

Causes of Structural Material Wastage on Building Construction Sites in Ebonyi State of Nigeria

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Abstract:

Background/Objective: Structural material wastage happens often on building construction sites. Reports of past research associate abandoned building projects in the developing nations with waste of materials during construction phase. Wastage of construction materials leads to financial and periodic building project failures. This paper determined causes of structural material wastage on building construction sites in Ebonyi state of Nigeria. **Methods/Statistical Analysis:** The descriptive survey design was used for the study. The target population was all craftsmen and supervisors of building construction in Ebonyi State of Nigeria. A structured questionnaire in line with the formulated research questions was used to guide the study. The statistical mean, standard deviation, and t-test analysis were used to analyze the data. **Findings:** Findings of the study showed that poor management of the structural materials, improper structural material storage, wrong measurement of the materials, and inadequate finished product by the craftsman are craftsman-based factors that cause high structural wastage on the building construction sites in Ebonyi state. Also, inadequate construction planning, inability to maintain construction specifications, hiring of incompetent craftsman, and poor supervision of material management are supervision-based factors that cause structural materials wastage on building construction sites in Ebonyi state. The paper recommended that building construction craftsmen and supervisors should be trained properly and motivated adequately to ensure effective handling of the construction materials towards structural material waste minimization in building construction sites. **Application/Improvement:** The findings of the study could be used in building technology and engineering economics, and in waste management and control for sustainable building construction projects.

Keywords —**Structural material, Material waste, Building construction, Waste generation, Construction site.**

I. INTRODUCTION

Construction materials that withstand forces are essential in the building construction industry. These construction materials are referred to as structural materials. Adedeji [1] describes structural materials as construction materials that have the ability to withstand both internal and

external forces considered in the design of a structural framework. They are basic ingredients of the building projects [2]. It is obvious that the cost, quality and durability of building and civil engineering projects depend largely on the type, quality, and quantity of structural materials used [3]. Patel and Vyas [4] opine that the manner at

which these materials are handled in construction sites affects the overall cost of building project.

Inappropriate handling of the construction materials could cause waste of the materials. Shen et al., [5] and Barbuta et al. [6] disclosed that materials wastage occurs at all stages of material handling on the sites: on arrival, when stacked, when moved and when fixed in position. In addition, factors like the craftsman factor and supervision factor could influence the amount of wastes generated in construction sites. It implies that workers that handle the materials and supervisors of the project during construction process could cause wastage of the structural materials. In the past, researchers like Adewuyi and Otali [7] used mixed method of research to assess the causes of construction material waste on building sites in River state of Nigeria. They reported that rework contrary to drawing and specification, design changes and revision, and waste from uneconomical shapes are the most common factors that contribute to material waste generation on building sites.

Whyte, Isaac and Lilly [8] adopted the relative importance index method to analyze the primary data derived from the responses to the structured questionnaire sent to the respective selected construction companies to study the sources and causes of material waste and effect on cost overrun at preconstruction and construction phases of building projects. Their finding of the study affirms that last minute client requirement, which leads to design variation is the main source of material waste in the building industry.

Bekr [9] studied the causes and magnitude of materials on construction sites in Jordan. They used questionnaire to gather information from respondents on causes and percentage of wastage of ten most popular kinds of materials used on

construction sites in Jordan. They disclosed that the most important causes of wastage of materials on construction sites in Jordan are frequent design and client's changes, rework due to workers mistakes, poor site condition, and poor contract documents, including others.

Although past studies have investigated causes of material waste, and waste management in construction sites, the studies are insufficient to draw rational conclusion on issues bordering construction wastes. In this paper, the causes of structural material wastage on building construction sites in Ebonyi state of Nigeria were determined. Emphasis was laid on the craftsman-based and supervision-based structural material wastages on the building construction sites. The study is significant in building technology and engineering economics, and waste management and control towards sustainable building construction projects.

A. Statement of the Problem

Material wastage has become a regular phenomenon in building construction sites. Reports of previous research associate abandoned building projects in the developing nations with waste of materials during construction stage. Wastage of construction materials leads to financial and periodic building project failures. Although past researchers have carried out studies on causes of material waste and waste management in construction sites, the studies are insufficient to draw rational conclusion on topics bordering construction wastes. A study on causes of structural material wastage on building construction sites calls for urgent research attention to lessen the above-mentioned problems. The research could direct future research on effective waste management of building construction materials in developing nations.

B. Research Objectives

- I. To determine craftsman-based causes of structural material wastage on building construction sites in Ebonyi state.
- II. To determine supervision-based causes of structural material wastage on building construction sites in Ebonyi state.

