Study of recycling demolition waste material product in Jakarta, Indonesia

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Abstract. Construction activities (construction and demolition) is one of the major contributors in the generation of waste generation in landfills. Recycling waste of demolition construction is considered effective, but for the case in Indonesia not many know the benefits of the utilization due to lack of socialization of the impact of construction waste and not many people who know the economic value in waste recycling products construction. The aim of this study is to analyze the potential of use construction waste recycling products in terms of economy and its development in Indonesia, case study in Jakarta area. This paper will use descriptive analysis with literature studies based on several references related to similar cases. The result show that 40-60% of waste from construction and construction can be recovered and recycled. Economically, waste minimization is also feasible because reuse of construction waste is estimated to be worth 2-3% of the total project budget. Therefore, the construction industry can save by applying waste minimization in the project.

1 Introduction

Infrastructure growth is a springboard from a stable and productive society, which always comes with unique challenges along with opportunities for the private and public sectors, the construction sector is one of the examples [1]. Recent Growing of construction activities nowadays has resulted in a production of residual materials that are currently requiring more substantial costs to be processed or disposed. There are several types of waste or residual material from construction including brick, concrete, pieces of wood, steel, asphalt roofing material, paving materials, and electrical materials [2]. Besides, waste material is not environmentally friendly and has a substantial cost if it is included in the budget. This causes many of these wastes to remain in the environment for a long time and continue to accumulate, while the facilities that used as waste storage are getting smaller [3]. Based on a survey, the waste disposal cost caused a negative impact on the construction company economics [4]. For some contractors, construction waste disposal has become more expensive due to the cheaper local landfills are increasingly scarce or even close to their capacity [5]. Therefore, the implementation of a waste management program in the site considered to be an essential component of the construction process [6].

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Construction activities such as renovation and demolition (i.e., road, bridges, flyover, subway, and building expansion) have to lead to the generation of waste. This pile of waste which are heavy and having high density often occupy a lot of space that possibly causes traffic congestion and disruption [10]. Moreover, the consumption amount in natural resources for the construction sector is in line with the amount of residual material produced from the sector [11]. Therefore, construction material recycling is necessary as the act of preserving and conserving the natural resources in efforts of sustaining the environment [10].

Material waste is one of the most significant environmental issues, it is evident that it also has the greatest potential to be reused through two methods, namely reusing components and recycling waste into new raw materials that used in construction building [7]. Besides, by recycling, reusing, and recovering the waste can reduce the amount of space used at the disposal site and saving more energy in the next new building installment [6]. Canada is one of the example, where its construction industry has contribute 27% from the total municipal waste in landfills, where more than 75% of that waste being recycled and reused for another construction purposes [8]. Not only in Canada, the construction industry in Malaysia also contributes 28.34% of the total municipal waste dumped in landfills, where almost 73% of the construction industry waste being recycled and reused, although it only occurs by certain private contractors. [9]. It can be inferred that based on the story, construction waste has been an issue and recycling the product has been popular to be implemented in certain countries. However, in Indonesia, this has not received enough attention or become an important issue. Given the massive consumption of natural resources in construction activities, proper planning in its management is necessary in order to be in line with the sustainability principality [12]. Therefore, this paper will be analyzing the economic potential for recycled construction products that have a new value. The economic aspect will be discussed by comparing the prices of buying and selling new products with recycled products and the efficiency of product use in new construction.

2 Methods

This paper use a quantitative approach using a systematic review to identify and analyse the previous study and issues related to the use of construction and compiling with the related news, selling prices and waste in Indonesia. The case in this paper is the potential for construction products that still have residual value and modified into a product that has new values and functions.

3 Result and Discussion

The sustainable construction defined as construction that takes into account sustainable aspects, namely the use of natural resources that pay attention to its carrying capacity to avoid a decline in environmental quality [13]. Regarding the limited quantity of natural resources, it is necessary to make efforts to conserve natural resources, such as the usage of recycled material that is still feasible without reducing the aspect of building strength [14]. Almost all types of construction waste materials are managed by reuse. The common recycled and usage of waste material, such as [15]:

a. Iron, reassembled to be used as a reinforcement of practical columns or as a stirrup

b. Wood, depending on the shape and quality of the wood, is processed into sills, door panels, as a fence in building projects, and some are used as molds or buffer during casting.
c. Brick, ceramic, tile (material from the ground), if the defect is only minimal, it is reused as new material.
d. Zinc and asbestos waves are used again as roofing and fencing materials in construction projects.
e. Debris, a material consisting of fine or coarse aggregates, and broken brick, wall or concrete fragments are used as fill material.
f. Plumbing tools, building accessories, pipes, electrical installations, are reused as they are used.

