A STUDY ON CONSTRUCTION WORK PROCESS OF A SEVEN- STORIED RESIDENTIAL BUILDING

Practicum Report
by
Md. Nur Hossain
ID#18206036
Program: BSCE

Department of Civil Engineering
IUBAT—International University of Business Agriculture and Technology

Dhaka

August 16, 2022

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Examination Committee

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Supervisor
Rifat Sumona Mollik
Senior Lecturer
Department of Civil Engineering

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Chair
Prof. Dr Md Monirul Islam
Dean, College of Engineering and Technology (CEAT)
Chair, Department of Civil Engineering

Department of Civil Engineering
College of Engineering and Technology (CEAT)
IUBAT—International University of Business Agriculture and Technology

This practicum report is done for the partial fulfillment of requirements for the Bachelor of Science degree at the
IUBAT— International University of Business Agriculture and Technology, Dhaka, Bangladesh.

August 16, 2022

Letter of Transmittal

May 22, 2022

Prof. Dr Md Monirul Islam
Chair, Department of Civil Engineering
IUBAT— International University of Business Agriculture and Technology
4 Embankment Drive Road, Sector 10, Uttara Model Town, Dhaka 1230, Bangladesh.

Subject: Submission of Practicum Report

Dear Sir,

This is a great opportunity and immense pleasure to submit my practicum report on ***"A Study on Construction Work Process of a Seven- Storied Residential Building"*** I have the opportunity to work in Design Professionals Ltd. for my internship program, which is an essential part of my academic program.

I have tried my best to prepare this report to the required standard. It was certainly a great opportunity to work on this report to actualize my theoretical knowledge in the practical arena.

I express my gratitude to you for going through this report and making your valuable comments. It would be very kind of you to evaluate my performance regarding this report.

Thanking you,

Sincerely Yours,

…….
Md. Nur Hossain

Letter of Authorization

This is to certify that the Practicum Report on ***"A Study on Construction Work Process of a Seven-Storied Residential Building"*** submitted for the partial fulfillment of the degree Bachelor of Science in Civil Engineering (BSCE) to the IUBAT− International University of Business Agricultural and Technology is a record of practicum report carried out by Md Nur Hossain bearing ID #18206036 under my supervision. No part of the practicum report has been submitted for any Degree, Diploma, Title, or Recognition before.

He is permitted to submit this practicum report. I wish him all the success in his future endeavors.

_____

Rifat Sumona Mollik
Practicum Supervisor
Senior Lecturer, Department of Civil Engineering
College of Engineering and Technology (CEAT)
IUBAT—International University of Business Agriculture and Technology

Recommendation Letter

Design Professionals
H-12, R-21, Sector -04
Uttara-1230
designprofessionals.ce@gmail.com

Let's Build Future

TO WHOM IT MAY CONCERN

This is to certify that **"Md. Nur Hossain"** bearing ID no: **18206036**, a student of Bachelor of Science in Civil Engineering **(BSCE)** of "International University of Business Agriculture and Technology **(IUBAT)"** has been completed his internship program as an "Intern Engineer" in our construction Project "***Mobarak Villa***" located at "***Chan Para, Uttarkhan, Uttara, Dhaka***".
He Started his intern period from *10th May, 2022 to 10th August; 2022.*

We found him an innovative, energetic and hardworking person. I wish him in every success in his future life.

Eng. Mahadi Hasan
Managing Partner
Design Professionals

H-12, R-21, Sector-04 Uttara, Dhaka aminul.shawon@gmail.com 01674898758, 01762749580

Student Declaration

I declare that this practicum report on ***"A Study on Construction Work Process of a Seven- Storied Residential Building"*** has only been prepared for the partial fulfillment of the degree Bachelor of Science in Civil Engineering (BSCE).

It has not been prepared for any other purpose, reward, or presentation and has not been submitted by me for any Degree, Diploma, Title, or Recognition before.

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……..

Md Nur Hossain

Program: BSCE

ID # 18206036

Executive Summary

This report contains the construction process of super-structure of a residential building under Design Professionals Ltd. I engaged myself as a trainee engineer at this project from May 2022 to August 2022 with a title on “A study on construction work process of a seven - storied residential building”. I have observed construction work of column, stair, beam and slab of my projects during practicum period. Detail construction process is included in this report. Besides this, I include the estimation of concrete and reinforcement used in my project. Materials, method and design specification are also mentioned in this report. In this report I have also discussed some field test of different materials which I have done during practicum period.

Acknowledgments

I deeply express my gratitude to Rifat Sumona Mollik my supervisor, for her immense assistance, guidance, and advice with encouragement.

Particularly, I would like to thank my supervisor Prof. Dr Monirul Islam, for his kind contribution to making this study successful.

In addition, I wish to thank Engr Md Aminul Islam Shawon and Engr Md Hasibul Islam, from Design Professionals Ltd., for their kind cooperation and continuous support during my study. And, I would like to thank all other laboratory staff of Design Professionals Ltd. for their assistance.

Moreover, I would like to thank Rifat Sumona Mollik for her guidance and advice for practicum report writing.

Finally, I deeply appreciate the love, moral support received from my fellow friends and colleagues who supported me in this crucial time as well. Besides this, I extend my thanks to all others who have supported me in any way.

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Abbreviations

ACI = American Concrete Institute

ASTM = American Society for Testing Materials

BNBC = Bangladesh National Building Code

BSRM = Bangladesh Steel Re-Rolling Mills

EIA = Environmental Impact Assessment

ETP = Effluent Treatment Plant

FM = Fineness Modulus

HVAC = Heating, Ventilation, and Air Conditioning

ISO = International Organization for Standardization

OHSA = Occupational Health and Safety Assessment Series

OPC = Ordinary Portland cement

PCC = Portland Composite Cement

RCC = Reinforced Cement Concrete

USD = Ultimate Strength Design

CHAPTER 1

Introduction

1.1 Background of the Study

During this practicum, I had a fantastic opportunity to put what I had learned theoretically in my academic life into practice. The super-structural construction method, such as column, floor beam, stair, and slab, is explained here. Almost all of the information for this report was gathered from the construction site, project engineer, and site supervisor.

1.2 Objectives

- To understand both architectural and structural drawing, design specifications
- To estimate different components of the construction at project according to the drawing
- To find the irregularities and how to overcome the irregularities in the construction site

1.3 My Responsibilities

- According to the structural design, observe the construction work.
- Estimate the quantity of cement, fine aggregate, coarse aggregate and reinforcement required for column, beam, stair and slab.
- Check the reinforcement placing, binding work day before the casting according to design.
- Field test of Cement, Brick, Aggregates, and Reinforcement to ensure the quality.
- Monitoring the casting and curing work.

CHAPTER 2

Company Profile

2.1 Company Name and Address

Name: Design Professionals Ltd.

Corporate office:

House #02, Road #20, Sector-11, Uttara, Dhaka-1230.

Cell: 01674898758

Email: designprofessionals.ce@gmail.com

2.2 Company Logo

Figure 2.1 Company logo

2.3 Mission

Planned growth of the construction industry, such as the construction of industrial complexes, roads, bridges, rail lines and flyovers, power stations, housing infrastructures, airport development, and so on, is a prerequisite for achieving the goal of overall national development in a developing country like Bangladesh. Engr Md Aminul Islam Shawon created the company as a partnership Company in the year 2018 with this goal in mind. The Company, which began operations almost from the ground up, has grown rapidly and steadily under the youthful exuberance and dynamic leadership of its late founding Managing Director as well as its current Managing Director in particular, with the able assistance and concerted efforts of its directors, engineers, technicians, and employees in general, and is now in its current position.

2.4 Vision

- To finish high-quality construction projects that meet the needs of the client in the shortest possible period and with the least amount of money spent by planning and organizing the employment of men, materials, equipment, and financial resources.
- To maintain a constantly high standard and quality of work in the fields of civil, sanitary, and plumbing in connection with the construction of multi-story office buildings, functional buildings, academic and industrial buildings, and other similar structures.
- Employees, Clients, Consultants, Joint Venture Partners, Subcontractors, Suppliers, and Financial Institutions must all have strong working relationships.

2.5 Company Organogram

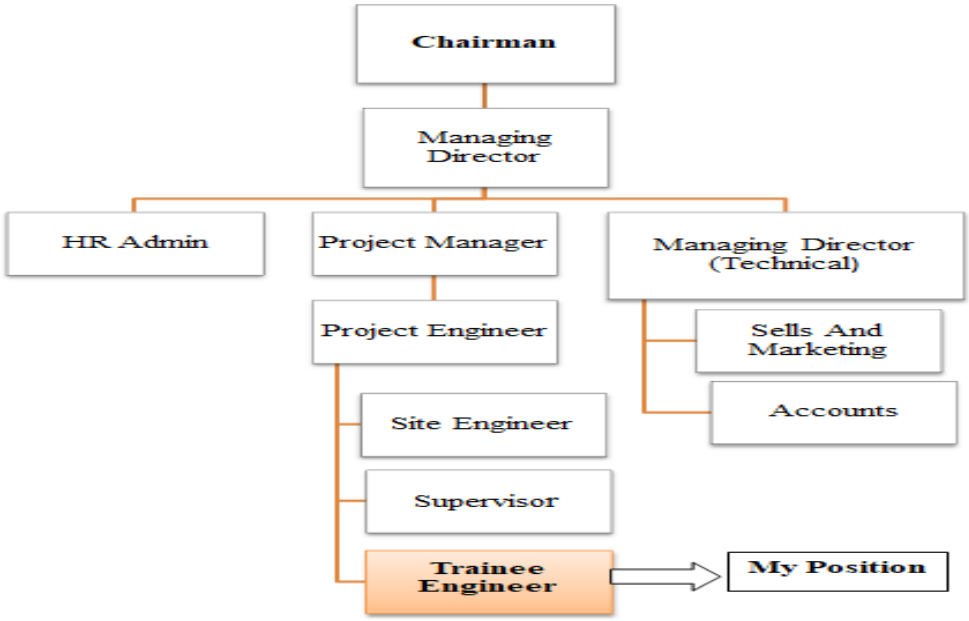


Figure 2.2 Company organogram

2.6 My Project

My project name was the residential building "Mobarak Villa". The whole land was this project is 5.282 Katha (3802.89sft). In this building there were three unit in each floor.

2.6.1 Basic Information of the Project

Table 2.1 A Brief Project Information of the Residential Building is Presented

Name of the Project	Mobarak Villa
Address	Chan Para, Uttarkhan, Uttara, Dhaka.
Land Area	2830.69 Sft
Building Type	Residential
Unit	A, B, C
Area of Unit	A-874.14 sft, B-874.14 sft, C-874.14 sft
Facilities	Lift, Gas, Generator, Stair, Fire Safety,Secuirity
Facing	North
No of Apartment	18 Nos

Project Starting Date: 10th April 2021

2.6.2 3D View of The Project

Figure 2.3 3D view of the project

2.6.3 Ground Floor Plan

Here is one guard room, one Generator Room and one driver's waiting room along with seventeen car parking.

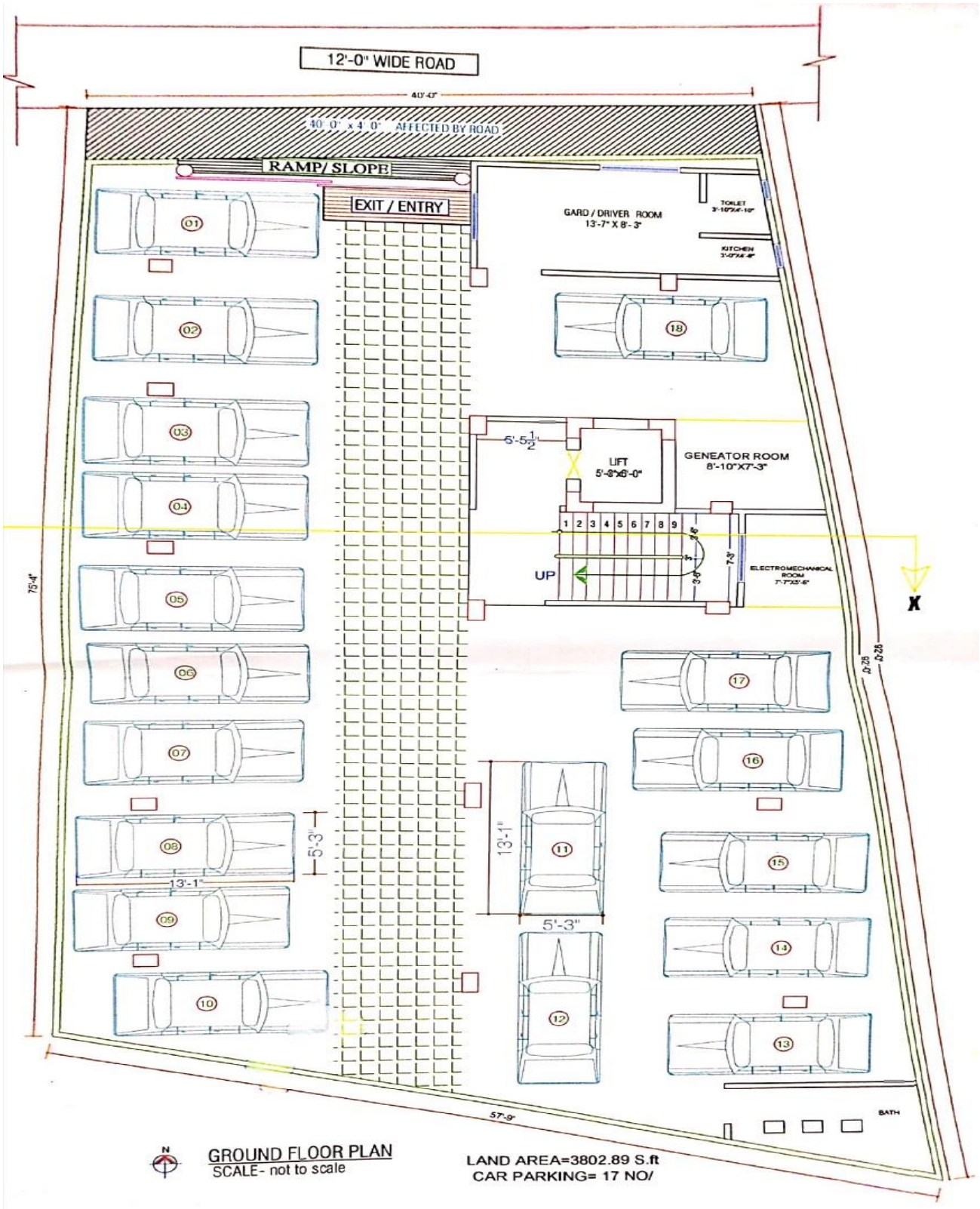


Figure 2.4 Ground floor plan

2.6.4 Typical Floor Plan

Each floor has three unit from 1st to 6th floor. Each unit contains Two master bed with attached toilet, one general bed room, one common toilet, one kitchen with attached dining and drawing room.

