INTERNSHIP REPORT IN CONSTRUCTION

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1 author:

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Kampala International University
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SEE PROFILE

WESTERN CAMPUS
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

DEPARTMENT OF CIVIL ENGINEERING
BACHELORS OF SCIENCE, CIVIL ENGINEERING

THIRD YEAR INDUSTRIAL TRAINING REPORT SUBMITTED IN FULFILLMENT OF THE

REQUIREMENTS FOR AWARD OF A BACHELOR'S DEGREE IN CIVIL ENGINEERING

PROJECT TITLE:
CONSTRUCTION OF TWIN APARTMENTS IN KANSANGA

CCLIENT: Mr. KALANZI ABRAHAM

CONTRACTOR: MANGRON INVESTMENT LIMITED

REPORTED BY: BUKENYA RASHID
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SUPERVISED BY:

Miss. BABYESIZA JUSTIN

AUGUST, 2024

DECLARATION

I BUKENYA RASHID declare that the information presented in this report is in no way a duplication of any other document. It is based on the knowledge and skills I attained my Industrial training and research on related areas.These Industrial training activities were carried out after the third year of first semester, in partial fulfillment of the requirements for the award of a Bachelor of Science in Civil Engineering at Kampala International University, Western Campus.

SIGNATURE, DATE

……..……..

APPROVAL

I hereby confirm that this industrial training report has been thoroughly reviewed and meets the required standards for academic and professional excellence. The insights and experiences documented within reflect a comprehensive understanding of the practical applications of the knowledge gained during the training period. I commend the effort and dedication demonstrated throughout this report and approve it for submission.

Engr. EMIRU E. MICHEAL

.....

PROJECT MANAGER

DEDICATION

I dedicate this report to papa kinanu Jeremiah who supported in all steps of preparation plus my friends who have given me advice.

ACKNOWLEDGMENT

My sincere gratitude goes out to every individual who in his/her own capacity helped me in one way or another during my industrial training which was more than a success. First and foremost, I would like to thank the Almighty God for the gift of life and love, wisdom knowledge, strength, good health and courage. May His glory and honor prevail. Special thanks go to our site supervisor and a mentor Engr. Emiru Emanuel Logos, who made available this training opportunity, guided me and shared his experiences regarding the requirements, areas of concentration to take note of before and during this industrial training and sharing vital information, ideas and contacts, also made the industrial training experience worthwhile with his never ending and generous efforts to dispense field knowledge and competencies in line with the civil engineering discipline, both technical and practical, and for his patience while at it. Gratitude is also extended to my fellow trainee Opiyo Rogers for always looking out for me.

TABLE OF CONTENTS

ABSTRACT

This report not only includes the activities I went through during my civil engineering industrial training with Mangron Investment Limited, but also the various literature that I read to enhance my understanding of the methodologies, systems and equipment used in the field of civil engineering. The material presented in this report is what I did during my industrial training in third year, Bachelors in Civil Engineering Kampala International University, Western Campus. During this industrial training period, I was expected to have a record of whatever activities I engaged in, their objectives and the observations/ outcomes of it. The activities involved in the practical(s) include; setting out, excavation of pits and trenches, block work and brick laying, steel bending concrete works, carpentry, plastering, ceiling installation to mention but a few. I participated in all the above activities and a detailed description of all the activities is presented in this report. Photographs have also been included in this report to aid in the explanation of some of the methodologies and equipment that was used. The reference books and documents used have also been included

CHAPTER ONE

INTRODUCTION

1.1 Background

As part of our Civil Engineering program, we're required to complete industrial training with a registered construction firm or consultancy after our second year. This training aims to apply theoretical knowledge to real-world engineering problems, gain practical skills, and acquire technical knowledge. This report documents my experiences and learnings during my training with Mangron Investigation Limited

1.2 Industrial Training Objectives

To expose us to various working conditions in the field.
To enable us acquire supervision skills and control of projects to ensure that the work being done is of good quality.
To enable us acquire interpersonal and managerial skills so that they can be able to account for what is done on site.
To enable us acquire skills in the various civil engineering fields.
To enable us relate what we do in lecture rooms to what done on site or in the field.
To enable us learn to work and interact with other people in the field in their respective positions.

1.3 Methods Employed During Training:

In order to capitalize on the benefits from the industrial training, several methods of learning and data collection were employed according to the different prevailing circumstances on the different sites I was exposed to. These methods included the following;

1.3.1 Participation

This was the most used method since the industrial exercise was majorly practical. I had to be involved in the site activities like blockwork, safety and review meetings, concrete works, surveying activities, finishing work, carpentry work, Etabs structural design, to mention but a few, so as to gain hands on experience and knowledge on the construction site activities.

1.3.2 Observation

This involved carefully observing the experts as they carried-out a given task and then it was followed by practice of what was observed. Observation was accompanied by asking questions and interviews to obtain clarity on specific areas where needed.

1.3.3 Consultations

This was an ongoing process in every activity. This involved making inquiries so as to obtain clarification on certain processes involved in activities being done from the knowledgeable persons that is to say masons, carpenters, electricians, plumbers, foremen, store keepers, helpers, site engineer or any other person with knowledge in the area of interest. It was also used to obtain any necessary information pertaining the documents and any other information relevant to the training.

1.3.4 Study of Project documents

This method involved the study and interpretation of project documents like the architectural drawings, structural drawings, materials specifications, store inventory, attendance book, requisitions, receipts to mention but a few. These documents provided a lot of information during my training that was relevant in the learning and the report writing process.

1.3.5 Watching tutorials and researching from internet

For the purpose of literature review and to obtain some information related to the training, and technical aspects of the project(s), I had to refer to some text books, lecture notes, and also search for information from the internet.

1.4 Company profile

MANGRON Investment Limited, a private construction company located in Soroti, P.O,56, Soroti.

1.4.1 Company Vision

To ensure our operations safeguard the health, environment and security of the communities from where we work

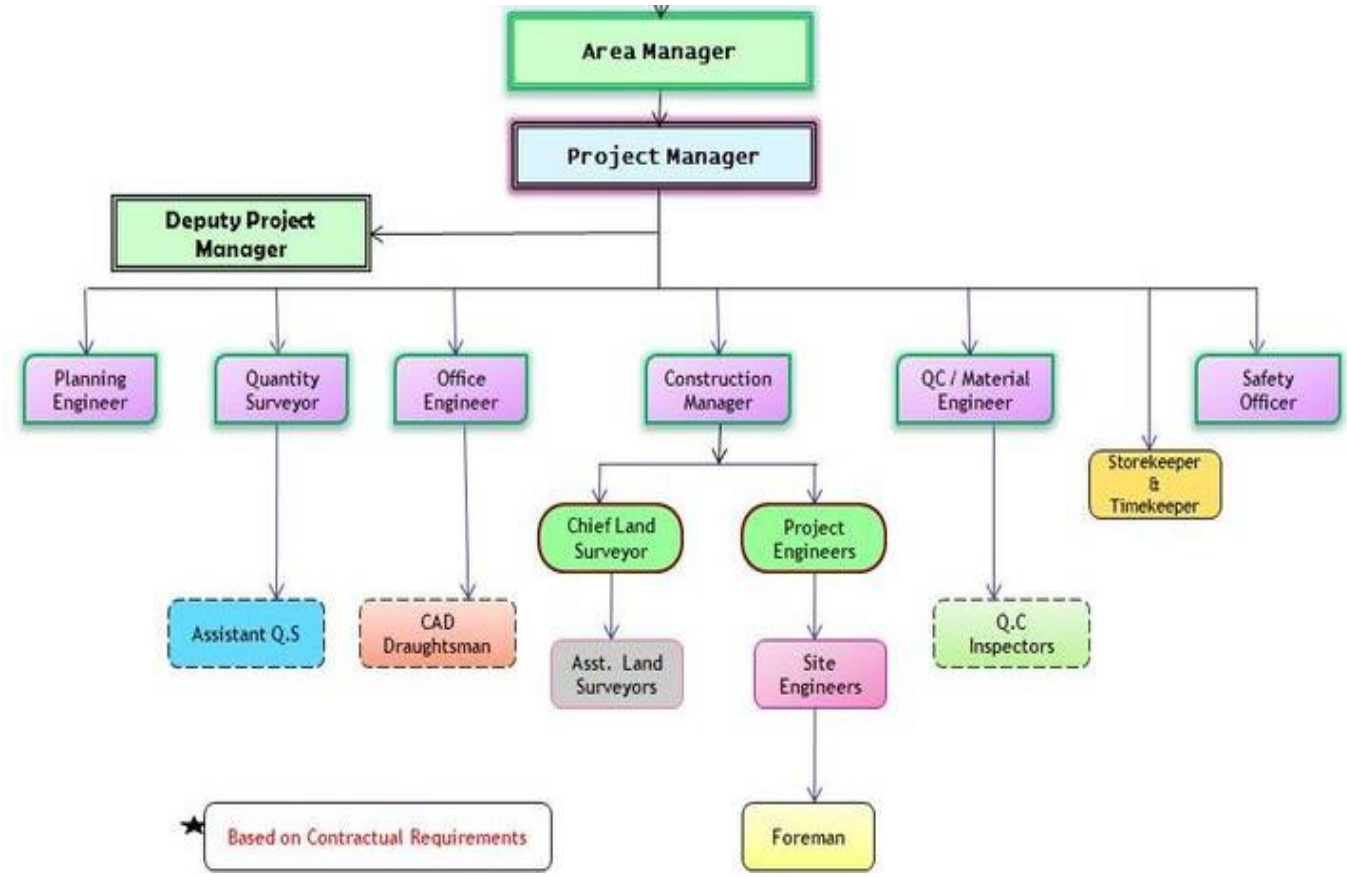
1.4.2 Company Mission

To strive for perfection in anticipation of exceeding our clients' highest expectation, banding good client relationship through leadership, creative solutions and hard work. Since construction can be hazardous business, we are dedicated to educating, implementing and self-monitoring of all safety programs to ensure the safest working environment for all our employees.

