Report on

Structural and Foundation Design for G+4-Storied Mosque at Badda, Dhaka

Plot-1435, South Badda, Dhaka-1212, Bangladesh

GROUP DESIGN PROJECT

Team

Kazi Sejan Ahmed Rafi

Amit Hasan

Md. Sajjad Hosan Fahim

Abdus. Sattar Jony

September 2022

Report on

Structural and Foundation Design for G+4-Storied Mosque at Badda, Dhaka

Plot-1435, South Badda, Dhaka-1212, Bangladesh

GROUP DESIGN PROJECT

Supervisor

Dr. Md. Naimul Haque

Team

Name	ID
Kazi Sejan Ahmed Rafi	2018-1-22-018
Amit Hasan	2018-1-22-058
Md. Sajjad Hosan Fahim	2017-3-24-035
Abdus. Sattar Jony	2018-2-22-035

A project report submitted in partial fulfillment of the requirements of degree of B.Sc. in Civil Engineering

September 2022

Department of Civil Engineering

East West University

EXECUTIVE SUMMARY

This report contains the structural and foundation design of an RCC mosque building. The project is about the structural design of a five-story mosque. In this project, we will analyze the structure and design all the structural elements like beams, columns, slabs, and foundations. The foundations were designed properly and strictly followed by the soil report. The proper use of ETABS software made the structural analysis and design easier for this project. The design of the Underground Water Reservoir (UGWR) and septic tank also used AutoCAD to create all the structural details. So the site engineer can understand all the details properly. There will be different kinds of environmental and societal impact during the construction period that were also included in this report. The project schedule and Bill of Quantities (BOQ) are estimated so that the cost of the project cannot exceed our expected budget. The entire report took nearly a year to complete, and construction will begin in the first month of next year. The report was written in the following sections: Introduction, Analysis, Design, BOQ, and Conclusion..

.

ACKNOWLEDGMENT

I would like to extend my sincere thanks to all of them. I am highly indebted to Dr. Md. Naimul Haque for his guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project. I would like to express my special gratitude and thanks to client for giving us such attention and time.

TABLE OF CONTENTS

CHAPTER-1

INTRODUCTION

1.1 PROJECT BACKGROUND

In South Badda, Our client wants to build a five-story mosque. This area is predominantly Muslim, with 95% of the population being Muslim. It is important to construct a new mosque in this location. Because there aren't enough mosques for everyone to pray in. Many people from the surrounding area, especially from South Badda, will be able to pray at this mosque. We propose to construct a mosque along Main Road and near Bank Asia as a result of all of the following facilities.

1.2 GENERAL PROJECT INFORMATION

Our client wants to build a mosque in his land. The area of land is 5 kata or 3600 sq ft. We provide him a plan G+4 story mosque. Because most of the people of South Badda are Muslim.

But there have not enough mosque for the Muslim. So we provide a plan of G+4 story mosque where a huge number of Muslim can takes their prayer in a time. May be all floor is not use every day but in Jummah there will be a lot of Muslim comes to pray Jummah. Even in Eid prayer can also take there.

Table: 1.1: Project Information

Area of Land	5 katha (3600 sqft)
Building type	Religious Assembly (Mosque)
Location	South Badda
No of story	G+4

1.3 NECESSICITY OF THE PROJECT

We are constructing a five-story mosque on Goni Road, Hatirjhil North U loop. This is a residential area and a commercial area. Every day a large number of people come here for work and commute through here. It is a densely populated area in Dhaka city. Around 90000 thousand people live in this area and 90% of people are Muslim in this area. In this area there are a lower number of mosques around our project area. These mosques are very small because so many people do not pray at the same time. Each mosque is small in size and no more than two to three storied. Initially, these mosques here were enough for people to pray five times a day, but there are not enough spaces in mosques for the Muslims who come here on Fridays for Jummah prayer. A large number of people prayed outside the mosque. It is very important to build another big mosque in this area.

There is no mosque in the vicinity of the project. There are two banks and a Chinese restaurant in the vicinity of the place where the mosque is to be built. Lots of people come here every day and there are not enough mosques for them to offer their prayers. In this area there are 3 universities and some universities are under construction. So, it is very important to build a mosque here.

1.4 SITE VISIT

Our Providing project site is not accessible for local people. It's protecting with wall. So, we are showing just around the site.

(a) Front road of our site

(b) Our site

(c) Side road of our site

Fig: 1.1: Site Visit

The proposed project site is at Merul Badda, Dhaka. and it is situated between Latituate 23°46'34.4"N and Longitude 90°25'31.3"E. It is also located at a distance of 20m from gani road and 40m from Badda main road. The soil nature of this site is observed Silt-Clay type soil. The

transportation system surrounding the site area is good .There is no agricultural and forest land surrounding the site. There is a water body at hatirjheel-Gulshan lake 485m away from the site.

Location map

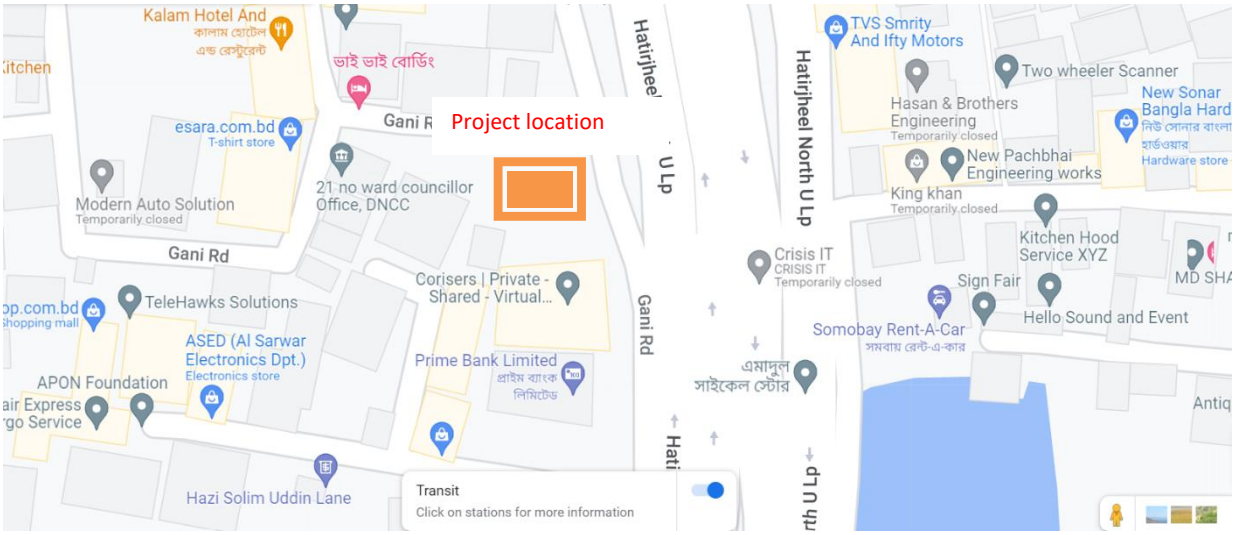


Fig: 1.2: Location Map

1.4.1 General Information

This place is located on the side of the main road. Here we can easily build the mosque and after the construction of the mosque people can easily come here and perform prayers. If a mosque is built here, not only the people of the area but also the pedestrians will be able to come to this mosque very easily.

1.4.2 Accessibility of the Site

Our site is located on Main Street. If a mosque is built here, the local people will be able to come by different roads. Again pedestrians will find it very easily. Construction material can be brought here and waste material can be removed very easily during construction. Due to the large size of the place, pedestrians or people in the area do not have to face any problem during construction period.

1.4.3 Site Condition

This place is completely empty. There is no need to demolish anything to build a mosque here. The soil here is also flat. So there is no need to bring new soil from other places and fill it. So, We can easily start our construction work.

1.4.4 Utility Services

As the project area is located on the side of the road, we can easily bring the cargo vehicle here and remove the waste material from here by vehicle or other ways very easily. We can rent a vehicle from Badda for transportation. So there will be no need to increase the cost by bringing vehicles from another place.

1.4.5 Material Storage Location

Our project area is like a total of 17 katha. But we are only going to build this mosque on 5 katha. Since most of our space will be empty during construction, we will be able to use the rest of the space to store construction materials. So we don't need to rent a separate place or occupy the road to keep the construction materials.

1.4.6 Local Workforce

In constuction site hiring experienced labours is very important part. If we hire labours from outside then the labour cost and lodging unit cost will be increased. And if we hire local labours then we can compromise the labour cost and expenses,

During site visit we asked to the people of our site area about local labours. And we got to know that there are enough well experinced anad skilled labours are available in this area and we can easily hire them.

1.4.7 Waste Management

We have facilities for waste disposal at the construction site. During construction we can bring dumping trucks here very easily and remove the waste under construction. Due to the good sewerage system on the side of the road, the daily waste can be easily removed even after the completion of the construction work.

1.5 REVIEW OF SUPPLIED DOCCUMENTS

The client has supplied the architectural drawing and the beam column layout of this project.

1.5.1 Architechtural Drawings

Contemporary mosques mainly have five architectural elements that distinguish its function, namely: prayers hall, dome, towers announcing call for prayers referred to as minarets, a sanctuary for the lead prayer referred to as mihrab, and an ablution space for pre-prayer wash. In our architectural drawing we proposed everything that client want.