C. Research Questions

- I. What are the craftsman-based causes of structural material wastage on building construction sites in Ebonyi state?
- II. What are the supervision-based causes of structural material wastage on building construction sites in Ebonyi state?

D. Hypothesis

- Ho₁ There is no significant difference in the mean responses of respondents on building construction craftsmen and supervisors on craftsman-based causes of structural material wastage on building construction sites in Ebonyi state.
- Ho₂ There is no significant difference in the mean responses of respondents on building construction craftsmen and supervisors on supervision-based causes of structural material wastage on building construction sites in Ebonyi state.

II. METHODOLOGY

The survey research design was used for the research. The study was carried out in Ebonyi State of Nigeria. The target population was all craftsmen and supervisors of building construction in Ebonyi State of Nigeria. A questionnaire survey that contained 13-item statements was administered to 200 respondents over a period of four weeks. The respondents were selected from the three

geopolitical zones of the state. The questionnaire sought for information from the respondents on craftsman-based and supervision-based causes of structural material wastage on building construction sites in Ebonyi state. The research instrument exhibited a Cronbach’s alpha reliability coefficient of 0.86.

The general characterises of the respondents are shown in Table 1. 75 % of the respondents were craftsmen while supervisors constitutes 25 % of the respondents. The opinion of the respondents was studied in line with the general characteristics of the respondents. 200 survey answers were returned, found reliable and used in the data analysis.

The statistical mean, standard deviation and t-test were used to analyse the data. The decision rule for the mean statistics was 3.0. A mean of 3.0 and above was accepted, while a mean below 3.0 was rejected.

TABLE 1
 GENERAL CHARACTERISTICS OF THE RESPONDENTS

Variable	Category	Person (%)
Status	craftsmen	150(75)
	supervisors	50(25)
	total	200(100)

Source: Researcher’s field work (2019)

III. RESULTS

Table 2 shows the results of the mean and standard deviation analysis of the respondents on craftsman-based causes of structural material wastage on building construction sites in Ebonyi state. Table 3 contains t-test analysis of the mean rating of the responses of building construction craftsmen and supervisors on craftsman-based causes of structural material wastage on building construction sites in Ebonyi state. Table 4 shows the results of the mean and standard deviation

analysis of the respondents on supervision-based causes of structural material wastage on building construction sites in Ebonyi state. Table 5 contains t-test analysis of the mean rating of the responses of building construction craftsmen and supervisors on supervision-based causes of structural material wastage on building construction sites in Ebonyi state.

IV. DISCUSSION OF FINDINGS

The mean rating and standard deviations results presented in Table 2 showed that all the five craftsman-based factors in the item statements cause structural material wastage on building construction sites with a grand mean of 3.50. Poor management of structural materials, improper structural material storage, and inadequate finished product by the craftsman have mean ratings of 3.85, 3.63 and 3.52 respectively. The respondents agree that wrong measurement of structural materials, and careless attitude of the craftsman cause structural material wastage with a mean ratings of 3.34 and 3.16. The finding of the study depicts likelihood of high cost of undertaking housing projects in Ebonyi state if the possible craftsman-based causes of structural material wastage in the construction sites are not checked. The finding of the study is in line with the submission of Anyigor-Ogah and Egba [10] and Nwekete and Egba [3] that artisans generate material wastes that have unpleasant consequences on the environment and economy of a given society. The t-test analysis in Table 3 indicates that the assumption that there is no significant difference in the opinions of building construction craftsmen and supervisors on craftsman-based causes of structural material wastage in building construction sites in Ebonyi state was upheld at 95 % confidence level for all the five items.

Analysis of the results in Table 4 revealed that inadequate construction planning, inability to maintain construction specifications, hiring of incompetent craftsman, and poor supervision of material management are supervision-based factors that cause structural materials wastage on building construction sites with mean scores of 4.33, 4.24, 4.20 and 3.94 respectively. Other supervision-based factors that cause structural materials wastage in building construction sites are poor site organisation, improper storage facility management, poor relationship among the supervisor and craftsman, and poor supervision of the use of structural materials with mean ratings of 3.04, 3.46, 3.67 and 3.78. The results indicated that all the supervision-based factors cause structural materials wastage on building construction sites in Ebonyi state with a grand mean of 3.82. It corresponds to the assertion of Egba et al [11], which connotes that the building construction supervisor is important personnel that need proper management in building construction sites for successful project delivery, and proper material waste management. The finding of the study also agrees with the submission of Bekr [9] that poor site condition and management causes wastage of materials on construction sites. The t-test analysis in Table 5 shows that the assumption that there is no significant difference in the opinions of building construction craftsmen and supervisors on supervision-based causes of structural material wastage in building construction sites in Ebonyi state was upheld at 95 % confidence level for all the eight items.