1.5 Project and site administration

The organization structure of the project summarizes the parties involved in the main contract and management of the whole project. Below is the project structure and parties who were involved in the contract and management of the site. This deals with the hierarchy of the decision making for the project to go on smoothly until it's completed.

1.5.1 Organizational Structure of the company



1.5.2 Project description.

The project undertaken in this industrial training by this company was construction ofTwin Apartments G+4, in Kansanga Kampala City.

1.5.3 Site safety and security.

All workers were told to put on safety gears for protection and students conducting industrial training from there were required to come with their safety gears so as to avoid unnecessary accidents of mainly cuts and falling items and instruments. These included; gumboots, helmets and gloves and reflectors.

1.5.4 Site documents

Before any activity was started on, some documents were filed to the relevant town authority (Kampala Capital City Authority) for span and for approval of the building plans. These documents included;

1.5.4.1 Geo-technical report:

This is a document presenting the nature of the soil after soil test were carried out. This report gives the soil properties and its suitability to support a given structure and also the load bearing capacity of the building.

1.5.4.2 Survey report:

As carried out by the land surveyor, this report was filed prior to opening up of the site boundaries and marking out the boundaries.

1.5.4.3 Environmental impact Assessment (EIA) report; the National Environmental

Management Authority (NEMA) carried out an assessment on the impact of the project on that particular plot to the surrounding environment. Since the impact was not negative, the project was given a green light. After the above documents had been submitted to the authority and it had verified them, the authority then had the role to approve the building plans and give permission for the construction work to begin after it has been satisfied with all the submissions

CHAPTER TWO

FOUNDATION:

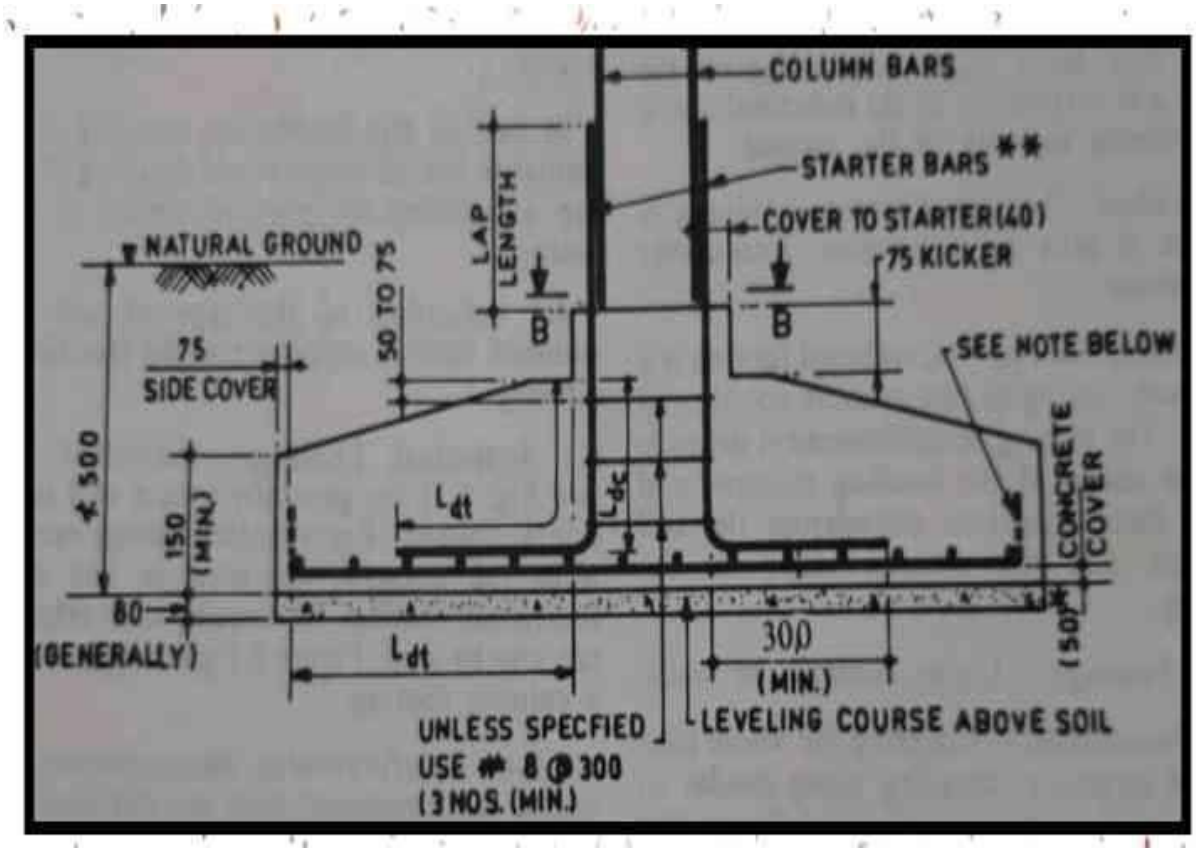
In construction, a foundation is the lower portion of a building or structure that transfers its load to the ground. It is a critical component that provides stability and support, ensuring that the structure remains upright and secure.

Foundations are designed to distribute the weight of the building evenly across the soil or rock beneath it, preventing settling, shifting, or other forms of structural failure.
There are various types of foundations, including:

Shallow Foundations: These are placed close to the surface and are typically used for smaller buildings. Examples include isolated, combined and strip foundation.
Deep Foundations: These extend deeper into the ground and are used for larger structures or in areas with poor soil conditions. Examples include piles and drilled shafts.
The type of foundation that was employed on the site was the shallow foundation of pad.

2.1 Pad foundation.

A pad foundation, also known as a spread footing or isolated footing, is a type of shallow foundation that is used to support individual columns or structural loads. It consists of a concrete pad that is placed directly on the ground, designed to distribute the load from the structure over a larger area to prevent excessive settlement or failure of the soil beneath.
Pad foundations are typically square or rectangular in shape and are used when the loads from the structure are relatively light and the soil conditions are suitable. They are often employed in residential and light commercial construction, where they provide a stable base for columns, posts, or walls. The size and depth of the pad foundation depend on factors such as the load it must support, the type of soil, and local building codes.



2.1.1 Procedure for construction of the foundation that was used on site.

Setting out for the entire building was done and the foundation bases marked.

Excavation for the trenches and the pits for the pads. The pits were of dimensions 4X4ft

Steelwork for the column bases was then done and paced into the pits which were also 4ft (1.2m)deep.

Blinding was then done using concrete which was casted upto about 500mm thick and left to cure.

After that the plinth walls were then constructed upto about 4courses.

Shuttering for the beam was done and then the beam casted. This was left to cure for some time.

Backfilling was then done and compaction carried out using a jumper.

Hardcore fill was then done at a thickness of about 300mm layer but generally it ranges from 150-300mm.

Sand blinding was then done at a thickness of about 50mm.

The damp proof membrane(DPM) was then layed on the blinding and the BRC was also placed on top of the DPM.

Shuttering for the plinth beam was done and concrete of class 25 was prepared and casted.

The floor slab was then casted and left to cure.

2.1.2 Backfilling and compaction

Backfilling in construction refers to the process of refilling an excavated area typically after the foundation of andations, as it helps to provide stability and support to the structure.

2.1.2.1 Purpose of Backfilling.

Support: Backfilling provides lateral support to the foundation walls and helps distribute loads evenly

Drainage: Proper backfilling can facilitate drainage, preventing water accumulation around the foundation, which can lead to structural issues.

Leveling: It helps to restore the ground level around the foundation, preparing the site for further construction or landscaping.