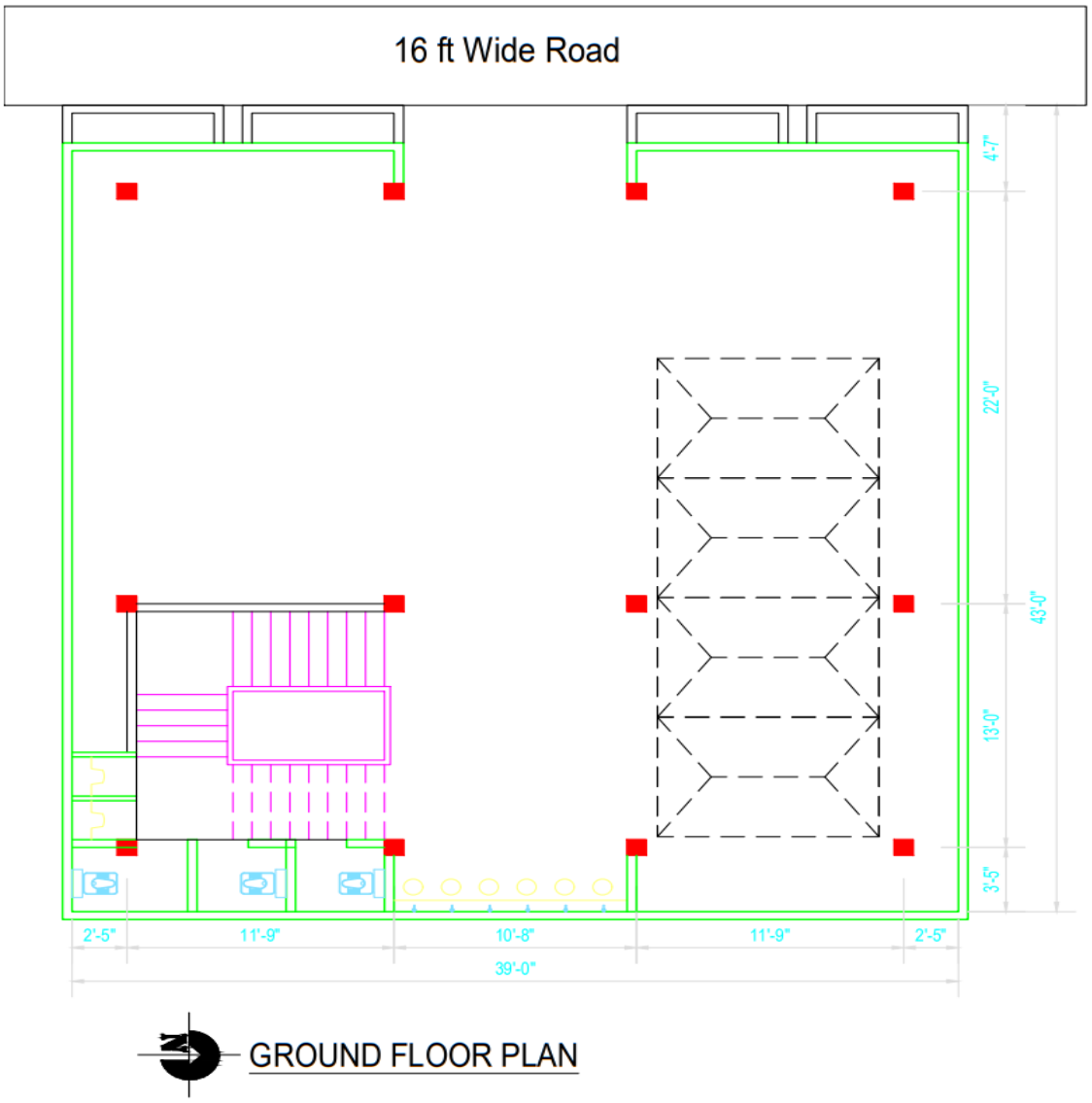


Fig: 1.3: Ground Floor Plan

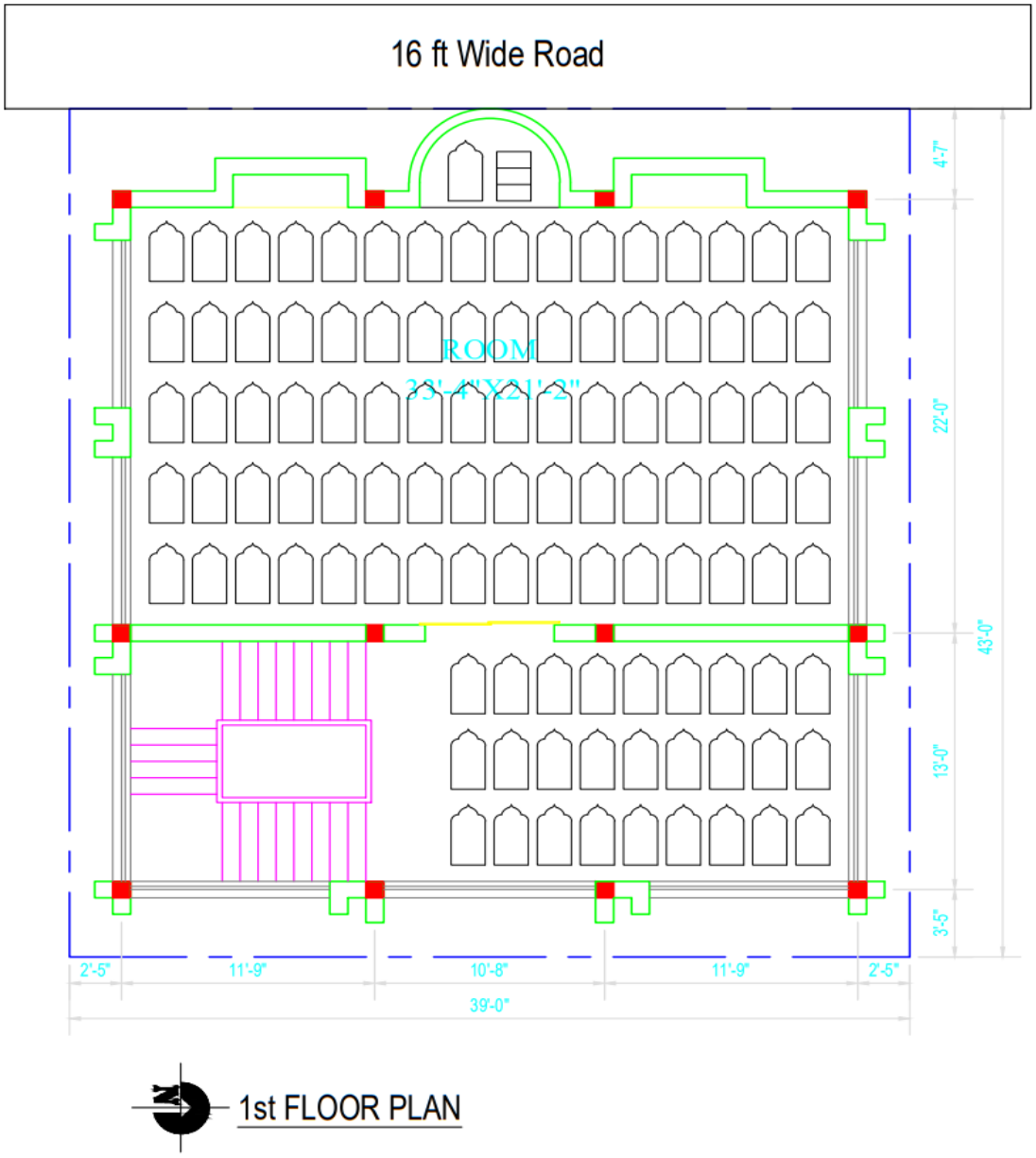


Fig: 1.4: First Floor Plan

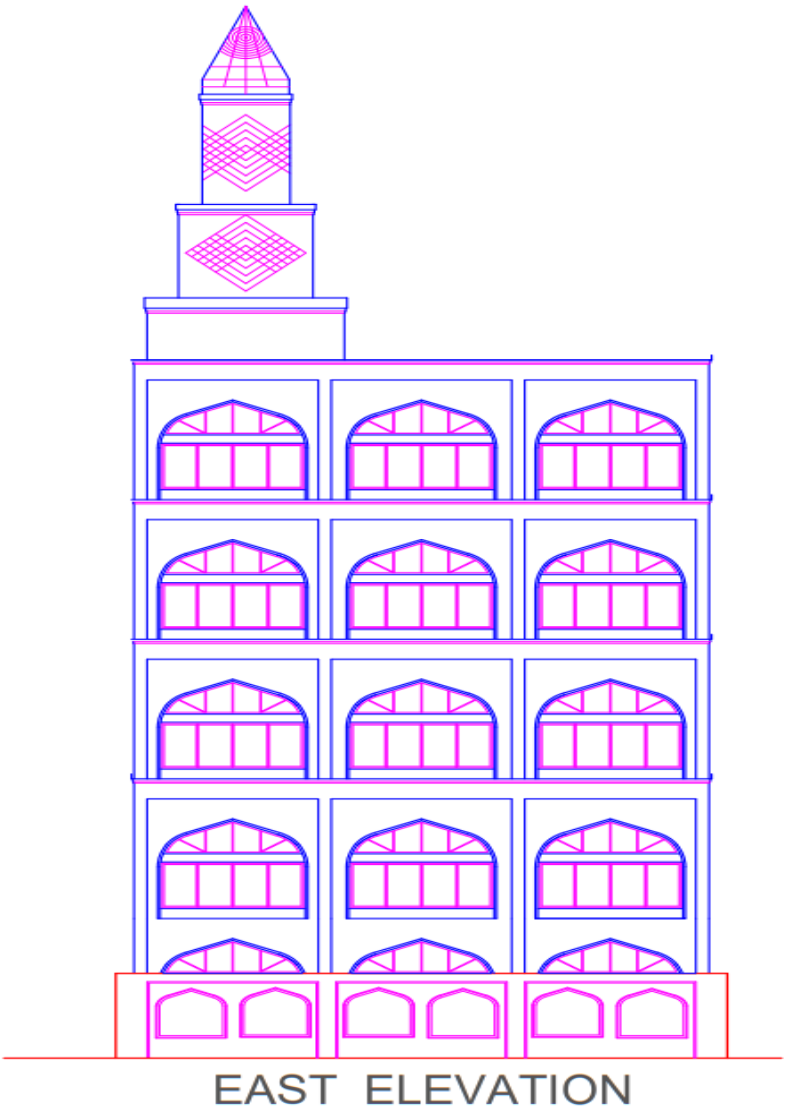


Fig: 1.5: East Elevation

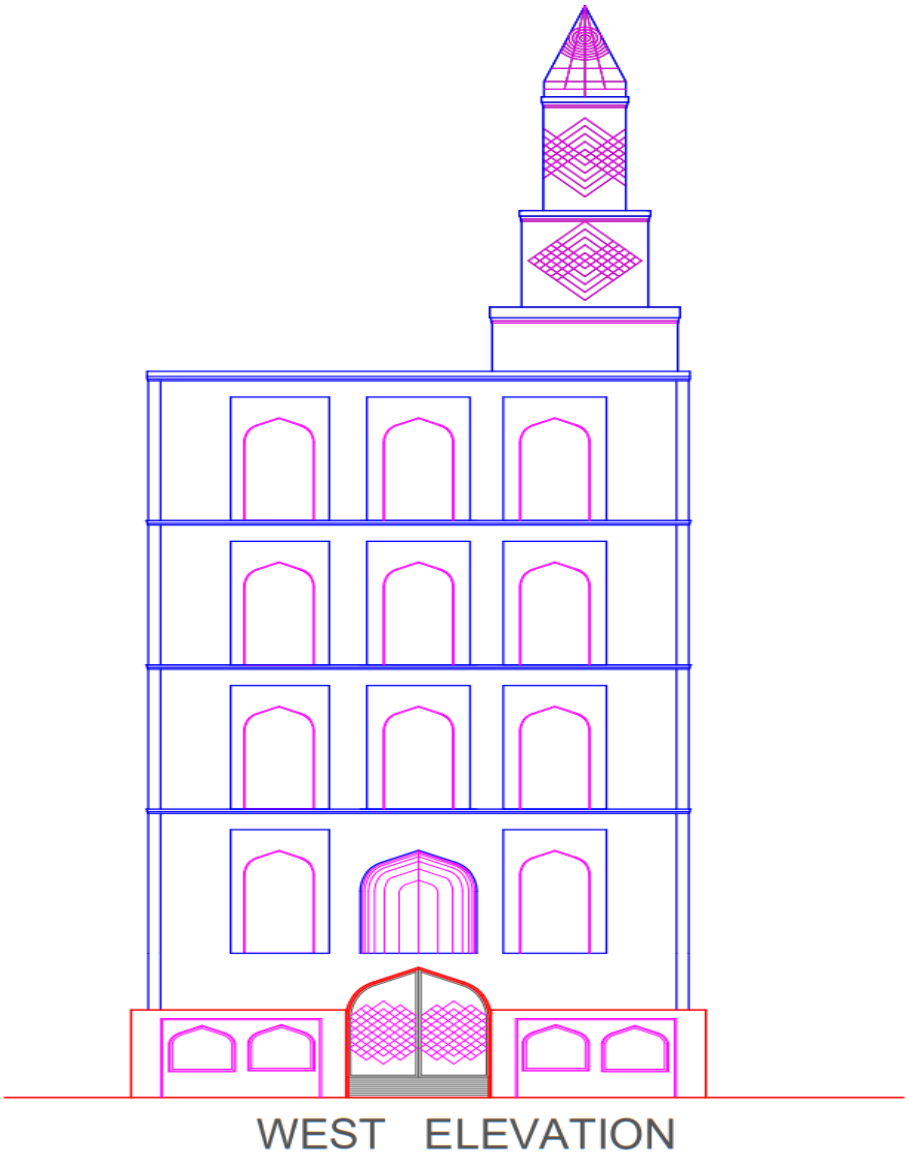


Fig: 1.6: West Elevation

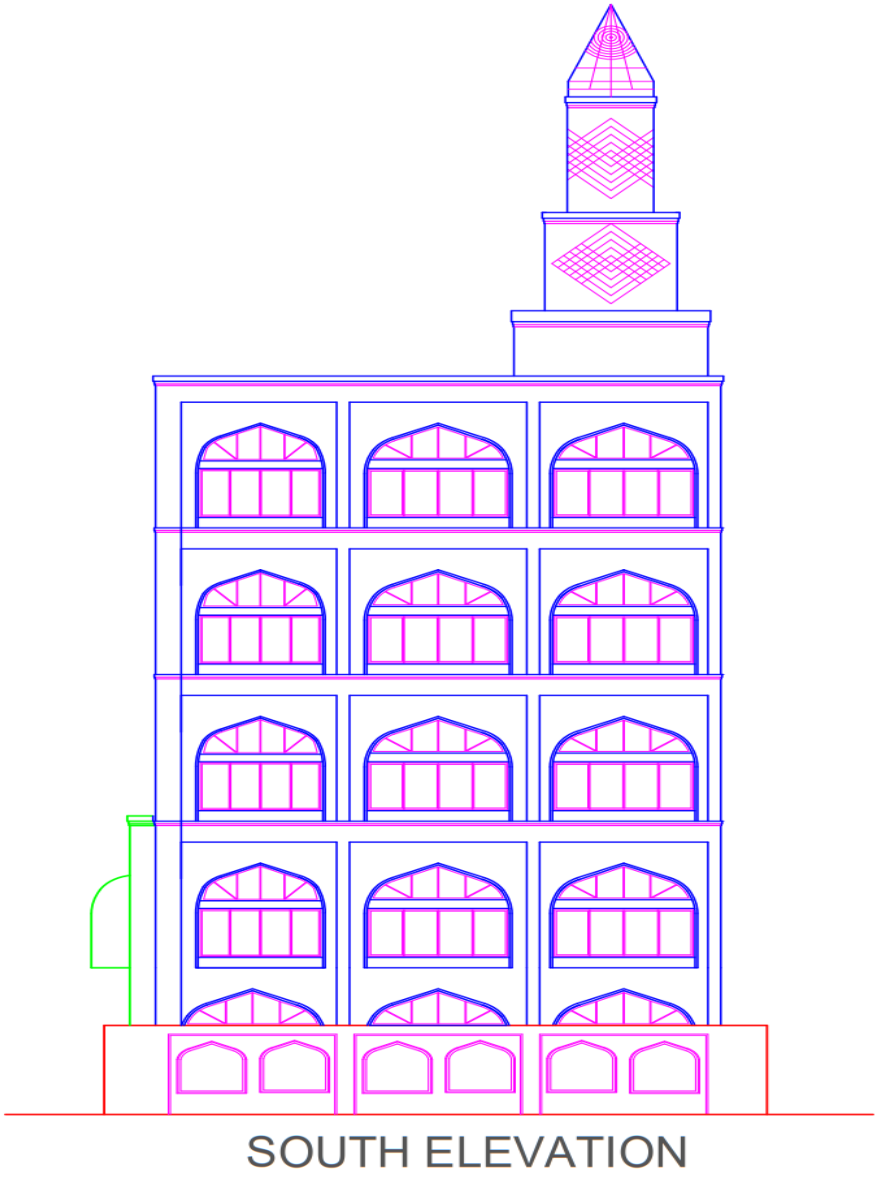


Fig: 1.7: South Elevation

1.5.1.1 General Observations

This project is a religious assembly project which is total 5 storied with a 30ft minar. In ground floor (GF) we can see there will be no activities will be held. 3 toilets and a large washroom are situated in GF, a wide staircase is there so that people can move to upstairs freely and easily during Jummah and Eid prayers. The main activities of prayers will be done from 1st floor. In 1st floor there is one main hall is 31x22ft which is air conditioned. In balcony section there is 21x13ft area without air conditioned. There is total 8 wide window so that enough light and air can pass easily.

1.5.1.2 Setback Rules

According to the Detailed Area Plan (DAP), RAJUK has given some set-back rules to ensure greening of the city, light ventilation, rainwater absorption, etc. The minimum amount of space to be left in front of, behind and on both sides of the building is determined by the setback rule. So it is not enough to just follow the FAR and MGC and leave space.

Table: 1.2: Set back rule for our project,

Name	Land (m)
Front	2.1
Back	2
Each side	1.25

1.5.1.3 MGC Rules

MGC Rule: Maximum Ground Coverage (MGC) is the percentage of the ratio of total covered area of building and total land area of the site. This calculation helps u determine how much percentage of land has been used up in constructing a building.

Our total land area is 5 kata or (5 × 720) = 3600 sq. ft and building type is E. According to Dhaka Imarat Nirman Bidhimala 2008 MGC is 60%.

Maximum Allowable Ground Coverage = 3600 × 60%

= 2160 sq. ft

So, Maximum Allowable Ground Coverage should be 2160 sq. ft. Our total area of ground floor is approximately 1677 sq. ft. So, the rules have been obeyed.

Ground Coverage of the project

Which is smaller than 60%. So, requirement is fulfilled.

1.5.1.4 FAR Rules

FAR Rule: Floor Area Ratio (FAR) is the ratio of a building's total floor area (gross floor area) to the size of the piece of land upon which it is built. It is often used as one of the regulation in city planning along with the building – to – land ratio. The terms can also limits imposed on such a ratio through zoning.

Our total land area is 5 kata or (5 × 720) = 3600 sq. ft and building type is E. According to Dhaka Imarat Nirman Bidhimala 2008 FAR is 2.25. So,

