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A STUDY OF STORAGE PRACTICES OF REINFORCED CONCRETE MATERIALS CONTRACTORS IN THE CONSTRUCTION FIRMS IN GHANA

BY

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DECLARATION

We hereby declare that this submission is our own work towards the award of MSc. in Construction Management and that, to the best of our knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

Materials management is one of the most important aspect in every construction process. Proper storage of construction materials is a key aspect of the processes. Studies have revealed that effective storage of concrete materials at the construction processes have positive effects on the successful completion of the project. The main aim of this research was to study the effect of poor storage of concrete materials on construction sites in Ghana. To achieve the stated aim, the following specific objectives were set, to identify the materials management practice contractors' use, to identify the mode of storage of concrete materials on site and to identify the effect of poor storage of concrete materials on site. Literature related to the aims and objectives were reviewed. The study involved twenty-five (25) respondents from D1K1 and D2K2 construction firms, registered with University of Education, Winneba and University of Cape Coast, Cape Coast. The data collection methods adopted were both qualitative and quantitative approaches. This was done to get better understanding of the objectives. Data obtained from the survey was further analysed using both descriptive statistics and relative importance index techniques. The study revealed that almost all the respondents had fair knowledge in materials management processes. Planning being the highest procedure applied in the processes and logistics being the least. The study also revealed the effects of poor storage of materials on building projects, and included the following; ineffective cash flow, delays in project duration, adequate security, low productivity level, working space, waste and double handling. The effect on the ineffective cash flow due to poor storage practice was recorded the highest and goes a very long way to affect the project and all the parties involved.

It is then recommended that effective proper storage of concrete materials is very important and should be a priority in every construction since it forms about

25% - 30% of the materials used in construction.

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Thank you and God bless you all.

DEDICATION

The project is dedicated to my beautiful and beloved wife**, Mrs. Rebecca Ofosua** and my Dad and Mum **Mr. & Mrs. Moro Asante**.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND OF STUDY

Storage of material is one of the most difficult tasks affecting contractors' performance on site. Most items are not properly stored at the construction site consequently, some go waste and at the end affects the project. Concrete materials are the raw materials used in concreting. Concrete is a mixture of different waste materials like binder (cement), fine aggregate, coarse aggregate and water (Patel et al., 2014). Some publications also define concrete as a mixture of aggregate and paste (Lovely, 2013).The aggregates are the sand and gravel or crushed stones; the paste is the water and Portland cement. The materials used in concreting are normally classified as raw materials and which include binding agent (cement), sand, chipping or stone, reinforcement and water. The normal practice of concreting is the batching method, mixing of raw materials, transporting of concrete, placing, compacting of concrete, finishing and finally curing of concrete (Patel et al., 2014). Different concrete materials have their means of storing them and contractors with their supervisors most at times ignore it and store them anyhow with intention of occupying space at the site.

Most at times these raw materials are normally the first items to be bought since concrete forms the basis of almost all construction projects in Ghana. The storage of concrete materials is very important since it forms about 25% - 35% of the entire materials needed in the construction (Kasim, 2013). These raw materials are also not ordered at the right time and in their right quantity. They are brought in long before the time it will be needed, and thus improper planning on behalf of the purchasing officer. There are times most of the purchased materials will be stuck in the soil or

being washed away by the rain water. Corrosive materials will be left to the mercy of the weather for corrosion to take place and all these affects productivity and increase waste (Valverde-Gascuena et al., 2011). All these boil down to the effective management of constructional materials and hence materials management.

Materials management is a scientific technique, concerned with the planning, organizing and total control of flow of materials from the initial purchase to destination (Hannure et al., n.d). It is therefore carried out to reduce wastage of materials, reduce shortage of materials, and minimize material damages, insufficient storage space and avoid delays in supply. It improves the productivity which at the end will have major cost and time benefits. The main aim of material managements include the following; thus to get the right quality, the right quantity of supply, delivery at the right time, at the right place and at the right cost.

However, when not managed well can lead to materials surplus, reduction in productivity and lack of up-to-date and real time information (Kasim, 2011). It should be ensured at every stage of the construction process, this is because poor material management can often affect the overall construction time, quality and budget. Material should be purchased on time and properly stored at the appropriate location. In order to have a proper and maximum storage of concrete materials, it should be included in the planning stage. The planning phase is justifiable because it will imply a profound study of the project, establishing a base from which to carry out an effective control (Gascuena et al., 2010).

1.2 STATEMENT OF THE PROBLEM

Materials resource management has been the backbone of every construction firm. Studies have shown that material forms about 60% - 70% cost of the entire project and 5% - 27% of the total

material purchased goes waste (Agyekum, 2012). The wastes generated are mostly concrete materials and products (Agyekum, 2012). The wastage may be due to lack of improper planning by most of the managing bodies. At the earlier stage of the construction period, this will not be noticed or realized. The impact is felt when coming to the final or later stages of the construction period. Effective minimization of concrete waste will contribute in the increment of the profit margin of the contractor.

The occurrence of this situation had made most of the projects abandoned at the final stages with the complaint of lack of capital. However, even if the materials are purchased, the mode of delivering, handling and storage turns to be a problem. Concrete materials are most at times over estimated and bought, the place to store for proper keeping and managing them become a problem. They are placed in the yard at the chosen location any how without any surface preparation on the floor and always get contaminated with foreign materials. Most completed projects have heaps of sand, chipping, quarry dust, rusted steel rods, and rotten timber, broken down vehicles left at the site. The contractor ignores these materials at the site with the idea of using them on another project. But the question is what about if no project is not taken in the next 5 – 10 years? what will happen to those abandoned materials? Most project professionals still doubt whether construction planning is possible (Gascuena et al., 2010).

Proper storage is very necessary in the construction industry both at the pre, during and post construction stage, since most of the materials go waste and hence an attempt to develop an adequate means of storage of materials at the site. This study was undertaken to have an insight of effective material management and to develop guidelines for the storage of construction materials.

1.3 AIM OF STUDY

The main aim of this research was to study the effect of poor storage of concrete materials on construction firms in Ghana and to develop guidelines for the proper storage of such materials in the building industries.

1.4 OBJECTIVES OF STUDY

To achieve the stated aim, the following specific objectives were set out:

i. To identify the materials resources management practice that the contractors use; ii. To identify the mode of storage of concrete materials on site; and iii. To identify the effect of poor storage of concrete materials on the contractor in the construction firms in the Ghana.

1.5 SCOPE OF THE STUDY

The research assessed the concrete materials resource management practices of construction firms in Ghana based on their storage facilities. The focus was limited to contractors with D1K1 and D2K2 classification registered with the Universities located in the Central regions of Ghana.

These institutions included: University of Cape Coast, Cape Coast, University of Education, Winneba.

1.6 RESEARCH METHODOLOGY

The methodology adopted for this research involved the gathering and critically reviewing the literature relevant to storage of concrete materials. This served as a guide to identify previous works undertaken, contributions made, criticisms, limitations, current findings and their effective applications in the Ghanaian construction environment.

Quantitative research methods were adopted to gather information concerned with the study. The quantitative approach is chosen because it helps in collection of thoughtful data from a randomly large

sample. The use of structured questionnaires was exercised to gather information on the study. Details of the methodology were discussed in chapter three of this research work.

1.7 SIGNIFICANCE OF THE STUDY

The construction industry is one of the most important components of every economy. However, with the scientific and technological advancement in the industry, it is still popular for its client dissatisfaction, project delays and cost overruns. Mostly, these problems can be associated with improper material management which leads to lots of waste generation and cost overrun.

The cost of materials represents the most important cost component in construction projects (Wegelius-Lehtonen, 1995). Also delay in construction projects are mostly associated with delay in materials delivery (Asssaf and Al.Hejji, 2005) which is a product of improper or lack of materials management. This research will tackle the problem of materials mismanagement and develop strategies and procedures to curb the generation of waste and reduce the occurrence of cost overruns.

