Construction Material Waste Management on Building Development Projects in Makassar City

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Abstract: ***To overcome the problems caused by material waste, a method is needed to minimize the emergence of material waste, so that the implementation of a project can increase profits in terms of time, cost and environmental quality improvement. Thus, in this work, construction material waste management on building development projects in Makassar city was done. The objective of this work is to analyze the type of waste material that is dominant in building projects, analyze the dominant factors that cause waste material to occur in building projects, analyze ways to minimize waste material and handle waste material in building projects. Results showed that for construction of a building project in Makassar for consumable materials, volume of iron, light brick and ceramics occupy the highest order with a volume of around 6-10%.***

Keywords: Building development, Construction, Material waste, Waste management.

I. INTRODUCTION

The provision of facilities and infrastructure cannot be separated from the construction process which certainly has some risks that may occur [1]. One of the things that must be of particular concern is the risk of waste material that will affect not only the implementation of development, but can have a negative impact on the environment [2].

Material procurement costs absorb huge costs in a construction project. Ervianto [3], argued that the cost of materials absorbs 50-70% of project costs, this cost does not include the cost of storage of materials [3]. John and Itodo [4] stated that the material costs for construction projects in Nigeria absorb more than 50% of project costs and material waste contributes 21-30% to the cost overrun of the project. Intan et al. [5] concluded that the minimum value of material waste costs was 3.33% and the maximum value of material waste costs was 4.67% of the total budget.

Besides having an impact on increasing costs, material waste also has an impact on project implementation. Job delays can occur due to material waste, as an example of material waste that occurs due to worker errors resulting in the work must be dismantled and repeated, giving rise to additional project implementation time. Nagapan et al. [6], stated that waste material can increase project implementation time without adding value to the project.

Waste construction materials in addition to increasing costs also have an impact on the environment, because it will increase waste generation [7]. Waste construction materials can reach 15-30% of municipal waste [8]. Shen et al. suggests that the construction process contributes greatly to waste generation and management of construction waste can potentially protect the environment[9].

Meanwhile, recycling methods in Indonesia are still difficult to implement because in general, trash bins in Indonesia have not been sorted according to the type of waste, so that all waste is integrated into one shelter [10] . In addition, technological progress has not been able to match technology in developed countries, because it requires high costs and the results of recycling have not been studied to be utilized [5].

Makassar is a developing city, so that in carrying out economic, trade, business and government activities it is necessary to provide supporting facilities and infrastructure such as building construction [11]. Building construction currently leads to vertical construction or high-rise buildings. This is due to limited land available [12].

To overcome the problems caused by material waste, a method is needed to minimize the emergence of material waste, so that the implementation of a project can increase profits in terms of time, cost and environmental quality improvement. Thus, in this work, construction material waste management on building development projects in Makassar city was done. The objective of this work is to analyze the type of waste material that is dominant in building projects, analyze the dominant factors that cause waste material to occur in building projects, analyze ways to minimize waste material and handle waste material in building projects.

II. METHODOLOGY

Research Location and Time

This research was carried out in the Makassar region in several contracting companies that were carrying out the construction process of multi-storey buildings, from each of the contractors the research was carried out on one of the projects being carried out.

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The implementation time is planned for 3 months, namely June to August 2015.

Population and Samples

The population in this study is a contracting company engaged in the construction of building projects in Makassar. The research sample is supervision and implementation of the company that has been established and has experience in building construction projects. The sample selection is done by purposive sampling technique which is the selection of samples that are tailored to the needs.

Data Collection

Data type used in this research consisted of primary data and secondary data. Primary data collection techniques in this study include: a. Observation, namely the collection of data by direct observation in the field, to observe the types and causes of material waste. b. Questionnaire that is by using a list of questions filled in by the respondent, with the answer provided in the form of a choice (rating scale).c. Interviews, namely interviews in depth and directly with respondents in the research location. Secondary data collection techniques in this study in the form of library data, namely data collection in the form of literature studies in the form of journals and research theses related to the problem under study.

Research Variables

The research that will be carried out includes four main things, namely the type of material waste, the cause of material waste, how to minimize material waste, and the handling of material waste. Each of these things has variables that are determined based on literature, the results of previous research and direct interviews with respondents in the field.

Data Analysis Method

The data analysis techniques were used using descriptive statistical methods, validity and reliability tests, one way ANOVA tests and AHP (analytical hierarchy process), using the IBM SPSS Statistic 22 and Microsoft Excel 2007 programs.

III. RESULT AND DISCUSSION

The volume of material waste in this study is estimated based on respondents' answers to the questionnaires that have been provided or based on their work experience during the building project development process. In this study eight types of waste were determined from consumable materials namely concrete, reinforcing iron, cement, sand, broken stone, light brick, ceramics, mortar, and one type of non-consumable material, wood.