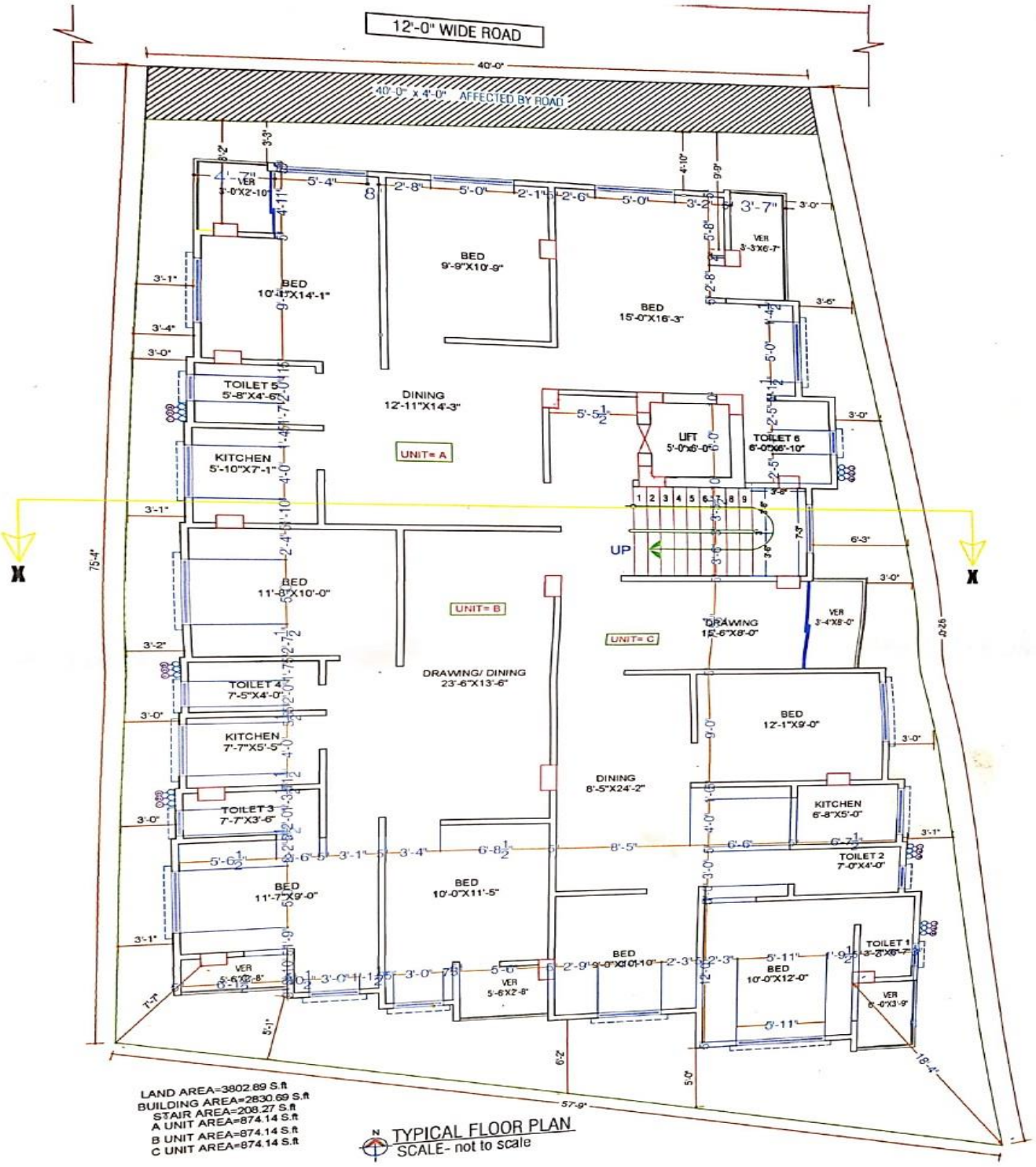


Figure 2.5 Typical floor plan

CHAPTER 3

Construction Materials and Methods

3.1 Cement

Cement is a very important material in construction work. It's a binding material which helps to compact fine aggregates and coarse aggregates to build a concrete form. In my project they have used Portland Composite Cement that is Shah Cement. The net weight of each bag is 50 kg.

a) Ingredients of cement

b) Storage of cement

Figure 3.1 Ingredients and storage of cement

Table 3.1 Ingredient of Shah Cement

Ingredients	Amount (%)
Clinker	65-79
Slag, Fly ash, Lime Stone	21-35
Gypsum	0-5

3.1.1 Temperature Test of Cement

If the hand is plunged into a bag of cement, it should be cool inside the cement bag. When I entered my hand into the cement, I felt it was cool.

Figure 3.2 Temperature test of cement

3.1.2 Colour Test

The colour of the cement should be uniform. The colour of the cement that I found in my site was grey and little bit light greenish shade.

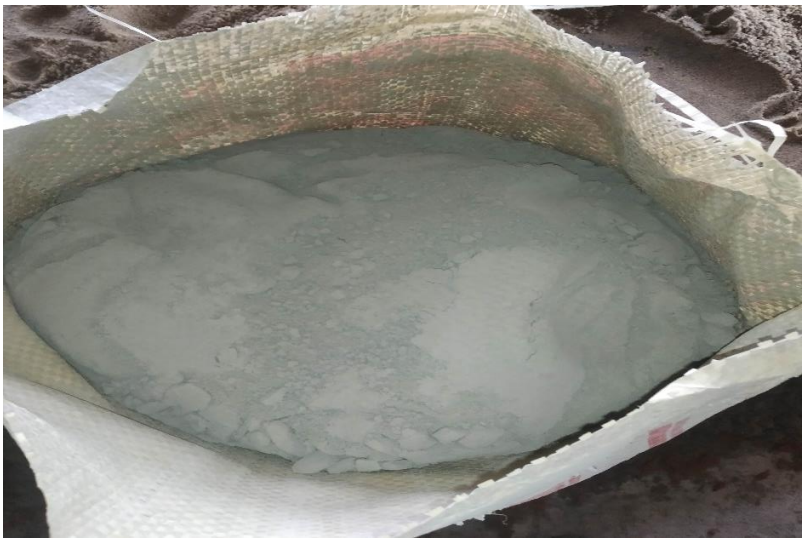


Figure 3.3 Colour test of cement.

3.1.3 Adulteration Test of Cement

I have taken some amount of cement as a sample in my hand and rubbed it with my two fingers. It did not have a lumpy or gritty feeling but given a smooth feeling. So, the quality of the cement was good.

Figure 3.4 Adulteration test of cement.

3.1.4 Float Test of Cement

For doing this test I took a hand full of cement and the simply released them in a bucket full of fresh water, I noticed the cement was floating for a while then it sunk in the bottom of the bucket.

Figure 3.5 Float test of cement.

3.1.5 Comparison between Standard and Field Test of Cement

Table 3.2 Comparison between Standard and Field Test of Cement

Test	Standard Test	Filed Test	Comment
Temperature Test	Temperature should be cool.	It was cool	ok
Colour Test	Should be gray or light greenish shade And Uniform	Colour was gray and uniform	ok
Adulteration Test	Should be felt smooth.	It felt smooth	ok
Float Test	Should take some time before finally Sinking	Takes time before final sinking	ok

From the Table, I can say that the quality of cement was good. This Cement is suitable for using in construction.

3.2 Brick

Brick plays very important role in the field of civil engineering construction. Bricks are used as an alternative of stones in construction purpose. In my site brick has been used to make brick walls and to produces coarse aggregates for stair, beam and slab casting.

Figure 3.6 Brick.

3.2.1 Soundness Test of Brick

A soundness test on bricks is carried out to determine the nature of bricks when subjected to sudden impact. It is a simple test in which two bricks are taken randomly from the stack of bricks. The bricks are then struck against each other. It emits a clear metallic ringing sound; the brick is of good quality.

Figure 3.7 Soundness test of brick

3.2.2 T-test

This test has been conducted to finding the strength of the bricks, I took two bricks that has been used in my site, and formed a T shape by placing them vertically and horizontally. Then released those from 6 feet above from ground surface. I found the bricks didn't break, which assures the quality of brick was quite good.

Figure 3.8 T-test

3.2.3 Homogeneousness Test

The structure of the brick should be homogeneous, compact and free from any defects. For this test I crushed a brick into two pieces almost in mid portion. Then I observed the structure, found no defects inside, it was compact which indicates structure was homogenous.

Figure 3.9 Homogeneousness test

3.2.4 Colour Test of Brick

A good quality brick should be bright and uniform in color throughout its body. In my site the bricks color was uniform and evenly matched. Even after scratching with nails the colours remain uniform.

Figure 3.10 Colour Test

3.2.5 Size and Shape

The standard size of the brick without mortar is 9.5’’×4.5’’×2.75’’. Randomly I took ten bricks and take the measurement of length, width and thickness. The shape should also be uniform as rectangular shape.

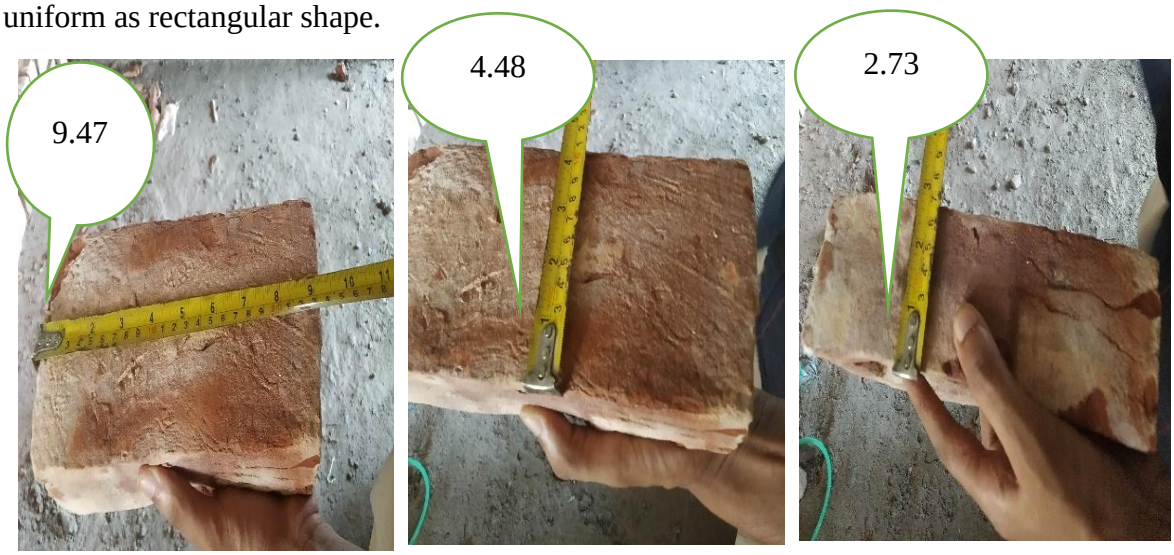


Figure.3.11 Size and shapes of a brick

Table 3 .3 Brick Size Data

Sample Number	Length (inch)	Width (inch)	Thickness (inch)
01	9.50	4.50	2.75
02	9.48	4.50	2.74
03	9.47	4.48	2.73
04	9.48	4.49	2.70
05	9.50	4.47	2.72
06	9.49	4.50	2.70
07	9.46	4.47	2.70
08	9.50	4.48	2.74
09	9.48	4.49	2.75
10	9.45	4.50	2.74

Average size if the brick without mortar = 9.48"×4.49"×2.70"

Size and shape of the brick is almost uniform. So, the brick quality is good.

3.2.6 Comparisons between Standard and Field Test of Brick

Table 3.4 Comparisons Between Standard and Field Test of Brick

Test	Standard Test	Field Test	Comment

Soundness Test	Should give metallic Sound	Gave metallic sound	Ok
T-Test	Should not break	It was not breaking	Ok
Color Test	Should be bright and Uniform	It was bright and uniform	Ok
Homogeneousness Test	Should be compact and free from defects.	Almost free from defects	Ok
Size and Shape	Should be 9.5"×4.5"×2.75"	Average size was 9.48"×4.49"×2.70"	Ok

So, the bricks were good quality.

3.3 Fine Aggregate

Sand was used in my project as fine aggregate materials. Sand is a very important and effective component in a concrete mixer. Generally, two types of sand (local sand and Sylhet sand) have been used in my construction site. I got both types of sand for super structural work.

a) Local sand

b) Sylhet sand

Figure.3.12 Fine aggregates

3.3.1 Clay Test of Sand

I grabbed a bottle. Then I poured the water over it. I then took a handful of sand in my hand. That is what I did with it. I threw it into the water. After a few seconds, I see a color that looks like clay. As a result, the sand was of moderate quality.