No of stories

Total no of storied = 3.75 + Ground floor

= 3.75 + 1

= 4.75

≈ 5

Our building is also 5 storied building. So, rule is obeyed.

Area of each floor = 8100/4 = 2025 sq. ft

Our each floor is 1677 sq. ft. Which is smaller than 2025 sq. ft. So all requirement is fulfilled.

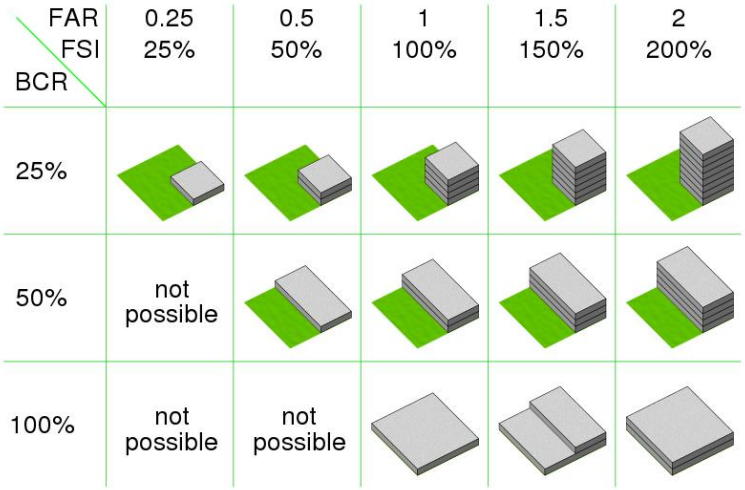


Fig:1.8: FAR Rule

1.5.1.5 Minimum Occupancy Requirements

Each plot shall have setback as per rule 46 from the existing land boundary and open space outside the maximum land cover as rule 50 as mandatory uncovered space. (Dhaka Imarat Nirman Bidhimala 2008, Chapter 5 Point 45).

Our building is a religious building (Type E). We need to follow the rule for width of stair, hight of roof and parking area.

According to Dhaka Imarat Bidhimala, width of stair will be 2 m or 6.56 ft. Hight of roof is 2.6 m or 8.5 ft if we use air condition and 3 m or 9.84 ft if we not use air condition. One minimum car parking space for less than 300 sq meter or 3229 sq ft area.

In our project, we have 3.35 m or 11 ft stair, hight of roof is 3.66 m or 12 ft. So we obeyed the rules for width of stair and hight of roof. We can park more than one car. Because we have 3600 sq ft space and we use only 1677 sq ft area. Here we can easily park more than one car. So we also obeyed the rules for parking area.

1.5.2 Geotechnical Report

In the geotechnical report, two boreholes were done in the site. Both the boreholes were checked for 15m which is almost 50ft. The allowable bearing capacity of each pile is Qall=161.71 kips. The ground water level is located at 19ft depth.

1.6 ENVIRNMENTAL IMPACTS AND MITIGATION MEASURES

1.6.1 Air Pollution

- Machinery used in construction site produce black smoke. It will affect air directly
- Dust will also produce during construction procedure. Different type of dust created on construction site will hamper air environment.
- Contaminants spreading around in air can travel large distance in a short time, so it can pollute different places at the same time.

1.6.2 Noise Pollution

- During construction, there will be a huge noise pollution for using heavy machinery.
- Loud machinery, vehicles, raised voice of labours and physical work such as hammering, drilling, digging etc. can also pollute environment.

1.6.3 Water Pollution

- From our construction site, pollutants can soak into the groundwater.
- Different types of chemicals can pollute groundwater and human drinking water . As our construction site area is a residential area, so we must need to take proper steps about water pollution otherwise residents will be in risk with their drinking water.