1.8 ORGANIZATION OF THE STUDY

This research was categorized into five independent but interrelated chapters. They are discussed as follows:

Chapter one entailed the introduction which is subdivided into seven sections: Background of the Study, problem statement, research questions, aim and objectives, significance of the study, methodology and scope of study. Chapter two entailed the literature review followed by chapter three which consisted of three sections namely: Research methodology, research design and data collection.

Chapter four entailed two sections: Data analysis and discussion of results. The last chapter is chapter five which entailed three sections: findings, conclusion and recommendations. The structure is illustrated graphically below:

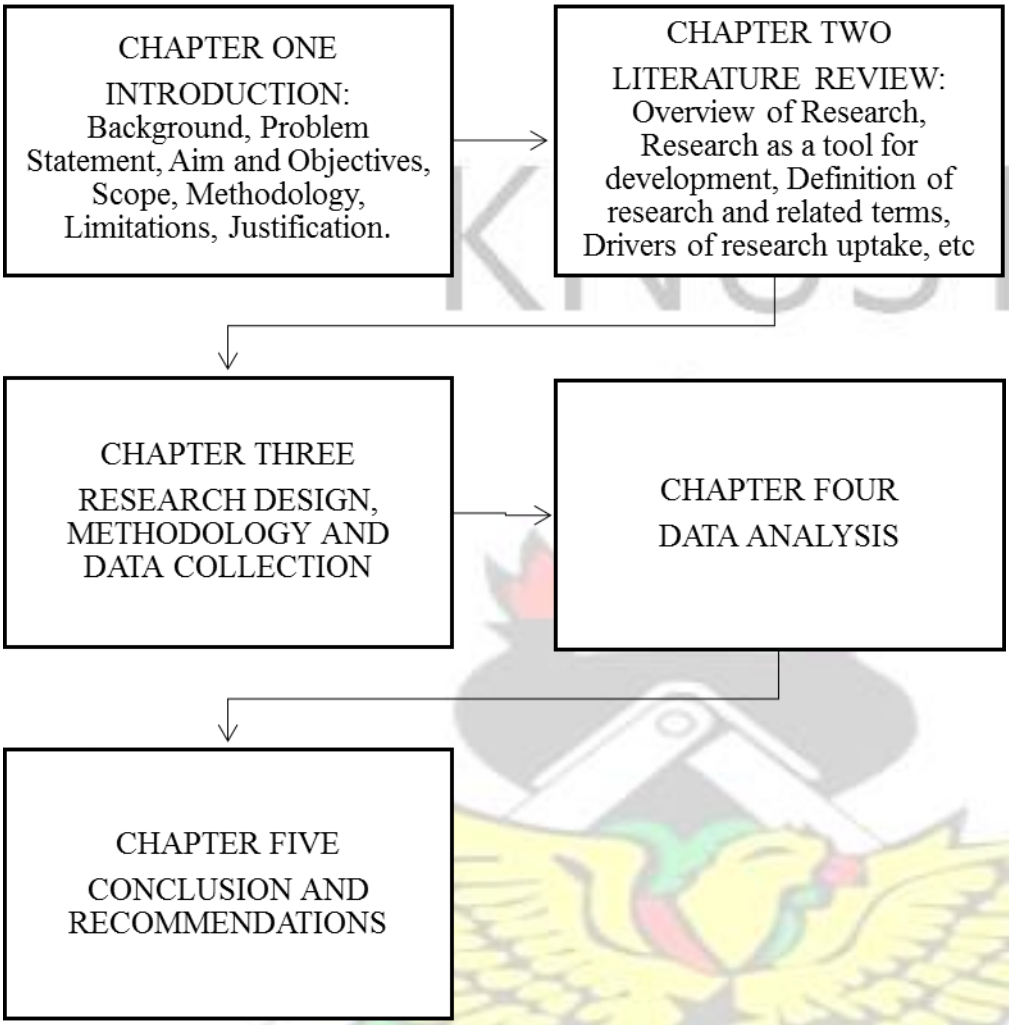

Fig. 1.0 the detailed structure of the chapters

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Storage of materials is one of the processes of materials management (Hendrickson, 2008). Materials management is an important function that helps in the productivity in the construction project. It should be considered at every phase in the construction industries. Poor concrete

materials management normally result in high cost during construction. Planning and controlling of materials is very important at this stage to enhance productivity.

Materials management is not only concerned during monitoring stage but also decision about the procuring of materials at the planning and scheduling stage. Hendrickson (2008) conducted a study for twenty heavy construction sites and these are the benefits from the introduction of materials management system;

- Reduction of 6% in craft labour cost occurred due to the improved availability of materials as needed on site and 8% saving due to reduced delay for materials.
- Comparison between two projects reveal that a change in productivity from 1.92 manhour per unit without a system to 1.14 man-hours per unit with a new system. Also much of the difference was attributed to the timely availability of materials.
- Warehouses cost were found to decrease 50% on one project with the introduction of improved inventory management.

Materials management can be defined as a system responsible for the planning and controlling the flow of materials (Kasim, 2011). Donyavi (2009) defines materials management as a system for planning and controlling to ensure the right quality and quantity of material and equipment are specified in a timely manner. Materials Management is a key business function that is responsible for co-ordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner so as to provide a pre-decided service to the customer at a minimum cost (Mathur, 2014). Materials management comprises of series of processes of which a storage management is part. These processes include planning, purchasing, logistics, handle and stock and waste control.

2.1.1 Planning

Planning is a very major factor in the management of material. It takes care of all the process and at the same time coordinates the rest of the processes. Material planning includes measuring, ordering and scheduling which helps to increase productivity. Most construction firms tend to be costly when proper planning is not implemented (Donyavi, 2009).

2.1.2 Purchasing

Purchasing of the materials and services from outside the firm to support the operations of the firm to marketing, sales and logistics (Hendrickson, 2008). A detailed material schedule and coordination of purchasing and order of materials are important in assuring material availability (Kasim, 2010).

2.1.3 Logistics

Is the concept that deals with the delivery of materials to site and also involve the planning, implementation and controlling the movement and storage of all the things from raw materials to finish product. The routing of the materials also affects the cost and time to completion of the project (Hendrickson, 2008).

2.1.4 Handling

Handling of materials deals with the flow of materials form the suppliers to the site. Due to the rate of handling materials, there are considerations that are used in the materials handling system. The selection of material handling most at times depends on it went or the center of gravity of the material and which enhance the production process, provide effective operation of manpower, increase production and advance the system to be more flexible (Eynon et al., 2014).

2.1.5 Stock and waste control

Stock control is the technique planned to ensure that materials or equipment are available at all time. It includes raw materials, processed materials, assembly components, consumable stores, general stores, maintenance materials and spares, work in progress and finished products. Construction activities generate a lot of waste and cause difficulty to the construction industry. The implementation of materials management which is effective will help to minimize waste of materials and increase profit for the firm (Kasim, 2011).

2.2 SITE STORAGE

Thomas et al. (2005) cited in Spillane et al. (2011), as storage being the first step in material management and failure to accommodate materials result in poor productivity and waste. Effective site and space utilization is a fundamental to material management (Chau et al., 2004). Materials stored on site can either be small or valuable and large or bulk storage item. All these items have the means of storing them on site. Small and valuable items are stored on racks or bin systems and similar items are kept together in a lockable store. Large or bulk storage items are kept within a lockable fenced compound (Chudley et al., 2006). The form of fencing chosen may give visual security by an open nature which is easier to climb than the close boarded type of fence which locks the visual security property. Some of the materials that are used for fencing include the following;

- Woven wire fence;
- Strained wire fence;
- Cleft chestnut pale fence;
- Wooden palisade fence; Wooden post and rail fence; and Metal fence.