Figure.3.13 Clay test of sand

3.3.2 Silt Test of Sand

I took some Sylhet sand in my palm and rubbed those for a while I found the sand was clear from silts and other foreign materials. It assures that the quality of the sand was good enough.

Figure.3.14 Silt test of sand

3.4 Coarse Aggregate

Coarse Aggregate can be defined as those particles that are predominantly retained on the 4.75 mm (No. 4) sieve and will pass through 3-inch screen, are called coarse aggregates. Stone and brick chips are known as coarse aggregate. They used stone chips for column and bricks chips for stair, floor beam and slab.

a) Bricks chips

b) Stone chips

Figure.3.15 Coarse aggregate

3.5 Reinforcement

When reinforced used in Cement Concrete to Gain an Extra tensile strength in this cement concrete. since concrete is very weak in tension, but is strong in compression. In my site, they mainly used, 20mm, 16mm, 12mm and 10mm bar for column, stair, floor beam and slab.

Figure.3.16 Reinforcement

3.5.1 Smoothness Check

The reinforcement should be smooth in cutting face. I observed 12mm bar and checked the surface. It was smooth.

Figure.3.17 Smoothness check

3.6 Construction Equipment

These are the different tools and machines used during the construction work process. In my site all sorts of tools and machines were available.

3.6.1 Mixture Machine

It was used to mix concrete for column, stair, floor beam, slab and so on. The materials are poured inside the machine and it starts moving clockwise during the movement sufficient water is added as per mixtures requirements,

Figure.3.18 Mixture machine

3.6.2 Grinding Machine

Grinding Machine was used to cut the reinforcements in desired length. The bars are placed on top of the steel plate and then the circular blade made of silica, which is powered by electric motor, starts circulating and it cuts the bars with smooth finishing,

Figure.3.19 Grinding machine and it's use

3.6.3 Electric Vibrator Machine

Electric Vibrator Machine was used to remove the void from the concrete and make dense concrete. Vibrator machine has a metal tube which is attached with the motor, during casting time workers place the metal tube in fresh concrete mixtures of slabs, beams, columns and stairs while casting. The vibrations helps the concrete to reach in every void and fill the gaps.

Figure.3.20 Electric vibrator machine and it's use during casting

3.6.4 Plump Bob

Plump Bob is used to align the column vertically and to maintain the center line. It's a cone metallic cone which is tied with nylon wire and used during shuttering to maintain proper measurements.

Figure.3.21 Plump Bob

3.6.5 Handle

Handle is used to bend and straight the reinforcement. Workers bend reinforcements manually using handle. They place the bars on top of a table and bend those according to the measurements.

Figure.3.22 Handle and it's use

3.6.6 Concrete Blocks

In my site workers used two type of block one is cylinder block and another one is cube block. Cylindrical block was 3 inch in height and the cube block was 1.5 and 0.75 inch in dimension. Cylindrical block was used to maintain the clear cover in slab and cube block was used to maintain the clear cover in slab and floor beam.


Figure.3.23 Cube block and cylindrical block

3.6.7 Wooden Planks

They have been used wooden plank for the shuttering of floor beam, stair and slab. The common width of the wooden plank was 6", 5"and 4". These wooden planks are fixed with steel nuts to form shuttering of beams and molded with plastic so that honeycomb doesn't occur while casting.


Figure.3.24 Wooden plank

3.6.8 Bamboo Props

Bamboo props is the common material to support the formwork during the construction work. The sizes of the bamboo props are 8 feet to 10 feet. Bamboo props are jointed with wooden planks which is strong enough to hold the entire structure before casting.


Figure.3.25 Bamboo props

3.6.9 Steel Wire

Steel wire is used to bind the reinforcement. It is used in reinforcement binding of beam, column, slab, stair and every type of RCC works. Workers take a single wire and bind them in reinforcement joints manually.


Figure.3.26 Steel wire

3.6.10 Turnbuckle

Turnbuckle is used to make vertical alignment of column shutter. It aligns the shuttering of column by tightening the screws. One end is connected with a wire which is connected to ground and another end is connected with the wire connected to shuttering.


Figure.3.27 Turnbuckle

CHAPTER 4

Investigation of Construction Work and Design Verification

4.1 Design Verification

4.1.1 General

- Design method used is USD according to BNBC 1993, ACI Code 1999.
- Basic Wind Speed = 210 km/h
- Seismic Zone = 2
- Other Load as Per BNBC 1993

4.1.2 Foundation

- The building has been designed for 7 storied residential building.
- Factory of safety have been taken 2.5

4.1.3 Concrete Clear Cover

Table 4.1 Concrete Clear Cover

Member	Location or Condition	Thickness of Cover
Column	Basement floor and above ground level	1.5”
	Contact with earth	2.5”
Beam	Indoors face: Top, side and bottom	1.5”
	Outdoors face:	1.5”
Slab and Stair	Top	¾”
	Bottom	1”

4.1.4 Concrete

Compressive Strength

1. Pile f'c = 3500 psi
2. Pile Caps, Columns, Grade Beam and Lift Core f'c = 3500 psi
3. Floor Beam, Slab, Lintel and Stair f'c = 2500 psi

4.1.5 Curing

1. Curing minimum 28 days
2. Method of Curing-
    a) Horizontal surface – by ponding of water.
    b) Other surface – by warping moist Jute fabric and sprinkling water by hose pipe frequently.

4.1.6 Water

Portable water to be used for concrete mix.

12” wide PVC water stopper to be used at all construction joints below ground in MAT, Shear wall, Water tank wall etc.

4.1.7 Lap Location

- For beam bottom bar, lap not to be provided at middle third zone of the span.
- For beam top bar, lap may be provided at middle third zone of the span.
- Not more than 50% of the bars shall be spliced at one place.
- Lap slices are to be confined by hoops with maximum spacing or pitch of d/4 or 100 mm where d is the effective depth of the beam.

4.1.8 Chairs

Use chairs of necessary dimension made of 10 mm/12 mm/16 mm bar to support top bars @30-inch C/C.

4.1.9 Steel Reinforcement

All reinforcements for lift core base, column, slab, edge beam, under-ground water reservoir, stair is 60 grade high strength deformed bar made from billet steel.

Steel of column, beam, slab, railing, drop wall & parapet are 72 grade.

Yield strength of steel fy = 500 Mpa (72500 psi) conformed to one of the following specifications:

4.2 Column

In my project, I have observed 14 columns of 6 different sizes.

4.2.1 Column Layout Plan

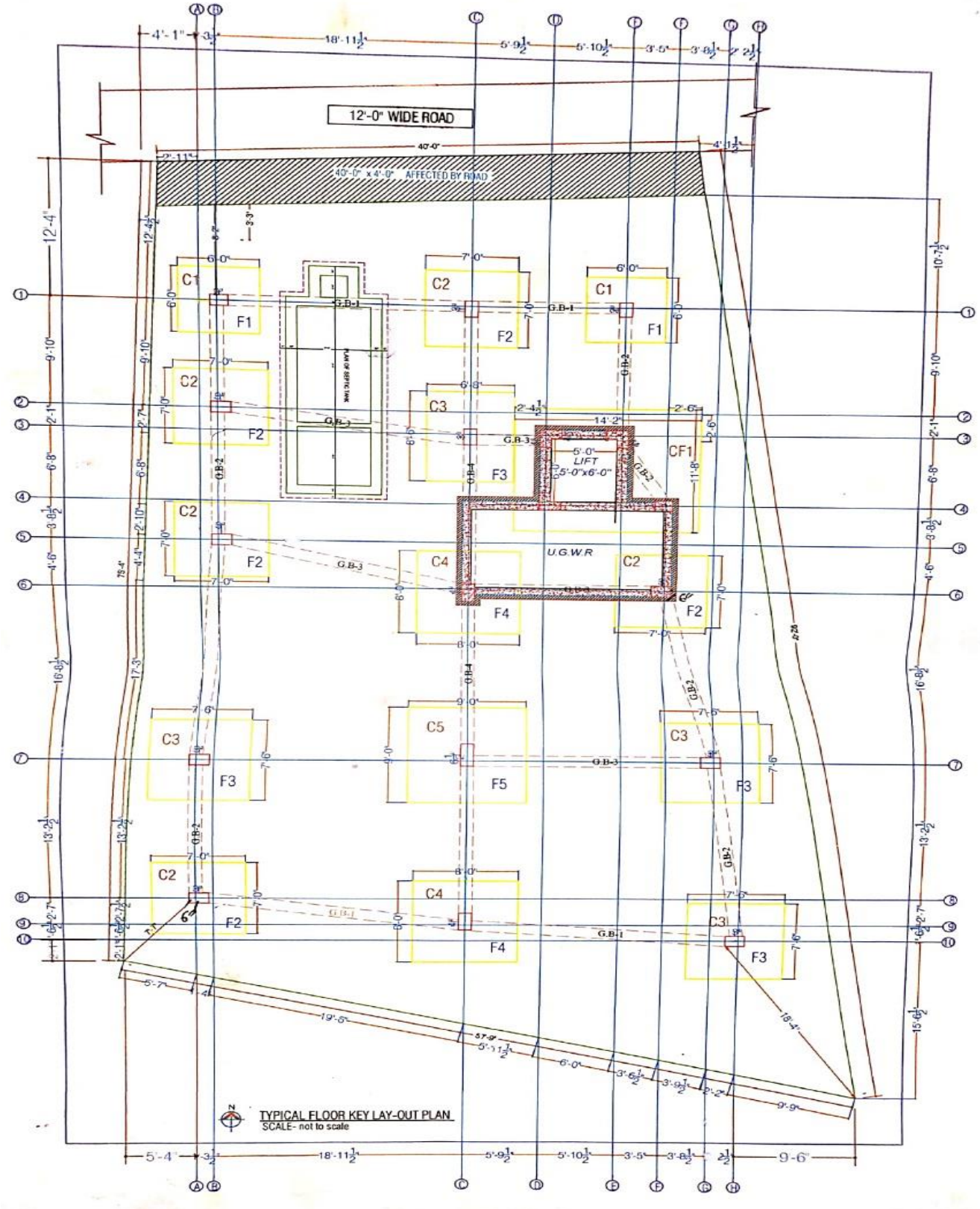
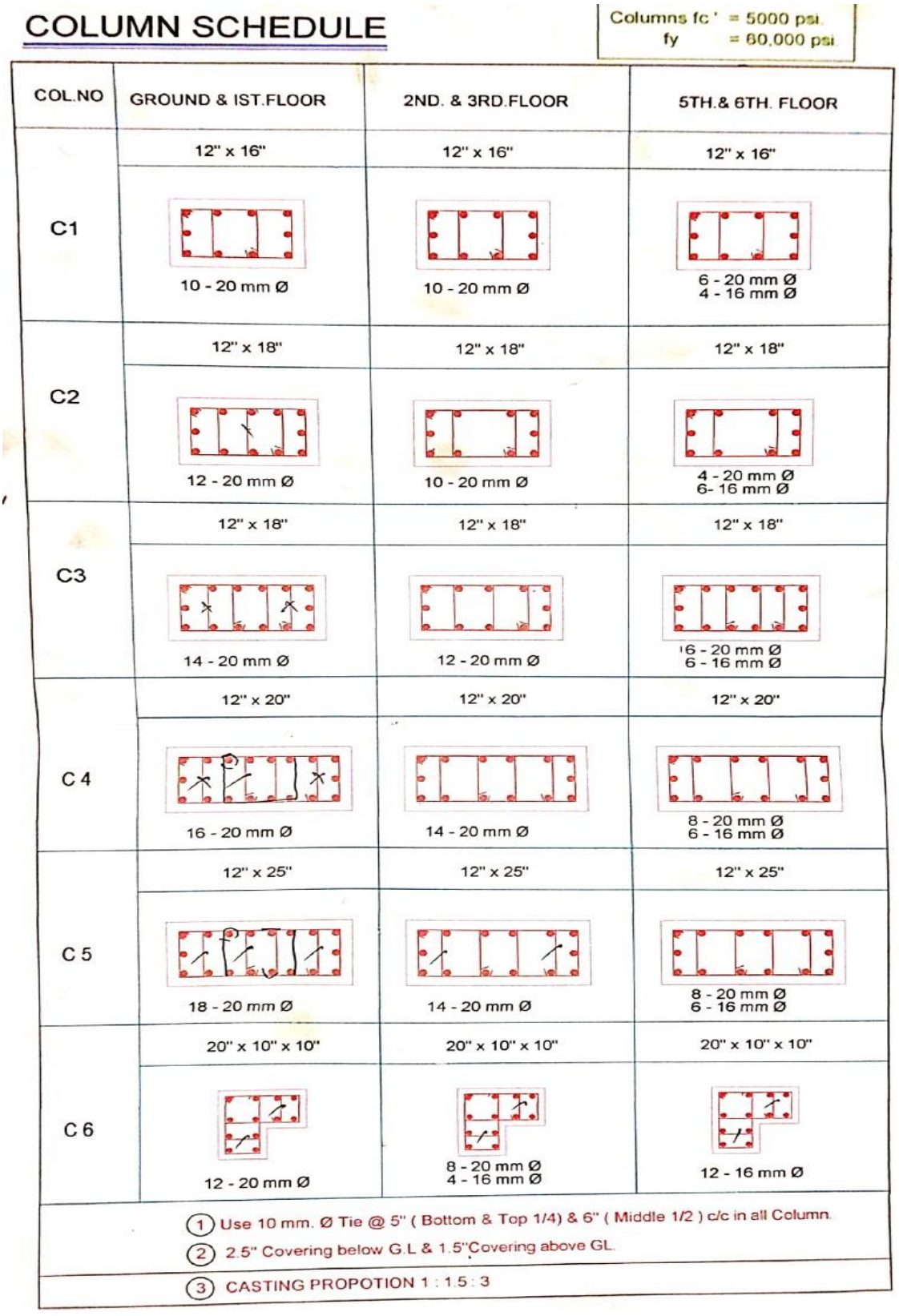


Figure 4.1 Column layout plan

4.2.2 column schedule

In column schedule of my project, the cross-section of the column is given for 6 types of columns.