1.6.4 Soil Pollution

- Dust produce from construction site can pollute soil directly
- Soil can be polluted due to air transport followed by deposition of construction contaminants.
- Waste materials deposits in soil can also pollute soil

1.6.5 Other Pollution

- In construction site, light pollution is also a major problem. Lights emitted from electric devices run through glasses of residential building and can disturb the residents.
- Waste bricks, waste cement, different kind of packages, household waste of workers also impact the surrounding environment.

1.7 SOCIETAL IMPACTS

Every construction site has a bad impact on the social environment. It creates lots of dust and sound which is very harmful for humans and animals. Construction waste also has a bad impact on the social eco system and environment. So, we try to reduce the impact during the construction period and obey all safety rules.

1.7.1 Health & Safety

- For reducing the risk of injuries, personal protective gear will be used in our construction site.
- Helmets, hand and leg protective gear, mask, vest will be used.
- Different type of emergency symbol will be placed in our whole construction site.
- There is a public road besides our site, we will be more conscious about pedestrian so that no pedestrian will be injured.
- Fire extinguishers will also placed in our construction site.

1.7.2 Impact of Employability

- A huge number of unemployed worker Can get opportunity to work.
- After completing this project, there will be many vacancy for different post for this Mosque. Similarly many unemployed can get job here.

1.7.3 Impact on Traffic Volume

- Traffic safety
- Traffic delays
- Traffic regulations and restrictions
- Adjacent road network traffic patterns
- Pedestrians routes around the construction site

1.7.4 Socio-Economic Environment

- Impact on education
- Impact on Income
- Impact on employment on that area
- Community safety issue

1.7.5 Other Impacts

- Land acquisition & disposal
- Relocation of local people
- Health risk due to waste

1.8 SCOPES OF WORKS

In this project we will work from analysis to design. Firstly we will analysis the whole building with a software. After that we will design the beam, column, slab and foundation. We will also design Over headed water tank, septic tank, underground water reservoir (UGWR). Estimation and Project planning will be also done by us.

Some works can be done by contractors. The electrical and wiring work will be done by others. Sanitary and plumbing, painting, floor finishing like tiles etc also excluded from our engineering design.

1.9 OBJECTIVES

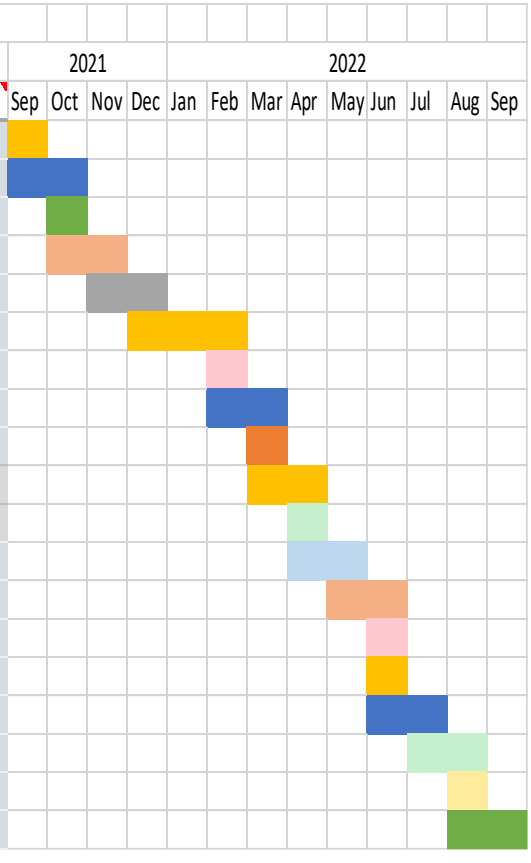
Our project is a religious assembly in Badda, Dhaka. The objective of this project is to cover the Muslims people of Badda area during five times of prayers including Jum'ah and Eid prayers also.

1.10 PROJECT SCHEDULE

This design project will be completed within 1 year. Provide gang chart here.

Design Project Schedule

ID	Task	START	END	DAYS
1	Site Visiting and fesibility study	20-Sep-21	27-Sep-21	7
2	Architectural drawing analysis	28-Sep-21	8-Oct-21	10
3	Study Environmental and Social impacts	9-Oct-21	19-Oct-21	10
4	BNBC Code Analysis	20-Oct-21	29-Nov-21	40
5	Learning Setback and MGC rules	30-Nov-21	10-Dec-21	10
6	ETABS Learning	11-Dec-21	9-Feb-22	60
7	Analayis and Design	10-Feb-22	20-Feb-22	10
8	Soil report analysis	21-Feb-22	8-Mar-22	15
9	Design Beam Column Layout	9-Mar-22	19-Mar-22	10
10	Structural design Analysis Results	20-Mar-22	10-Apr-22	21
11	Apply Load at ETABS model	11-Apr-22	26-Apr-22	15
12	Load analysis at ETABS	27-Apr-22	18-May-22	21
13	Design building components by ETABS	19-May-22	9-Jun-22	21
14	Design water and septic tank	10-Jun-22	20-Jun-22	10
15	Plotting all data in report	21-Jun-22	28-Jun-22	7
16	Bill of Quantities of Structural Design	29-Jun-22	29-Jul-22	30
17	Project schedule	30-Jul-22	6-Aug-22	7
18	Drafting and drawing	7-Aug-22	22-Aug-22	15
19	Add all data at report	23-Aug-22	2-Sep-22	10



1.11 OUTLINE OF THE REPORT

Chapter: 1

This chapter is our introduction part. In introduction part we discussed about the background of the project, Site visiting information, environment and social impacts of this project etc. We aslo reviwed architectural drawing and analysised Dhaka Imarat Nirman Bidhimala, MGC, FAR rules etc.

Chapter: 2

In this chapter, we analysis load combinations on beam coloum, Live load, Dead load. For this analysis we use Etabs.

Chapter: 3

This is our design part. In this chapter, we design and analysis of the super structure and sub structure.

Chapter: 4

Here, we calculate BOQ Bill of Quantity for our project.

Chapter: 5

In this chapter, we give conlusion of our whole project.

CHAPTER – 2

DESIGN CONSIDERATION

2.1 GENERAL

The main purpose of building codes is to provide minimum standards to protect the public health, safety, and general welfare as they relate to the construction and occupancy of buildings and structures. Model building codes provide protection from tragedy caused by structural collapse, and general deterioration.

Structural standards, the building's occupancy, types of wall assemblies, safe egress, type of foundation, floor assemblies, roof structures/assemblies, energy rules, stairs and halls, mechanical, electrical, plumbing, site drainage, lighting, fixtures standards, occupancy rules, and swimming pool regulations.

Requirements for natural disasters such (wind load, earthquakes, etc.)

2.2 CODES AND STANDARDS

For our mosque design we used BNBC 2020, Dhaka Imarat Nirman Bidhimala and ACI 318 code

2.3 MATERIAL PROPERTIES

Table: 2.1: Strength of Construction Materials.

Material	Unit Weight (psi)
Concrete for foundation (1:1.5:3)	4000
Concrete for super-structure (1:1.5:3)	4000
Grade 60 re-bar	60000

Table: 2.2: Unit Weight of Basic Materials

Material	Unit Weight (kN/m3)
Brick	18.9
Cement	14.7
Sand, dry	15.7
Concrete -stone aggregate (unreinforced)	22.8*
Brick aggregate (unreinforced)	20.4*

2.4 LOADING

The first step of structure analysis is application of loads. We consider different types of loads such as dead load, live load, superimposed load, wind load and earthquake load. Though there are more loads which is not consider in our country. These five types of loads we actually apply according to BNBC 2020 code in the following structure.

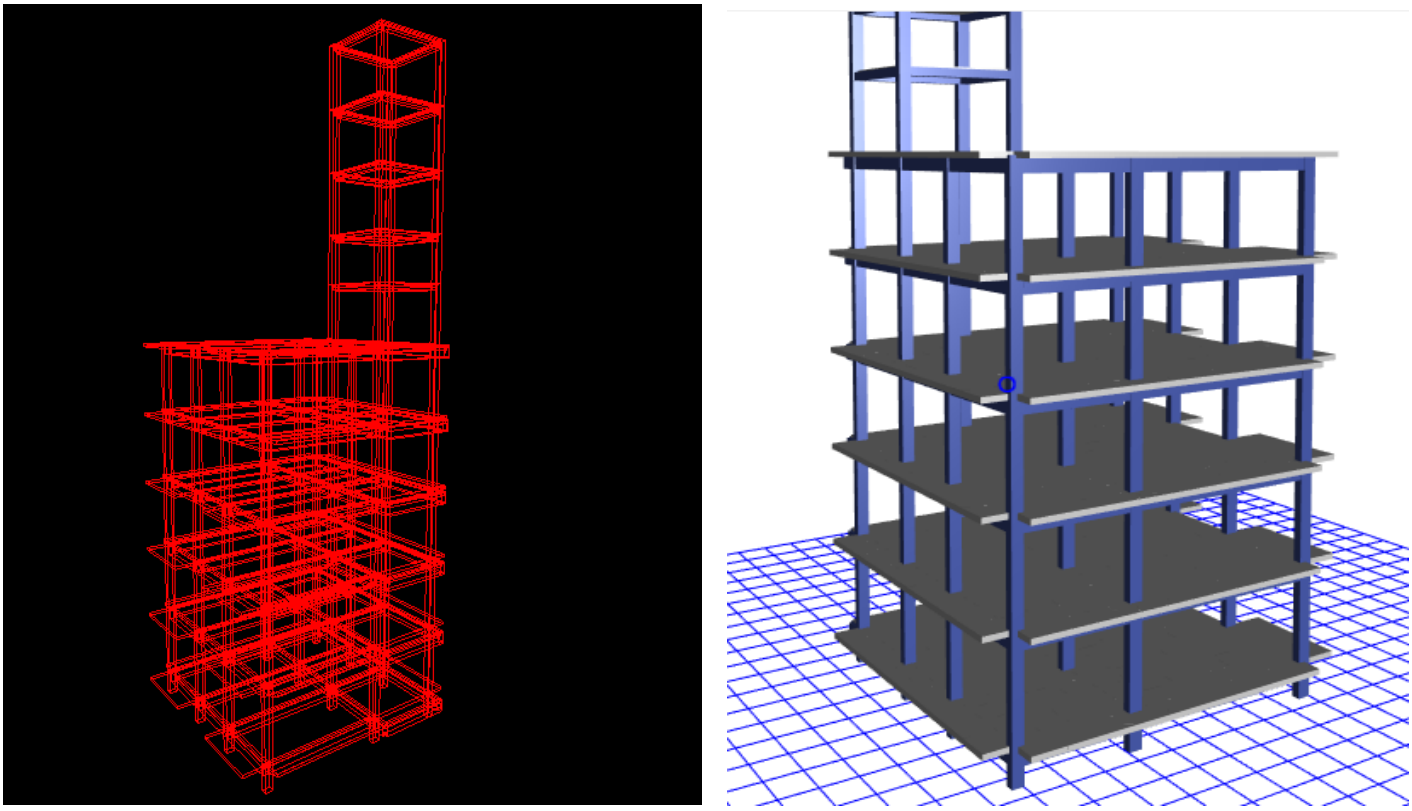
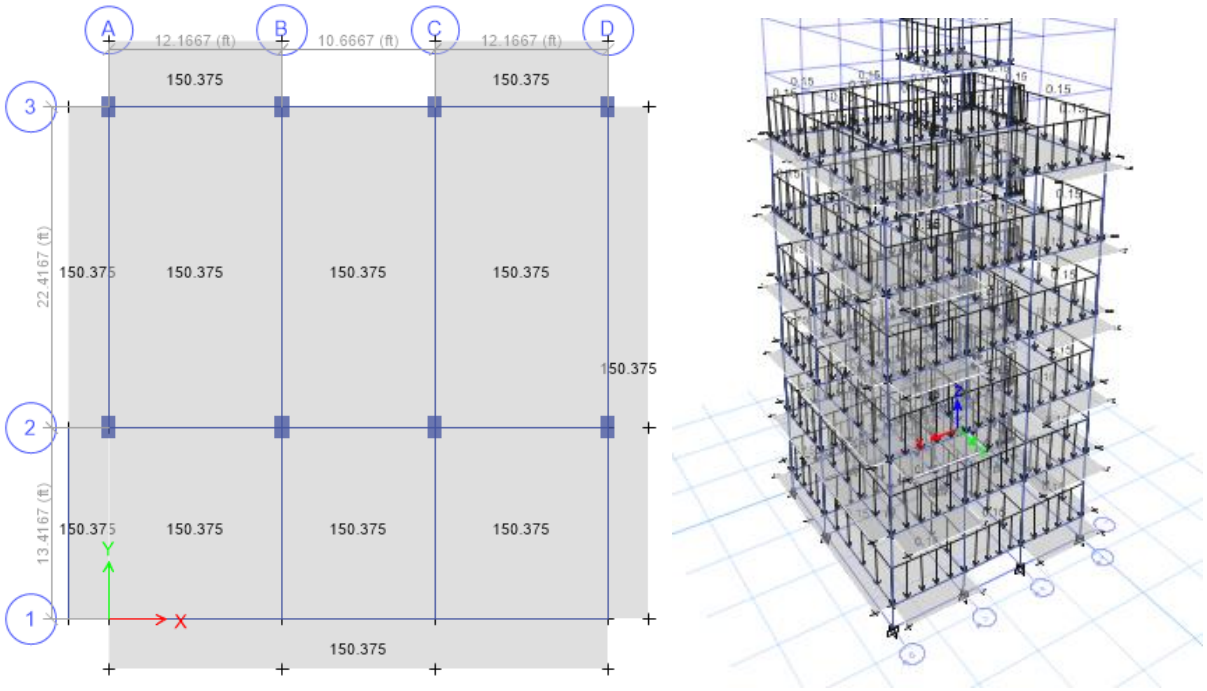


