ASSESSMENT OF CONSTRUCTION WASTE MANAGEMENT IN NIGERIAN BUILDING PROJECTS

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ABSTRACT
Construction and demolition waste management is one of the major environmental problems facing this country. Waste management entails reduction, recycles and reuse. The paper is to assess the causes of wastage on construction site, finding out which of the various trades generate highest level of waste on site. This will give insight to site activities focused should be in order to reduce building waste. The need for the paper is as a result of increase in the number of construction works and reduction in the landfills. The objectives are to examine the causes of wastage on site, assess the wastage level among the various trades, and to identify the strategy of managing construction and demolition waste on site. The research is conducted by means of questionnaire and by visiting work site. It was discovered that sorting of construction and demolition waste and recycling of waste materials are not widely practiced and formwork was the major contributor to the construction waste on most of the sites surveyed. It was recommended that government should impose charges; the construction company based on the volume of the waste generated and should encourage recycling of most of the used materials.
Keywords: *Construction, waste; recycling; reduction; and disposal*

1.0 INTRODUCTION

In the past nine years, rate of building development, as well as infrastructure development and rate of collapsed buildings have led to a significant increase in construction and demolition waste. Construction industry is one of the major solid waste generating sectors in this country according to Kibert (1994). A lot of emphasis is placed on solid waste generation with little emphasis on the construction and demolition waste. Construction and demolition waste management is one of the major environmental problems facing this country. Tremendous amounts of construction and demolition (C&D) wastes are being generated from ongoing new construction works as well as renovation and demolition works. Excessive building and infrastructure development projects as well as redevelopment of old structure have led to a significant increase in construction and demolition (C and D) waste generation in the last few years. In Nigeria, little emphasis has been paid on the control of generation of C and D waste in building projects. This can be attributed to the availability of relatively inexpensive (currently free) means of waste disposal and the generally low environmental awareness of the construction industry. Construction waste management strategy comprises of reducing, recycling and reuse of the materials generated as waste on construction sites. The problem to be addressed by this paper is to find out which of the variety of construction activities (trades) generate high level of wastage on construction sites.

2.0 OBJECTIVES.

The objectives of the study is to examine the causes of materials wastes on site, assess the waste level among the various site activities (trades) and to proffer solution to avoid or reduce materials wastage on sites

3.0 METHODOLOGY

The study is carried out by means of questionnaire, personal observation and interview on visited sites. The sites visited were randomly selected within the state capital of Kebbi State. The respondents were the building professionals such as construction managers, architects, structural engineers and foremen. Ten different building project sites were visited. Forty respondents opinion were finally analyzed. The selection of this class of respondents was informed by their experience and depth of knowledge in the

subject matter on the site visited. Ten different site activities (trade) were identified on the sites visited.

Respondents' opinions were analyzed using descriptive statistics. Frequencies of responses were analyzed using percentage, the mean score of site activities prone to waste were ranked on a five point Likert scale. The activity with the greatest mean was ranked the most significant contributors to waste generation, and any factor having a mean score below 3.00 was considered not a significant contributor (Unoh and Odesola, 2006). The attached Appendix A shows the data obtained from sites visited, although waste index formula is applied to get some of the information in the columns.

4.0 CONSTRUCTION WASTE REDUCTION STRATEGIES

The best way to reduce impact upon landfill once we have adopted waste reduction practices in design and construction is to sort the waste on –site before disposal. This will ultimately open up recycling and therefore business opportunities for recyclers. On –site sorting should be an integral part of construction waste management. Sorting technique is one of the most important factors for waste recycling (Hen et al, 1992). The strategy to manage construction and demolition (C and D) material comprises three tasks: reduce, reuse and recycle.

According to Toe and Loosemore (2001) there are two principles in reducing waste, first to reduce the quantity generated , and second to adopt an effective system to manage unavoidable waste. Reuse and recycling are the best methods of dealing with unavoidable waste. Reduction and reuse are preferable to recycling, which requires waste to be re- processed before it can be reused (Lingard et al, 2001). The next best disposal route is energy recovery from incineration, although it does have some undesirable environmental effects. Disposal to landfill is the least desirable approach. Landfill is the traditional approach to waste management. Majority of waste throughout the world goes to landfill. The purpose of waste management is to reduce the amount of waste produced, thus reducing disposal costs and the environmental impact according to Pitt and (2002). In the opinion of Pitt and Smith (2003) social costs will be reduced in turns for residential communities near landfill sites and incinerators.