COLUMN SCHEDULE

Columns fc ' = 5000 psi.
fy = 60,000 psi.

COL.NO	GROUND & IST.FLOOR	2ND. & 3RD.FLOOR	5TH.& 6TH. FLOOR
C1	12" x 16"	12" x 16"	12" x 16"
	10 - 20 mm Ø	10 - 20 mm Ø	6 - 20 mm Ø 4 - 16 mm Ø
C2	12" x 18"	12" x 18"	12" x 18"
	12 - 20 mm Ø	10 - 20 mm Ø	4 - 20 mm Ø 6- 16 mm Ø
C3	12" x 18"	12" x 18"	12" x 18"
	14 - 20 mm Ø	12 - 20 mm Ø	6 - 20 mm Ø 6 - 16 mm Ø
C 4	12" x 20"	12" x 20"	12" x 20"
	16 - 20 mm Ø	14 - 20 mm Ø	8 - 20 mm Ø 6 - 16 mm Ø
C 5	12" x 25"	12" x 25"	12" x 25"
	18 - 20 mm Ø	14 - 20 mm Ø	8 - 20 mm Ø 6 - 16 mm Ø
C 6	20" x 10" x 10"	20" x 10" x 10"	20" x 10" x 10"
	12 - 20 mm Ø	8 - 20 mm Ø 4 - 16 mm Ø	12 - 16 mm Ø

(1) Use 10 mm. Ø Tie @ 5" (Bottom & Top 1/4) & 6" (Middle 1/2) c/c in all Column.
(2) 2.5" Covering below G.L & 1.5" Covering above GL.
(3) CASTING PROPOTION 1 : 1.5 : 3

Figure 4.2 Column schedule

4.3 Column Construction Work Process
The whole work can be divided by 4 steps.

4.3.1 Column Kicker Construction
In my project I found how to make a kicker frame and how to put it in the place where the column will be setup. The wooden shutter was used for kicker. The kicker height was 5 inches.

Figure 4.3 Column kicker construction

4.3.2 Tie Binding
Then they bind the tie. There were two types of ties, one was external tie and another one was internal tie. Internal tie was provided alternately. The spacing of the tie was 4"-8"-4" C/C.

Figure 4.4 Tie binding and tie spacing

4.3.3 Column Casting

Column was cast after checking the clear cover. In my project, a single column was casted in one step. Mix ratio was 1:1.5:3. A vibrator machine was used to compact the concrete properly.

Figure 4.5 Column casting

4.3.4 Column Curing

For column curing at first, they wrapped the column with jute fabric. Then they sprinkled water by pipe frequently two times in a day.

Figure 4.6 Column curing

4.4 Beam & Slab Construction Work Process

In my project I found that the beam and slab were casted monolithically by concrete. I observed the construction of 2nd floor beams and slab in my project.

4.4.1 Beam and Slab

In my project there are 4 types of beams. The construction process of all the typical beams were the same 12-inch width. And there were 7 Panels in the slab.

4.4.2 Floor Beam & Slab Reinforcement Layout plan

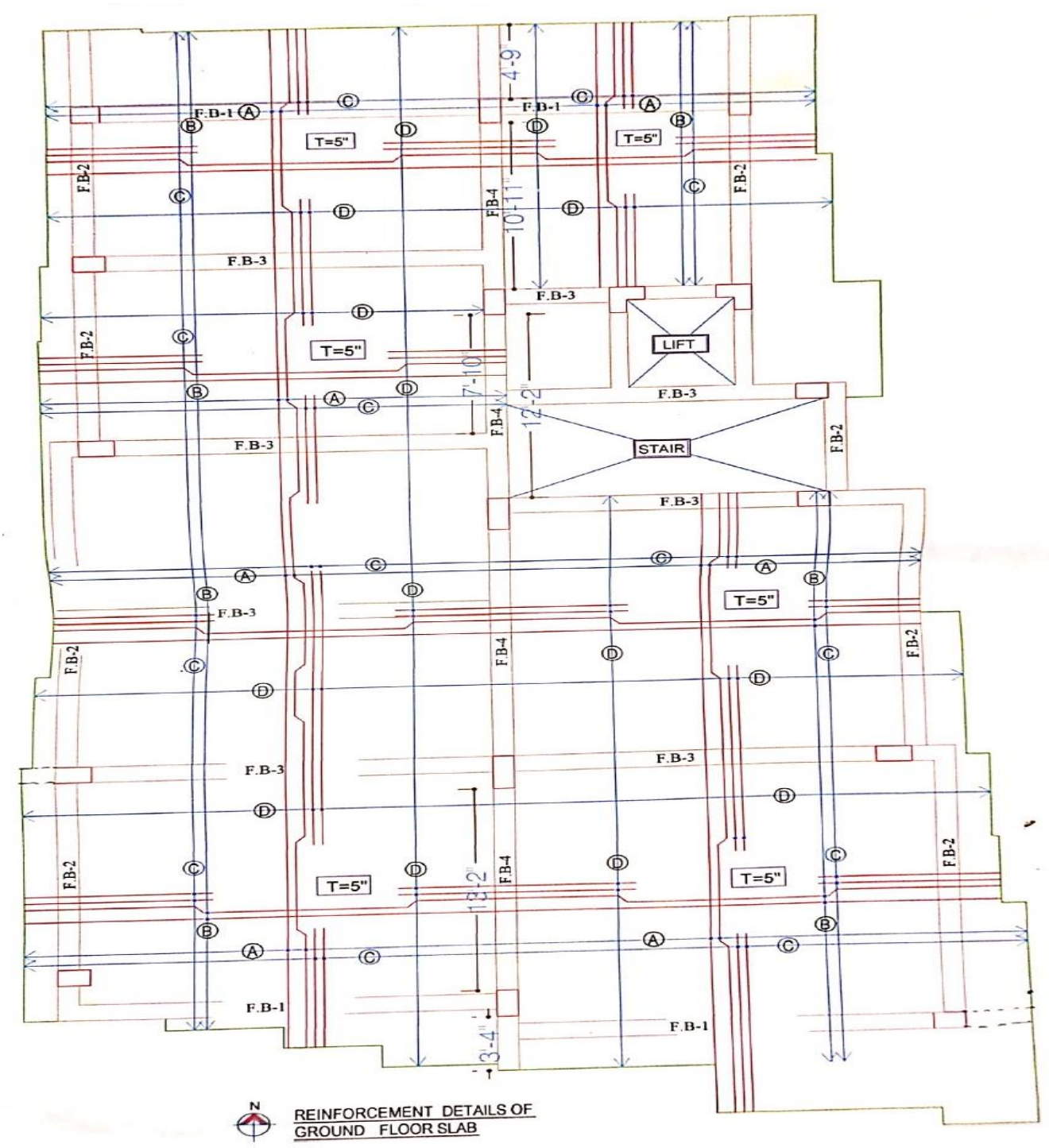


Figure 4.7 Floor beam slab & reinforcement layout plan

4.4.3 Shuttering Work of Beam

In my project the bottom and side shutter of all beams was made of wood shutter and bamboo props. the beam size was 12″ × 16″. At first, they prepared bottom shutter of the beams. The bottom shutter width of all beams was 12″.

Figure 4.8 Shuttering work of beam

4.4.4 Shuttering Work of Slab

At first, they prepared runners for the slab shutter. The entire runner in my project was made of wood. Then they placed chamber wood to the side shutter of the beam and its width was 11 inches. Then they placed the steel sheets on top of the wooden planks which was supported by the bamboo props.

Figure 4.9 Shuttering work of slab

4.5 Reinforcement work of Beam

4.5.1 Reinforcement Preparing

After finishing the shutter work of slab, at first, they prepared reinforcement and stirrup for the beam.

4.5.2 Placing of Straight Bar and Stirrup

After preparing the main rebar and stirrup, they started arranging them. Before placing the straight bars, I created a 5-inch unfolded length on each side of each bar. First, they placed

a straight bar at the top of the beam, then inserted stirrup into them. They tied the shackle to the straight bar with steel wire depending on the spacing of the shackle. Up to an additional upper beam length, they provided stirrups with a spacing of 4'c / c, and the rest of the beam portion provided stirrups with a spacing of 6'c / c.

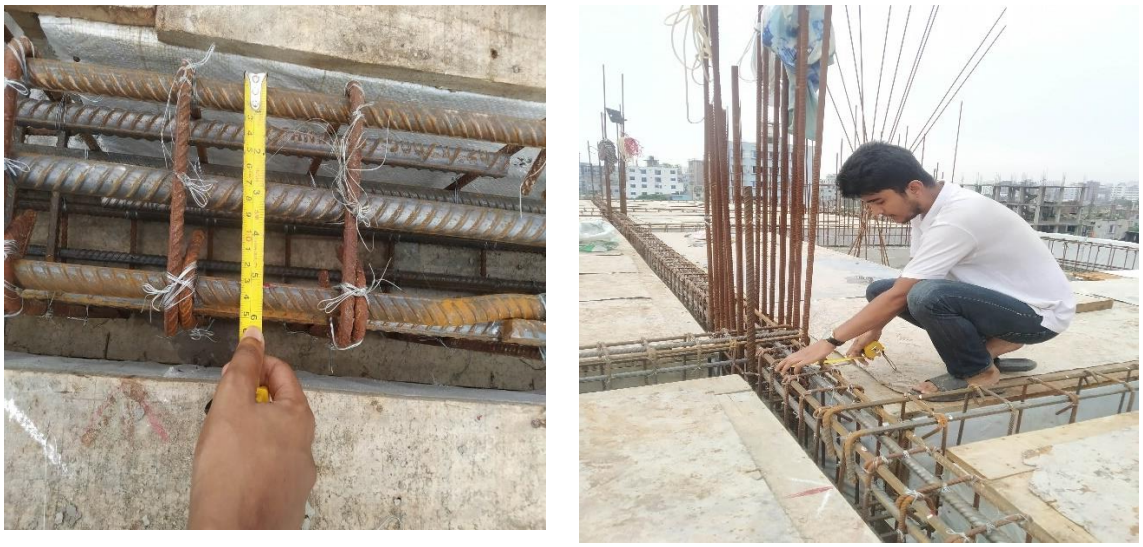


Figure 4.10 Placing of straight bar and stirrup

4.5.3 Placing of Extra Top and Bottom Bar

After tying the straight bar and stirrup, we placed additional top and bottom bars and tied them together with the stirrup. Finally, 1.5-inch concrete blocks were placed at the bottom and sides of the joists to cover them clearly.

Figure 4.11 Placing of extra top and bottom bar

4.6 Reinforcement Work of Slab

They started preparing reinforcement for the slab after completing the reinforcement work of the beam. They cut the 10 mm and12 mm bar according to the length. On my site, these two types of reinforcement were used in the slab. At first, they marked each panel with chalk so that they could put the bars easily. They placed the 10 mm main bars in both short directions 5inch c/c and long direction 6inch c/c. They tied the rods with steel wire. I checked

the spacing between the slab reinforcing bars. Since the slab was 5 inches thick, I used 3 inch and 3/4-inch cylindrical concrete blocks.

Figure 4.12 Reinforcement work checking of slab

4.6.1 Casting of Beam and Slab

On my website I saw beams and slabs cast monolithically. But first the stigmas were cast, then the beams, and finally the slabs. Before casting the column head and beams, they were washed with water and cast. To maintain the 5-inch cast, they used local sand, Sylhet sand, brick chips, and stone chips. The mixing ratio of concrete was 1: 1.5: 3.

Figure 4.13 Casting of beam and slab

4.6.2 Curing of Beam and Slab:

For the curing of beam and slab, they at first made a barrier for the ponding of water. As a result, water can’t go outside of the slab area.

Figure 4.14 Curing of beam and slab

4.7 Concrete Estimation

4.7.1 Concrete Estimation Column

Sample calculation of concrete estimation of columns has been presented in this section and all the estimation according to sample calculation

Sample calculation of column (Column Types: C-4)

Quantity = 02

Mix ratio = 1: 1.5: 3

Sum of the mix ratio = (1 + 1.5 + 3) = 5.5

Height of the column = 10 ft

Dimension of the column = 1’-0” × 1’-8” × 10’-0”

Wet volume = 1 × 1.66 × 10 = 16.6 cft

Dry volume = 16.6 × 1.5 = 24.9 cft

Cement required = 24.9/ (5.5x1.25) = 3.622 = 4 bags

Fine aggregate = (24.9x1.5)/5.5 = 6.79 cft

Coarse aggregate = (24.9x3)/5.5 = 13.58 cft

Total Cement required = 4 × 2 = 8 bag

Total Fine Aggregate = 6.79 × 2=13.58 cft

Total Coarse Aggregate = 13.58 × 2= 27.16 cft`

Table 4.2 Concrete Estimation of Column.

