Classification and Quantification of Construction Waste at Housing Project Site

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Abstract - This paper discusses the identification of waste generated at construction site and also the estimation of the waste accumulated. The construction sites considered in this study are two housing schemes located in Batu Pahat, Malaysia. The data were collected at the site for a period of three months using observation and quantification at the sites. The estimation of volume was carried out using the rectangular prism and pyramidal shape method. Results show that five main types of waste generated at both sites were concrete, timber, steel, brick, and packaging waste. The estimated total waste generated from both sites was 154.31 m³. Timber waste was identified as the largest percentage (49%) in volume of waste produced at both sites. However, steel waste was found the least percentage generated at both sites. The amount of waste generated at both site signified the issue of sustainability in terms of our environment. The waste has caused higher demand in construction materials which in turn bringing more damaging to our environment. Thus, it is also a moral obligation for the entire construction player involved to minimize the waste generated.

Keywords: Construction Waste; Housing Projects; Quantification and Environment

I. INTRODUCTION

Construction industry is known for contributing economic growth especially in developing countries. However, it is also contributing to negative impact to the environment by generating waste from the construction activities (Begum et al., 2010; Ekanayake and G. Ofori, 2000; Poon et al., 2004). The generation of construction waste has caused serious problems both locally and globally. The amount of waste generated is directly proportionate to the heavy demands of projects such as residential building or housing projects, hypermarkets or shopping complex and many infrastructure projects need for upgrading life style of Malaysian peoples (Nasaruddin et al., 2008; Siti and Noor, 2008; Begum et al, 2006). Research had shown that housing construction is responsible for producing varieties of waste such as wood, concrete, metal, brick, drywall, roofing, material packaging, plastics, papers, cardboard and others (Lau et al. 2008; Nagapan et al., 2013). The amount of waste generated depends on the stage of construction and methods of construction practice used on site.

The common practice of disposal construction waste in Malaysia is by dumping at landfills (Nagapan et al., 2012). This practice is also common to many countries in the world. In Australia, about 20% to 30% wastes generated are deposited in landfills. Other countries such as Germany and Finland the construction wastes contribute 15% to landfills (Faniran and Caban, 1998).

A case study on construction waste in Malaysia found that more than 175,000 tonnes of wastes were generated annually in Kuching and more than 100,000 tonnes were generated in Samarahan (The Star, 2006). Meanwhile, Faridah et al., (2004) conducted study on 30 construction sites and found that the major waste generated were concrete (12.32%), metal (9.62%), brick (6.54%), plastic (0.43%), wood (69.10%) and others (2%). Hence, this study was carried out to investigate the types and the quantity of construction waste generated at two different sites of housing project using conventional method of construction.

II. IDENTIFICATION OF CONSTRUCTION WASTE

Construction wastes at site are clustered into physical waste and non-physical waste. The physical waste is defined as loss of materials, damaged, cannot be repaired, cannot be used or losses during construction activities. However, the non-physical wastes are related to cost overrun and delay in construction projects (S. Nagapan, 2012). This can be interpreted as losses of money and time and not physical.

For this study the focus is on physical waste only. Site visit and observation approach was used to identify the type of waste generated at the site. The observation was done for three months on the construction sites and it was found 5 main types physical of wastes at the sites as shown in Figure 1-5.

A. Concrete Waste

Concrete waste can be generated due to mishandling of construction components like concrete pile as shown in Figure 1. The figure shows the broken pile dumped in soil site.
B. Timber Waste

Timber is used in traditional construction especially as formwork. Usually this timber formwork is used for a minimum of three times before it is disposed. This generated waste as site which needs to be managed properly as it would create negative impact to environment if the timber is burnt openly. Figure 2 shows timber wastes are not being arranged properly at site.

C. Steel Waste

A steel reinforcement bar is one of the important elements in construction. The waste commonly occurs at the site due to wrongly cut-off the bar by inexperienced site workers. Figure 3 shows gathered of rusted steel waste at site.

D. Brick Waste

Bricks and blocks are the most common materials used for wall. The nature of bricks is brittle. Hence, this type of waste was easily found at sites. The waste usually generated because of improper handling of the materials during construction stage. Figure 4 shows of brick waste at observed site.