The materials for building projects are numerous ranging from the most common sand, reinforcement bars, tiles, timber just to mention but a few. Examination of the life cycle of the materials on site from inception of project to completion shows those large portions of the materials are being wasted because of poor material control on site. Bossink and Brouwers' (1996) assert that 1-10% by weight of the purchased construction materials leaves the sites of projects as waste. Public fill is full of substances such as debris, rubble; earth and concrete which are suitable for land reclamation and site formation, and a large proportion of the public fill can be reused / recycled.

Construction and demolition waste contains a mixture of inert substances and non inert substances as explained by Evia and Robin (2004), Poon et al (2004b) Poon and Jaillon (2004) and Pitt and Smith (2003). Poon et al (2004) classified the main kinds of building construction waste as structure waste and finishing waste. Structure waste are waste generated during the course of construction while finishing waste is generated during the finishing stage of a building such as cement mortar, broken tiles, paints. Example of inert substances are sand, blocks and concrete while that of non-inert substances are bamboo, plastics, glass wood and organic materials. Evia and Roblin (2004) claim that construction and demolition (C and D)waste with more than 50% of inert substances is not acceptable to landfills and thus the inert substances should be sorted out from C & D waste before they are disposed of at landfills. When properly sorted, material such as clean concrete and asphalt can be recycled for use in construction. Poon et al (2004 b) affirmed that an effective means is to reduce disposal of waste at landfills, by separating the inert portion from the non inert portion. Non inert waste would be disposed of at landfills while inert waste could be reused / recycled.

Waste according to Ojimelekwe (1999) occurs on site at all stages of materials handling when they arrive, when they are stacked/ stored, when they are moved and when they are fixed or placed. Some actions off-site contribute to waste such as poor specification, lack of dimensional co-ordination etc, and the operatives who handle the material on- site. Pitt and Smith (2003) assert that increase in demand for roads, air travel, building projects etc. has led to increase construction activity. Construction industry has

been slow to embrace environmentally friendly practices and for decades, landfill has provided a convenient and cost effective solution to its wasteful practices. Pitt et al (2002) confirmed that landfill is the traditional approach to waste management. The majority of waste throughout the world goes to landfill. The best way to reduce impact upon landfill once waste is generated on site is to sort the waste on site before disposal. This will open up recycling and therefore, business opportunities for recyclers. On- site sorting should be an integral part of construction waste management. The on-site sorting technique is used for sorting inert from non inert waste is one of the most important factors for waste recycling. Poon et al (2004_b) affirm that descriptions for sorting, segregation labeling, storing, protecting and disposing procedure should be described more fully.

The factors affecting the choice of a sorting scheme are as follows: site space, management effort, labour, cost interference with normal site activities, and waste storability. Site space is the most dominating factor affecting the choice of an on-site sorting. The various equipment uses in the management of C and D waste are truck, refuse chute and refuse bins. For proper waste management, a waste management plan should puts the waste issue on the map, making it the step to identify whether potential waste problems exist. In general, a waste management plan lists specific wastes and identifies the amounts to be targeted for reduction, salvage, and reuse (McDonald and Smithers, 1998).

There is need to plan ahead of waste before generating it, and for effective planning the need for quantities of waste to be generated is important. The calculation of the waste index aims at helping the project manager of a building project to anticipate the quantities of waste that will be produced in projects in order to establish awareness of waste management to develop good planning on resources and environmental management and to reduce wastes generated during all stages of a construction project. The methodology of calculating the waste index is as follows according to Poon *et al* (2004)

V = Trunk Volume (m^3)
N = Total no. of trunks for waste disposal
W = Total waste generated from the project (m^3) = V x N.
C = Waste index = $\frac{W}{GFA}$

Recycling of construction and demolition waste involves the sequence of activities, including collection and separation of C & D waste generated from construction projects, and transforming them into secondary materials for construction use.

5.0 RESEARCH FINDINGS AND DISCUSSION

The materials found to be majorly wasted on sites are; timber, block work, concrete, and tiles. Timber formwork was the major contributor to construction waste. Closely followed the timber formwork is wet trades in finishing such as screeding, rendering to walls and ceiling. Third on the list is concrete work, most of the site visited made use of in-situ concrete and fourth on the list is block work. It was noted that human factor were the major cause of the wastage. Most of the materials significant to waste are as a result improper handling, misuse, incorrect processing.

