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A MANAGEMENT APPROACH TO CONSTRUCTION AND DEMOLITION WASTES IN IBADAN METROPOLIS

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Abstract - The construction and demolition waste impacts negatively on the natural economy and the environment. This paper examines some engineering and management approaches such as waste segregation, reduction concept, reuse concept, waste exchange concept and waste rethink concept to construction and demolition wastes in Ibadan Metropolis. Two sites each were visited for construction and demolition activities to observe and quantity their waste characteristics. Construction site A is of a 40.375m length by 39.225m width storey building at decking slap stage with a total waste components of 2500Kg having 32% of it as wood(planks) and 36% of it as bamboo. Construction site B has 42.1m length by 24.385m width storey building at lintel stage has total waste components of 625.5Kg with 48% of it being wood(planks) and 0.90% of it being cement bags(sacks). Demolition site C has a total of 10850Kg with 92.2% of it as concrete/brick wastes and 0.50% of it constitutes electrical and paper materials and demolition site D of total waste components of 8630Kg has 93% of it as concrete/brick materials and 2.3% as metal wastes. These figures show that an enormous amount of wastes are generated from construction and demolition activities and if not properly managed, it could negatively impact our environment. Therefore, it is ideal that appropriate measures are taken to ensure effective management of these waste hence the various waste components identified in all the sites under consideration can be harnessed and transformed into other uses.

Keywords: Construction, demolition, wastes, reduce, recycle, management and components.

1 INTRODUCTION

The term waste derives from the latin “vastus”, meaning to ravage, to leave desolate, or to fail to cultivate [1]. [2] suggested that wastes could be defined as things that one does not want, or fails to use. Therefore waste can be regarded as materials that are discarded because they are deemed to be worthless or unneeded.

Construction and demolition (C&D) waste is a term commonly used when referring to waste resulting from the construction industry. It encompasses a wide variety of materials resulting from various activities including soil, rocks and vegetation resulting from excavation, land levelling, civil works and site clearance [3]. They also include road work materials like aggregates and pavement, worksite waste materials such as wood, plastic, paper, glass and metals and demolition waste which include bricks, concrete, soil, gravel, gypsum and steel.

Ibadan, the study area, is the capital of Oyo State found in the Southwestern part of Nigeria and it is one of the largest indigenous metropolitan areas in Sub-Saharan Africa with an estimated population of about two million coming from different parts of Nigeria and other parts of the world. The City, located on a major transport route to the northern parts of Nigeria, is the largest contemporary traditional Yoruba town.

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Due to the rapid growth in the City population in the recent time which has led to erecting of structures in areas not supposed to and traffic congestion in most main roads, it has become extremely difficult for the State Government to manage the affairs of the State well and that has led to enormous wastes generated from demolition and construction of such structures (found in areas like Eleyele, Sango, Polytechnic road, Ring road, Molete) that poses a great threat to economic development. Construction, demolition, reconstruction and restoration of buildings result in high quantities of C&D wastes, also known as rubbles [4]. In Nigeria, a huge quantity of construction and demolition waste is always generated or produced every year. The disposal of the waste has become a severe social and environmental problem in the country. In 2009, when the Nigerian Railways Corporation (NRC) demolished all the structures near its rail lines, across the country, a lot of wastes were generated. In most parts of the country, landfill space is diminishing, therefore instead of looking for a space to dispose the rubble, it is rather appropriate for rubbles as concrete to be reduced, recycled and reused in most construction works again. Waste in the construction industry is important not only from the perspective of efficiency, but also in terms of the effect of the waste of building materials on the environment and it is also a major generator of waste in any society [5]. The construction industry has a major impact on the environment, both in terms of the resources it consumes and the waste it produces. It is responsible for reproducing a whole variety of different wastes, the amount and the type of which depends on factors such as the stage of construction, type of construction work and practices on site [6]. Waste has been considered to be a major problem in the construction and not only does it have an impact on the efficiency of the construction industry but also on the overall

state of the economy of a Country [7]. Demolition waste is considered as the debris that is generated when existing structures are removed. The removal of these structures may be due to different factors. When a structure is built with sub-standard materials such that it poses a threat to both lives and properties, in such case, it warrants that the structures be removed. If structures are situated in areas prone to flood, high tension cables and areas meant for specific purposes, such structures are also meant to be demolished. The removal of these structures constitutes waste generation which can be detrimental if not properly managed. With some of these factors in mind, it is worthy to note that the economic growth of any Nation or State depends largely on how existing structures comply with the master plan. The most largely type of waste common in demolition works include rubble materials such as concrete, brick, wood, roofing materials and sometimes metals. Due to the bulky nature of some of these wastes, their presence in the environment constitutes a lot of problems ranging from environmental degradation to traffic congestion on roads.