Another school of taught also agrees that the position of the material also affects the progress of the project. Materials should be positioned very near to where ever it is needed to avoid waste in the delay of transportation of the materials (Eynon et al., 2014).

There are basically two types of stores depending on the nature of business, location of action raw, market place, etc. thus, functional and physical stores

2.2.1 Functional stores

The one which depends on the use of which the material is put. They are normally named by the purpose of the material. Eg. Raw materials store, production store, general stores, tool stores, transit sheds, open yard, etc. (Mathur, n.d).

Open yard store; the type which is normally used in the constructional fields, the items are stored in the open space. The surface of the ground are cover with sheets or steel mats or lean concrete and are normally used to store bulk items which do not required specialized storage (Mathur, n.d)

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2.2.2 Physical stores

The stores that depend on the size and location. The naming is in respect to how big or small the store is and the place where is located or the distance from the point of usage. Eg. Central stores, sub-stores, transit stores, site stores, etc. (Mathur, n.d).

Site store; this is usually at the project site containing building or construction materials like cement, steel, tools, etc. (Mathur, n.d).

2.3 STORAGE OF CONCRETE MATERIALS

Chudley (2006) defines storage of material as the provision of adequate space, protection and control for building materials and components held in the site during the construction process.

Chao, et al, defines storage of materials by including the handling of the materials as part. Handling and storage of materials involve the unloading of materials such as steel with a crane, driving a truck loaded with concrete blocks, carrying bays or materials manually; and other materials such as drums, barrels and timber. It provides a continuous flow of parts and assemblies through the workplace and ensures that the materials are available when need. Improper handling and storage of materials always results in cost increment and may sometimes cause accidents at the work place. Proper training and education should be adhering to in the stores since most of them cause accident when moving, handling and storing (Chudley, 2006).

Materials which are to be used on site should be carefully planned before brought to the site for storage. Poor planning leads to inefficiency, low productivity, excessive waste, health and safety problems (Donyavi, 2009). This will prevent the possibility of damages to the materials and occupying space. Stockpiling of material on site is essential in the management production and reduce cost (Sanders et al., 1991). The system of just-in –time is very effective in the minimizing handling and damages to the material. The location for the storage should be

- sheltered and well secured;
- located at a place for easy material handling and distribution;
- availability of space;
- closeness of materials in relation to the working area; and
- Stock holding policy: thus the material being stored at the site for the works should not be too small or too large, each have its own implications. Too small will result in shortages and causes delay whilst too large may also involve a large sum of capital to maintain the stores in terms of weather and security.

Concrete materials are unique in nature and normally come in their raw state. Different materials have different properties and hence different means of storing them. The means of storage is depended on the following properties:

2.3.1 Physical properties

Materials used in the building industries have different shapes, sizes, weights and different means of delivery. These help in the determining of the proper handling and stacking methods which are to be employed on site and intends to help in estimating the storage cost (Chudley et al., 2006).

2.3.2 Organization

This deals with the planning process and making sure that materials are delivered at the right quantity, the right quality and the right time. The proper manner of loading and off-loading is always in place and sufficient space for storage (Chudley et al., 2006).

2.3.3 Protection

All materials should be protected against the weather and prevented from deterioration whilst in storage (Chudley et al., 2006).

2.3.4 Security

Many materials have high resale and usage value to persons other than those for whom they were ordered and unless site security is adequate material loss can become unacceptable (Chudley et al., 2006).

2.3.5 Control

Thus taking inventory of the materials delivered, and monitoring the stocking method and the usage of the material in order to get value for the materials (Chudley et al., 2006).

2.3.6 Storage space

There are couples of factors to be considered when chosen a particular space to store materials. Planning the location and size of the area is very important, thus calculate the area to the store material. It helps in the handling, storage and very convenience on site when working (Chudley et al., 2006).

2.4 CLASSIFICATION OF CONSTRUCTION MATERIALS

Kamau (2011) and other studies have categorized construction materials in terms of how they appear, thus either in their raw state or finished product. These classifications are as follows;

i. Raw materials: These categories represent the original state of the materials and are the materials which are normally in its natural process. They are not affected so much by the weather and pilferage; and most at times bulky in nature. Consumes a lot of space when not properly planned well at the site. Chippings (gravels) and sand are examples;

ii. Factory goods: These categories deal with those items which have passed a series of processes and the end point are to pick and install. They are normally well packaged and most of them are off the shelf items. Examples include cement, ceramic items (closets, bath, basin, tiles) and ironmongery; and iii. Workshop finished items: They are the semi-finished product, thus slight works will be done on them before using. They are normally with their standard measurements and those materials are normally expensive since any default on it will create for it replacement. Examples include glass, timber, roofing materials, etc.

Hendrickson, (2008) also classified materials by the way of loading and unloading or the process of delivery and these are as follows;

i. Bulk materials: These are materials which are in their natural or semi-processed state, such as excavated materials, wet concrete mix, etc. They are usually measured in banks and volumes; ii. Standard off-the-shelf: These are standard materials which can be stored on shelves are easily to be stockpiled; and their process of delivery is very simple. Example are the standard pipes, valves, mortise locks, hinges, etc.; and iii. Fabricated members: These are the materials that are already made and sent to the site to be stored. They are normally made to the specific dimension and units depending their weight and how it will be delivered. Example is the I-beam and columns.

2.5 EFFECTS OF IMPROPER STORAGE AND HANDLING

The effect of improper storage location is also an issue and that can lead to poor productivity and waste (Enshassi et al., 2007). The effect of purchasing materials early may lead to capital tied up and interest charges incurred on the excess inventory of materials and to top it all, materials will deteriorate during storage and be stolen (Hendrickson, 2008). Oziegbe (1991) cited in Oladiran (2010) shows that an effective storage system should be operated with the planned activities of construction and revealed the building projects, procurement of materials should be well documented while location for materials should be made in good time; and materials should be delivered according to the programme of work. Improper storage and handling of materials have made a lot of project stack along the way and costing the client (Chao et al., 2004). It is better to have proper plans even before the start of the project. The mismanagement of material storage is a leading factor in spatial congestion and result in the reduced level of productivity in the construction project (Thomas et al., 2006 cited in Spillane et al., 2011). It is very important to take effective measures to counteract this instance on-site, the negative effects of inadequate or

inappropriate material storage is an issue with the various trades on site (Sanders et al., 1991). The place for the storage should be accessible and large enough to accommodate most of the materials.

Many researches have been conducted to reveal some of the challengers that do encounter when working in a confined area. Spillane et al. (2011) identified some basic challengers that confront the storage of materials on site by using the severity index (SI) ranking. The five top most issues included;

- Contractor's material spatial requirement exceed the available space;
- Difficult to coordinate the storage of materials in line with the programme of works;
- Location of the site entrance make delivery of materials particular difficult;
- Difficult to store materials on site due to lack of space; and
- Difficult to coordinate the storage requirement of the various sub-contractors

2.6 GUIDELINES FOR THE STORAGE OF CONCRETE MATERIALS

There are number of building materials used in the construction industry, most of them go waste during the storing process. Kasim et al. (2011) cited in Song (2005) and Nasir (2008) that materials form the bases of every project and occupying about 50% -60% of the cost of the entire project. Wastage in the storing of these materials have very big negative impact on the project. Most of the concrete materials and their storage used in the construction industry included the following;

2.6.1 Cement

Lovely (2013) describes cement as material having both adhesive and cohesive properties that enables it to form a good bond with other materials. Cement, from the encyclopedia, is defined as a binder or a substance that sets and hardens and can bind other materials together. Is made from heating limestone with small quantities of clay at high temperature of 1450^{o}C in a kiln. They are

normally term the Portland cement and come in five (5) different classifications depending on the physical and chemical properties (Lewis et al., 2007).