The marram soils that were excavated from the pits and the trenches was filled back upto the brim of the foundation wall. This was done manually by the workers on site.

2.1.3 Compaction:

This refers to the process of densifying soil or other materials to increase their load-bearing capacity and stability. This is typically achieved through mechanical means, such as using rollers, vibratory plates, or other compaction equipment, which compress the soil particles closer together, reducing air voids and increasing density.

2.1.3.1 This was achieved on the site using a compaction jumper.

A compaction jumper, also known as a jumping jack or rammer, is a construction tool used to compact soil and other materials in foundation work. It typically consists of a heavy, rectangular base plate attached to a powerful engine that drives a piston, causing the machine to jump and deliver repeated impacts to the ground. This process effectively densifies the soil, reducing air pockets and increasing stability, which is crucial for creating a solid foundation. Compaction jumpers are particularly useful in confined spaces or areas where larger compaction equipment cannot operate, ensuring that the ground is adequately prepared to support structures and prevent future settling or shifting.

2.1.4 Hardcore fill

'Hardcore' is the construction term used to denote'engineered' infill material that is placed within the confines of a building foundation (after removal of any unsuitable ground layers) in order to support a ground-bearing floor slab. Typical of older buildings, the term also refers to material used to support an 'oversite' concrete slab, which carries sleeper walls beneath a suspended timber floor. As such, the hardcore must provide a firm, dry, level base, at an appropriate height. Materials for hardcore should be granular and drain and compact readily, as well as being chemically inert and not affected by water. They should also be well compacted in layers of appropriate thickness.

2.1.4.1 Importance of hardcore in the foundation.

Load Distribution: Hardcore provides a stable base that helps distribute the weight of the structure evenly across the ground. This is crucial for preventing settling or shifting over time.
Drainage: The use of hardcore can improve drainage around the foundation. It allows water to flow through and away from the foundation, reducing the risk of water accumulation and potential damage.
Compaction: Hardcore can be compacted to create a solid and stable surface. This compaction helps to prevent movement and settling, which can lead to structural issues.
Cost-Effectiveness: Using hardcore can be a cost-effective way to prepare a foundation, as it often utilizes recycled materials and can reduce the amount of concrete needed.

2.1.4.2 Sand blinding

Sand blinding in foundation construction refers to the practice of placing a layer of sand on the hardcore fill before the construction of a foundation. This is very important in a way that it provides a proper drainage and also protects the DPM from being affected by the hardcore.
This was placed manually at a layer of thickness of 50mm.

2.1.4.3 Dump proof membrane (DPM) and BRC placement.

The dump proof membrane was layed on top of the sand blind. The primary function of a damp proof membrane is to act as a barrier to moisture from the ground. It prevents water from rising through the foundation and into the building, which can lead to dampness and mold growth.

The BRC mesh was then layed on top of the dump proof membrane and made to pass over the plinth bean reinforcements. This was of wire diameter 5.5mm, Length 48m, and width 2.4m by LAXMI steel limited.

2.2 CONSTRUCTION MATERIALS THAT WERE USED ON SITE.

The construction materials that were used on site were sand, cement, aggregates etc.

Sand: the type of sand that was being used was the lake and plaster (pit) sand.

Aggregates: these were machine crashed stones made of the same size. These were majorly used in the concrete works.

Cement: is a fine powder made from a mixture of minerals, primarily limestone and clay, that, when mixed with water, forms a paste that hardens over time. It serves as a binding agent in construction, allowing various materials such as sand, gravel, and crushed stone to adhere together, forming concrete and mortar. Cement is a crucial component in the construction industry, used in a wide range of applications, including buildings, bridges, roads, and other infrastructure.

2.2.1 Types of cement

Not all structures use the same cement grade, and knowing the types of cement helps in using the right one for certain constructions:

Portland Cement: is one of the most common types of cement used in India. It is primarily used for general construction purposes, such as building dams, bridges, roads, etc., since its main features are strength, durability and versatility. PC is made by grinding clinker along with gypsum. There are 3 grades available for PC, namely PC 33 Grade, PC 43 Grade, and PC 53 Grade. Each grade differs in compressive strength and is used in varying applications.

2.2.1.1 Pozzonic cement:

Pozzolanic cement is a type of cement that incorporates pozzolanic materials, which are siliceous or siliceous and aluminous materials that, when mixed with lime and water, form compounds possessing cementitious properties. These materials can be natural or artificial and include substances like volcanic ash, fly ash, silica fume, and calcinedclay.

2.2.1.2 White Cement

This type of cement is predominantly used for aesthetic purposes where a bright, clean and polished surface is required. White cement is mainly used for decorative applications, tile manufacturing, and the upkeep of historical monuments. It is produced using raw materials with low iron content such as limestone, kaolin clay, and gypsum to give the cement its distinct white colour. Due to its specific manufacturing process and raw materials involved, white cement tends to be more expensive than regular cement.

2.2.1.3 Rapid Hardening Cement

Rapid-Hardening Cement is designed to achieve high strength in a shorter curing time. It is used in situations where quick construction or repair is required, such as precast elements, road repairs, and urgent construction projects.

The type of cement that was used on site was the portland cement and pozzolanic cement CEM IV B(P)32.5N. The portland cement that was used was the portland pozzolana cement CEM II B(P) 32.5N.

CEM II and CEM IV are classifications of cement defined by the European standard EN 197-1, which specifies the composition and performance characteristics of different types of cement. These classifications are part of a broader system that categorizes cements based on their chemical composition and the types of materials used in their production. CEM II: Portland Composite Cement Composition:

CEM II is a type of Portland composite cement that contains Portland cement clinker and a certain percentage of supplementary cementitious materials (SCMs). The SCMs can include materials such as fly ash, slag, limestone, or natural pozzolans. The percentage of these materials can vary, leading to different subcategories of CEM II:

CEM II/A: Contains 6% to 20% SCMs.

CEM II/B: Contains 21% to 35% SCMs.

CEM II/C: Contains 36% to 50% SCMs.

Applications:

CEM II is widely used in various construction applications due to its improved properties compared to ordinary Portland cement (CEM I). Some common applications include: General Construction: Suitable for structural applications, including buildings, bridges, and roads. Precast Concrete Products: Used in the production of precast elements due to its good workability and strength.

Sustainable Construction: The use of SCMs helps reduce the carbon footprint of concrete, making it a more environmentally friendly option.

CEM IV: Pozzolanic Cement

Composition:

CEM IV is a type of pozzolanic cement that contains Portland cement clinker and a significant proportion of pozzolanic materials. The pozzolanic materials can include natural pozzolans, such as volcanic ash, or artificial pozzolans, such as calcined clay. The percentage of pozzolanic materials in CEM IV can range from 20% to 55%, leading to different subcategories:

CEM IV/A: Contains 20% to 35% pozzolanic materials.

CEM IV/B: Contains 36% to 55% pozzolanic materials.

Applications:

CEM IV is particularly valued for its durability and resistance to aggressive environments. Its applications include

Durable Concrete Structures: Ideal for structures exposed to harsh conditions, such as marine environments, wastewater treatment plants, and chemical plants.

Sustainable Construction: Like CEM II, CEM IV contributes to reducing the environmental impact of concrete by utilizing pozzolanic materials, which can also enhance the long-term strength and durability of concrete.

Repair and Rehabilitation: Used in repair mortars and overlays due to its compatibility with existing concrete and improved resistance to crackin In Summary; Both CEM II and CEM IV are important types of cement that enhance the performance and sustainability of concrete. CEM II is a composite cement that incorporates various SCMs, while CEM IV is a pozzolanic cement that relies on pozzolanic materials. Their applications span a wide range of construction projects, with a focus on improving durability, reducing environmental impact, and enhancing the overall performance of concrete structures.

2.3 BLOCK AND BRICK WORK (BRICK LAYING).

2.3.1 Blockwork

Blockwork is a construction technique using large concrete or cement blocks. They're often much larger than a standard clay brick, but have a hollow centre to make them lighter and easier to work with, as well as improving their capacity for insulation.

Blockwork is often used in construction projects because of its cost effectiveness and ease of use.

Brick work

Brickwork is masonry produced by a bricklayer, using bricks and mortar. Typically, rows of bricks called courses are laid on top of one another to build up a structure such as a brick wall.

2.3.1.1 Types of blocks used in construction.

Concrete blocks can be classified into two main types hollow and solid. These two varieties of concrete blocks can be utilised for a variety of tasks in addition to wall construction.

Hollow concrete blocks are blocks that have one or more cavities or voids in their structure. Solid concrete blocks are dense blocks with little to no voids, providing a solid mass throughout.

However, on this site bricks and concrete hollow blocks were used in construction. The bricks were used in the building of the foundation walls and concrete blocks were used while building the superstructure. For the first floor concrete blocks of dimensions 200x2000x400mm were used while for the other floors the blocks used were of dimensions 150x200x400mm.