Respondents' responses and responses to both the supervision level and the implementing level regarding the volume of waste material are presented in the form of a table. Based on Table 1, it can be seen the tendency of respondents in choosing the quantity of waste for each material. Consumable materials are: concrete, cement, sand, broken stone and mortar the amount of waste volume is between 0-5% of the total material procurement with the percentage of respondents respectively 67.65%, 70.59%, 70.59%, 76, 47% and 58.82%. Iron, light brick and ceramic materials have a waste volume between 6-10%, with the percentage of respondents respectively 55.88%, 58.82% and 55.88%. Wood material which is a non-consumable material provides the highest waste value, which is between 11-15% with the percentage of respondents at 61.76%.

Table. 1 Quantity of waste material based on supervisor view

No	Material	Quantity	Respondent Percentage
1	Concrete	0-5 %	(67,65%)
2	Iron	6-10 %	(55,88%)
3	Cement	0-5 %	(70,59%)
4	Sand	0-5 %	(70,59%)
5	Broken stone	0-5 %	(76,47%)
6	Light brick	6-10 %	(58,82%)
7	Ceramics	6-10 %	(55,88%)
8	Mortar	0-5 %	(58,82%)
9	Wood	11-15%	(61,76%)

Based on Table 2, it can be seen the tendency of respondents in choosing the quantity of waste for each material. Consumable materials are: concrete, cement, sand, crushed and mortar stones the amount of waste volume is between 0-5% of the total material procurement with the percentage of respondents in a row of 80.00%, 76.00%, 80.00%, 77 14%, and 73.33%. Iron, brick and ceramic materials have waste volumes between 6-10%, with the percentage of respondents being 65.00%, 80.00% and 70.00%. Wood material which is a non-consumable material provides the highest waste value which is between 11-15% with the percentage of respondents as much as 65.00%.

Table. 2 Quantity of waste materials based on the implementers view

No	Material	Quantity	Respondent Percentage
1	Concrete	0-5 %	(80,00%)
2	Iron	6-10 %	(65,00%)
3	Cement	0-5 %	(76,00%)
4	Sand	0-5 %	(80,00%)
5	Broken stone	0-5 %	(77,14%)
6	Light brick	6-10 %	(80,00%)
7	Ceramics	6-10 %	(70,00%)
8	Mortar	0-5%	(73,33%)
9	Wood	11-15 %	(65,00%)

The material waste causes in this study are divided into two parts; the first part of supervision is in the form of general factors that cause waste. The second part of the view of the implementers working in the field in the form of waste factors from each material based on their experience in the field.

One way ANOVA test begins by formulating a hypothesis, with the hypothesis of:

H_0: There is no significant difference in the average of the variables because of differences in position, level of education and work experience.

H_a: There are significant differences in the average of the variables because of differences in positions, levels of education and work experience.

Testing criteria can be based on significance value or F value. If the significance value is> 0.05, Ho is accepted, and vice versa if the significance value is <0.05, then Ho is rejected or Ha is accepted, and if the F value counts ≤ F table then ho is accepted, otherwise if F counts> F table, then Ho is rejected.

One way ANOVA test is only done to analyze the factors that cause material waste from the point of view of supervision, because to implement the causal factors of some material have different respondents. In table 21, one way ANOVA test results will be given.

In table 3 it is seen that for the design, handling, workers, management, procurement / purchase groups, location conditions and external factors a significance value of> 0.05 thus Ho is accepted, or there is no significant difference in the average of the variables due to different positions, level of education and work experience. The value of F table for group data based on position is 3.305 (for df 1 = 2 and df 2 = 31 (see attachment 6), and in table 21 it is seen that the F value for each factor is <3.305 thus Ho is accepted.

Table. 3 Test result of one way anova

Factors causing waste	Department		Level of Education		Work Experience	
	F.	Sig.	F.	Sig.	F.	Sig.
Design	1,147	0,375	2,529	0,096	2,529	0,096
Handling	1,862	0,103	0,085	0,918	0,085	0,918
Worker	1,487	0,206	1,981	0,155	1,981	0,155
Management	1,888	0,099	1,930	0,162	1,930	0,162
Procurement / Purchasing	2,099	0,067	0,573	0,569	0,573	0,569
Location Conditions	0,979	0,492	2,157	0,133	2,157	0,133
External factors	0,680	0,742	2,920	0,069	2,920	0,069

IV. CONCLUSION

Based on the results of the analysis and discussion of waste material control in the building project in Makaassar, it is concluded that, for the construction of a building project in Makassar for consumable materials, volume of iron, light brick and ceramics occupy the highest order with a volume of around 6-10%. Materials of concrete, cement, sand, gravel and mortar have the next waste volume, which is around 0-5%. Waste formwork wood which is a non-consumable material occupies the highest volume of around 11-15%.

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