attitude towards some parties in managing waste and floods.

1.1 Objective of Study

This study was conducted to achieved these objectives:

- a) Identify the types of waste materials commonly found in housing construction projects.
- b) Identify problems encountered in waste management of waste material's in housing construction projects.
- c) Proposed methods of improving waste management of waste material's in housing construction project.

1.2 Scope of Study

This study focuses on common types and materials of construction waste for housing construction projects and problems encountered in waste management as well as suggestions for improving waste management to contractors. Its importance is to create a systematic, orderly and practical waste management and waste management as well as reduce the waste of building materials. The study was conducted in a residential construction area around Port Dickson.

2. Literature

Waste materials are defined as waste and surplus construction which is no longer used whether in construction, structural repairs and demolition work of houses, buildings and other structures. Waste and excess material from dredging material and tree stumps from construction, excess dredging soil and so on. Any solid waste generated from construction or demolition activities including development, preparation, repair or alteration work. For example, brick, cement, wood, iron and so on. New construction area, renovation or demolition of buildings and so on. In addition, construction waste and waste also refer to soil, mortar, concrete and plant material removed during or after soil levelling or construction work is carried out. Activities construction waste due to design changes, cutting and embankment processes as well as excess ordering of building materials. Excess materials and not used in construction, repair and demolition of structures are categorized as waste. According to Siti Khatijah, et al (2014) classify the source of waste and construction waste is concrete, mortar, soil, wood, metal, ferrous, rubber, plastic, glass, mortar and hazardous construction waste.

Nowadays the problem of waste management and building materials has become a global problem. This problem is no longer an easy task under the responsibility of local authorities and the government, but it has become a problem with every community, especially developers and contractors (Aslina Ismail, et al (2015). Economic development will lead to increased construction activities and increase the amount of construction waste generation in this country (Seow, 2006). This increase causes serious problems at the local and national level. This waste problem can be categorized into two groups, namely at the construction and national activity level. Involves contractor problems by affecting profits and revolves around the environment such as waste management and waste disposal on site are problems that arise to the country.

Seow (2003) states that construction waste management can be defined as a waste management method that covers from every aspect from generation to disposal stage. Proper management of construction waste can reduce disruption to humans, animals and the environment in the area. The stages in waste management are the stages of waste generation, storage, collection, transfer and transportation, processing and disposal. While according to Muhammad Tahir, et al (2019) stated the elements in construction waste refer to construction waste production, control and segregation, collection, transportation and delivery, segregation, processing and transformation of construction waste and landfills. Each of these elements has its own way of control and its own way. Meanwhile, according to the Construction and Demolition Waste Management Guide (2006) states that there are six options hirerki construction waste management system namely waste reduction, reuse, recycling, composting, combustion and disposal.

Waste management is a process where waste generation reduction is done by adopting several internal management practices in a planned manner that is planning and controlling the purchase of building materials in advance, training staff or employees in managing building materials well on the construction site, supervision by engineers to ensure work construction and materials used properly to avoid wastage.

3. Methodology

This research is a quantitative and descriptive study. Primary data collection is through the distribution of questionnaires and interviews to respondents in the study area. The main source of information and data related to building waste at the landfill is obtained through the National Solid Waste Management Department, SWCorp and CyPark Smart industries Sdn. Bhd. The total sample is 10 housing project areas around Port Dickson. Sampling procedure is probability sampling with random selection of respondents. The selection criteria of the respondents are based on the main feature that is the respondents are contractors or housing developers in the study area. Data were analysed using statistical formulas i.e. average index and frequency.

4. Findings

This chapter discusses the data that has been obtained while making the questionnaire. All data collected will be analysed in the form of tables, diagrams, pie charts, graphs and so on.

4.1 Identify the types of waste materials commonly found in housing construction projects

The status based on the average index for each frequency of waste materials generated at the construction site refers to the average index table as below.

Table 1: Average Index (P.I)

Frequency value	Status	Average index (P.I)
1	Very infrequently	$1.0 \leq P.I \leq 1.5$
2	Not often	$1.5 \leq P.I \leq 2.5$
3	Usually	$2.5 \leq P.I \leq 3.5$
4	Often	$3.5 \leq P.I \leq 4.5$
5	Very often	$4.5 \leq P.I \leq 5.0$

Based on Table 2 shows the average value of the index for building material waste generated at the construction site.

Table 2: Waste Material on Housing Project

Waste Category	Average Index	Status
Concrete	4.25	Often
Brick	4	Often
Wood	4	Often
Soil	3.7	Often
Mortar	3.5	Often
Ferrous Metals	3	Usually
Steel	2.75	Usually
Latex	2.5	Not often
Plastic	1.28	Very infrequently
Glass	1.44	Very infrequently
Chemicals (Dangerous Waste)	0.8	Very infrequently

Based on the information obtained from the questionnaire, all the building materials listed are concrete, brick, soil, steel, ferrous and non-ferrous metals, rubber, plastic, mortar, glass and hazardous waste. As a result of the information obtained, there are 5 types of waste materials that are most frequent and commonly wasted and discarded during the process and after the construction process, namely concrete, brick, wood, soil and mortar. There are five types of building material waste that are often found on construction sites. The rest of the construction is concrete, brick, wood, soil and mortar.