Column Type	Column Size (B × W × H)	No Of Column	Wet volume (cft)	Dry volume (cft)	Total Dry volume (cft)	Cement Required, (Bag)	Sand Required, (cft)	Stone Required (cft)
C-1	12″ × 16″ × 10′	02	13.33	20	40	6	10.9	21.8
C-2	12" × 18" × 10′	05	15	22.5	112.5	17	30.68	61.36
C-3	12″ × 18″ × 10′	04	15	22.5	90	13	24.54	49
C-4	12" × 20″ × 10′	02	16.6	24.9	49.8	8	13.58	27.16
C-5	12" × 25" × 10′	01	20.83	31.25	31.25	5	8.5	17
C-6	20" × 10"× 10" × 10′	04	20.83	31.25	125	19	34.1	68.2
	Total=	18	101.6	152.4	448.55	68	122.3	244.6

4.7.2 Comparison Between Actual Estimate and Manual Estimate

Table 4.3 The Difference Between Manual and Actual Concrete Estimation of Column

SL	Materials	Manual Estimate	Actual Estimate	Difference
1	Cement (bags)	68	70	2
2	Sand (cft)	122.3	125	2.7
3	Coarse Aggregate (cft)	244.6	248	3.4

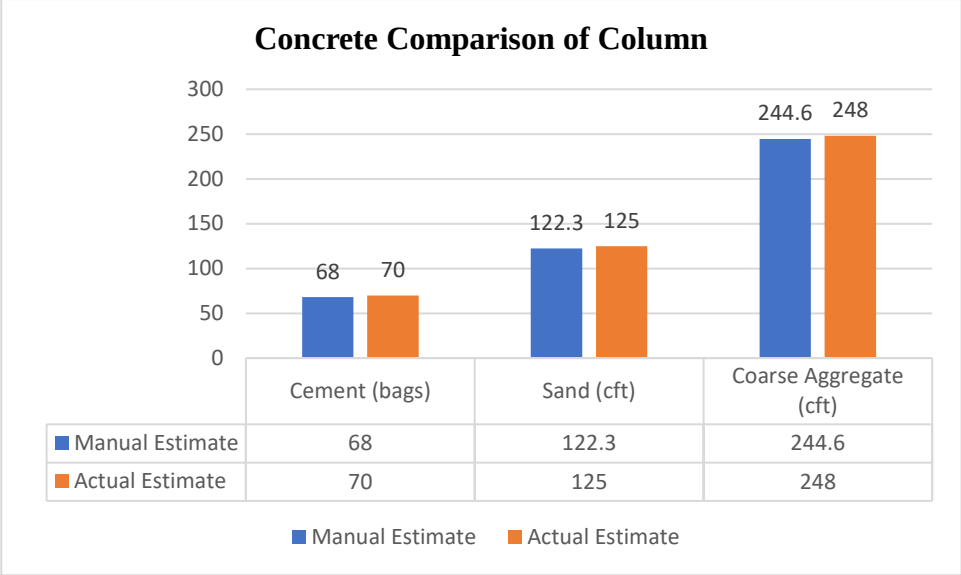


Figure 4.15 Concrete comparison of column

4.7.3 Concrete Estimation of Beam

Sample calculation of concrete estimation of beam has been presented in this section and all the estimation according to sample calculation is shown in table.

Sample calculation of beam (Beam Types: FB-3)

Mix ratio = 1: 1.5: 3

Summation of the mix ratio = 1 + 1.5 + 3 = 5.5

Length of the beam = 19’

Dimension of the beam = 12” × 16”

Wet volume = (12”x16”)/144 × 19’ = 25.33 cft

Dry volume = 25.33 × 1.5=38 cft

Cement required = 38/ (5.5×1.25) = 5.53 = 6 bags

Fine aggregate = (38×1.5)/5.5 = 10.36 cft

Coarse aggregate = (38×3)/5.5 = 20.72 cft

Table 4.4 Concrete Estimation of Beam.

Beam Type	Beam Size (B × H × L)	No of Beam	Wet volume (cft)	Dry volume (cft)	Total Dry volume (cft)	Cement Required, (Bag)	Sand Required, (cft)	Stone Required (cft)
FB-1	19′3" ×12" ×16"	2	25.66	38.5	77	12	21	42
FB-1	19′9" ×12" ×16"	2	26.33	39.5	79	12	21.54	43.1

FB-2	12′2″ ×12″ ×16″	2	16.22	24.33	48.66	8	13.26	26.52
FB-2	20′8″ ×12″ ×16″	2	27.55	41.33	82.66	14	15	30
FB-2	11′8″ ×12″ ×16″	2	15.55	23.33	46.66	7	8.5	17
FB-2	10′10″ ×12″ ×16″	2	14.44	21.66	43.32	7	7.88	15.76
FB-3	19′ ×12″ ×16″	4	25.33	38	152	23	41.43	82.86
FB-3	19′6″ ×12″ ×16″	4	26	39	156	23	42.54	85.1
FB-4	13′2″ ×12″ ×16″	1	17.55	26.33	26.33	4	7.2	14.4
FB-4	15′2″ ×12″ ×16″	1	20.22	30.33	30.33	5	8.27	16.54
FB-4	12′2″ ×12″ ×16″	1	16.22	24.33	24.33	4	6.63	13.26
FB-4	10′11″ ×12″ ×16″	1	14.55	21.5	21.5	4	5.86	11.72
	Total =	24	245.6	368.2	787.79	123	200	400

4.7.4 Concrete Estimation of Slab

Sample calculation of concrete estimation of slab has been presented in this section.

Sample calculation of slab:

Mix ratio = 1: 1.5: 3

Sum of the mix ratio = 1 + 1.5 + 3 = 5.5

Slab area without stair = 2622.42 sft and Thickness, t = 5 inch

Wet volume = 2622.42 × 0.42’ =1100 cft

Dry volume = 1650 cft

Cement required = 1650/ (5.5×1.25) = 240 bags

Fine aggregate = (1650×1.5)/5.5 = 450 cft

Coarse aggregate = (1650×3)/5.5 = 900 cft

4.7.5 Comparison of Actual Estimate and Manual Estimate of Beam and Slab

Table 4.5 Comparison of Actual Estimate and Manual Estimate of Beam and Slab

SL	Materials	Manual Estimate	Actual Estimate	Difference
1	Cement (bags)	363	360	2
2	Sand (cft)	650	655	5
3	Brick Chips (cft)	1300	1292	8

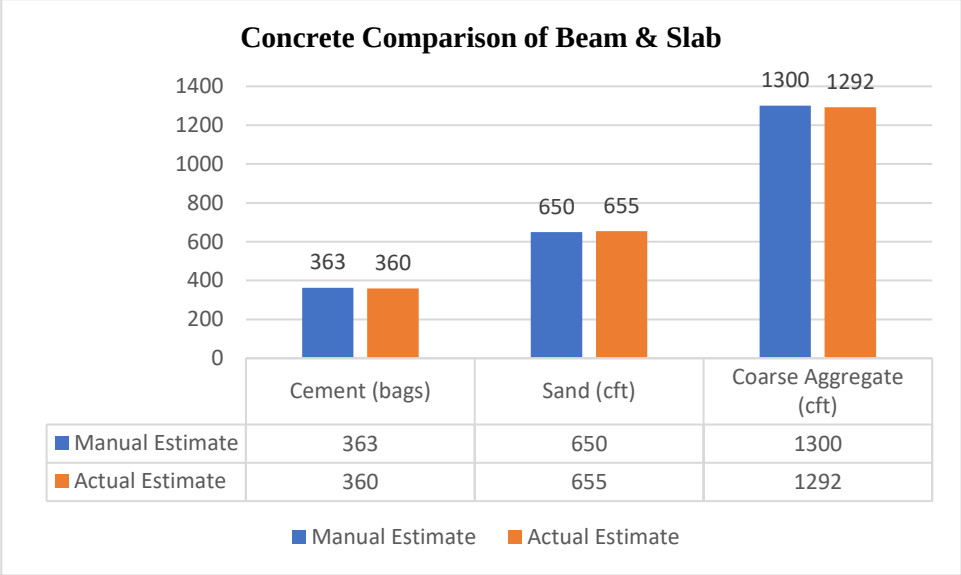


Figure 4.16 Concrete comparison of beam & slab

4.8 Reinforcement Calculation

4.8.1 Reinforcement Calculation of Column Types of column-C5

No. of column (C-4) = 2

Column dimention 12” × 20”

Clear cover = 1.5”

Dia. Of bar = 20mm

No. of main bar = 16 pieces

Unit weight of 20 mm bar = 0.752 kg/ft

Length of column 10 ft

Lap length 20mm bar = 32 inch= 2.67 ft

Total length = [16*(10+2.67)] =202.72 ft

Weight of the main Bar= 202.72 × 0.752= 152.45 kg

Dia. of the tie bar 10mm

Unit weight of 10 mm bar = 0.18 kg/ft

External tie dimension = 17" × 9"

Internal tie dimension = 7" × 9"

Length of the external tie = 2 × (17"+9") + 2 × 6db = [52 + 2×6 × 3/8] inch. = 56.5 inch =4.71 ft

Length of the internal tie = 2 × (7"+9") + 2 × 6db = [32 + 2 × 6 × 3/8] inch. = 36.5 inch =3.05 ft

Tie spacing = 4"-6"-4" c/c No. of external tie = 25 No. internal tie = 25

Weight of the tie = [(4.71 × 25 × 0.188) + (3.05 × 25 × 0.188)] kg = 36.47 kg

So, reinforcement required for 2 no. of column C-5 = 2 × (152.45+36.47) kg = 188.92 kg

4.8.2 Reinforcement Calculation of Floor Beam

Type of Beam = FB-3

Beam dimension = 12" × 16"

Beam length = 19'

Dia. of the top and bottom straight bar = 16 mm & 20 mm

Dia. of the extra. Top bar = 20 mm

Dia. of the extra. bottom bar =16mm

Unit weight of the 16mm bar= 0.480 kg/ft

Unit weight of the 20mm bar= 0.752 kg/ft

Total length of the 16mm straight bar= (2 × 19) =38 ft

Total length of the 20mm straight bar= (4 × 19) =76 ft

Total weight of the 16 mm straight bar= (38 × 0.480) =18.25 kg

Total weight of the 20 mm straight bar= (76 × 0.752) =57.15 kg

Total length of extra top = 2[(1 × 5) +(1 × 5)] ft.=20 ft

Total length of extra bottom= 10.5 x 2 ft=21 ft

Unit weight of 20 mm extra top bar= 20 × 0.752 =15.05 kg

Unit weight of 16 mm extra bottom bar= 21 × 0.480=10.1 kg

Total weight of 16 mm bar= (18.25 +10.1) =28.26 kg

Total weight of 20 mm bar= (57.15 +15.05) =72.2 kg

Total weight of steel= (28.26+72.2) =100.46 kg

Stirrup spacing = 6"-7"-6" c/c

No. of stirrup = 36 pieces.

Dia. of the stirrup = 10mm

Unit weight of 10mm bar=0.188 kg/ft

Length of the one stirrup =2[(9+13)] + (2 × 6 × 3/8) = 48.5inch = 4.1 ft

Total weight of stirrup= (36 × 4.1 × 0.188) =27.75 kg

So, reinforcement required for Beam FB-3 = (100.46 +27.75) =128.21 kg

4.8.3 Reinforcement Calculation of Slab

Panel No. = P-1

Panel size = 21'-3" × 20'-3"

Short Direction

Straight bar:

Length of straight bar = 20.25' Dia. of bar 10mm

Unit weight of 10 mm bar = 0.188 kg/ft

No of straight bar = [(20.25' × 12) / 6] + 1= 42 Nos

Total length of straight bar= 42 × 21.25 = 892.5 ft

Total weight of Straight bar= (892.5 × 0.188) =167.8 kg

Crank bar:

Dia. of the Bar = 10mm

No. of crank bar = (42 - 1) =41 Nos

Effective Depth, d = Slab thickness - (2 × clear cover) - diameter of bar

= 0.42' – [2 × (0.75"/12)] - (0.375"/12) = 0.26 ft

Crank bar length = 21.25 + (2 × 0.42 × 0.26') = 21.47 ft

Total Length = (41 × 21.47) = 880.27 ft

Total weight of crank bar= (880.27 × 0.188) =165.5 kg

Extra top bar:

2-10 Extra Top in between Ckd. No. of extra top = 2 × [(41-1)] =80 Nos

Length = 6.83' + 0.42'=7.25 ft

Weight of extra bar= (7.25 × 80 × 0.188) = 109.05 kg

Total weight of bar in short direction=(167.8 +165.5 +109.05)=442.35 kg

Long Direction

Straight bar:

Length of straight bar = 21.25' Dia. of bar 10mm

Unit weight of 10 mm bar = 0.188 kg/ft

No of straight bar = [(21.25' × 12) / 6] + 1= 44 Nos

Total length of straight bar= 44 × 20.25 = 891 ft

Total weight of Straight bar= (891 × 0.188) =167.5 kg

Crank bar:

Dia. of the Bar = 10mm

No. of crank bar = (44 - 1) =43 Nos

Effective Depth, d = Slab thickness - (2 × clear cover) - diameter of bar

= 0.42' – [2 × (0.75"/12)] - (0.375"/12) = 0.26 ft

Crank bar length = 20.25 + (2 × 0.42 × 0.26') = 20.47 ft

Total Length = (43 × 20.47) = 880.21 ft

Total weight of crank bar= (880.21 × 0.188) =165.5 kg

Extra top bar:

2-10 Extra Top in between Ckd. No. of extra top = 2 × [(43-1)] =84 Nos

Length = 7.167' + 0.42'=7.587 ft

Weight of extra bar= (7.587 × 80 × 0.188) = 119.8 kg

Total weight of bar in short direction=(167.5 +165.5 +119.8)=452.8 kg

4.9 Manual Design

Assumptions for Design:

Occupancy Load = 40 psf

Earthquake Load = 20 psf

Floor Finish = 25 psf

Partition wall load = 490 lb/ft or Distribution wall load = 45 psf

f'c = 3500; = 72000 psi

Unit weight of concrete = 150 psf

Unit weight of soil = 100 psf

4.9.1 Manual Design of Column

Tributary Area = 19.5 × 16.25 = 316.875 sft

Beam Length = 19.5 + 16.25 = 35.75

Beam Dimension = 12" × 16"

Self-weight of slab = (5/12) × 150 = 62.5 psf

Total live load = Occupancy Load +Earthquake Load = (40+20) =60 psf

Total dead load = 62.5 + 25 + 45 = 132.5 psf

Total factored load = 1.4 ×60 + 1.7 ×132.5 = 309.25 psf

Beam load = [(12×11)/144] × 150 × 35.75 = 4915.625 lb

Column load = [(12 × 25)/144] × 150 × 10 = 3125 lb

Total Load = 309.25 × 316.875 + 1.4 × (4915.625 +3125) = 109250.47 lb

For 7 stories = 109250.47 × 7 = 764753.3 lb = 764.75 $kips$

Ratio ρg = 5%; Here, Ast = 0.05 Ag

Column Load = 764.75 $kips$

We know,

$Pu = Ør\ [0.85\ f'c\ (Ag - Ast) + fyAst]$

$or\ 764.75 = 0.80 \times 0.65 \times [0.85 \times 3.5\ (Ag - 0.05\ Ag) + (60 \times 0.05\ Ag)]$

Ag = 252.42 in^2 < 252 in^2

Colum size = 12" × 21"

We got, Column size: 12" × 21" according my calculation

As well as, according by the Design we got 12" × 25"

Therefore: Calculated Column size < Design column size.