Suryakanta (2014) identified couple of ways which cement can be stored without going waste. Cement is a material which only acts as a bind product, it becomes waste when is not properly stored. It is a product which normally stored on site and must be stored in such a way that it is easily accessible for proper inspection. They are normally stored in bags or silos. Most big firms store them in silos since larger quantities are needed in their production. The building in which the cement is stored should be dry, leak proof and moisture proof as possible. There should be a minimum number of windows, and stack them above the ground on wooden pallets so that they do not absorb damp from the floor; and not be very close to the wall of the storage building (Lewis et al., 2007). There should not be more than 15 bags in a pile, when is to be stored for a long time cover it with a thick polyethylene sheet. Different types of cement must be stacked and stored separately but label the date of receipt of each consignment to know the age of the cement.

The time of usage should be on the first come bases and should not be stored for more a month (Suryakanta, 2014).

2.6.2 Timber

Timber is a material which can be used in any form. It possesses some specific qualities even when is not seasoned or treated, only that it will not last. Studies have shown that timber can be in the form of a round timber (log), sawn timber or board. Good timber possess the qualities; hard to resist deterioration, sufficient strength to resist heavy structural loads, enough toughness to resist shocks due to vibration, property of elasticity, should be very durable, easily workable, retain its

shape during the process of seasoning, etc. (Suryakanta, 2015). Timber should be prepared from the heart of the tree and free from sap, dead knot, shakes and other defects.

The process of drying of a timber is the seasoning of timber. Storing timber on site is just like the process of seasoning thus, the timber is stacked well on treated and even surfaced beams sleeper so as to be above the ground. Materials of equal lengths are piled together in layers with crossers separating the layers. A gap of about 25mm spacing is left between them to allow sufficient ventilation within the members. Suitable width and height of stack should be 1500mm to 2000mm and place the longer pieces in the bottom but keep one end of the stack in true vertical position. Stacked timber should not be in the hot dry winds, direct sun and rain and heavy weight should be placed on top to prevent it from wrapping. If the timber is to be stacked for a year or more then is better to coat the end of all members with coal tar or any other thick lubricant, this prevent the ends from cracking.

2.6.3 Steel reinforcing material

Reinforcement (i.e. deformed bars) is provided to control the extent and width of cracks at operating temperatures, resist tensile stresses and computed compressive stresses for elastic design, and provided structural reinforcement where required by limit condition design procedures (Naus, 2005). Steel normally used on site are the ferrous metal and non-ferrous metal. Steel used on site can either be of the steel rod, steel plate or a structural steel. All these materials can be a mild medium or high yield steel depending on the quantity of carbon contents (Chudley et al., 2006). They should store in such a way to avoid distortion and to prevent it from deterioration and corrosion (Suryakanta, 2015). Different type of steel have different means of storing them on site. Storing steel bars on site has been the commonness' and very difficult due to the prevailing weather conditions in our part of the world. The guidelines for storing them by Suryakanta (2015) is as

follows; store bars of different classes, sizes and lengths separately to facilitate issues in such sizes and length so as to minimize waste in cutting from standard length. The surface of the rod could be coated with cement slurry or lubricant to prevent it from scaling and rusting and should be stack above the ground to prevent direct contact with the soil.

The same will be applied when storing structural steel member only that the surface should be primed with a protective coating and always be place above the ground. Handling of these should very careful since they are heavy and normally causes accident on site.

2.6.4 Aggregate

Aggregates are inert granular materials and the most widely used material on site, it forms about 60% - 75% of concrete and can be of coarse aggregate (gravels or crushed stone) or fine aggregate (sand). Naturally, gravel and sand are dug or dredge from pits, river, lake or seabed.

Crushed stone aggregate is produced by crushing quarry rock, boulders, cobbles or large size gravels. The determination of the difference between coarse and fine aggregates are normally determine by the method of particle size distribution methods (Chudley et al., 2006).

Aggregate must always be neat, hard, strong particles free of absorbed chemicals or coating of clay and other fine materials that can cause the deterioration of concrete. These are the materials which normal becomes waste when improper planning is done. Most of them are being stack in the ground or being washed away by the running rain water and left on site even after completion of the actual works. Aggregate are used from the start of the project to the completion, this makes it a very important material in the construction industry. They are handled and stored in order to minimize segregation, degradation and prevent contamination (Chudley, 2006).

Suryakanta (2014) indicated storing aggregate on site is the cheapest and easiest but should be done with care. The place for the storage should a hard dry surface and level, it can be done by preparing a platform of planks or old corrugated iron sheets or a thin layer of lean concrete so as to prevent it from contamination with clay, dust, vegetables or other foreign matter. Fine and coarse aggregate should not be mixed together, they can be separated by providing wall to give each aggregate its own compartment. Aggregate should be carried out in regular stacks and be placed in a way to prevent loss due to effect of the wind. The floor of which the material is stored should have slight slope so as to avoid collecting water on the surface (Lewis et al., 2007).

2.6.5 Concrete blocks

Concrete blocks used on site are of different sizes and shapes or design. The normal sizes used in our local market are of the sizes 450mm x 225mm x 150mm or 450mm x 225mm x 125mm or 450mm x 225mm x 100mm. The size of the blocks is normally determined by the width, since the other dimensions are the same. The common shapes or designs used are as follows;

- Solid concrete blocks;
- Hollow concrete blocks;
- Solid and hollow light weight concrete blocks;
- Autoclave aerated concrete blocks; and Concrete stone masonry blocks.

Concrete block for project works should be well cured for 28 days before used for construction. The quality of the block is very important i.e. quality control, which includes the strength, dimensions and shrinkage. They should not be damp at the site and should be stored close to site of work so that least effort is required for their transportation. Loading and unloading should be done one at a time and stack in a regular tier to minimize breakage and defacement. The height of a packed and stacked block should not be more than 1200mm, the length should not be more than

3000mm and width of the stack should not be more than 2 to 3 blocks. Blocks which have not achieved adequate strength should be packed separately and allowed to cure. The date of the blocks are very important when is being manufactured on site. This is determines the age of the blocks and determine when to use (Suryakanta, 2015).

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter describes the approach in which the research is to be carried out. It describes how the information of the method was obtained, selection of the sample size, data collection and how the data is being handled. This chapter also enlightens the review of the methodology and also description of the sample processes and techniques. The statistical method for the analysis of the data is also discussed.

3.1 RESEARCH DESIGN AND METHODOLOGY

Research design describes the overall plan for obtaining answers to questions being studied and for handling some of the difficulties encountered during the research (Al-Moghany, 2006). It is also defined in some perspective as the strategy or plan to solve a research problem. Research design takes in the action plan from making something meaningful thus take the action for getting from 'here' to 'there' where 'here' is defined as the initial set of set of questions to be answered,

and ‘there’ is some set of conclusion about these questions which involves a couple of major steps, thus collection of data and analysis of these relevant data (Al-Moghany, 2006).

Research methodology is define as a systematic search for pertinent information which leads to new knowledge and compasses investigation into relationships among different factors operating in a given situation (Mutai, 2000). It is the study of problems through the use of scientific methods and principles (Goddard et al., 2001).

According to Hussey et al. (1997), some writers do interchange ‘methodology’ with ‘method’. Methodology is the overall approach taken as well as to the theoretical basis from which the researcher comes whilst the method is the various means by which data is collected and analyzed. There are a number of purposes of a research according to Goddard et al. (2001) and it included: to discover new knowledge, describe phenomena, enable prediction, enable control, enable theory development, etc.

In this study, interviews, structured questionnaires and site observations were mostly used in gathering of the data. Interview was adopted to have first-hand information about the contractors experience and impressions about the storage of materials in general, how to store concrete materials and the source of material management they undertook. It also helped in collection of information to structure the questionnaire. Closed ended types of questionnaires were forwarded to the contractors or their representatives to get more insight of their storage policies work. Site visits were also followed up to observe how the processes of their storage facilities were done and the impact on the performance of the contractor. The survey was conducted on contractors registered with public universities in the Western and Central Regions in Ghana who are currently on site working.