Referring to the average index that has been analysed, it is found that the highest index value is concrete which is 3.04 and the least generated at the construction site is hazardous waste with an average index value of 0.8. These values are obtained from the calculation of the average index using the formula below,

$$\text{Average Index, PI} = \frac{\sum a_i x_i}{\sum x_i}$$

4.1.1 Percentage of Common Waste Materials on Housing Projects

In general, the most common types of building materials found on construction sites are concrete, brick, wood, soil and mortar. Based on the questionnaire given to the respondents in the study area, it was found that the results of the questionnaire answered by the respondents showed that:

Table 3: Percentage Common Type Waste Material

No.	Waste Material Category	Finding of Percentage
1.	Concrete	Most respondents say that concrete is the main material. As many as 80% of the respondents chose scale 5 and 20% chose scale 4. For the percentage value for scales 1, 2 and 3 is 0%. This shows that concrete is a composite material that is often used in construction and based on the analysis obtained, concrete is a type of construction waste that is categorized as often dumped at construction sites.
2.	Brick	As a result of the questionnaire conducted, the percentage for scale 4 which is 50% shows the highest compared to scales 3 and 5 with 25% respectively. 0% indicated that none of the respondents voted for scales 1 and 2. Bricks are 4-sided building materials and are made of hard and rigid inorganic materials. Based on data analysis, bricks are often generated and dumped at construction sites.

3.	Wood	The results of the questionnaire show that the percentage for scale 4 is 50% higher than the scale of 3 and 5 with the same value of 25%. While for scales 1 and 2 show a value of 0%. Based on interviews, wood is commonly used for roofing. Based on the analysis of wood is also often generated and disposed of at construction sites.
4.	Soil	The percentage values for scale 1 and scale 2 are the same at 25%. As many as 50% of the respondents chose scale 3. Scale 4 no respondents i.e. 0%. According to the respondents, the excess land that is not used will be used as reclamation work in low-lying areas to be similar to the road level.
5.	Steel	The percentage for scale 2 is higher at 75% compared to 25% for scale 5 chosen by the respondents. While scales 1 and 3 show 0%. Based on the interview, steel is a waste of building materials that will not be disposed of. According to respondents, damaged or unused steel will be resold because the waste of this building material has a high price value and can reduce waste.
6.	Ferrous Metals	The percentage of respondents who chose scale 2 is high at 50%. While the respondents who chose the scale of 3 and 5 respectively are 25%. For scales 1 and 4 show 0%.
7.	Latex	The percentage of respondents who chose scales 1, 2, 3 and 4 is 25% respectively. While 0% for scale 5. This shows that the use of rubber on construction sites is small.
8.	Plastic	The percentage of respondents who chose scale 1 is 75%. While 25% were respondents who chose scale 2. None of the respondents chose ska 3, 4 and 5. This indicates that plastic is not a waste of building material critical at the construction site due to low use.
9.	Mortar	The percentage of respondents who chose scales 1, 2,4 and 5 was 25% respectively. While 0% for scale 3. This shows that mortar is also a building material that is often used on construction sites and can contribute to the rate of material waste.
10.	Glass	The results of the questionnaire found that the respondents chose scale 3 as 75% and others chose scale 1 which is 25%. This shows that glass is also often used on construction sites as an important material.
11.	Chemicals (Dangerous Waste)	The percentage of respondents who chose scale 2 is 75% compared to scale 1 which is 25%. While the scales 3, 4 and 5 are 0%. This indicates hazardous waste is not and is rarely used in construction sites.

4.2 Proposed methods of improving waste management of waste materials in housing construction project.

There are 12 methods that can be done by the responsible stakeholder to overcoming the problem of waste and waste generated. Granting status for each frequency is based on table 4 below:

Table 4: Average Index

Frequency value	Status
5	Very good
4	Good
3	Medium
2	Low
1	Lowest

Next, the average points earned will be used to determine the level of importance for each effective method used. Table 5 shows the analysis findings obtained from the questionnaire.

Table 5: Average Index

Status	Average Index (PI)
Very Good	$4.5 \leq P_i < 5$
Good	$3.5 \leq P_i < 4.5$
Medium	$2.5 \leq P_i < 3.5$
Low	$1.5 \leq P_i < 2.5$
Lowest	$0.0 \leq P_i < 1.5$

Table 6 shows that the method of controlling material stock to avoid excessive material ordering and the method of improving and enhancing the workforce knowledge of waste management is a high choice of respondents i.e. each average value of the index is 3.52. Methods of promoting construction waste of construction waste are considered to be the lowest with an average index of 1.44. In addition, the method of providing finance for construction waste management work and fines for severe waste management shows a value of 2.56 while the collection method for construction waste disposal and reuse work is in the middle class with an average index value of 2.88. The recycling method is in moderate status and the average index value reading is 2.72 similar to the method of appointing subcontractors who specialize in waste management and delivery strategies.