Within the City of Ibadan, the volume of C&D waste is growing as several structures are being demolished, new ones are under construction and renovation of old and partially demolished ones are ongoing. However, all these are as a result of Oyo State Government's effort to ensure that resources and infrastructural development correspond with the rapid Urbanization which the State is experiencing in the recent times. Moreover, the high level of construction and demolition waste generated in the State in recent time calls for immediate attention as its effects on the Socio-economic and environment cannot be overlooked. Depletion of natural resources and scarcity of, and difficulty in siting landfills encouraged the consideration of alternative ways for managing construction and demolition waste [8, 3 and 9]. These strategies, if judiciously employed will not only minimize the environmental impacts but will also provide employment opportunities to the Citizens of the State. These management strategies which is termed the 4R's include: Reduce, Recycle, Reuse and Rethink. . This concept necessitated the research which was aimed at looking at the different strategies that could be used to harness and manage this waste so as to minimize its effects on the Socio-economic and environment within Ibadan metropolis.

2 MATERIALS AND METHODS

Ibadan, the study area, is located on Longitude 3º 54'E and Latitude 7º 23'N. Different construction and demolition sites in Ibadan metropolis were visited out of which two construction and demolition sites each were selected as study areas. Two study areas on construction were located within the University of Ibadan environment. One of them is a construction of a 40.375m length by 39.225m width storey building meant for Aquaculture research laboratory and it is located along EL- Kanemi road. The ground floor of this building comprises of 9 offices, 1 lecture room, 1 reading room, 1 reception room, 6 fish ponds, and 4 recirculatory systems with treatment facilities, 4 stores and others. The construction stage of this site as at the time of visit was at the decking slap (Plate 1) and it possesses the following waste components woods (planks), bamboos, concretes/bricks, sands, metals and others and they were grouped as A. The other construction site visited is behind Computer Based Test (CBT) Centre, opposite Faculty of Technology building, University of Ibadan. This site is a 42.1m length by 24.385m width storey building meant for Atmospheric physics experimental laboratory and the ground floor comprises of 14 offices, 2 strong rooms, 1 admission office, 1 conference room and 8 toilets. The construction was at the Lintel stage (Plate 2) and the following waste components were identified: Cement bags (sacks), woods (planks), metals, concretes, bricks and others. The waste components here were grouped as B. Along, Eleyele road, were observed some buildings which were partially demolished and the major constituents of the waste components identified were: Concretes/bricks, wooden frames, and metals. The waste components identified in this site was grouped as C as shown in Plate 3. A similar category of waste components identified in Eleyele road was also identified along Ring road and was grouped as D and is shown in plate 3.

PLATE 1: STAGES OF CONSTRUCTION AT SITE A

PLATE 2: STAGE OF CONSTRUCTION AT SITE B

PLATE 3: WASTES FROM DEMOLISHED STRUCTURES

Questionnaires, interviews and visual inspection were used for this research. They were administered on various constructions and demolitions sites visited. Weighing scale and pan were also used and the various wastes identified in each site were manually sorted and separated into different components.

2.1 Identification, Sorting and Weighing

On visitation to the sites, stakeholders were interviewed to ascertain the stages of work on ground and the dimensions of structure. Visual inspection was used to identify the various waste components available on each site and the waste components identified in each site were sorted (Plates 4, 5, 6, 7and 8) and separated into different components manually with hands. Weighing pan of a known weight and a weighing scale were used to weigh a certain quantity of the wastes from each component and the known quantity was used to quantify the rest of the respective wastes in each component and the percentage of each component to the total weight in each group was also determined.

PLATE 4: SORTED WOOD WASTES

PLATE 5: SORTED BAMBOO WASTES

PLATE 7: SORTED CEMENT BAG WASTES

PLATE 8: SORTING AND TRANSFORMING OF METAL WASTES

3.0 RESULTS AND DISCUSSION

It is very obvious from this research work that enormous amount of wastes are generated via construction and demolition activities and some of these wastes are heavy, having high density, often bulky. The results for the two construction sites visited as presented in Table 1 and Figures 1 and 2 shows some level of similarities in the type of wastes generated but with some significant difference in the quantities of these wastes that were generated. This significant difference in the quantity of wastes generated can be from the size of the structure being constructed, level and stage of construction work, expertise of the workers and level of supervision at every stage of the construction work. The demolition sites visited had as a major constituent, waste of concretes/bricks which are always very bulky (Table 1, Figures 3 and 4) and negligible quantities of electrical and paper wastes which were categorized under others.