3.2 SOURCES OF DATA

The sources of data gathered for this study were depended on both primary and secondary data. Primary data was made up of the actual information or first-hand data obtained from the site survey, observations, interviews and questionnaires. Secondary source of data was obtained using relevant books, research papers, journals and magazines. The type of research approach is the triangulation, which involves the use of both qualitative and the quantitative approaches.

3.3 SELECTION OF DATA COLLECTION METHOD

There are different means of collection of data. It depends on a number of factors and it included+ field of study, availability of information, time of study, characteristics of the respondent, location of the study and many more. The purpose of the study is the most at times the paramount. Data collections are normally done in so many ways and may be obtained by either a primary source or secondary source or both. The method adopted for this particular study is mainly questionnaire and observations. Questionnaires and observations are effective and efficient way of gathering data but sometimes very difficult when the distances are far apart. Questionnaires comprised of a set of questions to which the respondents gave answers and could be a closed or opened ended form. The type of questionnaire adopted in this study was the closed ended form since the time available is short and it also involves time to do the analysis the data. In order to get quality data, the questions are short, clear and straight to the point. With the issue of site survey visual inspection was done on how the contractor stores the concrete materials, the distance from the work place, the type of storage facility they use and how the site is being protected. Photographs were taken to back the survey.

3.4 DESIGN AND DEVELOPMENT OF QUESTIONNAIRES

Generally, the design of the questionnaire was based on collection of information from construction firms registered with the public university in Western and Central Regions of Ghana.

This was on the basis of what was to be achieved thus the aims and objectives. Relevant literature also helped in the administering of the questions. All personnel on the construction site were possible respondents to the questionnaire. The questions were grouped into categories:

- The first part included the general information from the construction firm, the background of the respondent and the role or position in the firm; and
- The second portion asked questions on the material management practices, their storage facilities and the effect on the firm.

3.4 DISTRIBUTION OF QUESTIONNAIRES

Geographically, the study was carried out exclusively in Ghana and specifically in the public Universities in the Central Region thus University of Education, Winneba and University of Cape Coast, Cape Coast. The questionnaires were developed and personnel handed over to the contractor or the representative. The questionnaires were to target twenty-five (25) construction firms in the institutions. The class from the ministry of Water Resources, Works and Housing is D1K1 and D2K2.

3.5 RESEARCH POPULATION AND SAMPLING TECHNIQUES

3.5.1 Research population

According to Polite et al., (2006) defined research population as the totality of a well-defined collection of individual or object that have a common binding characteristics or traits. It can also be defined as a large collection of individuals or objects that is the main focus of a scientific query. (Hassan, n.d). The research covers a population of twenty-five (25) respondents made up of construction firms. This due to the fact that they are the people who handle and store construction materials at the site. The inclusion criteria is depended on contractors working in the public

university and having a class of D1K1 or D2K2 from the Ministry of Water Resources, Works and Housing certificate.

There are two (2) types of populations, namely;

- Target Population

It refers to the entire group or objects to which researchers are interested in generalizing the conclusion and has varying characteristics. It is sometimes known as the theoretical population.

(Hassan, n.d).

- Accessible Population

It refers to the population in which the researcher can apply their conclusions. It is a subset of the target population and also known as study population. It is from this that the researcher draws the sampling group. (Hassan, n.d).

3.5.2 Sampling

It is the process of selecting a portion of the population to represent the total population (Burns et al. 2001, Polite et al. 2006). Sample group is always a subset of the target population. It is important to select a sample group because is less costly and time saving than collecting information from a larger group of respondent. Each sample unit should have the same

characteristics to allow for generalization of the result to represent the target population (Burns et al., 2001, Polite et al., 2006). There are two types of sampling techniques, namely, probability and non-probability sampling. The type considered in the study is the non-probability sampling.

3.5.2.1 Non-Probability Sampling

The sampling technique where the samples are gathered in such a way that it does not give the individual in the population equal chances of being selected. The choice of sample group is left to

the researcher and the issue of bias sometimes arose. There are different types of this technique but the one adopted is the purposive sample and the snowball technique. Purposive sampling technique because is the only means where the target group can be reached so easy and the study is also bounded by time; and above all the sample is not so big. Snowballing was used since some of the contractors helped in locating the other contractors in the same institution.

3.6 CRITERIA FOR SELECTING RESPONDENT

Non-probability sampling technique includes convenience, consecutive, quota, purposive and snowball sampling. The purposive sampling technique was used to select D1K1 and D2K2 local construction firms registered under Ministry Of Water Resource, Works and Housing working with University of Education, Winneba and University of Cape Coast, Cape Coast. In all twentyfive (25) contractors were available and was taken as the population. The population was also taken as the sample size and was used in the analysis since all respondent were responsive.

3.7 DATA ANALYSIS

The data collected from the questionnaire was screened, edited to ensure consistency and readability. This was done by determining the average response of each individual from the different companies. The software used for the analysis was the Statistical Package for Social Science (SPSS) and Microsoft excel. Quantitative analysis approach was used in the data analysis and interpretation since the research is exploratory. It was final summarized in the form of charts and tables and was also involved in the categorization and ranking to reach various conclusions.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

This chapter analyses the data collected from the twenty-five respondents in which the respondents were randomly chosen from various construction firms. This chapter deals with the analyses and discussion of the storage practices of reinforced concrete materials of contactors in the construction firms in Ghana.

The analysis is pivoted around the objectives of the study, that is, to discuss the various material management processes, to identify the means by which contactors store reinforced concrete materials and the effects of poor storage of concrete materials on the contractor. The organization of the data presentation, description and analyses were done using Statistical Package for Social Sciences (SPSS) and Microsoft Excel. The statistical tools used for the analysis were the Frequency Index and Relative Importance Index (RII), which were used to rank the various variables. This chapter also presents the results of the analysis and discussions in the form of texts, figures and Tables.

4.2 DEMOGRAPHIC/ BACKGROUND INFORMATION

This section presents background information on various respondents. The background information included the respondent role in the construction industry, number of years in practice and the respondent's classification of works.

4.2.1 Role in the construction industry

The purpose of this question was to know the respondents position in the firm. They were to indicate whether they were building contractors, quantity surveyors, site supervisor or project manager.

Table 4.2.1 shows a summary of the roles of respondents in the construction industry. The table clearly shows that 24 percent of our respondents were building contractors while 28 percent were quantity surveyors. A substantial percentage of 40 percent were site supervisors and the remaining project managers. This clearly justify the fact that site supervisors are easy to come across with while on site and are also willing to answer the questionnaire.

Table 4.2.1: Role of respondents in the construction industry

Role	Frequency	Percent (%)	Cumulative Frequency (%)
Building Contractors	6	24.00	24.00
Quantity surveyors	7	28.00	52.00
Site supervisors	10	40.00	92.00
Project managers	2	8.00	100.00
Total	**25**	**100.00**	

4.2.2 Number of years of practice of respondents

Table 4.2.2 below shows a summary of respondent's years in service. The purpose of this background information was to know the level of experience in their sector. This information will give relevance to the quality of answers given out by the respondents. Also if respondents have gained more experience from working with their respective companies, it is likely that they are

well vexed in storage practices and processes of reinforced concrete and this will validate their response that is needed for this study.