2.3.1.2 The type of bonding used in block work.

1. Stretcher bond

Longer narrow face of the brick is called as stretcher as shown in the elevation of figure below. Stretcher bond, also called as running bond, is created when bricks are laid with only their stretchers showing, overlapping midway with the courses of bricks below and above.

2. English Bond

English bond in brick masonry has one course of stretcher only and a course of header above it, i.e. it has two alternating courses of stretchers and headers. Headers are laid centered on the stretchers in course below and each alternate row is vertically aligned. To break the continuity of vertical joints, quoin closer is used in the beginning and end of a wall after first header. A quoin close is a brick cut lengthwise into two halves and used at corners.

3. Flemish Bond

For the breaking of vertical joints in the successive courses, closers are inserted in alternate courses next to the quoin header. In walls having their thickness equal to odd number of half bricks, bats are essentially used to achieve the bond.

4. Header bond

Header is the shorter square face of the brick which measures 9cm x 9cm. Header bond is also known as heading bond. In header bonds, all bricks in each course are placed as headers on the faces of the walls.

However, on this construction site the types of bonding used were the header and stretcher bonds. The header bond was used during brick work for the foundation walls while stretcher bond was employed during the building of the walls for the superstructure.

2.3.1.3 The mix-ratio used:

The mix-ratio that was used was 1:3, 1bag of cement mixed with 3wheel barrows of sand. In the 3wheel barrows of sand 2were for lake sand and 1plaster or pit sand. These ratios were mixed with a suitable amount of water to form mortar.

2.3.1.4 Equipment/tools used in block and brick work.

Plumb Bob: a plumb bob is a simple yet effective tool used in construction and masonry to establish a vertical reference line. It consists of a weight, usually made of metal, attached to a

string or cord. When suspended, the weight pulls the string down due to gravity, allowing the user to determine what is perfectly vertical.

Spirit level: A spirit level, also known as a bubble level, is a tool used in construction and carpentry to determine whether a surface is horizontal (level) or vertical (plumb).

Water level: water level is a simple yet effective tool used to establish a level reference over long distances. It consists of a clear plastic or glass tube filled with water, with both ends open.

Trowel: a trowel is an essential tool used for various tasks, including mixing, spreading, and applying mortar.

String line: string line (or mason's line) is commonly used to ensure that the blocks are laid straight and level.

Hammer: a hammer is typically used as a tool for various tasks related to masonry and construction.



2.3.1.5 Procedures used in block and brick laying.

1. Planning and Preparation.

Design and Specifications: Review of the architectural plans and specifications was done to understand the dimensions, materials, and design requirements.

Material Selection: the appropriate type of blocks and bricks were chosen (e.g., clay, concrete) and mortar mix based on the project requirements.

2.Setting Up Tools and Materials

Tools Required: the necessary tools were gathered such as trowels, levels, measuring tapes, brick

hammers, chisels, and scaffolding.

Mortar Preparation: the mortar was Mixed according to the specifications, ensuring the right consistency for adhesion.

3. Starting the Brickwork

Corner Leads: corner leads were established (vertical lines of bricks) to guide the rest of the wall. These were plumbed very well using a plumber Bob to ensure they are on level. String Line: a string line was stretched between the corner leads to maintain a straight line for the bricks.

5.Laying Bricks

Mortar Application: a bed of mortar was applied to make the first course of bricks.

Brick Placement: the first brick at one end was layed, pressing it into the mortar. The laying of bricks was continued, ensuring that they were aligned with the string line.

6.Checking Alignment and Level.

Leveling: a level was used to check that each brick was leveedl and aligned with the others.

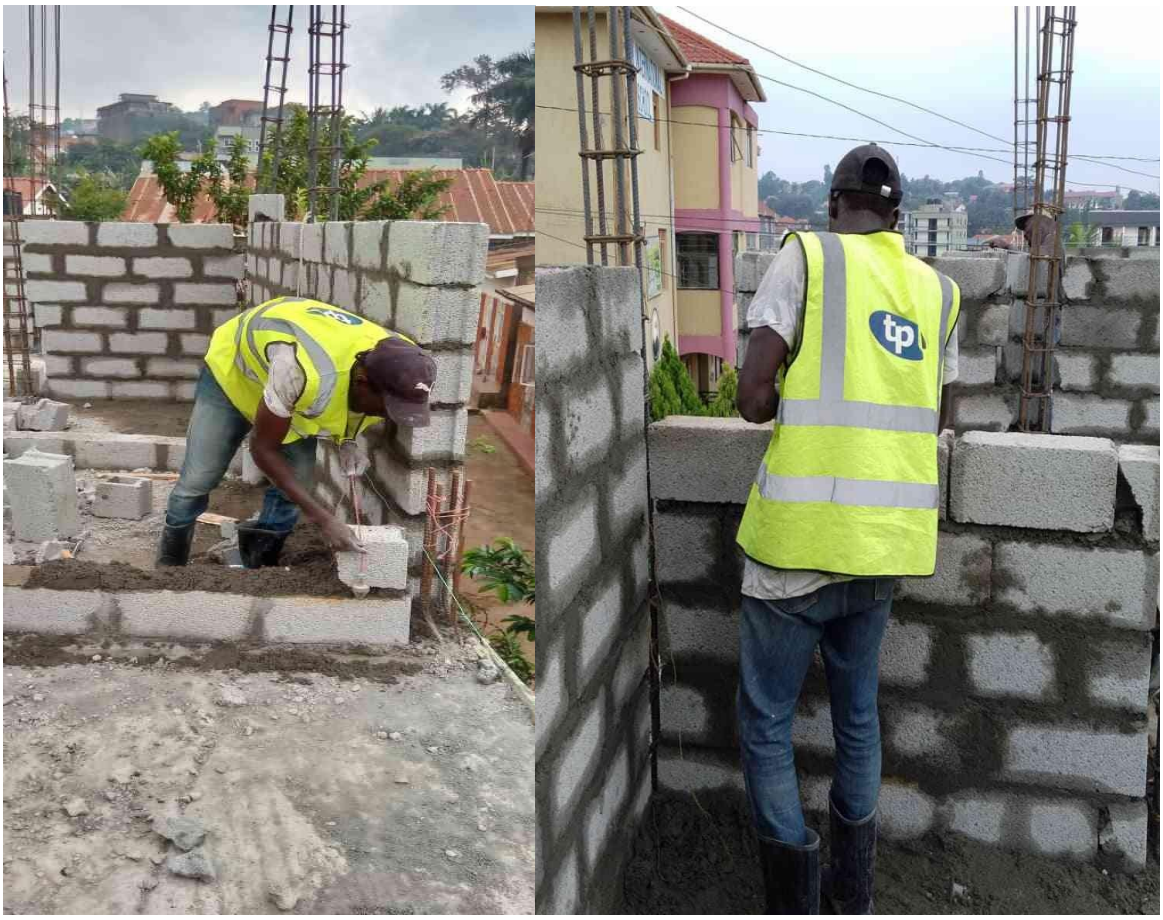
Adjustments :necessary adjustments were made by tapping the bricks with a trowel.

7. Mortar Joints

Joint Finishing: After laying a few courses, tool the mortar joints for a neat finish. Cleaning Excess Mortar: any excess mortar was then removed from the face of the bricks before it hardened

8.Continuing the Wall

Building Up: laying bricks was continued in courses, with checking for level and alignment regularly upto



2.4 CAPENTRY WORKS.

Carpentry works in construction refer to the skilled trade and craft of working with wood to create, install, and repair structures and fixtures.

2.4.1 Equipment/tools used in carpentry works.

Hammer

Bow saw

Tape measure.

String

Plumb bob

2.4.2 Shuttering

Shuttering in construction refers to the temporary structure or formwork used to support and shape concrete until it hardens and gains sufficient strength. It is typically made from materials such as plywood, steel, or plastic and is designed to hold the wet concrete in place during the pouring and curing process.

2.4.2.1 Shuttering serves several purposes:

Shape and Support: It defines the shape of the concrete element (like walls, slabs, or columns) and provides the necessary support to hold the concrete in place until it sets.
Surface Finish: The type of shuttering used can affect the surface finish of the concrete. Smooth surfaces can be achieved with high-quality formwork materials.

Safety: Shuttering helps ensure the safety of workers by providing a stable structure during the pouring process.
Time Efficiency: Properly designed and constructed shuttering can speed up the construction process by allowing for quicker pouring and setting of concrete. Once the concrete has cured and reached the required strength, the shuttering is removed, allowing the concrete structure to stand independently.