4.9.2 Manual Design of Beam

Load Calculation for Beam FB-3:

Tributary area = (121.6 + 90.25) =211.85 ft^2

Total Live Load = (Occupancy load + Earthquake Load) × Tributary Area

= (40+20) ×211.85 =12711 lb =12.7 kips

Total Dead Load = [(DL of Slab + FF) $x\ TA$] + [(DL of Beam + PWL) x Beam Length]

=21150 lb =21.15 kips

Factored Load = 1.4DL + 1.7LL = (1.4 × 21.15 + 1.7 × 12.7) = 51.2 $kips$

Load per length $W = 51.2/19 = 2.695$ kip/ft

Moment for Span:

(- ve) moment = $(WL^2)/11 = (2.695 \times 19^2)/11 = 88.445$ k-ft = 1061.34 kip-in

(+ ve) moment = $(WL^2)/14 = (2.695 \times 19^2)/11 = 69.5$ k-ft = 834 kip-in

(- ve) moment = $(WL^2)/11 = (2.695 \times 19^2)/11 = 88.445$ k-ft = 1061.34 kip-in

Maximum moment, Mu = 1061.34 kip-in

$\rho_{max} = \alpha\beta(f'c/fy)(\epsilon u/(\epsilon u+\epsilon y))$

$= 0.85\times0.85\times(3.5/60)\times[0.003/(0.003+0.008)]$

$= 0.0158$

We know,

$M_u=\Phi f_y\rho bd^2(1-0.59\rho f_y/f_c')$

⇨ $1061.34 =0.85\times0.0158\times60\times12\times d^2\times [1 - 0.59 \times 0.0158\times(60/3.5)]$

⇨ $d = 11.43 = 12$ in

Total depth of beam = 12+1.5+1.5= 14

So, Calculated Beam Size = 12 in × 15 in

Our Design Beam Size was = 12 in × 16 in

Therefore, Design Beam Size >Calculated Beam Size.

4.9.3 Manual Design of Slab

Thickness of slab = 5 in

Self-weight = 5/12 × 150 = 62.5 psf

Total dead load = 25 + 62.5 =87.5 psf

Total live load = 20 + 45 + 40 = 105 psf

Factor Load = 1.4 × 87.5 + 1.7 + 105 = 301 psf

Now, Design of the panel 1: Short length B = 15'-10" =15.8 ft

Long length A =20'-3" =20.25 ft

$m = B/A = 15.8/20.25 = 0.8$

Case - 4

Table 4.6 Moment Coefficients Chart for Slabs

Negative Moment Coefficient	CA_{neg}	0.071	CB_{neg}	0.029
Positive M. DL Coefficient	CA_{DL}	0.039	CB_{DL}	0.016
Positive M. LL Coefficient	CA_{LL}	0.045	CB_{LL}	0.022

Table 4.7 Moment in Short Direction

Moment in Short Direction			
(-) moment at continuous edge=	$CA\ neg \times W_u \times L_A^2$	5335.05644 lb/ft	64020.67728 lb/in
(+) moment at midspan=	$(CA_{DL} \times DL \times L_A^2) + (CA_{LL} \times LL \times L_A^2)$	3197.8884 lb/ft	38374.6608 lb/in
(-) moment at discontinuous edge=	$\{(CA_{DL} \times DL \times L_A^2) + (CA_{LL} \times LL \times L_A^2)\}/3$	1065.9628 lb/ft	12791.5536 lb/in

Table 4.8 Moment in Long Direction

Moment in Long Direction			
(-) moment at continuous edge=	$CA\ neg \times W_u \times L_A^2$	3579.43556 lb/ft	42953.22675 lb/in
(+) moment at midspan=	$(CA_{DL} \times DL \times L_A^2) + (CA_{LL} \times LL \times L_A^2)$	2414.03794 lb/ft	28968.45525 lb/in
(-) moment at discontinuous edge=	$\{(CA_{DL} \times DL \times L_A^2) + (CA_{LL} \times LL \times L_A^2)\}/3$	804.679313 lb/ft	9656.15175 lb/in

Table 4.9 Calculation of Short Span

Short Span			
	(-) continuous	(+) midspan	(-) discontinuous
Mu	64020.67728	38374.661	12791.5536
Effective depth	3.125	3.125	3.125
P	0.011435557	0.0064887	0.002064355
ρ_{min}	0.00288	0.00288	0.00288
$\rho_{selected}$	0.011435557	0.0064887	0.00288
Steel per feet	0.429	0.243	0.108

Table 4.10 Calculation of Long Span

Long Span			
	(-) continuous	(+) midspan	(-) discontinuous
Mu	42953.22675	28968.455	9656.15175
Effective depth	3.125	3.125	3.125
ρ	0.007329383	0.0048111	0.001550142
ρ_{min}	0.00288	0.00288	0.00288
$\rho_{selected}$	0.007329383	0.0048111	0.00288
Steel per feet	0.275	0.18	0.108

Balanced steel ratio, $\rho_{max} = \alpha\beta(f'c/fy)(\epsilon u/(\epsilon u+\epsilon y))$

$= 0.85\times0.85\times(3.5/60)\times[0.003/(0.003+0.008)]$

$= 0.0158$

We know,

$M_u=\Phi f_y\rho bd^2(1-0.59\rho f_y/f_c')$

⇨ $64020.67728 =0.85\times0.0158\times60000\times12\times d^2\times [1 - 0.59 \times 0.0158\times(60/3.5)]$

⇨ $d = 2.807$ in < 3.125 in

4.9.4 Comparison of Actual Design and Manual Design

Table 4.11 Comparison of Actual Design and Manual Design

Components	**Actual Design**	**Manual Design**
Column (C-5)	12″ × 25″	10″ × 21″
Beam (FB-3)	12″ × 16″	12″ × 15″
Slab (Panel 1)	Slab thickness = 5″ d = 3.125″	d_{min} = 2.807 ″

4.10 Stair

A set of steps leading from one floor of a building to another is called staircase. It is a structural member that supports the treads and risers. In my project, two flights of stair were required for one floor.

4.10.1 Reinforcement Details of Stair

In the slab, 12 mm reinforcing was employed. The primary bar was 12 mm bar at 4" c/c from the bottom and top flight. As a bottom binder bar, a 10 mm bar at 8" c/c was employed. At the top layer, 12 mm bar was utilized as the main bar at 4" c/c and 10 mm bar as the binder bar at 8" c/c. The waist slab's clear cover was 0.75" thick, and concrete blocks were employed to keep it in place.

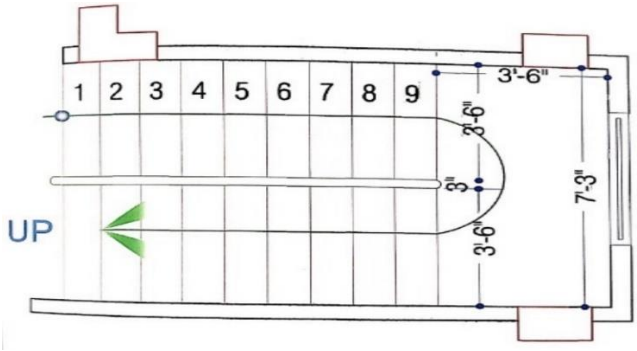


Figure 4.17 Plan of stair

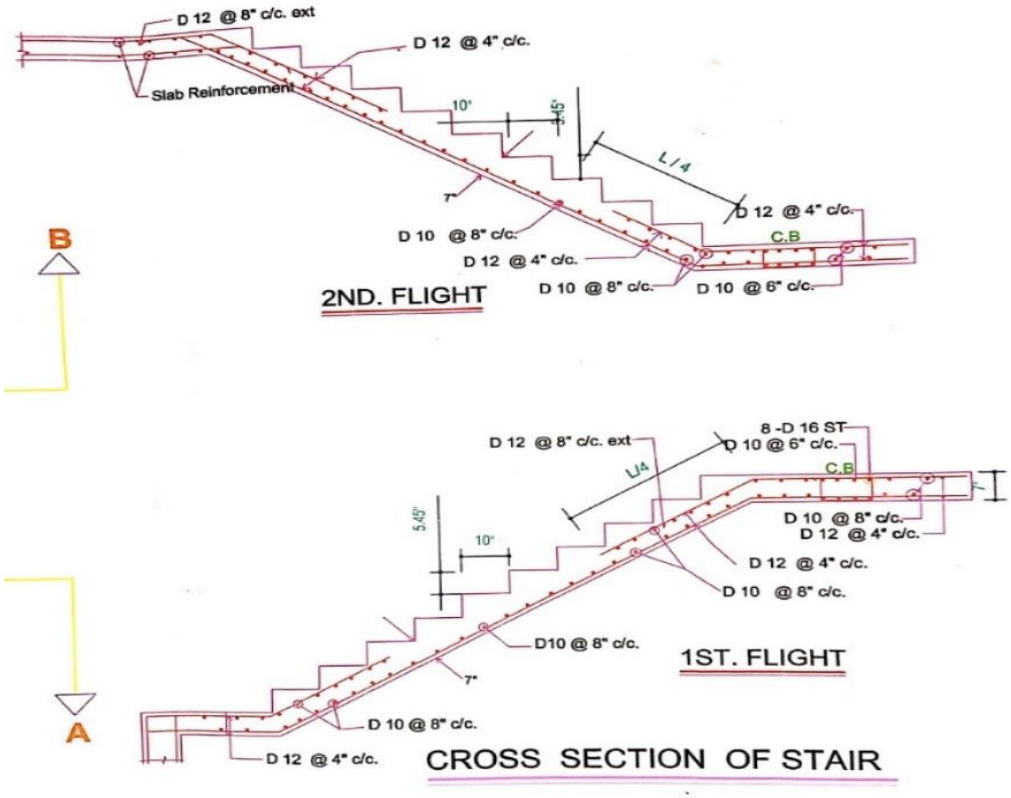


Figure 4.18 Stair layout and reinforcement details.

4.10.2 Stair Construction Work Process

Wooden planks were used to shutter the waist slab in this project. Steel sheets were used to create a sturdy platform for the step over the hardwood planks. Wooden planks were utilized to build the tread and riser once the reinforcement was correctly installed. After checking all the shuttering to measure the accuracy of the formwork, then the stair casting was done.


Figure 4.19 Formwork of stair and reinforcement check


Figure 4.20 Stair casting

4.10.3 Estimation of Concrete for Stairs

Concrete Estimation for Steps:

Tread Length = 10"

Riser = 5.45"

Total Slab Length =10.5'

Total Slab Width = 7.25'

Slab Thickness = 0.583'

Volume of the slab = 44.38 cft

Concrete in Waist Slab = 9.72 x 3.5 x 0.583 = 19.83 cft

Total Volume of Concrete in Waist Slab = 2 x 19.83 = 39.66 cft

Volume of Concrete in One Step = 0.5 x 0.83 x 0.454 x 3.5 = 0.66 cft

No. of Step in One Flight = 10

No. of Step in Two Flight = 10 x 2 = 20

Total volume of Step = 13.2 cft

Total Concrete required = 44.38 + 39.66 + 13.2 = 97.24 cft

Dry volume = 1.5 x 97.24 = 145.86 cft

Cement required = 145.86 / (5.5x1.25) = 3.622 = 22 bags

Fine aggregate = (145.86 x1.5)/5.5 = 39.78 cft

Coarse aggregate = (145.86 x3)/5.5 = 79.56 cft

4.10.4 Reinforcement Estimation of Stair

Table 4.12 Reinforcement Estimation of Stair

Flight	Bar Type	Bar dia (mm)	Length of one Bar (ft)	No. of Bar		Total Length (ft)		Weight (kg)	
				Req.	Used	Req.	Used	Req.	Used
First	Top (main)	12	13.5	12	12	162	162	43.74	43.74
	Top (binder)	10	3.375	21	20	70.875	67.5	13.32	12.69
	Bottom (main)	12	16.47	14	14	230.58	230.58	62.25	62.25
	Bottom (binder)	10	3.375	25	25	84.375	84.375	15.86	15.86
Second	Top (main)	12	13.5	12	12	162	162	43.74	43.74
	Top (binder)	10	3.375	22	22	74.25	74.25	13.96	13.96
	Bottom (main)	12	16.47	14	14	230.58	230.58	62.25	62.25
	Bottom (binder)	10	3.375	26	25	87.75	84.375	16.5	15.86
Total								**271.62**	**270.35**

CHAPTER 5

Sub-Soil Investigation

5.1 General

It is currently extremely difficult to keep the specification that is currently indicated in the drawing, EIA, and soil report in this construction project.

5.2 General Soil Investigations

Terzaghi's formula Solution:

Terzaghi's formula was used to determine bearing capacity.