TABLE 1: SORTED WASTE COMPONENTS AND THEIR WEIGHTS (KG)

	Construction sites		Demolition sites	
	Group A	Group B	Group C	Group D
Waste components	(Kg)	(Kg)	(Kg)	(Kg)
Wood/plank and wooden frame	800	300	600	400
Bamboo	900	****	****	****
Concrete/brick	400	200	10000	8000
Metals	300	100	200	200
Cement bag/sack	****	5.5	****	****
Others	100	20	50	30

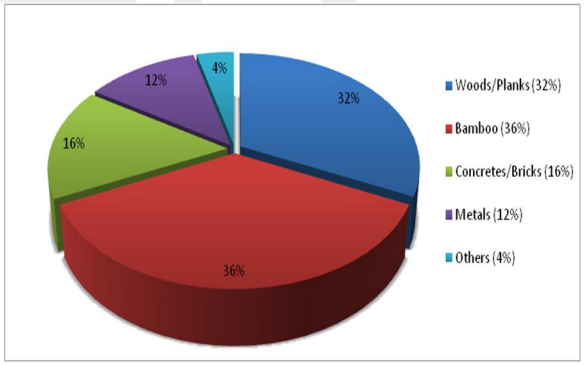

FIGURE 1: PIE CHART SHOWING THE % WEIGHT OF THE VARIOUS WASTE COMPONENTS IDENTIFIED AT CONSTRUCTION SITE A.

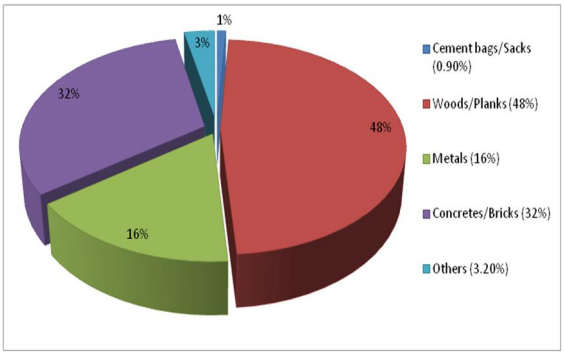

FIGURE 2: PIE CHART SHOWING THE % WEIGHT OF THE VARIOUS WASTE COMPONENTS IDENTIFIED IN CONSTRUCTION SITE B.

3.1 Management strategies to be adopted

3.1.1 Waste reduction concept

a. Design and construct in compliance with master plan: Designing and constructing structures in accordance with the existing master plan will greatly reduce the amount of wastes that would have been generated due to demolition of such structures for not complying with master plan. However, erecting structures in accordance with the master plan will greatly accelerate development in areas of housing, transportation, education, health, employment and waste management.

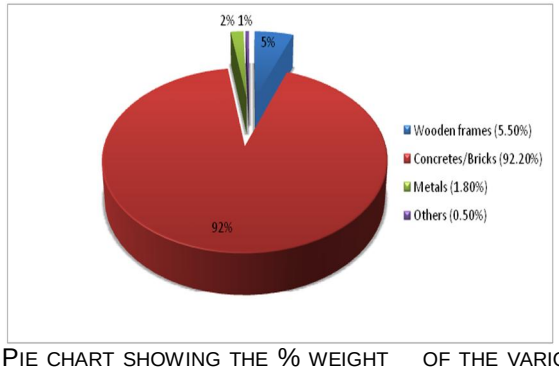

FIGURE 3: PIE CHART SHOWING THE % WEIGHT OF THE VARIOUS WASTE COMPONENTS IDENTIFIED IN DEMOLITION SITE C.

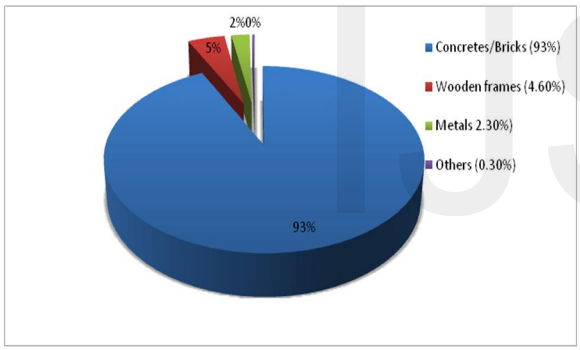

FIGURE 4: PIE CHART SHOWING THE % WEIGHT OF THE IDENTIFIED VARIOUS WASTE COMPONENTS AT DEMOLITION SITE D.

b. Avoid the use of sub-standard materials: Sub-standard materials such as reinforcement rods, steel sections and cement can contribute immensely to collapse of buildings and this will result into loss of lives and properties and generation of wastes. However, avoiding the use of sub-standard materials in construction works will greatly increase the quality of structures, reduce waste generation, and increase the life span of such structures, prevent loss of lives and properties.