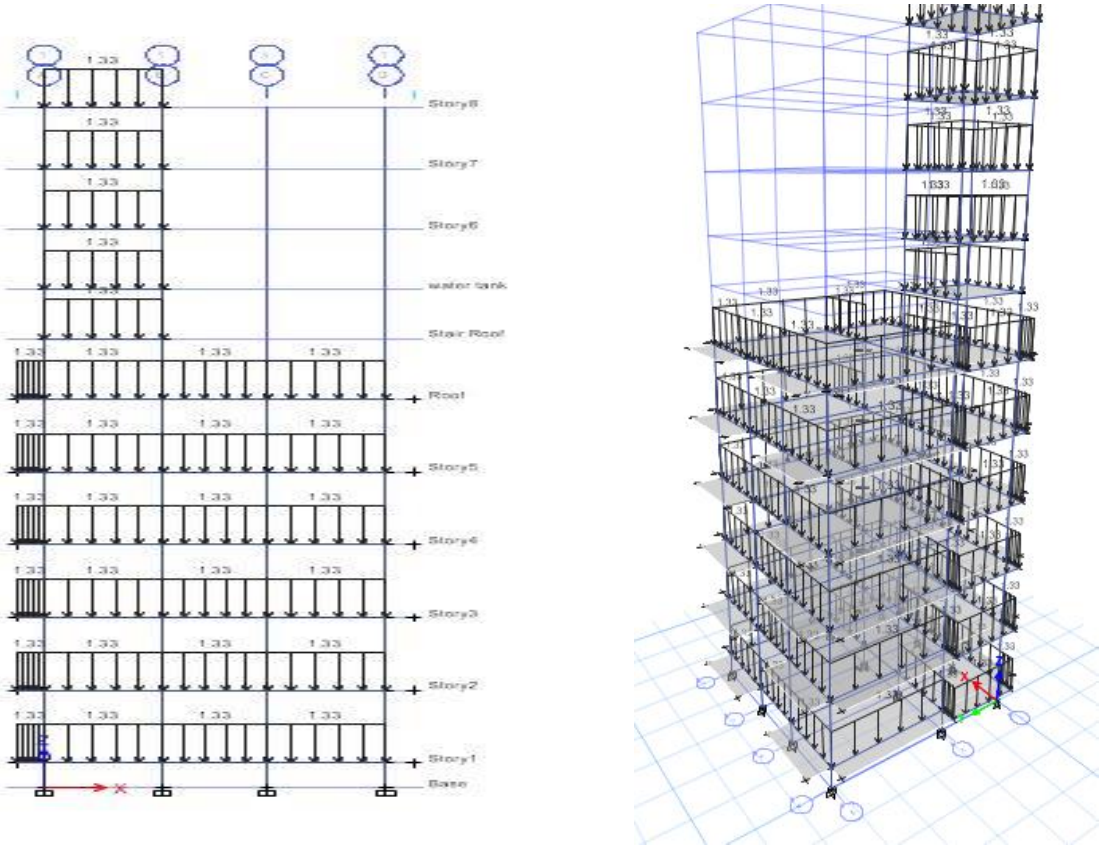
Fig: 2.1: 3d view of five storied mosques

In Etabs software dead load of structure is automatically calculated no need to input but other loads need to be input according to the code. Loading Diagram from Etabs software in the following figures.



(a) Plan view (b) 3D view

Fig: 2.2: Live Load Diagram



(a) Elevation view (b) 3D view

Fig: 2.3: Superimposed dead load

2.5 LOAD COMBINATION

Combinations of Load and Resistance Factor Design (LRFD) Method:

D = Dead Load

L = Live Load

EQx = Earthquake Load in X direction (Positive + Negative)

EQy = Earthquake Load in Y direction (Positive + Negative)

WINDx = Wind Load in X direction (Positive + Negative)

WINDy = Wind Load in Y direction (Positive + Negative)

1. 1.4DL+1.7LL
2. 1.4DL+1.4LL+1.4EQx
3. 1.4DL+1.4LL+1.4EQy
4. 0.75[1.4DL+1.7LL+1.7Windx]
5. 0.75[1.4DL+1.7LL+1.7Windy]
6. 0.9DL+1.3Windx
7. 0.9DL+1.3Windy
8. 0.9DL+1.3EQx
9. 0.9DL+1.3EQy

2.6 ANALYSIS AND DESIGN METHOD

We used the ETABS software to design the structure. Buildings with multiple stories are typically designed using this software. We used two different types of dimensions for the beam and four different types of dimensions for the column while designing it as a rigid frame. The restraints are regarded as being fixed to the structure.

CHAPTER - 3

ANALYSIS AND DESIGN

3.1 GENERAL

In this chapter we actually analyze our building with a software and design the required reinforcement bar size. After completing design, we will draft and draw the section of beams, columns, slabs and foundations.

3.2 STRUCTURAL ANALYSIS

3.2.1 Beam-Column Layout

Proposing beam-column layout with geometric dimensions for all structural analysis.

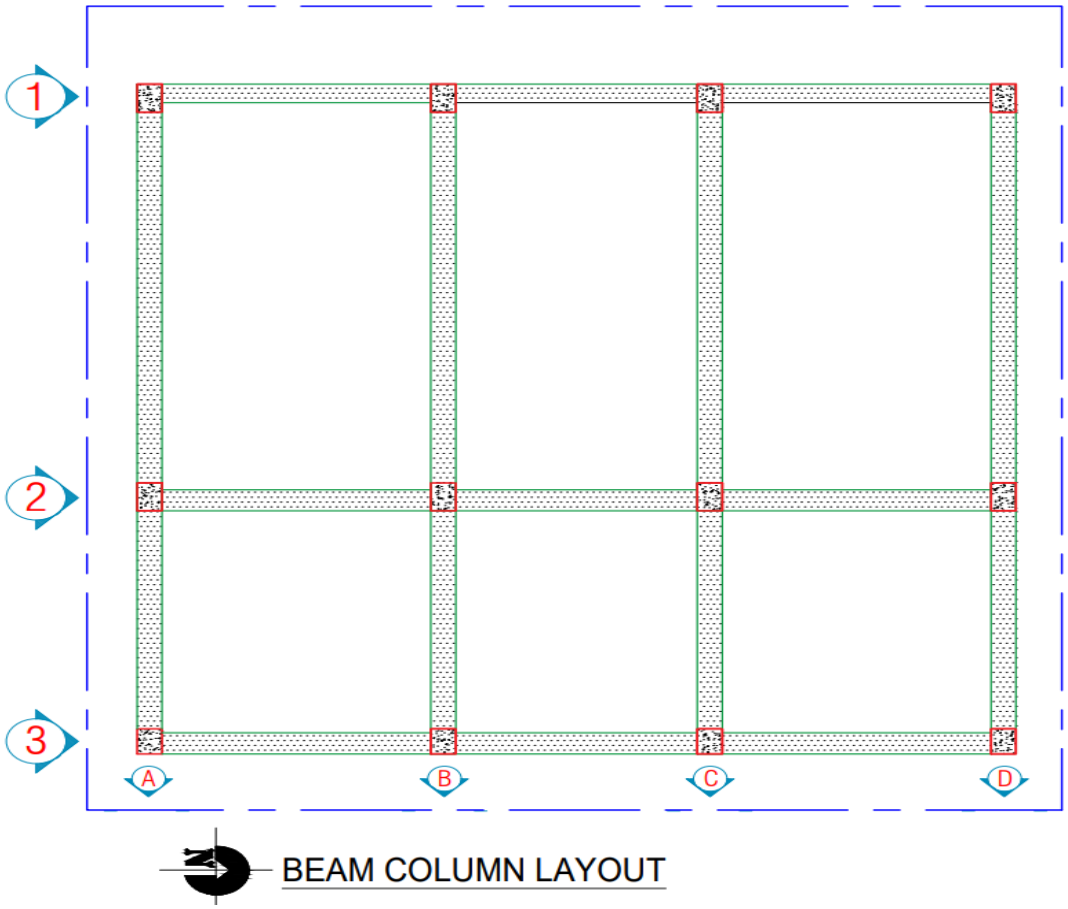


Fig: 3.1: Beam Column Layout

3.2.3 Validation Study

Comparing between software values and hand calculation of Axial load for validation in the following table.

