

# The Practice of Construction Waste Management in Penang Island

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**Abstract**—Construction industry contributes to the municipal waste. Unsystematic construction waste management has led to environmental pollution especially in Penang Island, Malaysia. The main objective of this paper is to study the construction waste management practices in Penang Island. This paper employs various methods including semi-structured interview, questionnaire survey and observation. The scope of this study is around Penang Island. The respondents in this study include 20 contractors registered under Class A, B and C in Contractor Services Centre (PKK) located in Penang Island and an Engineering Department officer from Penang Island Municipal Council (MPPP). The results show that contractors and the Municipal Council in Penang Island practiced reuse, recycle and reduce, but the percentage of disposal is quite high in Penang Island. In order to reduce environmental pollution in the island, contractors and the parties involved must manage construction waste systematically.

**Keywords**—construction waste, management, island

## I. Introduction

Unsystematic construction waste management has led to environmental pollution especially in Penang Island. Construction waste has caused an impact on the environment. The construction industry uses large quantities of raw material and contributes one of the environmental pollutants. Therefore, urgent solution action is needed to identify the impact of construction waste on the environment [1]. Environmental pollution problems have been considered as caused by construction waste disposal [2]. With the shortage of land in Penang Island and land prices soaring high, this has caused insufficient land for waste management [3]. Therefore, law enforcement is important in construction waste management to reduce environmental pollution [4].

There are several practices in construction waste management such as reuse, recycle, reduce and disposal. Reuse is defined as repeating using the material that can be reused [5]. Recycling is the second level in the option of

waste management hierarchy and where the waste that can be used as source material in large numbers of quantities [6]. Waste reduction or minimization can be managed within efficient planning for construction material and reducing the construction waste at the source of the material waste [7]. Landfill is defined as a system designed to dispose of the waste by burying the waste under the land to minimize the output of the polluted material to the environment [8].

To ensure the construction waste management process is systematic, there are several stages in the process that need to be identified as shown in Fig. 1. The first stage is construction waste generated at the construction site due to the carelessness of workers and machines. The second level is gathering and separation of generated construction waste. All the generated construction waste will be gathered at the construction site. After that, the construction waste will be separated according to the types of materials and also determined the reusability of the waste. After the waste separation, any reusable waste will be sent back to the construction site to be reused again during the construction stage. While, the waste that is recyclable will be sent to the process and recycled by using certain equipment. The unusable and unrecyclable waste will be collected and sent to landfill. The final stage is waste disposal at landfill [9]. Disposal is the last activity in the process of construction waste management and all the construction waste will be disposed through the methods set by Local Authority and Environmental Department [10].

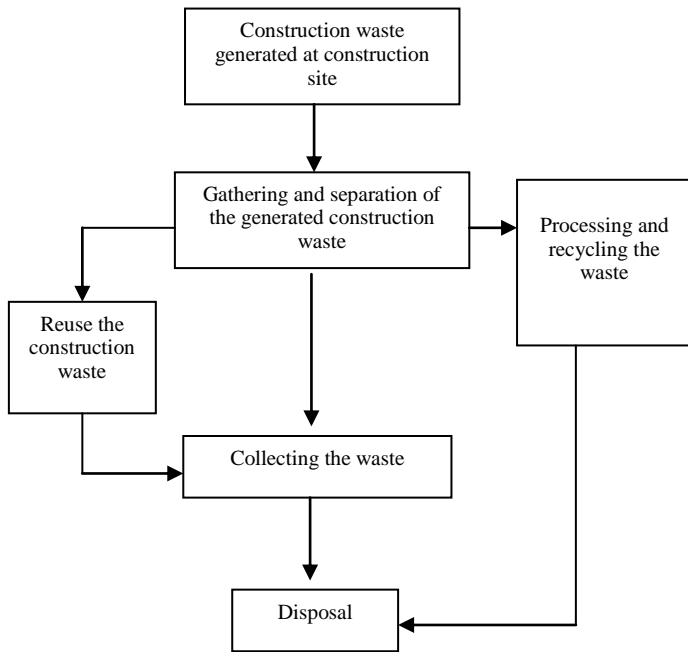


Fig. 1. Stages in the process of construction waste management (Modified from Seow & Mohamad (2007) )

This paper is to study the construction waste management practice in Penang Island. The study scope is the construction waste management in Penang Island and focused on 20 contractors registered under Class A, B and C in PKK located at Penang Island and the officer from Penang Island Municipal Council.

## II. Research methodology

The research methodology consist semi-structured interview, questionnaire survey and observation. The questionnaire survey was conducted by mailing, electronic mail and face-to-face distributed to the target respondent contractors. The interview section was done by face-to-face with an Engineering Department officer from Penang Island Municipal Council. Based on the sample size as shown in table of Krecjie and Morgan [11], 92 person samples required where the population are 115 persons. The respondents were selected randomly include an Engineering Department officer from Penang Island Municipal Council and 20 contractors registered under PKK Class A, B and C. The results of the questionnaire were analyzed by using Statistical Packages for The Social Sciences (SPSS) and Microsoft Excel. In order to get the actual situation in landfill, an observation was done in the Jelutong landfill located Penang Island.