c. Proper design and materials specification adherence: Structures will collapse or be demolished when structural drawings and specifications are based on false assumptions of soil strength. They can also collapse as a result of faulty structural details. However, proper design and materials specification adherence will ensure that quality structures are erected and as a result wastes generation due to collapse or demolition of such structures will greatly be reduced.

d. Proper supervision: Adequate and sufficient supervision of every stage of construction and demolition activities will ensure that less waste is produced because proper supervision ensures proper and efficient management of materials. And there will not also be structural failure as long as other factors are checked.

e. Non involvement of quacks in construction: Activities of quacks in construction activities will always result into structural failure and as a result a lot of waste will be generated, lives and properties will also be lost. The Council for the Regulation of Engineering in Nigeria (COREN) should monitor the process and the procedure of awarding contracts especially those that deals with structures to make sure that such contracts are executed by registered Engineers and experts who will abide by the code of conduct in Engineering practices and deliver quality materials and ensures that less waste is generated.

f. Timeliness of operation: Adequate project planning and scheduling is required in any project such as construction and demolition works. This will help to avoid unnecessary time wastage which may result into a lot of wastes been generated. The concept of employing some useful techniques such as Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT) will do a lot of good. These techniques allow activities that are critical to be determined so that energy, resources and time can be focused on such activities. g. The use of appropriate equipment: The use of right equipment for the right task will ensure precision and accuracy and hence less waste will be generated.

h. Involvement of experts in demolition: The use of experts in demolition will ensure that the right steps are followed in the course of demolition. The experts' involvements provides such ideas as demolishing in stages, using the right tools/machinery for demolition and salvage certain materials that can still be reused before structures are completely demolished. All this practice is with a view of reducing the waste that will be generated at the end of the day.

i. Demolition in stages: The demolition in stages here involved careful removal of certain materials that are still relevant for other purposes before the structure is completely demolished.

j. Sorting of wastes at source: Separation of wastes into different components at the source makes it easier for better management. With this kind of practice, those that can be reduced, recycled and reused are seen and are immediately shifted to where they are needed. Pictures of sorted waste components are shown in the Plates above.

3.1.2 The reuse concept

a. Metals and metallic materials: These groups of waste components can be reused for reconstruction. They can also be used locally by blacksmith to produce metallic tools like cutlass/knife, cooking pot stand, pegs and many other valuables. With this kind of practice, the huge costs and environmental pollution associated with producing some of these products from virgin materials are reduced.

b. Cement/sand/plaster/block/brick/concrete: They can be reused for construction, large ones can be used to fill low lying areas and can also be broken down and be used for

potholes filling of our rural roads.

c. Woods (planks)/timbers: This group of waste can be used for making furniture items and to construct animal/poultry houses. They are used to construct temporary workshops and kiosks. They can also be transformed into charcoals and be used for domestic purposes such as cooking.

d. Bamboo: It can still be reused as scaffold in construction and can also be used to construct animal/poultry houses and for domestic purposes such as cooking. Bamboo can be used as a wastewater treatment material by converting it to activated carbon.

e. Plastics and plastic materials: This group can be reused to produce plastic products such as polythene bags, plastic containers and many other valuable plastic products at a very considerable cost and less harm is done to the environment in terms of pollution.

f. Cardboards/papers and paper materials: These groups of waste can be turned into pulps and be used to produce egg crates, serviette papers, tissue papers and other paper products.

3.1.3 Waste exchange concept

Certain materials considered as wastes in one industry may serve as raw materials in another industry. In that case, such materials should be exchanged with that industry instead of allowing it to constitute nuisance to the environment. For instance, most metals and metallic materials from either construction or demolition industries can serve as raw materials for iron smelting industry where it could be placed in a furnace and melted to produce items such as cooking pot stand, pegs and cutlass.

3.1.4 Rethinking concept

Generally, man's activities will always result into one form of waste or the other and construction and demolition waste is not an exception. However, man's concern is how to effectively manage this waste from without causing a catastrophic damage to his environment. Therefore, there is need for construction and demolition industries and the general public to have a rethink on their perspective of how waste is handled and disposed. Educative programs that will sensitize industries and the public on waste handling and disposal need to be incorporated into our systems. Practice such as waste segregation should be encouraged in all areas such as schools, hospitals, social gatherings and ceremonies. There is also need to incorporate into our systems programs that will acquaint people in every social gathering the importance of avoiding indiscriminate waste handling and disposal. With all these put in place, general public and industries' perspective about waste handling and disposal will change.

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