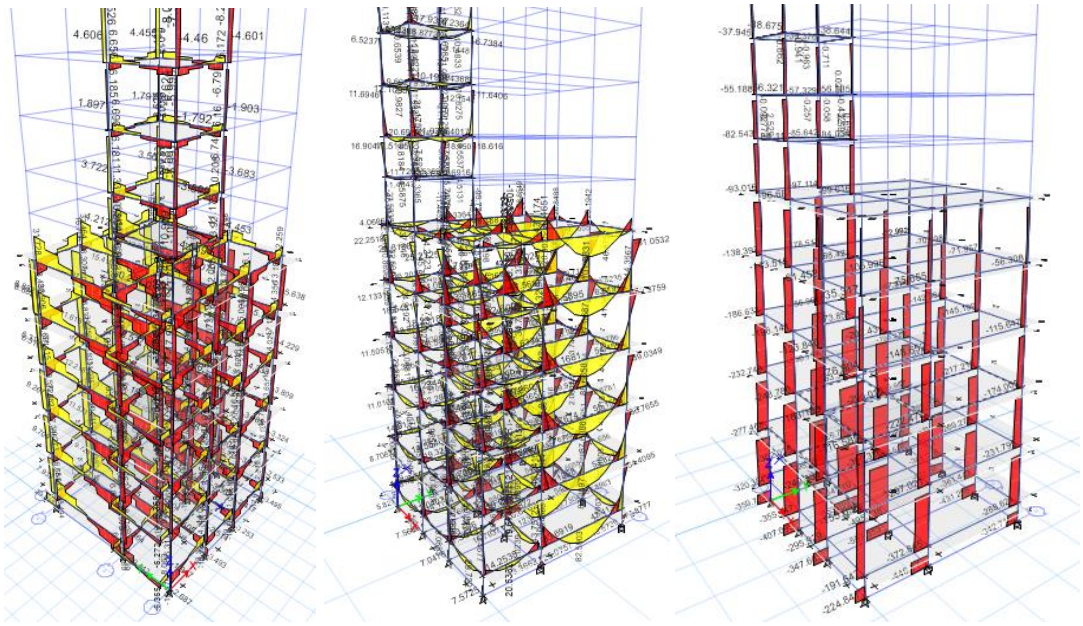
Table 3.1: Axial force

Content	Etabs	Hand Calculations	Variations
Axial Load (kip)	359.704	359.789	8%
	407.095	407.120	2.5%
	347.680	347.691	1.7%
	224.84	224.784	5.6%

The variation is acceptable so, software calculations is automatic.

3.2.4 *Analysis Results*

In analysis results is that how the structure is response with respect to load applications. We analyze shear force, bending moment, axial force and torsion force of structure. Some analysis diagram is showing in the following figures.



(a) Shear Force Diagram (b) Bendimg Moment Diagram (c) Axial Force Diagram

Fig:3.2: Analysis Diagram

Beam, Column and Slab analysis result's are showing in the following sections.

3.2.4.1 *Beam Responses*

Considering Ground Floor and 1st floor for frame analysis. There are 7 kinds of load combination are used for analysis.For shear force left end negative, mid zero and right end positive value is found. For bending moment both end zero and mid maximum value is found. Beam moments and shear forces resutls is shown in the following table.

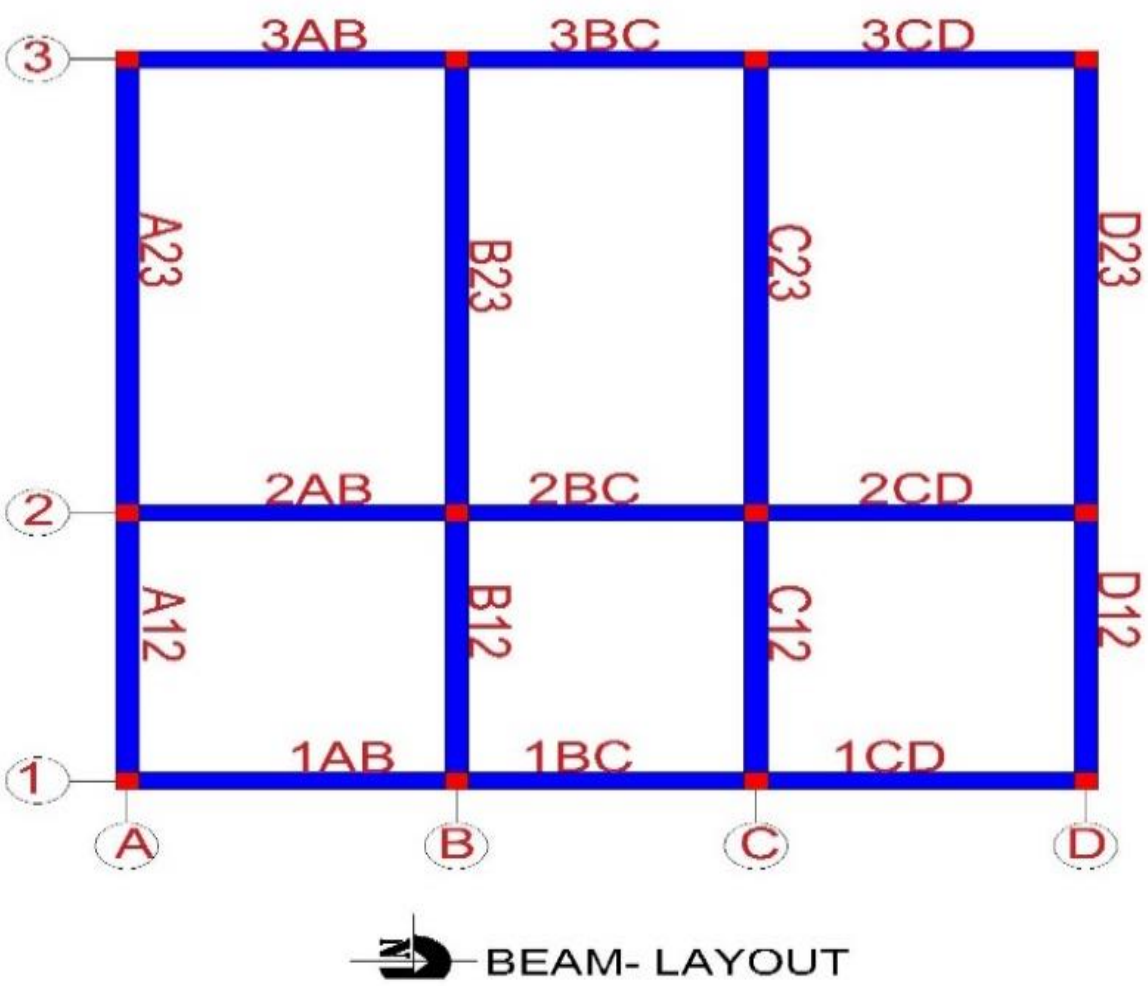


Fig: 3.3: Beam Column Layout

Table 3.2: Beam responses under load combinations (GF to 1 Floor)

Beam Id (Grid)	Beam Section	Load Combo	Story Level	Beam Shear (kip)			Beam Moment (kip-ft)		
				End	Mid	End	End	Mid	End
1AB	12x22	D+L	GF	-15.92	0	15.92	0	27.95	0
1BC	12x22	D+L	GF	-11.01	0	11.01	0	7.99	0
1CD	12x22	D+L	GF	-15.52	0	15.52	0	30.29	0
2AB	12x22	D+L	GF	-18.66	0	18.66	0	34.82	0
2BC	12x22	D+L	GF	-12.43	0	12.43	0	9.02	0
2CD	12x22	D+L	GF	-18.14	0	18.14	0	36.14	0
3AB	12x22	D+L	GF	-18.57	0	18.57	0	37.27	0
3BC	12x22	D+L	GF	-7.95	0	7.95	0	36.11	0
3CD	12x22	D+L	GF	-18.76	0	18.76	0	37.55	0
A12	12x22	D+L	GF	-10.05	0	10.05	0	23.32	0
A23	12x22	D+L	GF	-28.68	0	28.68	0	82.9	0
B12	12x22	D+L	GF	-19.94	0	19.94	0	24.82	0
B23	12x22	D+L	GF	-35.01	0	35.01	0	98.85	0
C12	12x22	D+L	GF	-19.27	0	19.27	0	25.18	0
C23	12x22	D+L	GF	-35.51	0	35.51	0	99.33	0
D12	12x22	D+L	GF	-16.39	0	16.39	0	22.41	0
D23	12x22	D+L	GF	-30.50	0	30.50	0	82.45	0
1AB	12x20	D+L	1st	-16.08	0	16.08	0	30.91	0
1BC	12x20	D+L	1st	-11.71	0	11.71	0	10.86	0
1CD	12x20	D+L	1st	-15.20	0	15.20	0	32.04	0
2AB	12x20	D+L	1st	-19.32	0	19.32	0	37.66	0
2BC	12x20	D+L	1st	-13.20	0	13.20	0	11.04	0
2CD	12x20	D+L	1st	-17.86	0	17.86	0	38.24	0
3AB	12x20	D+L	1st	-18.29	0	18.29	0	39.87	0
3BC	12x20	D+L	1st	-8.29	0	8.29	0	12.32	0
3CD	12x20	D+L	1st	-18.62	0	18.62	0	40.81	0
A12	12x20	D+L	1st	-23.50	0	23.50	0	23.5	0
A23	12x20	D+L	1st	-28.64	0	28.64	0	87.68	0
B12	12x20	D+L	1st	-18.52	0	18.52	0	25.00	0

