

CAUSES OF MATERIALS WASTAGE IN BUILDING CONSTRUCTION PROJECTS

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Abstract- Construction materials wastage is a notable issue in construction projects worldwide. This study aimed to study the causes of wastage of construction materials on building construction projects. To achieve the study aim, a questionnaire survey was used to collect data from building construction projects from the respective respondents from Bahir Dar city in Ethiopia. Questionnaires were distributed to the main stakeholders who were involved in the building projects to identify the frequent causes of wastage of materials from the factors that were extracted from literature review. The data analyzed using the Relative Importance Index (RII) technique to quantitatively measure the occurrence of the variables. The study revealed that workers mistake, loss of onsite material control and selection of low-quality products were the major causes of construction materials wastage in building construction projects in Bahir Dar. Based on the findings of the study, conclusions are drawn and recommendations for stakeholders and suggestions for future research are forwarded.

Keywords- Construction material, wastage, construction management, building project, Bahir Dar.

1. INTRODUCTION

Construction materials take major expenses (in terms of money) in any construction project. The cost of materials maybe 50%-70% of the total construction cost depending on need of projects [1]. It's important to consider effective materials management in the construction project management process. So in order to achieve successful building projects which fulfill all the parameters (cost, quality and time) it needs to have the appropriate and effective material management system.

Materials management is an important element in project management. Materials represent a major expense in construction, poor materials management can result in increased costs during construction. Effective management of materials can result in substantial savings in project costs and it is one of the major factors for any construction project to become successful. Whereas, failure to effectively manage one's own construction project materials will affect time, cost and quality of building projects.

From the preliminary study, poor construction materials management and material wastage onsite were very common in many building construction

projects. The objective of this study was to investigate the major causes of materials wastage in building construction projects and the scope is limited to Bahir Dar city. Bahir Dar is one of the well known cities in Ethiopia and it has many projects being executed. The findings of this research will enhance the awareness of the three main parties (employer, contractor, and consultant) and other professionals in the construction industry, about the major causes of construction materials wastage that are common in building construction projects.

2. RELATED LITERATURES

The construction industry is the most significant industry in the economy which needs successful measure to be completed within scheduled time, budget, and in accordance with the specification and satisfaction of stakeholders [2]. The term 'waste' can be defined in several ways. From the construction management point of view, waste is any incompetence that results in use of tools, material, labor, equipment, and the capital in larger amount, than those measured as essential for the construction. Waste refers to anything other than the amount of

equipment, material, worker's time, and space necessarily required to add value to the product [3]. Furthermore, construction material wastage can also be defined as the difference between the value of materials delivered and accepted on site and those properly used as specified and accurately measured in the work after deducting the cost saving of substituted materials transferred elsewhere in which unnecessary cost and time may be increased by the material wastage [4].

Materials management in construction projects is an important function that significantly contributes to the success of a project. Poor management of materials on site during construction process will influence the total project cost, time and quality [5]. Material wastage is one of the major causes of contractor's business failure in developing countries [6]. The reduction in construction materials wastage can significantly help in increasing total profit and gaining economic stability for a country and construction firms. Project managers and construction staff usually fail to control materials in construction projects and unable to identify the root causes of materials wastage due to absence of appropriate tools to measure it [7]. Construction materials wastage is considerable where poor management is a norm [8]. Construction site staff and project manager can reduce the construction waste with efficient management [9]. The reduction in construction waste can significantly help in increasing total profit and gaining economic stability for a country and construction firms.

Wastage of construction materials is much greater than the minor figures assumed by the companies while estimating cost of the project [10]. So, materials management is a vital function for improving productivity in construction projects. The management of materials should consider at all the phases of the construction process and throughout the construction and production periods.

There are many ways through which causes of wastage can be identified in construction. Waste can be categorized according to its source [11]. Waste may result from process preceding construction, such as material manufacturing, design, material supply, and planning as well as the construction stage. Wastage in construction sites is often due to inadequate storage and protection, poor or multiple handling, poor site control, over ordering of material, bad stock control, lack of training, and damage to material during delivery [12]. Most researchers categorized these causes into four categories [13], procurement, handling, operation, and culture; while

another researcher [14] grouped factors generating material wastage into design, procurement, handling of material, and operation.

3. METHODOLOGY

Quantitative research method is selected for this study which focused on measurements of the variables that identified from the literatures to achieve the study objective. A random sampling method was used for the study to collect the quantitative data from the respondents. The primary data for the study was obtained through distribution of questionnaires from professionals involved in building construction projects in Bahir Dar. The secondary data were obtained from relevant literatures that covered research on the related topic of the study. The questionnaire was designed using a Likert's scale of ordinal measures from 1 to 5. The Relative Importance Index (RII) method was used for data analysis which was calculated as follows:

$$RII = \frac{\sum a * n * 1}{N * 5} \quad (1)$$

Where: 'a' is a constant expression weight, 'n' is the frequency of the response, and 'N' is the total number of responses.