Bearing capacity equations developed by Terzaghi:

Square footings: $Qu = 1.3\ c' Nc + \gamma D Nq + 0.4\ \gamma B N\gamma$

Circular footings: $Qu = 1.3\ c' Nc + \gamma D Nq + 0.3\ \gamma B N\gamma$

strip footings: $Qu = c' Nc + \gamma D Nq + 0.5\ \gamma B N\gamma$

For purely cohesive soil Terzaghi assumed=0°, c´=c

From this Nc=5.7, Nq=1, Ny=0

Qu= c'NcFcsFcdFci+qNqFqsFqdFqi+0.5γBNγFγsFγdFγi

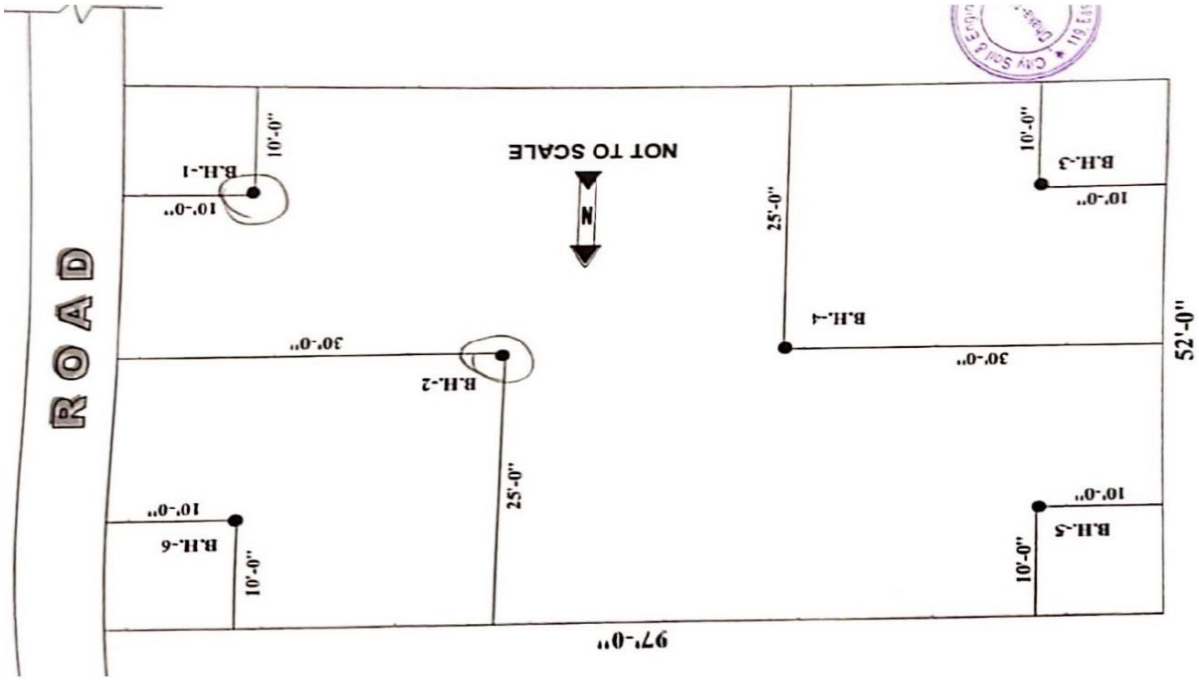


Figure 5.1 Site Plan of Boring Hole

c' = cohesion

q = effective stress at the level of the bottom of the foundation

γ = unit weight of soil

B = width of foundation (diameter for a circular foundation)

F_{cs}, F_{qs}, $F_{\gamma s}$ = shape factors

F_{cd}, F_{qd}, $F_{\gamma d}$ = depth factors

F_{ci}, F_{qi}, $F_{\gamma i}$ = load inclination factors

N_c, N_q, N_γ = bearing capacity factors

shape factors	depth factors	depth factors	load inclination factors
$F_{cs}= 1+(B/L)\ (N_q / N_c)$	$\Phi=0$, $Df/B <=1$	$\Phi=0$, $Df/B <=1$	$\Phi=0$
$F_{qs}= 1+(B/L)\ \tan\theta$	$F_{cd}= 1+0.4(Df/B)$	$F_{cd}= 1+0.4\tan^{-1}(Df/B)$	$F_{ci}=F_{qi}=(1-(\beta^0/90^0))^2$
$F_{\gamma s}= 1+0.4(B/L)$	$F_{qd}= 1$	$F_{qd}= 1$	$F_{\gamma i}= 1-(\beta/\Phi)$
	$F_{\gamma d} = 1$	$F_{\gamma d} = 1$	

5.2.1 Sample Calculation for Boring- 01

For Circular or Square Footing:

When the SPT value is 2 at a depth of 5 feet, the bearing capacity factor is as follows: N=0, Nc=5.14, Nq=1, N=0, N=0, N=0, N=0, N=0,

For Circular or Square Footing

Assume B=L=7 ft, Df=5ft

Fcs=1+1*1/5.14=1.194

Fcd=1+0.4*(5/7)=1.29

Fci=1, Fqi=1, Fγi=1

Fqs=1+1*tan0°=1

Fqd=1, Nγ=0, Fγs=1-0.4*1=0.6, Fγd=1,

γ=1.36 gm/cm^3=84.90 lb/ft^3

q =5*84.90=424.52 lb/ft^2 = 0.212Tsf, c'=0.125 Tsf

Qu=0.125*5.14*1.194*1.29*1+0.212*1*1*1*1+0=1.20 Tsf

Qall = Qu/2.5=0.48 Tsf

For continuous footing:

B/L=0

Fcs=1+0*1/5.14=1, Fcd=1+0.4*(5/7)=1.29

Fci=1, Fqi=1, Fγi=1

Fqs=1+0*tan0°=1, Fqd=1, Nγ=0

Fγs=1-0.4*0=1, Fγd=1

γ=1.48 gm/cm^3=84.90 lb/ft^3

q =5*84.90=424.52 lb/ft^2 = 0.212 Tsf, c'=0.125 Tsf

Qu=0.125*5.14*1*1.29*1+0.212*1*1*1*1+0=1.06

Qall=Qu/2.5= 0.42 Tsf

Table 5.1 Bearing Capacity Calculation

Depth in ft	Depth in meter	Field S.P.T. Value	Corrected S.P.T. Value	Bearing Capacity in Tsf	
				For Circular or Square Footing	For Continuous Footing
Boring no 1					
5	1.52	2	2	0.48	0.42
10	3.05	4	4	0.79	0.66
15	4.57	7	7	1.34	1.10
20	6.10	10	10	1.88	1.54
Boring no 2					
5	1.52	2	2	0.40	0.35
10	3.05	5	5	0.52	0.42
15	4.57	6	6	0.86	0.72
20	6.10	7	7	1.42	1.36
Boring no 3					
5	1.52	3	3	0.396	0.35
10	3.05	4	4	0.51	0.42
15	4.57	5	5	0.80	0.62
20	6.10	5	5	1.40	1.36
Boring no 4					
5	1.52	3	3	0.396	0.35
10	3.05	4	4	0.51	0.42
15	4.57	6	6	.86	0.72
20	6.10	7	7	1.42	1.36
Boring no 5					
5	1.52	3	3	0.396	0.35
10	3.05	4	4	0.51	0.42
15	4.57	5	5	0.80	0.62
20	6.10	7	7	1.42	1.36
Boring no 6					
5	1.52	3	3	0.396	0.35
10	3.05	4	4	0.51	0.42
15	4.57	5	5	0.80	0.62
20	6.10	5	5	1.40	1.36

5.2.2 Conclusion

The overall investigation results of the site define that pile foundation is suitable for the best economic and structurally safe for the project.

CHAPTER 6

Plumbing and Electrification

6.1 General

Plumbing is a system of pipes and fittings built in a structure for the distribution and use of potable (drinking) water as well as the removal of waterborne wastes. Water and sewage systems that serve a group of buildings or a city are usually identified.

6.1.1 Plumbing drawing

All of the plumbing works have been investigated on my site. I witnessed the procedure of adorning the building's piping. Make an effort to learn about the distribution of pipes in various industries.

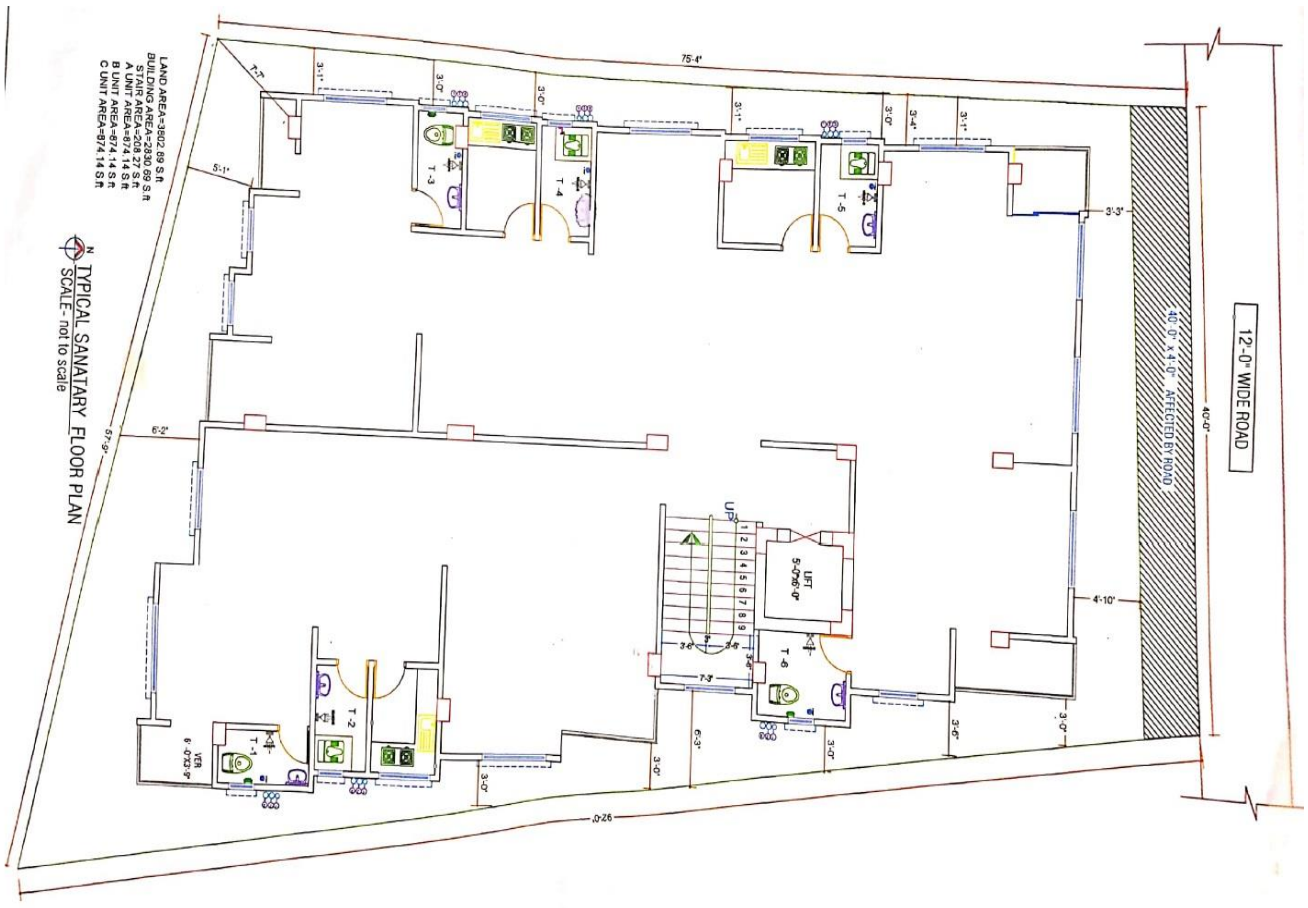


Figure 6.1 Plumbing drawing

6.1.2 Plumbing Pipes

Plumbing pipes are used to distribute waters in the baths, toilets and faucets and carry the waste water from toilets to the septic tank and drains. These pipes have different diameter according to their use. Generally, 6",4" pipes carry the blackwater from toilets, 3" pipes carry grey water from faucets and sinks, ½, ¾, 1" pipes usually distribute the water to taps in different usages.

Figure 6.2 4", 3" Pipes and placement in dug location

6.1.3 Common Section of Toilets

Common section of toilets are also provided according to the toilet area of the flats. Design for faucets, bath tubs, pans, water connections everything is shown and applied in the site according to the drawings.

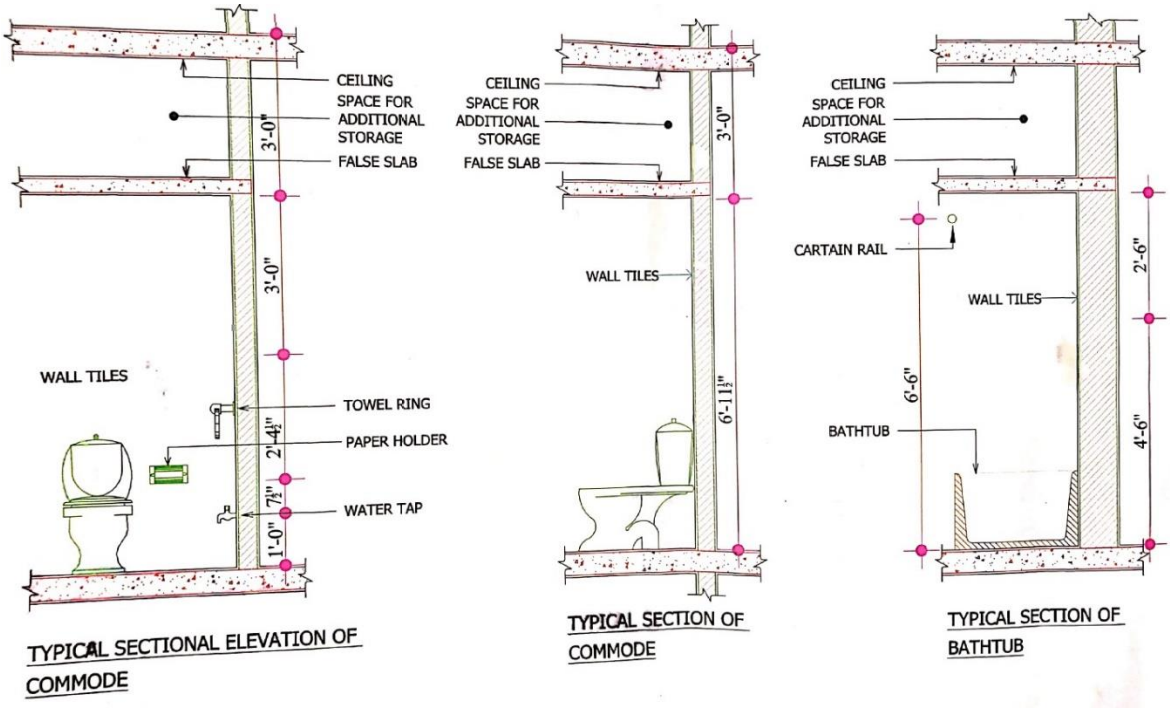


Figure 6.3 Common section of toilets

6.2 Electrification

6.2.1 General

It is currently extremely tough to maintain the electricity work in this construction project. Electrification has accomplished a great deal. I attempted to comprehend the diagram of the electricity component.