2.4.2.2 Materials used for shuttering.

Plywood:
Description: Plywood is a popular choice for shuttering due to its strength and versatility.
Advantages: It can be easily cut to size, is relatively lightweight, and provides a smooth finish to the concrete surface.
Disadvantages: It can be susceptible to water damage and may require treatment to enhance durability.
Steel:
Description: Steel formwork is made from steel sheets and is often used for large-scale projects.
Advantages: It is very strong, reusable, and can be assembled quickly. It also provides a smooth finish.

Disadvantages: It is heavier and more expensive than other materials, and it requires skilled labor for assembly

Aluminum:

Description: Aluminum formwork is lightweight and easy to handle.

Advantages: It is durable, reusable, and provides a good finish. It is also resistant to corrosion.

Disadvantages: It can be more expensive than plywood and may require specialized handling.

Plastic:

Description: Plastic formwork systems are made from high-density polyethylene or other plastic materials.

Advantages: They are lightweight, easy to clean, and resistant to water and chemicals.They can also be reused multiple times.

Disadvantages: They may not be as strong as metal or plywood and can be more expensive.

Fiber-Reinforced Plastic (FRP):

Description: FRP formwork is made from composite materials that include fiberglass.

Advantages: It is lightweight, durable, and resistant to corrosion and chemicals.

Disadvantages: It can be more expensive and may require specialized handling.

Concrete:

Description: In some cases, concrete can be used as a formwork material for specific applications.

Advantages: It provides excellent strength and stability.

Disadvantages: It is not reusable and can be labor-intensive to remove.

Timber:

Description: Traditional timber formwork is made from wooden planks and beams.

Advantages: It is readily available, easy to work with, and can be customized on-site.

Disadvantage: It may not be as durable as other materials and can be affected by moisture.

Modular Formwork Systems:

Description: These systems consist of pre-fabricated panels made from various materials, often steel or aluminum.

Advantages: They are quick to assemble and disassemble, and they can be reused multiple times.

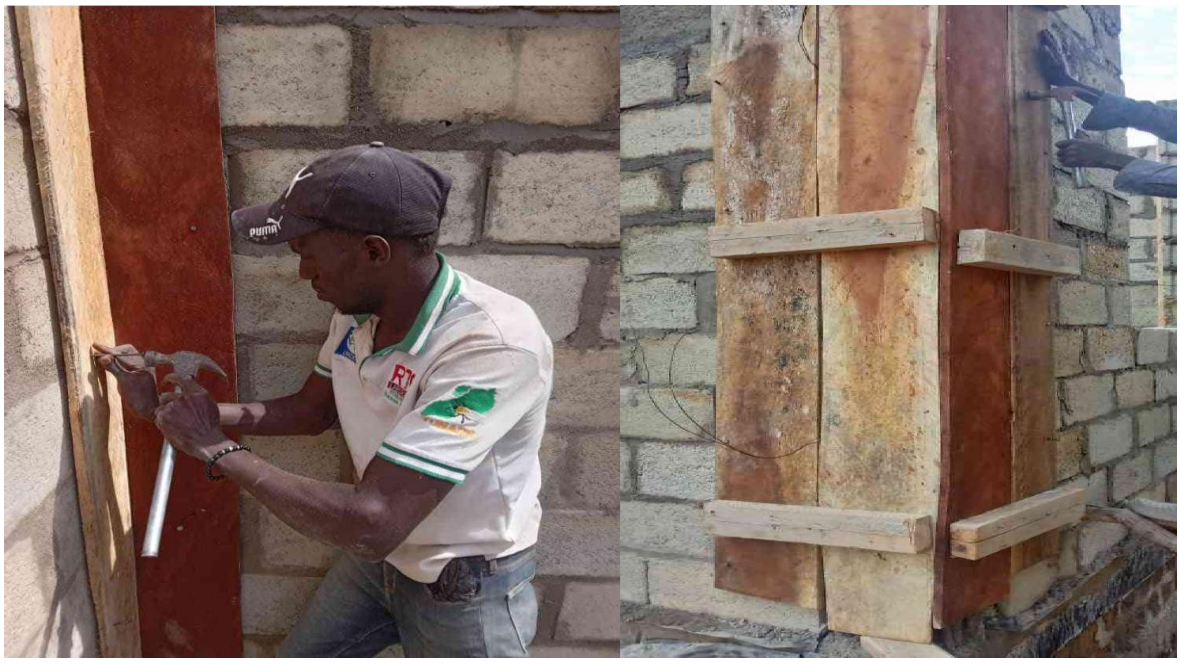
Disadvantages: Initial costs can be high, and they may require storage space. The choice of shuttering material depends on various factors, including the type of construction, budget, project scale, and desired finish.

Each material has its own set of characteristics that make it suitable for specific applications.

2.4.2.3 Shutting for the columns.

Shuttering for columns refers to the temporary formwork used to shape and support concrete columns during the curing process. Proper shuttering is crucial for ensuring that the columns maintain their shape and structural integrity until the concrete has set and gained sufficient strength.

Formwork for shuttering the columns was prepared by joining timber of 12X1 inches and bracing it with timber of 4X2inches with nails to form the molds for the column



2.4.2.4 Shuttering for the beams.

Formwork for shuttering the beams was prepared by joining timber of 12X1 inches and bracing it with timber of 4X2inches to form the mold for the beam. The stoppers were also placed at the top to prevent it from loosing its shape.

2.4.2.5 Shuttering for the slab.

This refers to the use temporary structure used in construction to support and shape concrete until it hardens and gains sufficient strength. When constructing a concrete slab, proper shuttering is crucial for ensuring the slab's dimensions, surface finish, and overall structural integrity.

This has various steps and processes which must be handled carefully with the guidance of an Engineer and in accordance to the design.

The timber used in shuttering for the slabs;

12X1inch timber size.

4x2 inch timber size.

Props of about 2.8m height.

2.4.2.5.1 Procedures that were used for shuttering the slabs.

The T- beams were first shuttered by using 12x1_inch timber.

Timber of 4X2 inches was placed at 2ft spacing from one timber to another.

The props of about 2.8m height were cut with a sizable cross head or headtree according to the measurements. These are placed in a way that they are on plumb.

After that then the 12x1inch timber was then layed on top of the 4x2 in timber and the props which was to protect the concrete from pouring.

At the openings such as doors and windows, timber called bottom was placed and supported by the props.

The form work for shuttering the beams at the sides of the entire structures was also placed (12x1,in timber size was used)




2.3.2 STEEL WORK.

Steel work in construction, particularly for the reinforcement of concrete, is a critical aspect of structural engineering. The combination of steel and concrete takes advantage of the strengths of both materials: concrete is strong in compression but weak in tension, while steel is strong in tension and can withstand significant loads.

Here's an overview of the key concepts, types of steel reinforcement, and best practices in this area:

2.3.2.1 Key Concepts while reinforcing concrete.

Reinforcement Purpose: The primary purpose of reinforcing steel (rebar) in concrete is to improve its tensile strength, ductility, and overall structural integrity. It helps prevent cracking and failure under load.

Bonding: The bond between the concrete and steel is crucial. The surface of the rebar is often deformed (ribbed) to enhance this bond, allowing the two materials to work together effectively.

Load Distribution: Reinforcement helps distribute loads more evenly across the concrete structure, reducing stress concentrations that could lead to failure.

2.3.2.2 Best Practices to be considered while using steel reinforcement in concrete.

Design Considerations: Structural engineers must calculate the appropriate amount and placement of reinforcement based on the loads the structure will experience, including dead loads, live loads, and environmental factors.

Placement: Proper placement of rebar is essential. It should be positioned to ensure that it is adequately covered by concrete to prevent corrosion and to maintain structural integrity.

Splicing and Lapping: When lengths of rebar need to be joined, proper splicing techniques must be used to maintain strength. Lapping lengths are specified in design codes.

Concrete Cover: Adequate concrete cover over the rebar is necessary to protect against corrosion and fire. The required cover varies based on exposure conditions and structural requirements.

Quality Control: Regular inspections and quality control measures should be implemented to ensure that the steel reinforcement meets specified standards and that it is installed correctly

Corrosion Protection: In environments where corrosion is a concern, epoxy-coated rebar or stainless steel reinforcement may be used. Steel reinforcement is a vital component of concrete construction, enhancing its performance and durability. Understanding the types of reinforcement, design principles, and best practices is essential for engineers and construction professionals to ensure the safety and longevity of structures. Properly designed and executed steel work in concrete can significantly improve the resilience and functionality of buildings, bridges, and other infrastructure.

2.3.2.3 The structural members that were reinforced were the columns, beams and slabs.

Columns.

is a structural element designed to support loads while providing enhanced strength and durability. The combination of concrete and steel reinforcement allows the column to withstand various forces, including compression, tension, and bending. These were reinforced using steel reinforcement bars of T16, stirrups of R8 at a distance of 200mm between the stirrups(6T16). These were over lapped at a suitable distance of about 800mm distance. The bars were tied on the stirrups using binding wires. The volume were of dimensions of 150 X 300mm

Beams.

is a structural element designed to carry loads while resisting bending, shear, and other forces. The combination of concrete and steel reinforcement provides enhanced strength and ductility, making it suitable for various construction applications.