From the Table, it is apparent that most of the respondents representing 56 percent have worked within the range of five to ten years while a small percentage of four representing just one respondent has worked for more than ten years .Only 8 percent of the respondents have worked for less than 5 years while the remaining respondents (32%) have worked between the years of 11-20. The different levels of experience gained by the respondents will make the study very feasible

Table 4.2.2: Respondents years of service

Years of service	Frequency	Percent (%)	Cumulative Frequency (%)
Less than 5 years	2	8.00	8.00
5-10 years	14	56.00	64.00
11-15 years	4	16.00	80.00
16-20 years	4	16.00	96.00
Greater than 20	1	4.00	100.00
Total	**25**	**100.0**	

Source: Field 2015

4.2.3 Classification of work

Table 4.2.3 represents the summary of analyses of the classification of work of our respondents. This question shows the class of the respondent's company. Majority of our respondents (20) were under the D1K1 class which represents 80 percent. The remaining respondents (5) represents D2K2 contracting companies. This shows that our respondent's bases were mostly high profile construction companies.

Table 4.2.3 Classification of work

Classification of work	Frequency	Percent (%)	Cumulative Frequency (%)
D1K1	20	80.00	80.00
D2K2	5	20.00	100.00
D3K3	0	0.00	100.00
D4K4	0	0.00	100.00
Total	**25**	**100.0**	

Source: Field 2015

4.3 PRESENTATIONS AND DESCRIPTIVE ANALYSIS OF DATA

Storage of reinforced concrete materials in the construction industry

The section of the questionnaire gave respondents the opportunity to show by indicating on a five point Likert scale, the material management practices, how specific concrete materials are stored and the effect of poor storage of materials on the construction industry.

4.3.1 Material management processes.

Donyavi (2009) defines material management as a system for planning and controlling to ensure the right quality and quantity of material and equipment are specified in a timely manner. Material

management comprises with a series of processes of which a storage management is part. These processes include planning, purchasing, logistics, handle and stock and waste control.

As a result, we sought to determine which of the management practices is often practiced in the Ghanaian construction industry, by asking the respondents to determine how high the factors outlined in **Table 4.3.1a in Appendix B and Table 4.3.1b** below affects the construction industry.

Table 4.3.1a in the appendix B represents the average percentile ratings of all the listed management practices that is mostly practiced in the construction industry. A critical look at the table shows that an average rating of 3.20 percent of our respondents proposes that the material management processes outlined are not frequently used while an average rating of 23.20 percent shows that the outlined practices are less frequently used. The respondents responded to the factors having a moderate frequency of usage constituting 28.80. 28.00 percent proposed that, the material management processes are used frequently and 16.80 percent showed that the outlined factors very often used in the construction industry. From the respondent's response, it can be said that majority were of the view that the material management processes outlined is frequently used in the construction industry.

Table 4.3.1b below employs the use of Relative Importance Index (RII) to rank the most widely used material management process.

Table 4.3.1b: Material management processes

ITEM	Material management processes	Total	∑W	Mean	RII	Ranking
1	Planning	25	91	3.64	0.73	1st

2	Purchasing	25	90	3.60	0.72	2nd
3	Handling	25	81	3.24	0.65	3th
4	Stock and waste control	25	81	3.24	0.64	4th
5	Logistics	25	72	2.88	0.58	5th

Source: Field 2015

4.3.1.1 Planning

Planning is a very major factor in the management of material hence, ranked as the most frequently used material management process in the construction industry with RII value of 0.73 and a mean score of 3.64. It takes care of all the process and at the same time coordinate the rest of the processes. Material planning includes measuring, ordering and scheduling and which helps to increase productivity.

4.3.1.2 Purchasing

Purchasing of materials was ranked as the second most used management process in the construction industry with RII value of 0.72 and a mean score of 3.60. Purchasing of the materials and services from outside the firm to support the operations of the firm to marketing, sales and logistics requires a detailed materials schedule and coordination of purchasing and order of materials (Kasim, 2011).

4.3.1.3 Handling

Handling of materials deals with the flow of materials form the suppliers end to the site. Handling is also an important aspect of material management and may also have a cost factor if not properly managed .It had an RII value of 0.65 and a mean score of 3.24.The respondents deemed handling as an important factor in material management.

4.3.2 Storage of concrete materials on site

There are number of building materials used in the construction industry, most of them go waste during the storing process. Kasim et al. 2011 cited in Song (2005) and Nasir (2008).Therefore this research seeks to give proper ways of storing reinforced concrete materials by asking respondents to indicate the most appropriate way storing those materials.

4.3.2.1 Cement

Suryakanta (2014) identified couples of ways which cement can be stored without going waste. It is a product which normally stored on site and must be stored in such a way that it is easily accessible for proper inspection. They are normally stored in bags or silos. Most big firms store them in silos since larger quantities are needed in their production. When respondents were asked to indicate how they store their cement on site, a substantial number of the respondents forming 96% stated they store them in bags and 4% store in silos. Their choice may be based on its ease of usage and cost effectiveness.

4.3.2.2 Steel reinforcing material

They should store in such a way to avoid distortion and to prevent it from deterioration and corrosion (Suryakanta, 2015). Different type of steel have different means of storing them on site. Storing steel bars on site has been the commonness' and very difficult due to the prevailing weather conditions in our part of the world. The guidelines for storing them by Suryakanta (2015) is as follows; store bars of different classes, sizes and lengths separately to facilitate issues in such sizes and length so as to minimize waste in cutting from standard length. The surface of the rod could be coated with cement slurry or lubricant to prevent it from scaling and rusting and should be stack

above the ground to prevent direct contact with the soil. When respondents were asked to indicate how they store steel on site, 72% stated the use of lubricants while 28% used cement slurry.

4.3.2.3 Aggregate

As already indicated, aggregate must always be neat, hard, strong particles free of absorbed chemicals or coating of clay and other fine materials that can cause the deterioration of concrete.

Suryakanta (2014) indicated storing aggregate on site is the cheapest and easiest but should be done with care. The place for the storage should a hard dry surface and level, it can be done by preparing a platform of planks or old corrugated iron sheets or a thin layer of lean concrete so as to prevent it from contamination with clay, dust, vegetables or other foreign matter. When the respondents were asked to indicate how they store aggregates, 68% indicated they stored on bare ground which is not a good practice. The remaining stored it on protected surface.

4.3.3 Effects of improper storage of reinforced concrete materials.

The effect of improper storage location is also an issue and that can lead to poor productivity and waste (Enshassi et al, 2007). Improper storage and handling of materials have made a lot of project stack along the way and costing to the client. Improper storage has a number of effects on the construction industry.

Table 4.3.3a in the appendix B represents the average percentile ratings of the effects of improper storage of materials in the construction industry. A microscopic look at the table shows that an average rating of 0.67 percent of our respondents proposes that the outlined effects are not severe while an average rating of 19.33 percent showed that the effects are less severe. The respondents responded to the factors having a neutral effect as 35.33 percent, 30.67 percent proposed that, the factors outlined have severe effects on their company and 14.00 percent showed that the factors

have highly severe effects on them. From the respondents' response, it can be said that majority were of the view that the outlined factors have severe effects on the construction industry **In Table 4.3.3b** below, the Relative Importance Index (RII), utilized shows how respondents ranked the factors with high severity.

Table 4.3.3a: Effects of improper material management

ITEM	Effect of poor storage	Total	∑W	Mean	RII	Ranking
1	Ineffective cash flow	25	94	3.76	0.45	1st
2	Project duration	25	89	3.56	0.42	2nd
3	Security	25	86	3.44	0.41	3rd
4	Low production level	25	84	3.36	0.40	4th
5	Working space	25	79	3.16	0.38	5th
6	Double handling	25	75	3	0.36	6th

Source: Field 2015

4.3.3.1 Ineffective cash flow

Cash flow projections are a major concept in construction projects. Contractors are able to predict their cash in and cash out using these projections. Sometimes these predictions fail them and one of the reasons for this happening is wastefulness on the part of the contractor which leads to cost implications. These additional unplanned cost causes contractor to become short of money during the construction process. That is why ineffective cash flow was ranked highest with an RII value of 0.45 and a mean score of 3.76 as shown in **table 4.3.3a.**This is an indication of the trend in the Ghanaian construction industry in that ineffective cash flow may sometimes result from improper storage of materials.