4. RESULT

The collected data from the questionnaire survey were analyzed according to their ranking on RII facilitated by Microsoft of Excel package. The result presented using tables and descriptive statistics.

A total number of 68 questionnaires were distributed to respondents and only valid 36 of them were returned. Among the 33 questionnaires distributed to respondents of contractors, 18 questionnaires were returned. From 24 distributed questionnaires to respondents of consultants only 15 valid questionnaires returned. And 11 questionnaires were distributed to clients and only 3 questionnaires were returned. The validity is determined based on the relevant response of the respondents. i.e., questionnaires with no responses and partial responses were considered invalid. As shown in Table 1 below, 68 questionnaires were distributed to the respondents and 36 of them were returned.

Table 1: Questionnaire return rate

Number of Questionnaires	Target Group			Total
	Contractor	Consultant	Client	
Distributed Questionnaires	33	24	11	68
Returned Questionnaires	18	15	3	36
Response Rate	54.54%	62.5%	27.27%	52.94%

Among the above 36 questionnaires successfully returned, 18 (50%) of the respondents had 0-5 years of work experience, 10 (27.78%) of the respondents had 5-10 years of work experience, 5 (13.8%) of the participants had 10-15 years of experience, and 3 (8.33%) of the participants had above 15 years of experience in the construction industry.

The respondents had also different positions in the industry. Their positions were one (2.78%) of them was project manager, nine (25%) of them were site engineers, two (16%) were of them were foremen, six (16.67%) of them were office engineers, and fifteen (41.67%) of them were resident engineers.

Respondents were asked to score different factors of major issues which cause construction material wastage. The variables or causes of materials wastage in construction projects were classified into four phases in the project, which are design, procurement, materials handling, and construction phase.

Table 2: Frequencies of causes of materials wastage in building construction projects in Bahir Dar

Causes of materials wastage in building construction projects	RII	Rank
Design phase		
Selection of low quality products	0.750	1
Determination of types and dimensions of material without considering waste	0.689	2
Errors in contract documents	0.672	3
Lack of information in the drawings	0.644	4
Lack of attention paid to standard sizes available on the market	0.639	5
Design changes and revisions	0.583	6
Incomplete contract documents at commencement of project	0.567	7
Changes made to the design while construction is in progress	0.533	8
Incomplete design	0.522	9
Lack of information about types and sizes of materials on design documentations	0.456	10
Procurement phase		
Lack of trade's skill	0.750	1

Ordering errors (e.g. ordering significantly more or less)	0.672	2
Lack of possibilities to order small quantities	0.667	3
Purchased products that do not comply with specification	0.617	4
Ordering of materials that do not fulfill project requirements defined on design documents	0.561	5
Damage during transportation	0.550	6
Materials handling phase		
Unfriendly attitudes of project team and laborers	0.511	1
Inappropriate storage leading to damage or deterioration	0.661	2
Damages during transportation	0.633	3
Materials supplied in loose form	0.628	4
Damage of materials due to deficient stockpiling and handling of materials	0.689	5
Construction phase		
Workers' mistakes	0.883	1
Lack of onsite materials control	0.828	2
Poor coordination among project participants	0.717	3
Required quantity unclear due to improper planning	0.717	4
Accidents due to negligence	0.600	5
Use of incorrect material, thus requiring replacement	0.522	6
Inclement weather	0.517	7
Imperfect planning of construction	0.417	8

5. DISCUSSIONS

As shown in Table 2 above, the major causes of construction materials wastage during design phase of building projects are selection of low quality products, determination of types and dimensions of material without considering waste, and errors in contract documents.

Materials wastage can also occur during procurement phase of a project. Lack of trade's skill with, ordering errors (e.g. ordering significantly more or less, and lack of possibilities to order small quantities are the

major causes of construction materials wastage during procurement.

Unfriendly attitudes of project team and laborers, inappropriate storage leading to damage or deterioration, and damage of materials due to deficient stockpiling and handling of materials, are the major causes of construction materials wastage during materials handling.

The major causes of construction material wastage during construction are workers' mistakes, lack of onsite material control, and poor coordination among project participants. The major causes of wastage frequently occur more during construction phase of a project.