E. Packaging Waste

Packaging waste generated at site during delivery process. Many supplier delivered construction material at site with a proper packaging procedure. Therefore, after material used or delivered, packaging waste remain or leftover at site. The wastes are usually detected are wrapping plastic and paper. Figure 5 shows packaging waste of cement bag at site.

III. QUANTIFICATION OF CONSTRUCTION

The method to quantify or estimate the waste generated on site was adopted from Lau et al, 2008 studied. Five types of physical construction waste at the sites were estimated. The quantification of waste was based on its volume. The volume (Vs) of stockpiled waste was determined based on rectangular prism and pyramidal shape as shown in Figure 6 and 7. For pyramidal shape, the volume, \( V_s = \frac{1}{3} (B \times L \times H) \). And for rectangular prism form, the volume is calculated using this formula, \( V_g = L \times B \times H \). Where L is the length, B is the base and H is the height.

Figure 1. Waste of concrete pile

Figure 2. Waste of timber

Figure 3. Waste of steel reinforcement

Figure 4. Waste of bricks

Figure 5. Packaging waste of cement bag

Figure 6. Estimation of volume based on Pyramidal shape

Figure 7. Estimation of volume using rectangular Prism method
IV. RESULT AND DISCUSSION

The generated waste was presented as in Table 1. From the table, the types of waste identified were concrete, timber, steel, brick and packaging waste. Other wastes were not classified because the amount is not significant to be considered. The table also indicates that site B produced more waste as compared to site A. Since site B constructed more houses than site A, this could be the reason why site B produced more waste.

<table>
<thead>
<tr>
<th>Types of waste</th>
<th>Site A m³</th>
<th>Site B m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>3.39</td>
<td>9.03</td>
</tr>
<tr>
<td>Timber</td>
<td>25.58</td>
<td>50.17</td>
</tr>
<tr>
<td>Steel</td>
<td>1.85</td>
<td>0.86</td>
</tr>
<tr>
<td>Brick</td>
<td>8.30</td>
<td>26.15</td>
</tr>
<tr>
<td>Packaging</td>
<td>13.21</td>
<td>15.77</td>
</tr>
<tr>
<td><strong>Total Volume</strong></td>
<td><strong>52.33</strong></td>
<td><strong>101.98</strong></td>
</tr>
</tbody>
</table>

A. Percentages of Waste Generated at Site A

Figure 8 displays the percentages of five type of physical waste generated in Site A. Timber waste contributes 49% of the waste generated and is considered the highest contributor in term of volume. These timber wastes were either from the scaffolding, timber off-cuts and formwork. Packaging waste was identified as second high generated waste in the site. The packaging waste used to protect or cover materials before it send to construction site. Then, the third highest waste contributor was bricks waste. It produced of 16% of bricks waste. The wastage generated due to cutting fault, damage during handling, unused bricks and some are left at site. From the pie chart, there also 6% of concrete waste were produced causes of careless, over-ordering and over-filling to container of lifting equipment while concrete casting. At last, steel waste are the smallest amount found and contribute only 4% at site A. Steel components included piped and reinforce bar. This is because of high recycles value of the steel in market.

B. Construction Waste Generated at Site B

Figure 9 shows 49% of timber waste generated at site B. The waste mainly was produced from scaffolding and formwork. Meanwhile, 26% of bricks waste was found in site B due to poor attitude of workers during handling the material. Packaging waste such as paper and plastic package was found 15% on site B. The waste generated when raw materials such as cement has been used. Then the packaging waste left over at site. There were 9% of concrete waste was produced in site B. These wastes produced because of over-ordering of concrete mixture and careless of worker while concrete casting. Lowest volume generated at site B is steel waste. There is only 1% of steel waste found on site. The wastes have very expensive and high recycle value in market.

V. RESULT AND DISCUSSION

Generated construction waste such as timber, concrete, steel, bricks, and packaging waste are main waste found at both project sites. Based on the data collected from two housing projects, the timber waste is the highest volume that produced on the sites. Therefore, the timber waste is essential to manage properly. Good management technique is very necessary for a country to grow in a sustainable manner.

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REFERENCES