B23	12x20	D+L	1st	-35.07	0	35.07	0	103.83	0
C12	12x20	D+L	1st	-19.03	0	19.03	0	25.56	0
C23	12x20	D+L	1st	-35.75	0	35.75	0	104.51	0
D12	12x20	D+L	1st	-15.89	0	15.89	0	23.23	0
D23	12x20	D+L	1st	-30.89	0	30.89	0	87.23	0
1AB	12x22	WINDX	GF	-15.92	0	15.92	0	27.95	0
1BC	12x22	WINDX	GF	-11.01	0	11.01	0	7.99	0
1CD	12x22	WINDX	GF	-15.52	0	15.52	0	30.29	0
2AB	12x22	WINDX	GF	-18.66	0	18.66	0	34.82	0
2BC	12x22	WINDX	GF	-12.43	0	12.43	0	9.02	0
2CD	12x22	WINDX	GF	-18.14	0	18.14	0	36.14	0
3AB	12x22	WINDX	GF	-18.57	0	18.57	0	37.27	0
3BC	12x22	WINDX	GF	-7.95	0	7.95	0	36.11	0
3CD	12x22	WINDX	GF	-18.76	0	18.76	0	37.55	0
A12	12x22	WINDX	GF	-10.05	0	10.05	0	23.32	0
A23	12x22	WINDX	GF	-28.68	0	28.68	0	82.9	0
B12	12x22	WINDX	GF	-19.94	0	19.94	0	24.82	0
B23	12x22	WINDX	GF	-35.01	0	35.01	0	98.85	0
C12	12x22	WINDX	GF	-19.27	0	19.27	0	25.18	0
C23	12x22	WINDX	GF	-35.51	0	35.51	0	99.33	0
D12	12x22	WINDX	GF	-16.39	0	16.39	0	22.41	0
D23	12x22	WINDX	GF	-30.50	0	30.50	0	82.45	0
1AB	12x22	WINDY	GF	-15.92	0	15.92	0	27.95	0
1BC	12x22	WINDY	GF	-11.01	0	11.01	0	7.99	0
1CD	12x22	WINDY	GF	-15.52	0	15.52	0	30.29	0
2AB	12x22	WINDY	GF	-18.66	0	18.66	0	34.82	0
2BC	12x22	WINDY	GF	-12.43	0	12.43	0	9.02	0
2CD	12x22	WINDY	GF	-18.14	0	18.14	0	36.14	0
3AB	12x22	WINDY	GF	-18.57	0	18.57	0	37.27	0
3BC	12x22	WINDY	GF	-7.95	0	7.95	0	36.11	0
3CD	12x22	WINDY	GF	-18.76	0	18.76	0	37.55	0
A12	12x22	WINDY	GF	-10.05	0	10.05	0	23.32	0

A23	12x22	WINDY	GF	-28.68	0	28.68	0	82.9	0
B12	12x22	WINDY	GF	-19.94	0	19.94	0	24.82	0
B23	12x22	WINDY	GF	-35.01	0	35.01	0	98.85	0
C12	12x22	WINDY	GF	-19.27	0	19.27	0	25.18	0
C23	12x22	WINDY	GF	-35.51	0	35.51	0	99.33	0
D12	12x22	WINDY	GF	-16.39	0	16.39	0	22.41	0
D23	12x22	WINDY	GF	-30.50	0	30.50	0	82.45	0
1AB	12x20	WINDY	1st	-16.08	0	16.08	0	30.91	0
1BC	12x20	WINDY	1st	-11.71	0	11.71	0	10.86	0
1CD	12x20	WINDY	1st	-15.20	0	15.20	0	32.04	0
2AB	12x20	WINDY	1st	-19.32	0	19.32	0	37.66	0
2BC	12x20	WINDY	1st	-13.20	0	13.20	0	11.04	0
2CD	12x20	WINDY	1st	-17.86	0	17.86	0	38.24	0
3AB	12x20	WINDY	1st	-18.29	0	18.29	0	39.87	0
3BC	12x20	WINDY	1st	-8.29	0	8.29	0	12.32	0
3CD	12x20	WINDY	1st	-18.62	0	18.62	0	40.81	0
A12	12x20	WINDY	1st	-23.50	0	23.50	0	23.5	0
A23	12x20	WINDY	1st	-28.64	0	28.64	0	87.68	0
B12	12x20	WINDY	1st	-18.52	0	18.52	0	25.00	0
B23	12x20	WINDY	1st	-35.07	0	35.07	0	103.83	0
C12	12x20	WINDY	1st	-19.03	0	19.03	0	25.56	0
C23	12x20	WINDY	1st	-35.75	0	35.75	0	104.51	0
D12	12x20	WINDY	1st	-15.89	0	15.89	0	23.23	0
D23	12x20	WINDY	1st	-30.89	0	30.89	0	87.23	0
1AB	12x22	EQX	GF	-15.92	0	15.92	0	27.95	0
1BC	12x22	EQX	GF	-11.01	0	11.01	0	7.99	0
1CD	12x22	EQX	GF	-15.52	0	15.52	0	30.29	0
2AB	12x22	EQX	GF	-18.66	0	18.66	0	34.82	0
2BC	12x22	EQX	GF	-12.43	0	12.43	0	9.02	0
2CD	12x22	EQX	GF	-18.14	0	18.14	0	36.14	0
3AB	12x22	EQX	GF	-18.57	0	18.57	0	37.27	0
3BC	12x22	EQX	GF	-7.95	0	7.95	0	36.11	0

3CD	12x22	EQX	GF	-18.76	0	18.76	0	37.55	0
A12	12x22	EQX	GF	-10.05	0	10.05	0	23.32	0
A23	12x22	EQX	GF	-28.68	0	28.68	0	82.9	0
B12	12x22	EQX	GF	-19.94	0	19.94	0	24.82	0
B23	12x22	EQX	GF	-35.01	0	35.01	0	98.85	0
C12	12x22	EQX	GF	-19.27	0	19.27	0	25.18	0
C23	12x22	EQX	GF	-35.51	0	35.51	0	99.33	0
D12	12x22	EQX	GF	-16.39	0	16.39	0	22.41	0
D23	12x22	EQX	GF	-30.50	0	30.50	0	82.45	0
1AB	12x20	EQX	1st	-16.08	0	16.08	0	30.91	0
1BC	12x20	EQX	1st	-11.71	0	11.71	0	10.86	0
1CD	12x20	EQX	1st	-15.20	0	15.20	0	32.04	0
2AB	12x20	EQX	1st	-19.32	0	19.32	0	37.66	0
2BC	12x20	EQX	1st	-13.20	0	13.20	0	11.04	0
2CD	12x20	EQX	1st	-17.86	0	17.86	0	38.24	0
3AB	12x20	EQX	1st	-18.29	0	18.29	0	39.87	0
3BC	12x20	EQX	1st	-8.29	0	8.29	0	12.32	0
3CD	12x20	EQX	1st	-18.62	0	18.62	0	40.81	0
A12	12x20	EQX	1st	-23.50	0	23.50	0	23.5	0
A23	12x20	EQX	1st	-28.64	0	28.64	0	87.68	0
B12	12x20	EQX	1st	-18.52	0	18.52	0	25.00	0
B23	12x20	EQX	1st	-35.07	0	35.07	0	103.83	0
C12	12x20	EQX	1st	-19.03	0	19.03	0	25.56	0
C23	12x20	EQX	1st	-35.75	0	35.75	0	104.51	0
D12	12x20	EQX	1st	-15.89	0	15.89	0	23.23	0
D23	12x20	EQX	1st	-30.89	0	30.89	0	87.23	0

3.2.4.2 *Column Responses*

Considering ground floor and 1st floor column. According to the load combination we analyzed that maximum axial load, column shear and moment is generated mid columns. Column Axial load, Column Shear and Column Moment is shown in the following table.

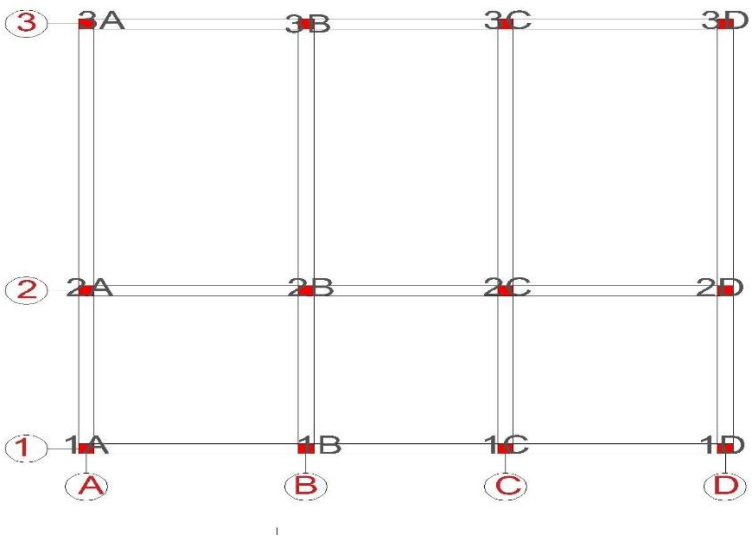


Fig: 3.4: Column-Layout

Table 3.3: Column responses under load combinations at GF and 1st floor

Column Id (Grid)	Column Section	Load Combo	Storey Level and Location	Axial Load (kip)	Column Shear (kip)		Beam Moment (kip-ft)	
					V3	V2	M3	M2
1A	12X12	D+L	GF	-319.332	8.156	1.033	30.29	27.02
1B	12X12	D+L	GF	-471.78	8.03	6.62	36.15	32.47
1C	12X12	D+L	GF	-406.21	8.85	5.65	27.95	34.82
1D	12X12	D+L	GF	-235.28	9.24	5.98	7.99	9.01
2A	12X22	D+L	GF	-383.00	7.44	6.58	30.29	36.14
2B	12X22	D+L	GF	-332.47	8.27	7.66	23.31	82.45
2C	12X22	D+L	GF	-345.28	6.83	11.82	24.82	99.33
2D	12X22	D+L	GF	-441.93	7.31	8.15	25.18	98.85
3A	12X22	D+L	GF	-456.62	7.66	14.06	22.41	82.89
3B	12X22	D+L	GF	-522.14	8.93	11.01	25.56	37.27
3C	12X22	D+L	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	D+L	GF	-383.81	7.59	10.05	22.68	37.56

1A	12X12	D+L	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	D+L	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	D+L	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	D+L	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	D+L	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	D+L	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	D+L	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	D+L	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	D+L	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	D+L	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	D+L	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	D+L	1st	-306.42	8.25	0.20	23.48	32.04
1A	12X12	EQX	GF	-332.45	8.156	1.033	30.29	27.02
1B	12X12	EQX	GF	-441.25	8.03	6.62	36.15	32.47
1C	12X12	EQX	GF	-235.45	8.85	5.65	27.95	34.82
1D	12X12	EQX	GF	-277.54	9.24	5.98	7.99	9.01
2A	12X22	EQX	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	EQX	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	EQX	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	EQX	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	EQX	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	EQX	GF	-512.14	8.93	11.01	25.56	37.27
3C	12X22	EQX	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	EQX	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	EQX	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	EQX	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	EQX	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	EQX	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	EQX	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	EQX	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	EQX	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	EQX	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	EQX	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	EQX	1st	-147.55	7.25	7.36	25.56	38.24

3C	12X22	EQX	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	EQX	1st	-306.42	8.25	0.20	23.48	32.04