## III. Result and discussion

Based on of interview, observation and questionnaire survey, the practice of construction waste management among the respondents in Penang Island was discussed as following.

### A. Construction waste management practiced by Penang Island Municipal Council

The Penang Island Municipal Council is the local authority that responsible for the cleanliness and safety in the Penang Island. They involve in construction waste management but do not interfere in the process of construction waste management at construction site. The Penang Island Municipal Council only provides the landfill and the disposal services in Jelutong landfill. While the contractors manage at construction site are responsible to transport the construction waste to Jelutong landfill.

According to the officer interviewed, Penang Island Municipal Council practices open dumping in the Jelutong landfill. The wastes that sent to the landfill can only be disposed by overturned the waste and the bulldozer will level the waste. Then, when waste reached a limited height level, the surface of level will be covered by soil usually is used clay. However, they also recycle the wood waste. The wood waste that sent to landfill will be separated and located at the place already set. The wood waste will be taken out by certain organization for recycling. The both parties Penang Island Municipal Council and the organization are no payment for each other in this activity which is win-win situation. It is because, they want to save time, labor and cost to manage the wood waste in landfill while the organization can take the wood waste to recycle with free of charge. The organizations have to apply this request with Penang Island Municipal Council. This application already received since the September 2011.

Besides that, Penang Island Municipal Council also practices reuse at Jelutong landfill. They reuse and recycle some of the construction and demolition waste that sent to the landfill. The construction waste such as rock, pilling, bricks, concrete chunks and hardcore will be used for the road maintenances at landfill. Moreover, excavation waste such as soil and sand will be used for cover the surface of waste level at the landfill. All the recyclable and reusable will be placed separate at landfill for easily to manage.

### B. Observation in Jelutong landfill

The observation carried out at Jelutong landfill was accompanied by the officer from Penang Island Municipal Council to visit and see the actual construction waste management practices in the landfill. The Jelutong landfill was managed by the Engineering Department of Penang Island Municipal Council and it was operating around 1992. The area of the landfill is almost 53 acres which is around 22000 m<sup>2</sup>. Due to the Jelutong landfill is the level 1 landfill, they do not use advanced technology. Besides that, there was also no any waste treatment in the Jelutong landfill.

The area of landfill that confronted with Expressway DR. Lim Chong Eu was already beginning partial closed since 2012. There are 2 types of contractors can apply for the entry permission to Jelutong landfill which is contractors from the Municipal services Department (BPP) of Penang Island Municipal Council and private contractors. All the private contractors have to pay fees for the entry permission. The Penang Island Municipal Council have set rules that need followed by contractors who entry into the Jelutong

landfill. There are some photos taken during the observation at Jelutong landfill. The Photo 1 shows the main entrances of the landfill. All the Lorries have to scale when go in the landfill and also needed to wash the lorry tire when go out.



Photo 1. Entrances of Jelutong landfill

Photo 2 shows the wood wastes are placed separate that will taken out for recycling. While Photo 3 shows the soil was sent to landfill. Normally soil waste will be used for cover the surface of waste level.



Photo 2. Wood waste



Photo 3. Soil waste

Photo 4 shows the big chunks of concrete and rock waste while the pile wastes and small chunks of concrete show in Photo 5. All the concrete and rock waste sent to landfill will be crushed in small and reused for the road maintenances in the landfill.



Photo 4. Big chunks of concrete and rock waste



Photo 5. Pile waste and small chunks of concrete waste

### C. Construction waste management practiced by the respondent contractors in Penang Island.

As the result analyzed of questionnaire survey from the 20 contractors, the most of respondent contractors were men contractor that is 16 persons. Contractors registered in class A are the majority of respondents who answer the questionnaire which are 80 percent while the class B and C cover 15 percents and 5 percents each.

TABLE 1 shows the percentages and number of contractors in practice of construction waste management in Penang Island. Reuse was practiced by majority of contractors which is 80 percent. The construction waste that be reused such as timber, steel, concrete, soil, pile, formwork, cement and brick. Timber waste normally used to make the huts for site workers while the wood waste in good condition will be used for concrete formwork. In addition, steel board waste can be used as the platform at soft ground. The pile waste can be crush like concrete and brick wastes and used as material for the road base and fill

the hole after crushed while the steel inside will be separated and sold for recycling. The plastic and steel formwork will be reused by many times. Moreover, 75 percent of contractors were also reused the construction waste in other projects. Usually the construction waste that reused for other projects such as timber, steel, concrete, formwork, cements, brick, soil, sand, rock and finishing materials.

However, 40 percent of contractors only practiced recycle construction waste in their projects. Contractors do not have the recycling technology. They only directly reused the construction waste that able to reuse. Therefore, recycling was less practiced by the contractors. Normally, contractors reuse construction waste such as wire, steel, concrete, timber and pile.