These were reinforced using steel reinforcement bars of T16, stirrups of R8 at a distance of 250mm between the stirrups(4T16). These were over lapped at a suitable distance of about 800mm distance. The bars were tied on the stirrups using binding wires.

Slabs.

is a structural element made of concrete that is strengthened with steel reinforcement bars (rebar) to improve its tensile strength and overall performance.

The type of slab that was casted was the ribbed slab using maxpans steel, reinforcement of T16 were used to reinforce the slab, these steel bars were passed through the ribs and tied using binding wires. The slab casted w**as of thickness 200mm.**

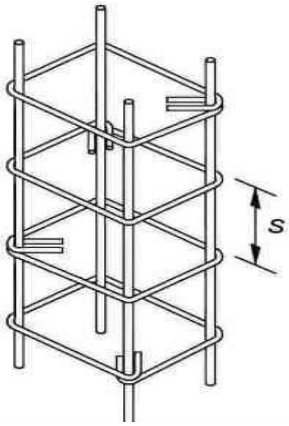
2.3.2.4 Placement of the Max-spans.

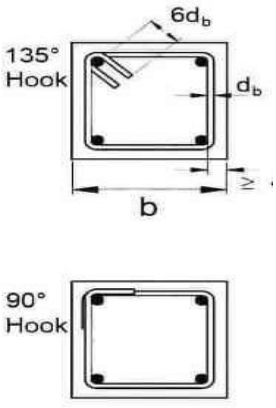
After the formwork and the steelwork for the slab was finished, max-spans were laid on of top the formwork. The max-spans were at a spacing apart at the bottom and were placed as seen in the figure below. A spacing was left between the max-spans and the reinforcement and between the max-pan and the column. Max-spans of dimensions 300mm×300mm max-spans of 175mm

thickness were used as manufactured by Uganda clays limited. Bars of T16 were used as ribs in between the layed maxpans which provide additional tensional strength to the slab not forgetting the conduits and the waterpipes.The BRC was then layed and bound to the rebars which held it firmly.

2.3.2.5 Stirrup.

These were made in different dimensions for the beams, columns and slabs beams. They were in two forms, the 135 degrees and 90degrees stirrups. But the best of all these are the 135 degrees stirrups.





2.3.2.6 Overlapping and development length for the bars in beams and columns.

The suitable distances for the overlap of bars in beams and columns, often referred to as lap lengths, depend on several factors, including the type of reinforcement used, the concrete grade, and the specific design codes being followed.

1. Lap Length for Beams:

Tension Reinforcement: The lap length for tension bars in beams is typically taken as 50 times the diameter of the bar (50d) for normal conditions. For high-strength concrete or when using high-strength steel, this may be reduced. Compression Reinforcement:The lap length for compression bars in beams is usually taken as 40 times the diameter of the bar (40d).

Minimum Lap Length: The minimum lap length should not be less than 300 mm or 24 times the diameter of the bar, whichever is greater.

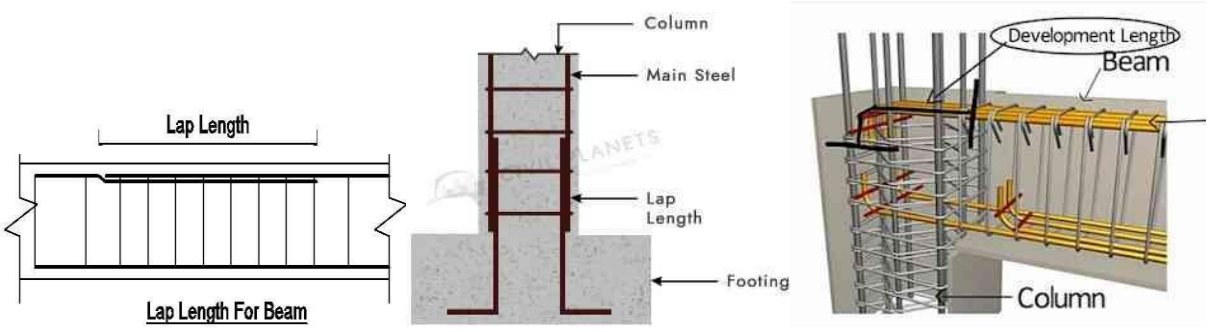
2. Lap Length for Columns:

Tension and Compression Reinforcement: The lap length for both tension and compression bars in columns is generally taken as 40 times the diameter of the bar (40d).

Minimum Lap Length: Similar to beams, the minimum lap length should not be less than 300 mm or 24 times the diameter of the bar, whichever is greater.

Development Length: Ensure that the lap length is sufficient to develop the full strength of the bars.

However on site the bar diameter that was used was T16 and also the lap length used was 800mm which corresponds to 50d(50x16 =800mm).



2.5 CONCRETE WORKS.

Concrete work: In the construction industry, concrete work involves using concrete to build foundations, fences and poles, overpasses, parking facilities, pavements, roads and bridges, walls and footings for gates and more.

2.5.1 Concrete

Concrete, in construction, structural material consisting of a hard, chemically inert particulate substance, known as aggregate (usually sand and gravel), that is bonded together by cement and water. It's used in all sorts of construction projects because it's affordable, durable, and can be moulded into nearly any shape. It is a building material made by mixing cement, aggregates, and water in precise proportions.

2.5.1.1 Types of Concrete.

Reinforced Concrete

This type of concrete is reinforced with steel bars or mesh to increase its tensile strength and durability. It is commonly used in the construction of high-rise buildings, bridges, and other structures that require extra strength and stability.

Lightweight Concrete

As the name suggests, this type of concrete is lighter in weight than normal concrete, making it ideal for construction projects where weight is a concern. It is commonly used in the construction of precast concrete elements, such as wall panels, roof slabs, and paving blocks.

High-Strength Concrete

This type of concrete has a compressive strength of over 40 MPa and is used in the construction of structures that require extra strength, such as tall buildings, bridges, and dams.

High-Performance Concrete

This is a specialized type of concrete that has enhanced properties, such as high durability, increased strength, and resistance to extreme temperatures and environmental conditions. It is commonly used in the construction of nuclear power plants, offshore structures, and other high-tech projects.

Precast Concrete

This type of concrete is manufactured off-site and then transported to the construction site. It is commonly used in the construction of precast concrete elements, such as wall panels, columns, beams, and staircases. Precast concrete offers several advantages over traditional cast-in-place concrete, including reduced construction time and increased quality control.

However, the type of concrete that was used on site is the reinforced concrete, here steel bars of diameter 16mm and 12mm were used to reinforce the concrete. T16 was used in the columns and beam while T12 was partly used in the slab and some beams.

2.5.1.2 Properties of Concrete

Concrete possesses several properties that make it an ideal building material for a wide range of applications. Here are some of the most important properties of concrete :

Workability: This refers to the ease with which the concrete can be mixed, transported, and placed into its final position. A high degree of workability is essential for achieving the desired shape and finish of the concrete.

Strength: Concrete is known for its strength and can withstand heavy loads and stresses. The compressive strength of concrete can vary widely depending on its composition and curing time.

Durability: Concrete s highly durable and can withstand exposure to elements, including water wind, and extreme temperatures. Proper curing and maintenance can extend the lifespan of concrete structures.

Creep: This refers to the gradual deformation of concrete under sustained loads over time. Creep can result in structural damage if not accounted for during the design and construction process.

Shrinkage: Concrete can shrink as it dries, which can result in cracking and other damage. Proper reinforcement and curing can help minimise the effects of shrinkage.

2.5.1.3 Concrete class;

Refers to the classification of concrete based on its compressive strength, which is a critical property that determines how well the concrete can withstand loads and stresses. The classification system helps engineers and builders select the appropriate type of concrete for specific applications, ensuring safety, durability, and performance. There are several concrete

grades or classes. Concrete grades include; C7/8 Concrete, C10 Concrete, C15 Concrete, C20 Concrete, C25 Concrete, C30 Concrete, C35 Concrete and C40 Concrete.bDifferent construction projects will require concrete of certain strength ratings, so understanding the difference between concrete grades is key to finding the ideal mix for your specific requirements.

The commonly used concrete classes used on sites are C20, C25 and C30.
However, on this site concrete class of C25 was used in the casting of all structural elements.This was in the ratio of 1:2:3. That is 1bag of cement, 2wheel barrows of sand and 3wheel barrows of aggregates.