V. CONCLUSION AND RECOMMENDATION

The paper discussed causes of structural material wastage on building construction sites in Ebonyi state of Nigeria. The study used the questionnaire research instrument to collect data from 200 respondents on craftsman-based and supervision-based causes of structural material wastage on building construction sites in Ebonyi state. The questionnaire contains 5-item statements for craftsman-based causes of structural material wastage, and 8-item statements for supervision-based structural material wastage. The 200 copies of the questionnaire survey were returned, found reliable and utilized in the study. The response of the respondents was studied based on status variable (craftsmen and supervisors). The statistical mean, standard deviation and t-test were used to analyze the data. The following deductions were made, namely:

- Poor management of the structural materials, improper structural material storage, wrong measurement of the materials, and inadequate finished product by the craftsman are craftsman-based factors that cause high structural wastage on the building construction sites in Ebonyi state.
- Inadequate construction planning, inability to maintain construction specifications, hiring of incompetent craftsman, and poor supervision of material management are supervision-based factors that cause structural materials wastage on building construction sites in Ebonyi state.
- There is no significant difference in the opinion of the respondents on causes of structural material wastage on building construction sites in Ebonyi state at 95 % confidence level.

Based on the findings of the study, it was recommended that building construction craftsmen and supervisors should be trained properly and motivated adequately to ensure effective handling of the construction materials towards structural material waste minimization in building construction sites. The findings of the study could be used in building technology and engineering economics, and in waste management and control for sustainable building construction projects.

REFERENCES

- [1] Y. M. D. Adedeji, "Sustainable housing provision: preference for the use of interlocking masonry in housing delivery in Nigeria," *Scientific & Academic Publishing (SAP): Architecture Research*, vol. 2, issue 4, p. 55-59, 2012.
- [2] S. Kumar, *A Practical Guide in the Technique of Building Construction for Student*, New Delhi: Standard publishers Distributors, 2010.
- [3] J. C. Nwekete, and E. I. Egba "Determining extent of structural material wastage in building construction sites in Ebonyi State of Nigeria," *African Scholar Journal of Env. Design & Construction Mgt*, vol. 18, issue 4, p. 127-136, 2020.
- [4] K. V. Patel, and C. M. Vyas, "Construction materials management on project sites," *A paper presented in the National Conference on Recent Trends in Engineering & Technology at the B. V. M. Engineering College, V. V. Nagar, Gujarat, India*, May 2011, p. 13-14.
- [5] L.Y. Shen, V. W. Y. Tam, C. W. S. Chan, and S. Y. J. Kong, "An examination on the waste management practice in the local construction site," *Hong Kong Surveyors*, vol. 13, p. 39-48, 2002.
- [6] M. Barbuta, R. Bucur, S. M. Cimpeanu, G. Paraschiv, and D. Bucur, (2015) Wastes in building materials industry [ONLINE], Available: <http://dx.doi.org/10.5772/59933>.
- [7] T. O. Adewuyi, and M. Otali, "Evaluation of causes of construction material waste -- case of Rivers State, Nigeria," *Ethiopian Journal of Environmental Studies and Management*, vol. 6, p. 746-753, 2013.
- [8] O. B. Whyte, O. E. Isaac, and M. T. Lilly, "Sources and causes of material waste and effect of material waste on cost overrun in the construction industry: a case study," *American Journal of Engineering Research*, vol. 7, issue 12, p. 13-22, 2018.
- [9] G. A. Bekr, "Study of the causes and magnitude of wastage of materials on construction sites in Jordan," *Journal of Construction Engineering*, Article ID 283298 | <https://doi.org/10.1155/2014/283298>, p. 1-7, 2014.
- [10] A. C. Anyigor-Ogah, and E. I. Egba, "Enhancing waste management in technical and vocational jobs through information technology," *Chemical Engineering Transactions*, vol. 63, p. 625-630, 2018.
- [11] E. I. Egba, E. B. Ogunbode, A. S. Elnafaty, S. Moveh, and C. Aliyu, "Repositioning activities of building industry professionals towards cleaner and sustainable housing in Nigeria," *Chemical Engineering Transactions*, vol. 61, p. 1705-1710, 2017.

TABLE 2.