It was also discovered from the research that most of the sites visited do not recycle any of their construction and demolition waste. They claimed that they are not aware of any C & D recycling process in their locality talk less of sorting construction and demolition waste at source. Metal steel formworks were fully recovered without waste. It was discovered that proper management were given to materials that have a significant impact on the project cost.

Table 1. Construction activities responsible for waste generation, their ranking and mean.

S/NO	Construction Activities	Score						Remark	Rank	Causes of Waste
		5	4	3	2	1	Mean			
1.	Timber Formworking	30	6	3	1	-	4.63	S	1ST	-Cutting scrap - Striking of Formwork - Removal on completion
2.	Metal formwork	-	1	1	6	32	1.18	N.S	10th	-
3.	Reinforcement bar (Fixing)	-	4	6	26	5	2.28	N.S	8th	- Cutting Scrap
4.	Concrete work	1	27	8	3	1	3.6	S.	3rd	- Leftover as residue - Waste on transporting
5.	Block work	-	26	9	3	2	3.48	S.	4th	- Transporting - Unloading & Stacking - Laying -excessive ordering -cutting waste
6.	Plastering (floor, walls & ceiling)	24	10	3	2	1	4.35	S.	2nd	- Applying waste - Unavoidable waste
7.	Tiling	2	19	4	10	5	3.08	S.	5th	- Cutting - Transporting - loading & Unloading -careless handling
8.	Plumbing work	1	16	8	8	7	2.90	N.S	6th	- Cutting waste -careless handling
9.	Painting	-	2	2	26	10	1.90	N.S	9th	- Residual waste -poor handling
10.	Electrical work	-	18	6	6	10	2.8	N.S	7th	-Cutting waste -damage due to careless handling

Note: S – Significant; N .S – Not Significant; Grand mean (X) = 3.14

From the above table, timber formworking had the highest means of 4.63, closely followed by plastering with mean score of 4.35. These implied that they significant contributed to the level of waste on construction sites. Metal formworking, reinforcement bars, plumbing and electrical works had mean score less than 3.00 which implied that they are non significant to the level of construction waste on the sites visited.

6.0 CONCLUSION

Sorting of construction and demolition waste at source and using recycled building materials are not widely practiced in Nigeria construction sites. They are not considered to be cost effective. Most of the site claimed that they are not aware of any recycling process in their locality. A lot of resources can be conserved and the amount of construction and demolition waste required to be disposed of should be greatly reduced if better management is practiced on building sites. Improper preparation and handling, misuse and incorrect processing were the major cause of material waste on construction sites. More management attention was given to the materials that have a significant impact on the project cost.

7.0 RECOMMENDATION

Based on the findings from the study the followings are therefore recommended:

1) Government should try to encourage good waste management on construction site by implementing a pay for waste management scheme. Under the scheme, contractors of government projects should be required to prepare and implement a waste management plan and carry out on-site sorting of construction waste before certain payment under the contracts are made.
2) It is suggested that contractors should provide the client with the waste indices (in m3/GFA) of their completed projects as a contract document. The client or developer can carry out periodic audits and disseminate the

waste indices to the public regularly. These waste indices can be used as a reference for future projects to promote waste minimization.

3) Recycle/reuse materials should be stored in a designated area that is clearly labelled and the wastes should be kept from contamination that may make them unsuitable for recycle. The projects should be handled by experienced contractors to reduce the level of waste generations.

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PPENDIX A

PROJECTS SURVEYED AND WASTE GENERATED

	Nature of project	No of truck of gene-rated waste	volume of waste gene-rated (m3) W	Gross Floor Area (m2) (GFA)	Waste index (W/GFA)
	A five storey shopping complex	6	19.68	320	0.062
	Haliru Abdul Islamic centre	8	26.24	280	0.094
	An ultra modern super market	7	22.96	240	0.096
	School of nursing ,Aliero	8	26.24	260	0.101
	College of Engineering Mult-purpose hall	3	9.84	100	0.098
	State library complex, Birnin Kebbi	4	13.12	120	0.109
	Federal poly girls' hall	8	19.68	120	0.164
	Badariya supermarket	8	26.24	110	0.239
	Presidential lodge, Birnin Kebbi	9	29.32	340	0.087
	Gesse phase II 3-bedroom flat (5 types)	10	32.8	420	0.07

Source: Author's field survey, (undated)