4.3.3.2 Project duration

Extensions of time mostly have cost implications. So not all time extensions are advisable, however, improper material storage can cause an extension in the duration of a project. That is why extension of project duration was ranked as the second most severe effect of poor storage of materials.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This dissertation, which essentially delves into storage practices of reinforced concrete materials in the construction industry is divided into five (5) independent but interrelated chapters. The main introduction to the research covered in Chapter One. The review of literature on the topic, which covered the various objectives listed in chapter 1.4., was captured in Chapters two. In Chapter three, the methodology adopted for the study including the philosophical positions, research design, and research strategy was discussed. The research process was in one main phase; survey questionnaires. Chapter four presented the empirical analysis and provided detailed discussions on the survey results. This chapter (Chapter five) summarizes the issues addressed throughout the study. It begins with a summary of how the research objectives were achieved, followed by contributions of this research to knowledge. The chapter concludes with recommendations for further research that can be conducted based on the conclusions and limitations of the study

5.2 ACHIEVING THE RESEARCH OBJECTIVES

This research was initiated with the primary aim of identifying the effect of poor storage of concrete materials on construction firms in Ghana and to develop a guidelines for the proper storage such materials in the building industries.

In order to achieve the stated aim, three research objectives were set in Section 1.4 Objective 1 was achieved mainly through literature reviews. Objectives 2 and 3 were achieved through the literature reviews and the survey questionnaires, which were conducted. Below are discussions on how the objectives were achieved.

5.2.1 The First Objective; to identify the materials resources management practice that the contractors use

This section began with the definition of materials storage and its importance in the construction industry. Also materials management was defined as its necessity in the industry was also identified. A number of material management practices were enumerated and described.

A questionnaire was designed to address this objective of which five (5) variables were identified, which was then tested on a number of construction firms. The questions were focused on material management processes such as planning, purchasing, logistics and handling. The responses were analyzed and a Relative Importance Index formula was applied to rank the variables in order of importance with planning being highest material management practice used in the construction industry.

5.2.2 The second objective; to identify the mode of storage of concrete materials on site

This section was introduced by indicating some of various materials used for producing concrete which included cement, aggregate and reinforcements. It was also established that all of these

materials are often stored on site because of the frequency of usage of concrete in construction in Ghana.

The questionnaire design incorporated this section by asking the various respondents how they stored the concrete raw materials on site. The results were discussed in chapter four but the main talking point was on the storage of aggregates where over 50% of the respondents indicated they stored it on bare untreated grounds. This is a wasteful practice because most of aggregate get mixed up with the natural soil.

5.2.3 The Third Objective; to identify the effect of poor storage of concrete materials on the contractor in the construction firms in the Ghana.

This section was treated similarly to the first objective where various negative effects of poor storage of materials were identified and discussed in chapter two.

Also a questionnaire was designed to address this objective of which six (6) variables were identified, which was then tested on a number of construction firms. The questions were focused on the effects of poor material storage on site which included extension of project duration, low working space, low production level and ineffective cash flow. The responses were analyzed and a Relative Importance Index formula was applied to rank the variables in order of importance with ineffective cash flow being the highest material management practice used in the construction industry.

5.3 RECOMMENDATIONS

The primary aim of this study was study the effect of poor storage of concrete materials on construction firms in Ghana and to develop a guidelines for the proper storage such materials in the building industries.

Consequently objectives were set to achieve the specific aim stated above; and in view of the findings of this research, the following recommendations are therefore prescribed for effective storage of concrete materials on site.

- Contractors should apply the concept of material management effectively in order to reduced or exterminate the occurrence of unplanned cost which may arise as a result of improper material management;
- Contractors to opt for proper storage of aggregates where treated ground will be used instead of the normal bare untreated ground; and
- Clients and consultants should include a penalty in the contract to punish contractors who do not effectively manage their materials and causes extra cost or duration to the project.

5.4 DIRECTIONS FOR FUTURE RESEARCH

There are numerous research avenues in the future as a result of this study. An open avenue for future research can be directed to the study of effective ways of storing other construction materials like timber.

5.5 CONCLUSION TO THE RESEARCH

The paper demonstrated that with effective material management, firms can save a substantial amount of money and makes more profits out of it. . The storage of concrete materials is very important since it forms about 25% - 35% of the entire materials needed in the construction. Therefore proper management of this material will go a long way to benefit both the client and the contractor and the economy as a whole.

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APPENDIX

APPENDIX A: QUESTIONNAIRE

RESEARCH TOPIC: A STUDY OF STORAGE PRACTICES OF REINFORCED CONCRETE MATERIAL OF CONTRACTORS IN THE CONSTRUCTION FIRMS IN GHANA.

COMPANY PROFILE

1. Company Name: ……..

2. Year of establishment: ……

3. Position/ Profession
   Building Contractor [ ] Quantity Surveyor [ ] Site Supervisor [ ]

   Project Manager [ ] others, (please specify): ……..
4. Level of education

HND [ ] Bachelor's Degree [ ] Master's Degree [ ] Doctorate Degree [ ] others, (please specify): ……..

5. Level of Experience in years

   < 5 [ ] 6 – 10 [ ] 11 – 15 [ ] 16 – 20 [ ] > 20 [ ]

6. Classification of works

   D1K1 [ ] D2K2 [ ] D3K3 [ ] D4K4 [ ]

MATERIAL MANAGEMENT PROCESS

7. Does your firm understand material management processes?

   Yes [ ] No [ ]

8. Who are your major client?

   Public Organization [ ] Private Organization [ ] Both [ ]

9. Below are possible material management processes. Rank on a scale of 1 – 5 which is mostly practice by your firm

1	2	3	4	5
Not frequent	Less frequent	Moderate frequent	Frequent	Very frequent

PROCESSES	1	2	3	4	5
Planning					
Purchasing					
Logistics					
Handling					
Stock and waste control					

10. Does your firm has means of protecting materials on site?

Yes [ ] No [ ]

11. Using a scale of 1 – 5, rank if the means of protecting material on site is very efficient?

1 – Not efficient [ ] 2 – Less efficient [ ] 3 – Moderate [ ]

4 – Efficient [ ] 5 – Very efficient [ ]

12. Below is the forms of fencing used in the construction in Ghana. Rank on a scale of 1 – 5, which is most practiced in your firm.

1	2	3	4	5
Not frequent	Less frequent	Moderate frequent	Frequent	Very frequent

FORMS OF SITE FENCING	1	2	3	4	5
Woven wire fence					

Strained wire fence					
Wooden palisade fence					
Wooden post & rail fence					
Cleft chestnut pale fence					
Metal fence					

13. A. Indicate the type of store facility used in your firm

Functional store [ ] Physical store [ ]

B. If functional store, which type exactly

Raw material store [ ] production store [ ] general store [ ]

Tool store [ ] transit store [ ] open yard store [ ]

C. If physical store, which type exactly

Site store [ ] central store [ ] sub – store [ ] transit [ ]

14. Below is a table containing some of the factors that helps in choosing a particular storage facility. Rank on a scale of 1 -5, why that particular system of storage in your firm?

1	2	3	4	5
Not high	Less high	Average high	High	Very high

FACTORS	1	2	3	4	5

Availability of space					
Accessibility to materials					
Security reasons					
Stock holding policy					
Location of materials					

15. How often do you check your storage facility?

1 – Not important [ ] 2 – Quite important [ ] 3. Neutral [ ]

4 – Important [ ] 5 – Very important

16. What stage do you normally decide in bring in materials?

Planning stage [ ] construction stage [ ] Anytime [ ]

When requested [ ]

17. Proper storage of concrete materials is a good practice which should be adopted by every contractor during the planning and construction stage. How do you consider this practice?