6.2.2 Electrical Drawing

I inspect all electrical work in accordance with the electrical drawing. They used 1 inch PVC pipe and a 4-way circular box for this build.

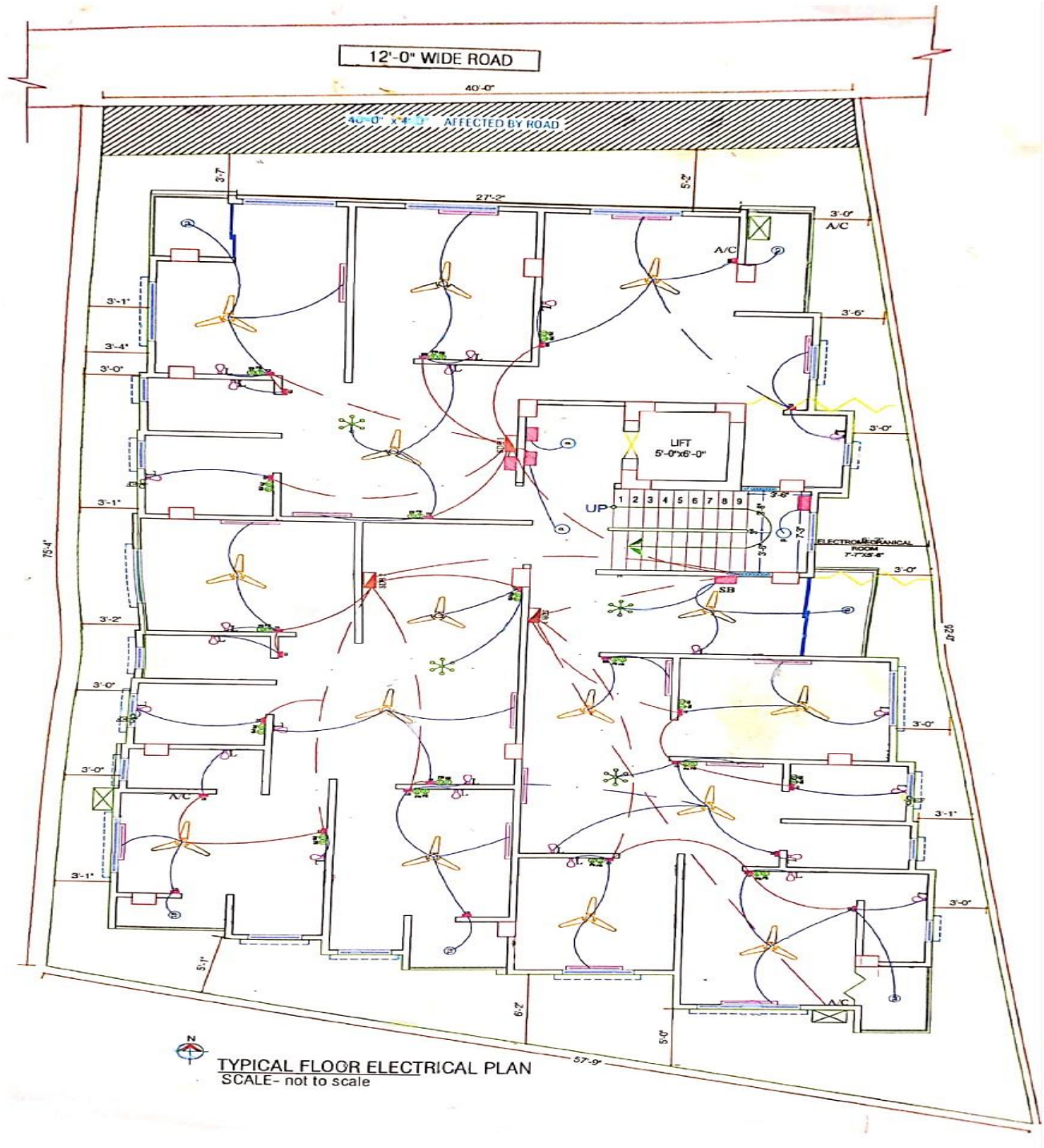


Figure 6.4 Electrical plan on drawing

6.2.3 Placing of Electrical Pipes in Slab

Electrical pipes are placed in between the reinforcement of the slab before casting, electricians did the placement in my site before the day of slab casting. The followed the drawing to place the pipes later they'll dug out the opening to pass the electrical wires inside the pipes. These pipes diameter was 1/2".

Figure 6.5 Placing of electrical pipes in slab

From the slabs after removing shuttering electricians conncets the pipes from slab with pipes that has been installed in the walls, by this electric wire reaches every corner of a building.

Figure 6.6 Placing of electrical pipes in wall

6.2.4 Electrical Legend

The electrical legend shows the names and symbols of the electrical elements. If the height is correct, the item size, item position, aperture, lights, fans, etc. will also be displayed. It shows the cable capacity of each element and the diameter of the PVC pipe.

Table 6.1 Electrical Legends

1		EM	Energy meter
2		v	Main distribution board
3		SDB	Floor / sub distribution board at 3’-0” level (bottom)
4		TJB	Telephone junction box (bottom)
5		AJB	Antenna junction box at skirting level
6		SB	Switch board at 4’-6” from floor level
7		PS	5A, 2pin switched socket outlet at skirting level
8		PB	5A, 2pin switched socket outlet at switch board level
9		RS	13A, 3pin switched socket outlet at skirting level
10		QB	13A, 3pin switched socket outlet at switch board level
11		QS	15A, 3pin switched socket outlet at switch board level
12		WL	Wall mounted single incandescent light fittings (1×100w) at 8’-0” level
13		CL	Ceiling mounted single incandescent light fittings (1×100w)
14		L	Ceiling mounted sport light fittings
15		FL	Wall mounted fluorescent light fittings (1×40w) at 8’-0” level
16		CH	Ceiling mounted chandelier light fittings
17		SL	Wall mounted security light fittings (1×100w) at 8’-6” level
18		CB	Calling bell at 8’-0” level
19		ML	Mirror light above mirror
20		BP	Bell push at 4’-6” level
21		CF	Ceiling fan (48”-56” sweep)
22		EF	Exhaust fan (8” sweep)
23		TS	Telephone socket outlet at skirting level
24		IS	Intercom outlet at 4’-6” level
25		AS	Antenna socket outlet
26		E	Earthing point
27		A/C	Window type air cooler

CHAPTER 7

Environmental Impact Study

7.1 Introduction

Environmental Impact Assessment (EIA) is the process of assessing the potential environmental impact of a proposed project or development, with positive and negative impacts on the relevant socio-economic, cultural, and human health. Consider both. Environmental impacts can be minimized in project planning and design, and mitigation measures can be applied during the construction and operation stages. Noise Air, sound, water and vibration pollution can occur both during construction and during operation, but the impact on the air quality of the project is limited to the construction stage.

7.2 Environmental Impact Assessment of My Project

The project is considered to be included in Orange or Amber B categorization as the project is a residential building and the area is densely populated. That's why this project has environmental impacts. These impacts are divided into two phase one is during construction and another is during operation.

7.2.1 Positive Impacts of My Project

- Socio economic condition of that area will increase
- Many people will be benefitted by getting employment
- Sustainable residential zone will be developed
- New business organizations will be built surrounding this place

7.2.2 Negative Impacts of My Project

- Various pollution will occur during construction and operation phase
- Destruction of natural inhabitants
- Ground water depletion due to excessive use
- Population growth may cause various problem as it's a densely populated area
- Traffic congestion

7.2.3 During Construction Phase the Environmental Impacts

- Air pollution
- Noise pollution
- Water pollution
- Destruction of natural habitats
- Dust problem

7.2.4 During Operation Phase the Environmental Impacts

- Traffic congestion
- Noise Pollution
- Solid waste generation

- Water consumption
- Wastewater generation

7.2.5 During Construction Phase EIA Matrix

Table 7.1 During Construction Phase EIA Matrix

Action affecting environmental resources and values	Significant environmental impacts			
	None	Minor	Medium	Major
Air pollution			√	
Noise Pollution		√		
Water Pollution		√		
Destruction of natural habitats				√
Dust problem				√

7.2.6 During Operation Phase EIA Matrix

Table 7.2 During Operation Phase EIA Matrix

Action affecting environmental resources and values	Significant environmental impacts			
	None	Minor	Medium	Major
Traffic congestion			√	
Noise Pollution		√		
Solid waste generation				√
Water Consumption			√	
Wastewater generation				√

7.3 Mitigation Measures

Mitigation measures are a critical part of the EIA process, as these actions aim to prevent adverse impacts from the planned project on the environment and people, ensuring that unavoidable impacts are maintained within acceptable levels. For my project Mitigation measures has been applied to mitigate the concerning environmental impacts.

Table 7.3 Mitigation measures to mitigate environmental impacts

Environmental impacts	Mitigation measures	
	During Construction Phase	During Operation Phase
Air pollution	Restricting the burning of waste materials	Reducing number of trips taken in vehicles
	Using low sulfur diesel	Try to avoid fire place
	Improving existing equipment's	
Dust Pollution	Water maybe used to reduce dust	Try to reduce traffic
	Cover construction materials such as cement, sand, stone, bricks with plastic wrapping.	Improve road design and surrounding areas of the project.
Water Pollution	Maintenance of wastewater disposal	Keep out oil, grease and unusual substance from sinks and faucets
	Coverup all drains and maintain proper cleaning	

Noise Pollution	Reduce Powerful tools and equipment	Less use of sound box, mikes without any reason
	Schedule work	
	Switch off machineries when not in use	
Traffic Congestion	Built proper parking spots and wide roads	Try to use limited vehicles
Solid waste generation	Use suitable design for solid waste generated	Reducing wasteful washing habit
	Installation of dumping spot nearby	Using dustbins to minimize waste generation
Wastewater generation	Proper drainage system	Proper drainage system
Water consumption	Design suitable water supply system	Installing water efficient toilets
		Unnecessary use of water

7.4 Conclusion

In conclusion we can say this project has both negative and positive impacts on the environment. As Bangladesh is a developing country, there is so many disadvantages and it's not possible to maintain each and every rules and regulation while constructing a project. For the betterment of the society, we have to consider many things. We should mitigate the negative impacts as much we can, for this we should apply the mitigation measures properly. By maintaining these rules, the project will have a better outcome and there will be less negative impacts on environment.

CHAPTER 8

Knowledge Gap and Learning from the Field

8.1 General

I have completed my internship at **"Design Professionals Ltd ".** It has given me a chance to get practical knowledge about construction process, materials and equipment. It was a great opportunity for me to gather practical knowledge about the superstructure. There were lots of things which all were difficult to know from the university study theoretical period but in the practicum that all were become known to me with the help of theoretical study. I have tried to involve myself in every work that I found during my internship period.

8.2 Knowledge Gap

In my internship period, I have learnt so many things by observing the working procedures with the help of my gained theoretical knowledge. But there were few things that I have missed to learn from the project that I need to know. Such as-

- Construction process of sub structural components such as footing construction, grade beam, underground water reservoir, septic tank etc.
- Construction process of overhead water tank.
- In situ soil test and piling process.
- Finishing works such as plastering, floor finishing etc.

8.3 Learning from the Field

In my internship period I've learned about many new things, the things I've studied theoretically in my university I observed such things practically during my internship period. Which has been very beneficial for me as this thing will help my build my career in this sector in future. The main things I've learned or gained experience during my internship period are shown below -

- Gained experience about observing and understanding both structural and architectural drawing.
- Learned about formworks of structural members and alignment process, reinforcement detailing, placing, lapping of column, beam and slab.
- Learned about the process of casting various superstructural components.
- Gained experience in site supervision and inspection of the construction work based on the structural drawing.
- Learned about the use of different construction equipment's that has been used during construction work.
- Learned about the quality of various construction materials by doing some field test.

CHAPTER 9

Conclusion

9.1 Conclusion

For the internship, I worked in a 7-story apartment. I completed my CEN490 practicum and started my internship as a trainee engineer at "Design Professionals" from May 10, 2022, ending on August 16, 2022. When I started, I did not have any practical knowledge of construction work. In my practicum period, I have gained real project-based experience. In the field, I have gained knowledge about construction materials, construction processes and practices, conducted some field tests, and observed differences between field data and standard results. I also observed the structural, architectural, plumbing, and electrical drawings on the site and learned about the drawings, meanings of symbols and notations as well as general construction practice in the context of local projects and the duty of project engineer to cross check the work before casting. Finally, to expertise in the field of engineering knowing the process of implementing theoretical knowledge in real life situation is very much crucial which can be learned only from practical fields, and this internship program helped me to achieve this.

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