2.5.1.4 Equipment/tools used in concrete works.

Here are some of the most common concrete equipment used in construction: Here are some of the most common concrete equipment used in construction:
Concrete Batching Plant
Also known as concrete plant, this equipment mixes various materials to form concrete. These materials include sand, aggregate, slag, cement, fly ash, and water among others. Concrete batching plants come in various types: dry mix concrete plant, wet mix concrete plant, mobile concrete plant, stationery concrete plant
Temporary site projects and projects that don't require much concrete typically use mobile plants. But projects like ports, bridges, tunnels, dams, and large buildings use stationary ones.

Concrete Pump

A concrete pump is used to transport liquid concrete from the production to the casting area. It works by having one piston draw the concrete from the source and another pushes it into the discharge pipe. There are two types of concrete pump: line and boom.

Line concrete pumps are typically used in small construction projects. It uses a line pump attached to the back of a truck, hence the name. While big construction projects use boom concrete pumps as it can pump in different heights and lengths. This makes it ideal for constructing multi-level buildings and bridges.

Concrete Mixer

As the name suggests, this equipment mixes cement, aggregates and water to create concrete. It may have the same function as a batching plant but a concrete mixer i usually a single machine. Batching plants, on the other hand, belongs to a whole production line.

Depending on the type, a concrete mixer can produce concrete by batch or continuously. Batch concrete mixers are ideal for small projects where concrete is not on constant demand. While continuous mixers are typically used in big projects like roads, bridges, dams, etc Concrete being poured at a construction site.

Concrete Vibrator

It's unavoidable for small bubbles to form when concrete is poured. But when left to dry, these bubbles create holes within the concrete and affect its integrity. This is why concrete vibrators are important. By shaking the newly poured concrete, a vibrator forces the air bubbles out. This creates a more compact and stable slab. Most construction projects use internal vibrators as they are usually cheaper and offer more flexibility. But for vertical constructions like walls, an external vibrator is more suitable. Concrete conveyors are ideal for large projects like dams and power plants because of their placing capacity. They also allow companies to save on labor cost as it only requires few people to operate. Most construction projects use internal vibrators as they are usually cheaper and offer more flexibility. But for vertical constructions like walls, an external vibrator is more suitable.

Concrete Tank

Concrete tanks are not just for storing water. In some construction sites, concrete tanks are built to store, well, concrete. They're usually installed on a higher ground and have pipes at the bottom for the concrete to pass through to the site.

Concrete Crusher Unlike most types of concreting equipment on this list, a concrete crusher isn't typically used for construction work but for demolition. When buildings are demolished, it usually leaves behind lots of waste concrete. Since they contain high-quality aggregates, throwing them away is a waste of resources. Besides, they take up lots of space and may cause pollution. To avoid this, some construction companies use concrete crushers to recycle waste concrete.

Concrete Conveyor

As the name suggests, a concrete conveyor is a type of conveyor belt that carries concrete horizontally or vertically (in limited distances). This type of conveyor is usually cheaper and may reduce the need for cranes and other such equipment. Concrete conveyors are ideal for large projects like dams and power plants because of their placing capacity. They also allow companies to save on labor cost as it only requires few people to operate.

The equipment that were used on site for concrete works was the concrete mixer and the porker vibrator.

Concrete mixer.

A concrete mixer (also cement mixer) is a device that homogeneously combines cement, aggregate (e.g. sand or gravel), and water to form concrete. A typical concrete mixer uses a revolving drum to mix the components. For smaller volume works, portable concrete mixers are often used so that the concrete can be made at the construction site, giving the workers ample time to use the concrete before it hardens.

The cement, aggregates and water were placed manually by hands into the revolving drum so as to be mixed to form concrete.

Poker vibrator.

A poker vibrator, often referred to simply as a "vibrator," is a tool used in construction, particularly in the process of consolidating concrete. Its primary function is to eliminate air

bubbles and ensure that the concrete mix is properly compacted, which enhances the strength and durability of the finished product.

How It Works:

The poker vibrator consists of a long, flexible shaft with a vibrating head at the end. When activated, the head vibrates at high frequency, creating rapid oscillations. The vibrating head is inserted into the freshly poured concrete. The vibrations cause the concrete to flow more freely, allowing it to fill voids and settle into place.

As the concrete vibrates, trapped air bubbles rise to the surface, where they can escape. This process reduces the risk of honeycombing (voids in the concrete) and improves the overall density of the mix.

2.5.1.5 Curing process of concrete.

Concrete curing is the process of maintaining adequate moisture in concrete within a proper temperature range in order to aid cement hydration at early ages. Hydration is the chemical reaction between cement and water that results in the formation of various chemicals contributing to setting and hardening. Some of the factors that affect the hydration process are the initial concrete temperature, the ambient air temperature, the dimensions of the concrete, and the mix design. Therefore, for the success of this process, in-situ concrete must have sufficient moisture and a temperature that favours this chemical reaction at a rapid and continuous rate.

Water Curing:

Description: This method involves keeping the concrete surface continuously wet. It can be achieved by ponding, spraying, or using wet burlap or mats.

Advantages: Water curing is effective in maintaining moisture levels, which is essential for the hydration process. It helps prevent cracking and improves the overall strength of the concrete.

Application: Commonly used for large slabs, pavements, and structures where water can be easily applied and maintained.

Membrane Curing:

Description: This technique involves applying a curing compound that forms a film on the surface of the concrete. The compound helps retain moisture by reducing evaporation.

Advantages: Membrane curing is convenient and can be applied quickly. It is particularly useful in situations where water curing is impractical, such as in hot or windy conditions.

Application: Often used for vertical surfaces, precast elements, and in areas where water availability is limited.

Covering with Blankets or Mats:

Description: This method involves covering the freshly poured concrete with insulating blankets, burlap, or other materials to retain moisture and heat.

Advantages: This technique is particularly useful in cold weather, as it helps maintain the temperature of the concrete, promoting proper curing and preventing freezing.

Application: Commonly used in colder climates or during winter construction when temperatures drop significantly.

Each of these curing methods has its own advantages and is chosen based on the specific conditions of the construction site, the type of concrete used, and the environmental factors at play. Proper curing is essential for achieving the desired strength and durability of concrete structures.

However, the curing method that was used on site was water curing.

2.6 PLASTERING

Plastering in construction refers to the process of applying a mixture of materials, typically composed of lime, gypsum, or cement, along with water, to walls, ceilings, and other surfaces to create a smooth, even finish.

2.6.1 Purpose of Plastering:

Plastering provides a suitable surface for painting or wallpapering, enhancing the aesthetic appeal of a space.

It helps protect the underlying structure from moisture, fire, and other environmental factors.

Plaster can contribute to thermal and acoustic insulation, improving the comfort of a building.

In some cases, plastering can add to the structural strength of walls and ceilings.

2.6.2 Plastering technics.

Traditional wet plastering.

Dry lining (using plasterboard).

Decorative plastering.

2.6.3 Batching in plastering works(mix-ratio).

The mix-ratio that was used on the site for plastering was 1:4, that is 1bag of cement and 4 wheel barrows of sand. On the 4wheel barrows of sand, 3were for plaster sand and 1for lake sand.

2.6.4 Equipment/tools used during plastering.

Trowel: A flat tool used to apply and smooth plaster.

Plastering Float: A tool used to level and smooth the plaster surface. It can be made of wood, plastic, or metal.

Plumb bob: A tool used to ensure that walls are vertical and to check for alignment.

Scaffolding: Temporary structures used to support workers and materials during the plastering of high walls or ceilings.

Straight Edge/angle l: A long, straight tool used to check the flatness of the plaster surface and to help level it.

2.6.5 Procedures for plastering.

Preparation of the Surface: Ensure the surface to be plastered is clean, free from dust, grease, and loose particles.

Mixing the Plaster: Cement, sand and water were mixed in the appropriate ratio as discussed above to form mortar.

Moistening: The surface was moisturised to make sure that the plaster sticks very well on the wall.

Applying the Plaster: The plaster was then applied on the surface of the wall with a thickness of about 10-15mm or 2 inch and left to cure or set for some time about 2hours.

The plumb Bob was then used to take the levels to ensure the the plaster is on level and then cutting was done using a straight edge or angle line to level the plaster.

Finishing; this was done to smoothen the surface of the plaster using both the wooden and metallic floats.

2.7 CEILING INSTALLATION.

Ceiling, the overhead surface or surfaces covering a room, and the underside of a floor or a roof. Ceilings are often used to hide floor and roof construction. They have been favourite places for decoration from the earliest times: either by painting the flat surface, by emphasizing the structural members of roof or floor, or by treating it as a field for an overall pattern of relief.

2.7.1 Types of ceilings.

Conventional Ceiling.