Table 6: Improvement of WASTE Materials Management System.

No.	METHODS	Average Index	Status
1	Provide financial allocation for construction materials waste management work.	2.56	Medium
2	Provide a collection point for disposal work for housing material waste	2.88	Medium
3	Recycle waste material on housing construction site	2.72	Medium
4	Reduce the level of waste production of housing materials.	2.72	Medium
5	Reuse of housing materials waste.	2.88	Medium
6	Encourage the accumulation of waste materials on housing project constructions.	1.44	Lowest
7	Burning the remaining built-in waste materials.	1.92	Low
8	Control material stock to avoid ordering of excessive materials.	3.52	Good
9	Appoint subcontractors who specialize in waste management.	2.72	Medium
10	Improve and increase the knowledge of the workforce about managing residuals.	3.52	Good
11	Impose fines for severe and weak waste management.	2.56	Medium
12	Delivery strategy	2.72	Medium

Based on the analysis of data from the information obtained there are 5 methods that have the highest average index value which is the method of controlling material stock to avoid excessive material ordering, improve and improve the workforce knowledge of construction waste management, provide a collection point for construction waste disposal work, reduce the level of production of building material waste and recycle building material waste.

It was found that many respondents agreed that the method of controlling material stock for the detection of excess material and improve as well as increase the knowledge of employees on the management of waste materials due to high average index readings. Indirectly the contractor can control and reduce waste of materials and materials.

4.3 Identify problems encountered in waste management of waste material’s in housing construction projects.

Referring to the questionnaire Part C.

The first question is whether there are problems encountered in managing the waste of building materials throughout the project? 22% of respondents who have problems managing building waste. While 78% of respondents stated that they did not have any problems where the construction waste dumps. The second question is doing the company get financial allocation for waste management of building materials from the authorities? Respondents gave the same answer that 100% no financial allocation was received.

The third question asked to the respondents is whether the absence of clear legal provisions from the authorities is the cause of the problem of waste management of building materials occurs at the construction site? Based on the information received from the respondents shows that 100% of the respondents stated no. This indicates that the waste management is already aware that the authorities have put in place a law or act that describes the waste management of building materials. Among the parties responsible for waste management is the Solid Waste Management and Public Cleansing Corporation (PPSPPA).

5.0 CONCLUSION

Systematic waste management of building materials is very important for a construction project. As is well known, any waste generated can cause the company to suffer losses if this problem is not addressed immediately and preferably. Therefore, the management hierarchy method is introduced in overcoming the problem of waste management of building materials.

5.1 Hierarchy Management Methods

Based on the information obtained, waste management of building materials at the construction site can be overcome by following the correct method. Figure 1 below shows the stages that can be practiced and followed in the building material waste management system.

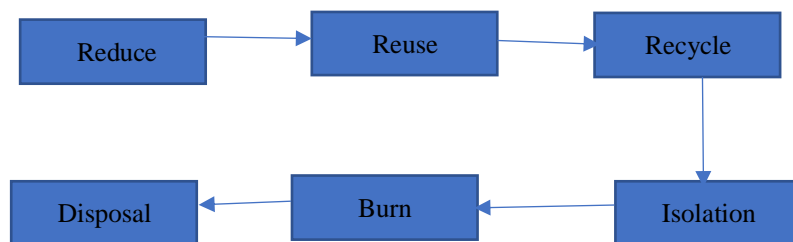


Figure 1: Waste Management Hierarchy in Construction and Demolition (source: adapted from Tchobanoglous, 2003)

Based on the diagram, shows the 6 main stages in the construction material waste management system in a systematic construction site. These stages are waste reduction, recycling, recycling, segregation, combustion and disposal. Where, significant reductions in ensuring the production of surplus waste and construction waste at the generated construction site can be reduced. Usually, the contractor states that a lot of building material waste is generated due to the negligence of workers working on the construction site.

For the first objective which is, to identify the types of waste building materials that are commonly found in construction sites, especially residential project areas, the study found that there are eleven types of waste that are often generated and disposed of. The data obtained after analysis shows 5 types of waste building materials that are often generated and disposed of, namely concrete, brick, soil, wood and mortar. Objectives are achieved because each factor discussed for waste management of building materials has been obtained by knowing 5 types of waste building materials that are frequently generated and disposed of at construction sites.

Based on the results of data analysis obtained, the second objective of the study can also be achieved which is to be able to identify problems faced in waste management of building materials. While the objective of the last study, which is the method of improving the waste management of building materials shows that the method of providing landfills, recycling, reuse, controlling the material ordering stock and improving and improving employees' knowledge of building waste management is in a good class.

Recommendations obtained to improve a few things related to the management of building waste at the construction site are:

- i. Using more advanced and efficient technology in the construction sector to reduce waste of building materials on construction sites such as the use of IBS.
- ii. Contractors need to train workers in handling building materials to avoid wastage and frequent material damage.
- iii. Every method in management to reduce waste can be practiced to be more efficient.

Therefore, all the problems encountered can be solved well.

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