As it can be seen in Table 2 above, the first major cause of construction materials wastage is workers' mistake with an RII value of 0.883. Workers mistake may result from different issues such as lack of knowledge and negligence of workers. The second major cause of wastage is lack of onsite materials control (0.828). It is the major problem in most sites as there is no material control system on sites. Selection of low quality products have been ranked as the third major cause for construction materials wastage (0.750), because contractors are profit makers and they want to minimize their expenses by using products with low quality and these products can be damaged before their application in the project or in the very near future after use. The fourth ranked major cause of wastage is lack of trade's skill (0.750). This could be due to lack of experience of staff's materials selection for the specified quality during purchasing. Procurement needs skills and experience to identify the standard specification among the products. Poor coordination among the parties (0.717) is the fifth major cause of materials wastage in building construction projects. This is because the less the participants coordinate; the more misunderstanding will be among the participants. This may result in performing irrelevant activities in the project and that's why it became the major cause of materials wastage in building construction.

6. CONCLUSION

From the finding, the major causes of materials wastage in building construction projects in Bahir Dar city are workers mistake, lack of onsite materials control, low quality product selection, lack of trade's skill, and poor coordination among the parties. Most causes of materials wastage occur during construction phase of building projects. Project executing or construction stage is the critical phase which comprises lots of activities and it needs high level materials management.

7. RECOMMENDATIONS

In order to efficiently manage and minimize materials wastage in building construction projects in Bahir Dar, the contractor should control workers to avoid wastage occurs due to mistakes during construction. Qualified personnel should be assigned to control onsite materials. The materials need to be controlled as per the design and specification made for the project. Experienced professionals should be assigned for materials purchasing during procurement. Coordination of the project participants is a key to minimize materials wastage in building construction projects for successful completion of the project within the time frame, budget, and to the specified quality. Since this research was limited to only building projects, further research should be conducted to identify the cause of materials wastage in other construction projects.

8. REFERENCES

- [1] Pataskar, A.R., "Analyzing Material Management Techniques on Construction Project"; *International Journal of Engineering and Innovative Technology*; vol. 3, pp. 96-100, 2013.
- [2] Nguyen, L.D., Ogunlana, S.O. and Lan, D.T., "A Study on Project Success Factors in Large Construction Projects in Vietnam"; *Engineering Construction and Architectural Management*"; vol. 11, no. 6, pp. 404-413, 2004.
- [3] Chapman, S.N., Arnold, J.T. and Clive, L.M., *Introduction to Materials Management*, Upper Saddle River, NJ, USA: Pearson Prentice Hall, 2012.
- [4] Shen L.Y., and Tam, V.W., "Implementation of Environmental Management in the Hong Kong Construction Industry"; *International Journal of Project Management*; vol. 20, no. 7, pp.535–543, 2002.
- [5] Che Wan Putra, C.F., Ahmad, A., Abd Majid, M.Z. and Kasim, N., "Improving Material Scheduling for Construction Industry in Malaysia"; *Malaysian Science & Technology Congress*; Johor Bahru, Malaysia, 6-8 Disemher 1999.
- [6] Enshassi, A., "Materials Control and Waste on Building Sites"; *Building Research and Information*; vol. 24, no 1, pp. 31–34, 1996.
- [7] Li, H., Chen, Z., Yong, L. and Kong, C., "Application of Integrated GPS and GIS Technology for Reducing Construction Waste and Improving Construction Efficiency"; *Automation in Construction*, vol. 14, no. 3, pp. 323–331, 2005.

- [8] Nagapan, S., Abdul Rahman, I. and Asmi, A, "A Review of Construction Waste Cause Factors"; *Proceedings of the Asian Conference of Real Estate: Sustainable Growth Managing Challenges*; Johor Bahru, Malaysia, 3–5 October 2011.
- [9] Kulatunga, U., Amaratunga, D., Haigh, R. and Rameezdeen, R., "Attitudes and Perceptions of Construction Workforce on Construction Waste in Sri Lanka"; *Management of Environmental Quality: An International Journal*; vol. 17, no. 1, pp. 57–72, 2006.
- [10] Saidu, I. and Shakantu, W., "A Relationship Between Quality-of-Estimating, Construction Material Waste Generation and Cost Overrun in Nigeria"; *Fourth Construction Management Conference*; Nelson Mandela Metropolitan University, South Africa, pp. 95–104, 30 November – 1 December 2015.
- [11] Formoso, C.T., Isatto E.L., and Hirota E.H., "Method of Waste Control in the Building Industry"; *Proceedings of the 7th Conference of the International Group for Lean Construction*; University of California, Berkley, Calif, USA, 1999.
- [12] Shen L.Y. and Tam W.Y., "Implementation of Environmental Management in the Hong Kong Construction Industry"; *International Journal of Project Management*; vol. 20, no. 7, pp. 535–543, 2002.
- [13] Lingard H., Graham, P., and Smithers, G., "Employee Perceptions of the Waste Management"; *Construction Management and Economics*; vol. 18, no. 4, pp. 383–393, 2000.
- [14] Ekanayake L. and Ofori G., "Construction Material Waste Source Evaluation"; *Proceedings of the 2nd South African on Sustainable Development in the Built Environment*; Pretoria, South Africa, 2000.

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