MEAN AND STANDARD DEVIATION RESPONSES OF THE RESPONDENTS ON CRAFTSMAN-BASED CAUSES OF STRUCTURAL MATERIAL WASTAGE ON BUILDING CONSTRUCTION SITES IN EBONYI STATE.

S/N	Item Statements	X	SD	Remarks
1	Poor management of the structural materials	3.85	0.99	Accept
2	Improper structural material storage	3.63	1.03	Accept
3	Wrong measurement of the materials	3.34	1.16	Accept
4	Careless attitude of the craftsman	3.16	1.01	Accept
5	Inadequate finished product by the craftsman	3.52	1.08	Accept
	Grand mean	3.50		Accept

Source: Researcher's field work (2019)

TABLE 3.

T-TEST ANALYSIS OF THE MEAN RATING OF THE RESPONSES OF BUILDING CONSTRUCTION CRAFTSMEN, AND SUPERVISORS ON CRAFTSMAN-BASED CAUSES OF STRUCTURAL MATERIAL WASTAGE ON BUILDING CONSTRUCTION SITES IN EBONYI STATE N=200

Variable	N	X	SD	Df	t-cal	t-tab	Decision
Item 1 Craftsmen	150	3.86	1.00	199	0.187	1.96	Accept Ho
Supervisors	50	3.83	0.98				
Item 2 Craftsmen	150	3.64	1.04	199	0.179	1.96	Accept Ho
Supervisors	50	3.61	1.02				
Item 3 Craftsmen	150	3.33	1.16	199	-0.159	1.96	Accept Ho
Supervisors	50	3.36	1.15				
Item 4 Craftsmen	150	3.17	1.01	199	0.181	1.96	Accept Ho
Supervisors	50	3.14	1.02				
Item 5 Craftsmen	150	3.53	1.08	199	0.169	1.96	Accept Ho
Supervisors	50	3.50	1.09				

@ 95 % confidence level

Source: Researcher's field work (2019)

TABLE 4.

MEAN AND STANDARD DEVIATION RESPONSES OF THE RESPONDENTS ON SUPERVISION-BASED CAUSES OF STRUCTURAL MATERIAL WASTAGE ON BUILDING CONSTRUCTION SITES IN EBONYI STATE.

S/N	Item Statements	X	SD	Remarks
6	Poor site organisation	3.04	1.08	Accept
7	Inadequate construction planning	4.33	0.96	Accept
8	Hiring of incompetent craftsman	4.20	1.13	Accept
9	Poor supervision of material management	3.94	1.06	Accept
10	Improper storage facility management	3.46	1.02	Accept
11	Inability to maintain construction specifications	4.24	0.94	Accept
12	Poor supervision of the use of structural materials	3.78	1.05	Accept
13	Poor relationship among the supervisor and craftsman	3.67	1.07	Accept
	Grand mean	3.83		Accept

Source: Researcher's field work (2019)

TABLE 5.

T-TEST ANALYSIS OF THE MEAN RATING OF THE RESPONSES OF BUILDING CONSTRUCTION CRAFTSMEN, AND SUPERVISORS ON SUPERVISION-BASED CAUSES OF STRUCTURAL MATERIAL WASTAGE ON BUILDING CONSTRUCTION SITES IN EBONYI STATE N=200

Variable		N	X	SD	Df	t-cal	t-tab	Decision
Item 6	Craftsmen	150	3.04	1.09	199	0.057	1.96	Accept Ho
	Supervisors	50	3.03	1.06				
Item 7	Craftsmen	150	4.34	0.96	199	0.193	1.96	Accept Ho
	Supervisors	50	4.31	0.95				
Item 8	Craftsmen	150	4.21	1.14	199	0.164	1.96	Accept Ho
	Supervisors	50	4.18	1.11				
Item 9	Craftsmen	150	3.95	1.06	199	0.175	1.96	Accept Ho
	Supervisors	50	3.92	1.05				
Item 10	Craftsmen	150	3.47	1.02	199	0.198	1.96	Accept Ho
	Supervisors	50	3.44	1.00				
Item 11	Craftsmen	150	4.23	0.95	199	-0.132	1.96	Accept Ho
	Supervisors	50	4.25	0.92				
Item 12	Craftsmen	150	3.79	1.05	199	0.177	1.96	Accept Ho
	Supervisors	50	3.76	1.03				
Item 13	Craftsmen	150	3.68	1.08	199	0.172	1.96	Accept Ho
	Supervisors	50	3.65	1.06				

@ 95 % confidence level

Source: Researcher's field work (2019)