Besides that, 65 percent of contractors had also practice reduce the construction waste generation. The respondent contractors were reduced the construction waste by measure and estimate the quantity of construction material in exactly and enough during the material procurement. Construction waste commonly can be reduced such as concrete, timber, bricks, steel, tiles and cement.

From the result analyzed, 55 percent of contractors had practiced disposal to manage the construction waste in their projects. It may be caused of respondent contractors want to take the easy way to manage the construction waste. They pay for the contractors who collect the waste from construction site and transport to landfill. Construction waste disposed among contractors such as timber, plastic, ceiling, roof, tile, brick, concrete and formwork. Waste like cement, steel and paper was less disposed due to the material of steel and paper is able and valuable for recycling. Besides that, soil wastes also sent to landfill for disposed.

TABLE I PERCENTAGE AND NUMBER OF THE RESPONDENT CONTRACTORS IN PRACTICE OF CONSTRUCTION WASTE MANAGEMENT IN PENANG ISLAND.

Practice of construction waste management	Yes	No
Reuse	80% (16)	20% (4)
Recycle	40% (8)	60% (12)
Reduce	65% (13)	35% (7)
Disposal	55% (11)	45% (9)
Reuse waste in other project	75% (15)	25% (5)

Fig.2. shows that several stages that important for construction waste management such as building design, material quantity calculation in procurement, material handling, construction stage and material storage. Based on the result, construction stage is the most important stage for construction waste management where agree with 85

percents of contractors which is 15 persons. It is because, usually the most construction waste were generated during the construction stage in a project. Then the following are the stage of material handling and material quantity calculation in procurement cover that agrees by 12 and 11 respondents each. While, the building design stage are the less contractors agree that important for construction waste management which is 5 respondents, 25 percent.

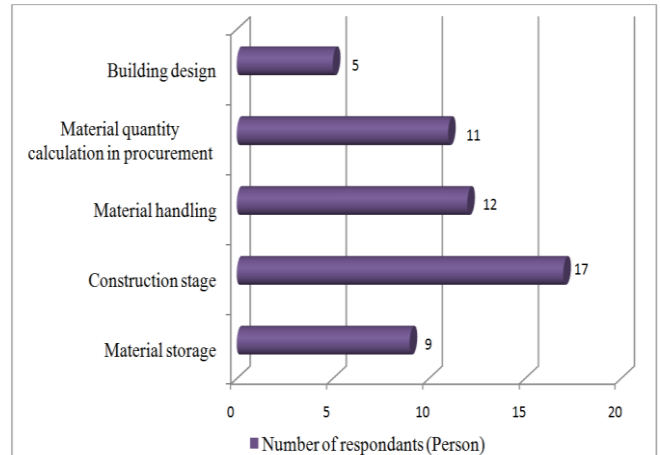


Fig. 2. The important stages in the construction waste management agree with respondent contractors

#### IV. Recommendation

3R (Reuse, Recycle and Reduce) is the best practice in Penang Island. 3R practice can help to reduce the waste disposed in landfill due the lack of the land for landfill. 3R practice also can also help to reduce the payment for waste disposal fees among the contractors. Besides that, 3R practice can also help to save the used of raw material in order to protect to the environmental.

Reuse is the best suitable practice in construction waste management. It is because the reuse can be practiced after the construction project begins and the material waste can also be reuse in other projects. After optimization reused the construction waste, the waste able to recycle can send for recycling. Besides that, the architects and consultants can also advice or select to use the certain construction waste that able to reuse. The construction waste that able to reuse should be used in the current projects, new projects and also keep for future use.

Besides that, recycle is considered as the stage that the construction waste turned becomes products. The construction waste can be turned into the other usage such as steel and wood. Contractors also will get profit from selling the recyclable construction waste to recycling center. Therefore, contractors should initiate voluntary in recycling program and also shall permit the qualified recycling companies collect the recyclable construction waste at the construction site. With this, contractors can save the time,

labor cost, transport cost and disposal cost and also gain profit at the same time.

In addition, reduce can be practice by contractors during the planning phase in order to reduce generation of construction waste. During the planning phase, the designers should maximize use the materials to prevent a large number of construction waste generation during the construction begins. Besides that, the practice of reduce also important in the construction phase where involved the materials procurement, materials handling and material storages. The contractor should estimate the materials quantity accuracy before make order with supplier. Moreover, the construction materials should be arranged and tidy store in order to reduce the waste generated during the materials storage.

## V. Conclusion

Due to the rapid development of construction industry in Penang Island, the large quantity and construction waste has led to environmental pollution. This paper discusses the practice of construction waste management among the contractors and Municipal Council in Penang Island. Contractors and municipal council play an important role in the construction waste management. Besides that, various types of the construction waste able and potentially to manage through 3R practice. As the conclusion, systematically construction waste management important to reduce the environmental pollution in the island where reduce waste disposed in landfill and illegal dumps.

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