A conventional ceiling construction type is commonly found in homes. These ceilings have a standard drywall finish and are made of lower-cost materials, requiring easy installation. Conventional ceilings are plain and flat and are usually between 8 to 9 feet high and can fit with typical construction material sizing. Although more readily accessible, a room can feel closed-in if the ceilings are too low. Raising the ceiling by a few feet can open up space significantly and even increase a building's value for resale. But upgrading conventional ceilings comes with a higher price tag, since it will require the use of materials that are not standard fit. You'll need to weigh the cost and potential resale value, as well as how important the aesthetic appeal is to you.

Suspended Ceiling.

A suspended ceiling (sometimes referred to as a dropped ceiling) hangs from a metal grid below the existing ceiling that is already in place. Commonly used with noise-regulating acoustic ceiling tiles, these flat drop ceilings allow designers to conceal mechanical, electrical, plumbing, and lighting fixtures (MEP) above the dropped, exposed ceiling, such as pipes and wiring. This ceiling variety is most commonly used in commercial buildings, offices, and retail spaces, as suspended ceilings give designers remarkable flexibility. Most wood ceilings are suspended using standard commercial T-bar grids and are a cost-effective option.

Coffered Ceiling.

Commonly found in high-end homes, churches, libraries, and hotels, coffered ceilings reflect a classic, even luxurious, aesthetic. A pricier option than conventional options, coffered ceilings require installation by specialists who are familiar with this variety

Tray Ceiling.

Tray ceilings are multi-level ceilings – they start from one height, then drop as you add levels. As the name suggests, the ceiling layout resembles a tray. The flat ceiling on the outside of the tray surrounds the raised center, which is the highest part of the ceiling. Tray ceilings (also known as panned ceilings) become slightly lower with each added step or "level" that surrounds the raised center, creating a three-dimensional effect as the ceiling expands outwards. These ceilings can add a dramatic effect to a space and also make a room seem taller. Panned ceilings typically have two to three levels, with each level dropping between 5 to inches below the level above. You can add trim or molding as a fascia in between the layers.

Cathedral Ceiling.

Cathedral ceilings are often found in large living rooms, dining rooms, bedrooms, and even the master bath.Cathedral – or vaulted – ceilings are known for their inverted Vshape where the tip of the V is the highest point and the sides of the V slope down.

Flat Ceilings:

The most common type, typically made of drywall or plaster. Framed with wooden or metal studs, then covered with drywall, which is taped, mudded, and painted.

However the type of ceiling that was used on this site was the flat ceiling, this was typically of dry wall and plaster. This was done by mixing sand, cement and water in a mix ratio of 1:4(1bag of cement and 4wheel barrow of sand (3 plaster sand and 1lake sand).

2.7.2 Procedures for installing or constructing a ceiling.

The frames or timber was placed and the wire mesh tied at the bottom of it.

The mortar was then placed on the wire meshes from above and then left to cure.

After some days plastering of the ceiling is then done by applying the mortar, cutting it with the angle line or cutting edge to level it and then carrying out the finishes for the ceiling


2.8 Door and window frame installation.

The doors and windows frames were installed.

Door; A door is a movable barrier used to close off an entrance, typically consisting of a solid panel that swings on hinges, slides, or folds. Doors are commonly made from materials such as wood, metal, or glass and serve various functions, including providing security, privacy, and protection from the elements.

Window; a window is an opening in a wall or structure that is typically filled with glass or other transparent materials to allow light and air to enter while providing a view of the outside. Windows can be framed with materials such as wood, metal, or vinyl and maybe operable (able to be opened and closed) or fixed (stationary). They serve various functions, including ventilation, illumination, and aesthetic appeal, and can also contribute to the energy efficiency of a building. Windows come in various styles and designs, such as casement, sliding, double-hung, and bay windows.

Door/window frame; A door or window frame is a structural component that surrounds and supports a door or window.

2.8.1 Procedure that was used to install the door/window frames.

Some opening or holes were made in the wall in order to allow an easy fixing of the door/window frames.

The door frames were fixed and put on plumb to make sure that the frames are in a straight line and on level.

The mortar was then prepared by mixing sand, cement and water.

The mortar was then applied and the holes were sealed.

CHAPTER THREE

3.1 Observations Made On Site

Once again, it's been a pleasure working with Mangrone Investment limited I have been able to participate in the construction of a mult-storey apartment all the way from foundation to finishes.

Personal Protective Equipment are very important during work. While working with steel, the binding wire would cut one without safety gloves or an overall. So, to be safe, one needed to wear full PPE.

Communication is also vital. This is needed to avoid making errors and repeating work. Good communication environment aids in quick fulfillment of the desired daily goals effectively.

Accuracy is a major break-through and indicates one's efficiency in work.

Material storage areas should be well built and secure from weather interference. At each site we had a store where we kept all stock-pile material brought to site to keep their strength properties mostly intact.

Excavated areas on site were demarcated with warning signs and tape to avoid accidents from happening.

The site was fenced out from the public to reduce on the project risk to the public which would be an added cost to the Company in terms of medical facilitation. Site works are carried out amid favorable working weather conditions.

Casting works are not done on rainy days as it would alter the mix proportions. Concrete tests were kicked off immediately casting works were done to ensure that the strength of the mix was in line with that of the mix design.

3.2 Knowledge And Skills Acquired.

There was involvement in a number of activities that took place on site. Among them were plastering, masonry work, concreting, setting out and steel work from all which these skills were attained.

The trainee learnt how to lay bricks, plastering , capentry, ceiling installation, batching of mortar and concrete and how to plumb formwork, wall and others. Skills in setting out, providing level and gauges using a string and plumb bob were acquired which is considered as one of the most important skills that one must have to be able to manage a project.

Skills on how to use a trowel, plumb Bob, tape measure, water level, jumper and concrete mixer were acquired.

Knowledge on the procedures for constructing different elements were acquired for example foundation, rising walls, columns, beams, slabs Ceiling, etc.

3.3 Common Mistakes That Trainees Were Warned Against In Foundation Construction.

1. Pouring Concrete from a high rise or distance
2. Setting out uneven foundation levels
3. Short or no development length for Footing hooks
4. Skipping anti-termite treatment
5. Foundations less than 1 metre
6. Ground Floor SSL unrelated to the road level (RL)
7. Concrete for the GF SSL less than 25mm or 1inch
8. Setting up buildings before determining the SBC

3.4 Challenges Faced During Industrial Training.

There was limited Practical Experience though the theoretical knowledge was there.

Communication Barriers with professionals, subcontractors, and laborers.
Time Management; Balancing training responsibilities with other personal responsibilities was challenging.

Adapting to Work Culture was also challenging.
There was technical skills gap making it challenging to contribute effectively.

CHAPTER FOUR
CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Below are the conclusions I could come up with regarding the training process;

Creativity is one well exploited character on site as one has to adjust to site works basing on the nature of the site at times and not fully base on the design. Concrete tests are important and should be cautiously monitored when casting of concrete is being done.

Soil tests such as moisture and compaction must be done immediately, and the sample collection must be done just after final compaction is done to reduce on error margin in final results.

Steel should be stored in a clean dry place as exposure causes it to rust and it loses its strength as time goes by. This also applies for the other site materials as they contribute to the construction process.

Volume batching is easier to deal with compared to weight batching because it's easier to use batching boxes than continuously measure the weights per mix.

In case any tests done on site fail, that particular element must first be removed and corrected to avoid wasting material and time, allowing for an acceptable strength capacity such as marram when rain clogs during filling and the underlying layer is soggy, it must be removed and refilled with better marram to reduce chances of over settlement in that particular place.

Cases of theft of material left especially for open sites with no clear stock pile (pipe laying sites) have risen implying that for one to procure materials in such an area, one must procure exactly what shall be used that day so that it can all be buried and the remaining material should be taken back to the main store to avoid such incidences from happening.

4.2 Recommendations.

I recommend that students should take it upon themselves to involve themselves in all the activities concerned with the industrial training, since it is through active participation that more is learnt and skills gained.

Health and safety inductions should be done for each and every employee in the project and tool-box meetings are key to workers due to induction to different hazards to keep a look out for as well as emergency protocols.

Immediate health personnel are required on site in case of injury and a first aid box, fully equipped is needed on site at all times Continuous assessment of drawings should done by the engineers on field so as to make interpretation of ground data easier. No compromise must be made to errors on site because they can prove to be costly with time.

All worn out PPEs should be replaced to reduce chances of accidents due to poor dress code as per the site requirements.

Tight supervision of the contractor to avoid conflict and time wastage due to possible shoddy works.

Warning signs must be placed in areas with deep excavations to avoid having casualties at that particular site. If possible, it can be enclosed with warning tape.

The site should be fenced out from the general public so as to reduce chances of public harm within the contract site which can be costly to the Contractor or Consultant in terms of compensation.

To the students, relating theory to the practical work in the field is paramount, during the training.

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APPENDICES

APPENDIX I: PROJECT PHOTOS