1 – Not good [ ] 2 – Quite good [ ] 3 – Neutral [ ]

4 – Good [ ] 5 – Very Good [ ]

18. Describe by ticking how your firm stores the following concrete materials:

A. CEMENT

i. How do you normally store it?

In silos [ ] By the use of Bags [ ] ii. Where do you store it?

On-site [ ] Off-site [ ] iii. From what source do get the materials?

Factory [ ] Wholesale [ ]

B. TIMBER

i. How do you normally store it?

Logs [ ] Sawn timber [ ] ii. At what stage do order?

Treated [ ] Untreated [ ] iii. Where do you store it?

On-site [ ] Off-site [ ]

C. STEEL REINFORCEMENT

i. How do you protect the steel?

By the use of cement slurry [ ] By the use of lubricant [ ] ii. Where do you store it?

On-site [ ] Off-site [ ] iii. From what source do you get the material?

Factory [ ] Wholesale [ ]

D. CONCRETE BLOCKS

i. From what source do you get it?

Self-moulding [ ] Factory [ ] ii.

Where do you store it?

On-site [ ] off-site [ ] iii.

How do store the blocks?

Stack on pallet [ ] Damp on the floor [ ]

E. AGGREGATE

i. How do you store your aggregate?

On protected surface [ ] On the bare ground [ ] ii.

Where do you get source of materials?

Mechanical means [ ] manual means [ ] iii.

Where do you store it?

On-site [ ] Off-site [ ]

19. Below are some of the effect of poor storage of concrete materials on the contractor.

Rank on a scale 1 – 5 which of these severely affect your company on site

1	2	3	4	5
Not severe	Less severe	Average	Severe	High severe

EFFECT	1	2	3	4	5

Duration of the project					
Cash trap up					
Double handing of materials					
Production level					
Working space					
Security					

APPENDIX B: FREQUENCY TABLES

APPENDIX B: FREQUENCY TABLES

Table 4.3.1a: Average ratings of material management practices affecting the construction industry.

Management practices	Not frequent	Less frequent	Moderate	Frequent	Very frequent
Planning	8	20	8	28	36
Purchasing	0	16	32	28	24
Logistics	0	44	28	24	4
Handling	8	12	36	36	8
Stock and waste control	0	24	40	24	12
Average Ratings (%)	**3.20**	**23.20**	**28.80**	**28.00**	**16.80**

Table 4.3.2a: Effect of poor storage of materials

Effects	Not severe	Less severe	Average	Severe	Highly severe
Project duration	4	16	24	32	24
Ineffective cash flow	0	8	44	12	36
Double handling	0	36	28	36	0
Low production level	0	16	36	44	4
Working space	0	28	36	28	8
Security	0	12	44	32	12
Average Ratings (%)	**0.67**	**19.33**	**35.33**	**30.67**	**14.00**

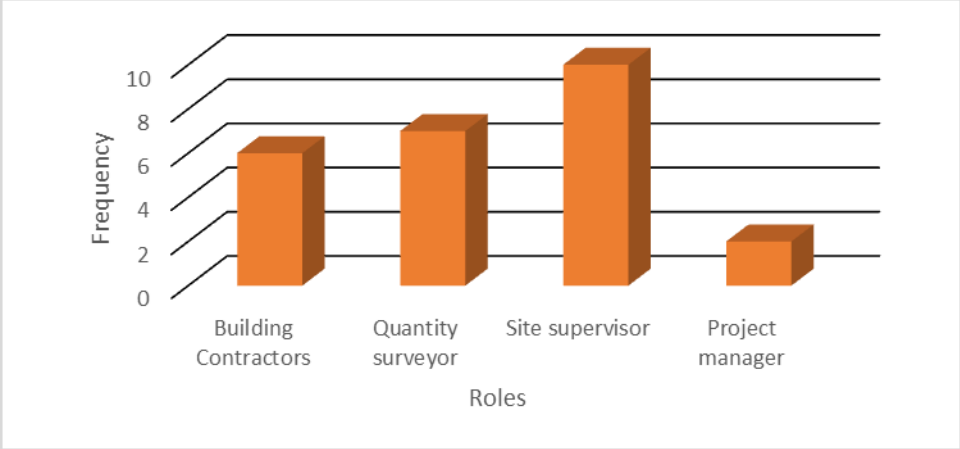

Fig. 4.2.1: Role of respondents in the construction industry

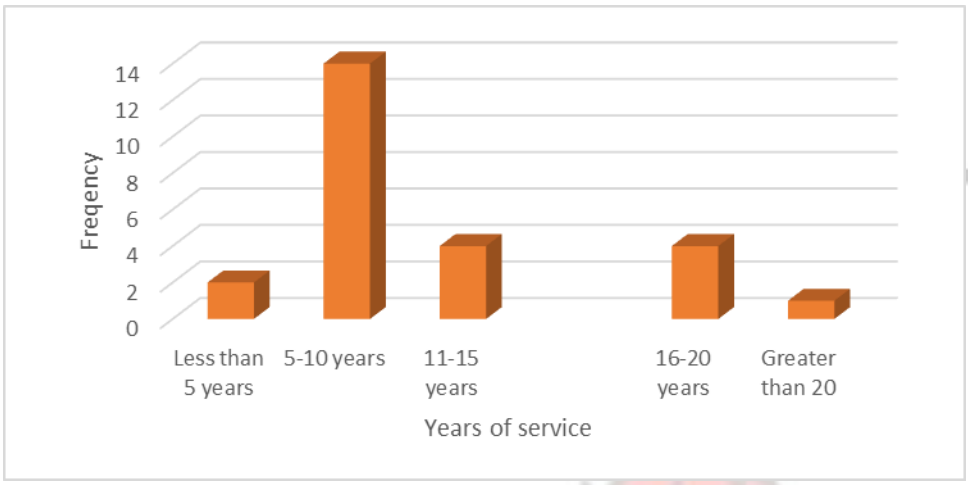

Fig. 4.2.2: Respondents' years of service

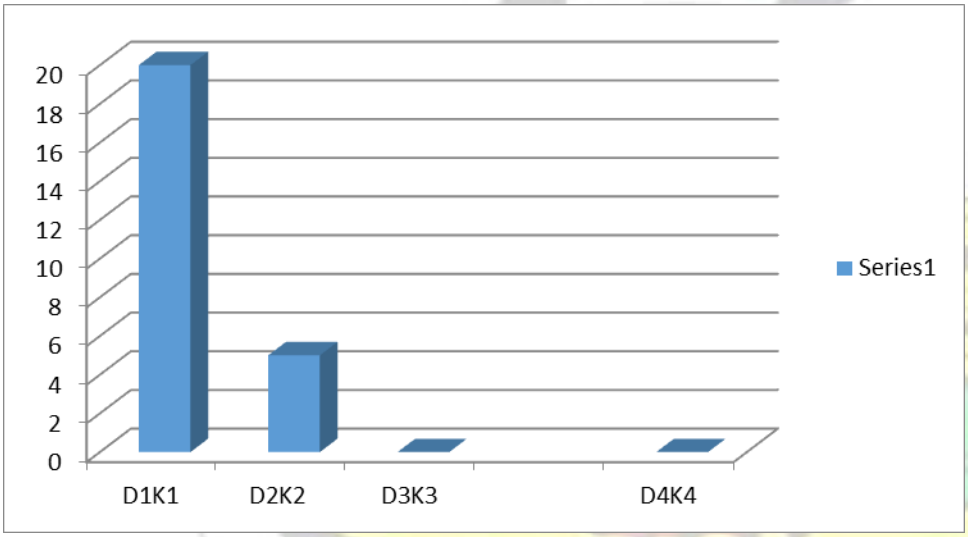

Fig. 4.2.3 Classification of works