There are two advantages of using a recycled waste material, mainly Indirect benefits (i.e., saving transportation costs and leasing land to allocate construction waste) and direct benefits (i.e. cost savings in the budget for the purchase of new materials and income from the sale of used materials that have been recycled) [16]. In Indonesia, before being managed according to the material function, it is being sorted before being sold. Some used materials sold in Indonesia that can be known in the used material market, such as [13]:

1. The roof cover, the used material market is valued at around Rp 600 per piece.
2. Used toilet, in the used material market, is valued around Rp 90,000 for squat toilets and Rp 350,000 for toilet seats. In addition to used toilet materials, in the used material market there are also new closets sold but with poor conditions in the production process which is valued at around Rp 100,000.
3. Reproduced sills, for 6/12 cm old teak wood frames valued at around Rp 125,000 / meter long (if calculated, Rp 17,361,111/m^3) compared to new sills where the best grade teak wood is Rp 15,000,000/m^3, the price of used sills is around 20% cheaper.
4. Iron, the selling price of used steel reinforcement is 70% of the purchase price of the new reinforcement. Iron needs in buildings are around 0.5% to 1% of the total building budget.

As a comparison from the study in Indonesia, Malaysian Construction Industry has predicted that almost 73% construction waste able to be used or being recycled, such as aggregates, concretes, bricks, blocks, metals, roofing material, sand, soil, and woods [9]. Table 4 below representing an estimation of profit by using recycled material to building construction in Malaysia. In the Malaysian construction industry that equates the price of used materials with new material prices. About 25% from total cost savings will be reduced at the end of overall calculation, where the percentage value is an informal assumption based on the forum group discussion with the project manager and supervisor on site. In addition to calculating the price of used materials, the construction industry in Malaysia also takes into account transportation costs.

Table 1. The Purchasing Calculation Cost for Reuse and Recycled Construction Waste Material on the Site [9]

Construction Waste Material	Amount of waste generated (t)	Average price of market (RM)	Cost savings from market price (RM)	Transportation Cost (RM)	Total Cost Saving (RM)
Brick and block	315	117,14	14759,64	8622,75	23382,39
Concrete	17820	54,5	728392,5	-	728392,5

and aggregate					
Wood	1350	600,00	486000	12150	498150,00
Roofing materials (tiles)	54	533,33	2880	360,00	3240,00
Total			1232032,14	21132,75	1253164,89
25% deduction*					313291,22
Net purchasing cost savings					939874,00

Based on the calculation in the table 1, it can be concluded that it is possible to get saved costs when using recycled materials. This case provides information that the income cost of using used materials is known to be RM 1055796 which consists of costs that can be saved if using used material (RM 939874.00), sales revenue from construction waste, costs saved if the material is not disposed of into landfills, costs transportation, and labor costs. After the cost of income, there is an expense if you use recycled materials amounting to RM 198754 so that you can get a net benefit from the use of recycled used material, which is RM 1055796 - RM 198754 = RM 857042. The profit of using the recycled material in new construction project can save around 2.5% from the total project budget, with the total project budget being RM 34 million. The case in Malaysia revealed that 2.5% acquisition from the total project budget are economically feasible, while it also supports an essential key for improving the environmental management in Malaysia [9].

Unlike Indonesia, the use of used materials or recycled products has not become a major issue so there has been no calculation of the exact amount of waste produced in 1 construction project or the calculation of the profits derived from the use of used construction materials. The Indonesian construction industry is currently more concerned with solutions for practical, concise, economical and environmentally friendly development. An example is PT Etex Building Performance Indonesia (EBFI) which in March 2018 promoted a variety of new products for building materials solutions that carried technology from Belgium's Etex Company. EBPI is a manufacturer of building materials for fiber cement boards with the Kalsi and Equitone brands. Some of the building materials promoted are KalsiClad, Kalsi Floor 20, Kalsi Formwork, Kalsi Joint Compound, Kalsi Plinth 8, and Kalsiplank 12 Fascia. There are several advantages of promoted building materials such as Kalsi Bekisting which can be used to replace wood boards or multiplexes for formwork or concrete molding applications. Kalsi Formwork is more waterproof, termite resistant, fire stage and can be used 3-4 times for concrete molds. This product can also be nailed, screwed, or cut because it is resistant to slime.[17]

4 Conclusion

The use of used materials in Indonesia is not optimal because the Indonesian construction industry has not made this an important issue that can support a better environment. Indonesia is still more concerned with technology development in building materials that support practical, concise, economical and environmentally friendly solutions for

development. Unlike the case in Malaysia which has calculated the feasibility of the cost that can be saved if using recycled materials in construction projects. It is estimated by the Malaysian construction industry as the example that using recycled materials are able to save 2.5% from the total budget, while in the Indonesian construction industry, the exact calculation of the cost that can be saved in construction projects cannot be found but the use of used materials in Indonesia actually saves costs The budget can be seen if a construction project using a used frame that is reproduced, for example a used teak frame with a size of 6/12cm is valued at around Rp 125,000/meter length (if calculated, Rp 17,361,111/m^3) compared to the new frame where the best grade teak wood is Rp 15,000,000/m^3, the price of used frames is still around 20% cheaper.

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