1A	12X12	EQX-	GF	-219.332	8.156	1.033	30.29	27.02
1B	12X12	EQX-	GF	-331.78	8.03	6.62	36.15	32.47
1C	12X12	EQX-	GF	-506.21	8.85	5.65	27.95	34.82
1D	12X12	EQX-	GF	-235.28	9.24	5.98	7.99	9.01
2A	12X22	EQX-	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	EQX-	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	EQX-	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	EQX-	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	EQX-	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	EQX-	GF	-512.14	8.93	11.01	25.56	37.27
3C	12X22	EQX-	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	EQX-	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	EQX-	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	EQX-	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	EQX-	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	EQX-	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	EQX-	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	EQX-	1st	-184.39	7.25	13.20	103.54	0.123
2C	12X22	EQX-	1st	-265.22	8.96	7.47	25.05	39.87
2D	12X22	EQX-	1st	-184.19	6.09	7.44	25.05	37.66
3A	12X22	EQX-	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	EQX-	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	EQX-	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	EQX-	1st	-306.42	8.25	0.20	23.48	32.04

1A	12X12	EQY	GF	-319.332	8.156	1.033	30.29	27.02
1B	12X12	EQY	GF	-571.78	8.03	6.62	36.15	32.47
1C	12X12	EQY	GF	-306.21	8.85	5.65	27.95	34.82
1D	12X12	EQY	GF	-335.28	9.24	5.98	7.99	9.01
2A	12X22	EQY	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	EQY	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	EQY	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	EQY	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	EQY	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	EQY	GF	-512.14	8.93	11.01	25.56	37.27

3C	12X22	EQY	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	EQY	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	EQY	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	EQY	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	EQY	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	EQY	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	EQY	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	EQY	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	EQY	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	EQY	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	EQY	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	EQY	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	EQY	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	EQY	1st	-306.42	8.25	0.20	23.48	32.04

1A	12X12	EQY-	GF	-319.332	8.156	1.033	30.29	27.02
1B	12X12	EQY-	GF	-571.78	8.03	6.62	36.15	32.47
1C	12X12	EQY-	GF	-306.21	8.85	5.65	27.95	34.82
1D	12X12	EQY-	GF	-335.28	9.24	5.98	7.99	9.01
2A	12X22	EQY-	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	EQY-	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	EQY-	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	EQY-	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	EQY-	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	EQY-	GF	-512.14	8.93	11.01	25.56	37.27
3C	12X22	EQY-	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	EQY-	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	EQY-	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	EQY-	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	EQY-	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	EQY-	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	EQY-	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	EQY-	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	EQY-	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	EQY-	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	EQY-	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	EQY-	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	EQY-	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	EQY-	1st	-306.42	8.25	0.20	23.48	32.04

1A	12X12	WINDX	GF	-319.332	8.156	1.033	30.29	27.02
1B	12X12	WINDX	GF	-571.78	8.03	6.62	36.15	32.47
1C	12X12	WINDX	GF	-306.21	8.85	5.65	27.95	34.82
1D	12X12	WINDX	GF	-335.28	9.24	5.98	7.99	9.01
2A	12X22	WINDX	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	WINDX	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	WINDX	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	WINDX	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	WINDX	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	WINDX	GF	-512.14	8.93	11.01	25.56	37.27
3C	12X22	WINDX	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	WINDX	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	WINDX	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	WINDX	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	WINDX	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	WINDX	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	WINDX	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	WINDX	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	WINDX	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	WINDX	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	WINDX	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	WINDX	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	WINDX	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	WINDX	1st	-306.42	8.25	0.20	23.48	32.04
1A	12X12	WINDX-	GF	-319.332	8.156	1.033	30.29	27.02
1B	12X12	WINDX-	GF	-571.78	8.03	6.62	36.15	32.47
1C	12X12	WINDX-	GF	-306.21	8.85	5.65	27.95	34.82
1D	12X12	WINDX-	GF	-335.28	9.24	5.98	7.99	9.01
2A	12X22	WINDX-	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	WINDX-	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	WINDX-	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	WINDX-	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	WINDX-	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	WINDX-	GF	-512.14	8.93	11.01	25.56	37.27
3C	12X22	WINDX-	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	WINDX-	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	WINDX-	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	WINDX-	1st	-429.40	7.70	11.85	33.45	104.51

1C	12X12	WINDX-	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	WINDX-	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	WINDX-	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	WINDX-	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	WINDX-	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	WINDX-	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	WINDX-	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	WINDX-	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	WINDX-	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	WINDX-	1st	-306.42	8.25	0.20	23.48	32.04

1A	12X12	WINDY	GF	-319.332	8.156	1.033	30.29	27.02
1B	12X12	WINDY	GF	-571.78	8.03	6.62	36.15	32.47
1C	12X12	WINDY	GF	-306.21	8.85	5.65	27.95	34.82
1D	12X12	WINDY	GF	-335.28	9.24	5.98	7.99	9.01
2A	12X22	WINDY	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	WINDY	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	WINDY	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	WINDY	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	WINDY	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	WINDY	GF	-512.14	8.93	11.01	25.56	37.27
3C	12X22	WINDY	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	WINDY	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	WINDY	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	WINDY	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	WINDY	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	WINDY	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	WINDY	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	WINDY	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	WINDY	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	WINDY	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	WINDY	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	WINDY	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	WINDY	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	WINDY	1st	-306.42	8.25	0.20	23.48	32.04
1A	12X12	WINDY-	GF	-319.332	8.156	1.033	30.29	27.02
1B	12X12	WINDY-	GF	-571.78	8.03	6.62	36.15	32.47

1C	12X12	WINDY-	GF	-306.21	8.85	5.65	27.95	34.82
1D	12X12	WINDY-	GF	-335.28	9.24	5.98	7.99	9.01
2A	12X22	WINDY-	GF	-283.00	7.44	6.58	30.29	36.14
2B	12X22	WINDY-	GF	-182.47	8.27	7.66	23.31	82.45
2C	12X22	WINDY-	GF	-335.28	6.83	11.82	24.82	99.33
2D	12X22	WINDY-	GF	-571.93	7.31	8.15	25.18	98.85
3A	12X22	WINDY-	GF	-356.62	7.66	14.06	22.41	82.89
3B	12X22	WINDY-	GF	-512.14	8.93	11.01	25.56	37.27
3C	12X22	WINDY-	GF	-511.36	8.65	12.82	24.64	0.05
3D	12X22	WINDY-	GF	-383.81	7.59	10.05	22.68	37.56
1A	12X12	WINDY-	1st	-256.08	7.13	12.55	32.85	87.23
1B	12X12	WINDY-	1st	-429.40	7.70	11.85	33.45	104.51
1C	12X12	WINDY-	1st	-251.26	9.40	13.37	22.56	103.83
1D	12X12	WINDY-	1st	-284.19	6.09	10.07	24.59	87.83
2A	12X22	WINDY-	1st	-471.74	6.28	16.29	31.52	38.87
2B	12X22	WINDY-	1st	-284.39	7.25	13.20	103.54	0.123
2C	12X22	WINDY-	1st	-265.07	8.96	7.47	25.05	39.87
2D	12X22	WINDY-	1st	-284.19	6.09	7.44	25.05	37.66
3A	12X22	WINDY-	1st	-229.73	8.87	8.99	103.83	11.04
3B	12X22	WINDY-	1st	-147.55	7.25	7.36	25.56	38.24
3C	12X22	WINDY-	1st	-409.82	7.65	10.82	23.23	30.91
3D	12X22	WINDY-	1st	-306.42	8.25	0.20	23.48	32.04

3.2.4.3 *Foundation Reactions*

The foundation detials for five storey is summarzed below with necessary sign convention and axis detail.

Table 3.4: Foundation responses under

Foundation Id (Grid)	Axial Load (kip)	Shear (kip)		Beam Moment (kip-ft)	
		V3	V2	M3	M2
F1	-359.704	3.175	1.651	30.29	27.91
F1	-407.095	5.59	2.55	27.82	32.55
F1	-347.68	3.56	2.689	26.66	27.55
F1	-224.84	3.254	3.325	29.55	21.85

3.3 STRUCTURAL DESIGN

3.3.1 Design of Slab

The clitical slab is indicated in the following diagram and selected 2 and 4 is critical for two way slab design. We have got first layer in X-direction and second layer in Y-direction. Our minimum ration is 0.51 (slab 04) for X-direction and minimum ratio is 0.91 (slab 02) for Y-direction.

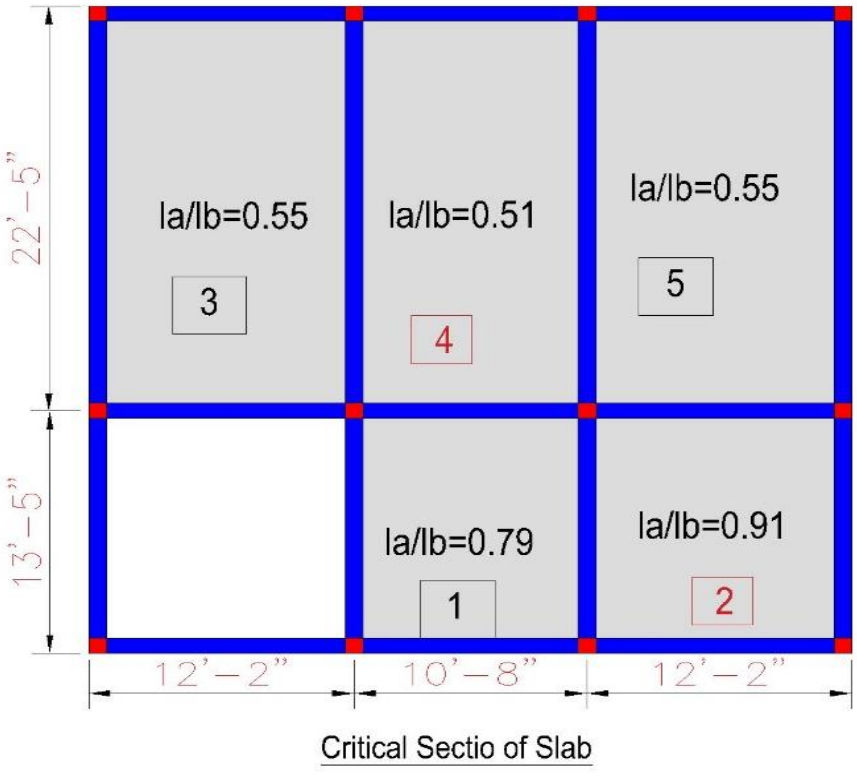


Fig: 3.5: Critical Section Of Slab

Table 3.5: Slab design detail

Slab ID	Design Direction	Thickness (in)	Effective Depth, d1 (in)	Effective Depth, d2 (in)	Mu_{neg} (Kip-ft)	Mu_{pos} (Kip-ft)	Aspos (in^2/ft)	Asneg (in^2/ft)	Design
4	X	5''	4.06	3.69	1.971	0.164	0.01	0.12	#4@10" c/c ckd
2	Y	5''	4.06	3.69	2.092	1.029	0.1	0.12	#4@8'' c/c alt ckd

3.3.2 Design of Beam

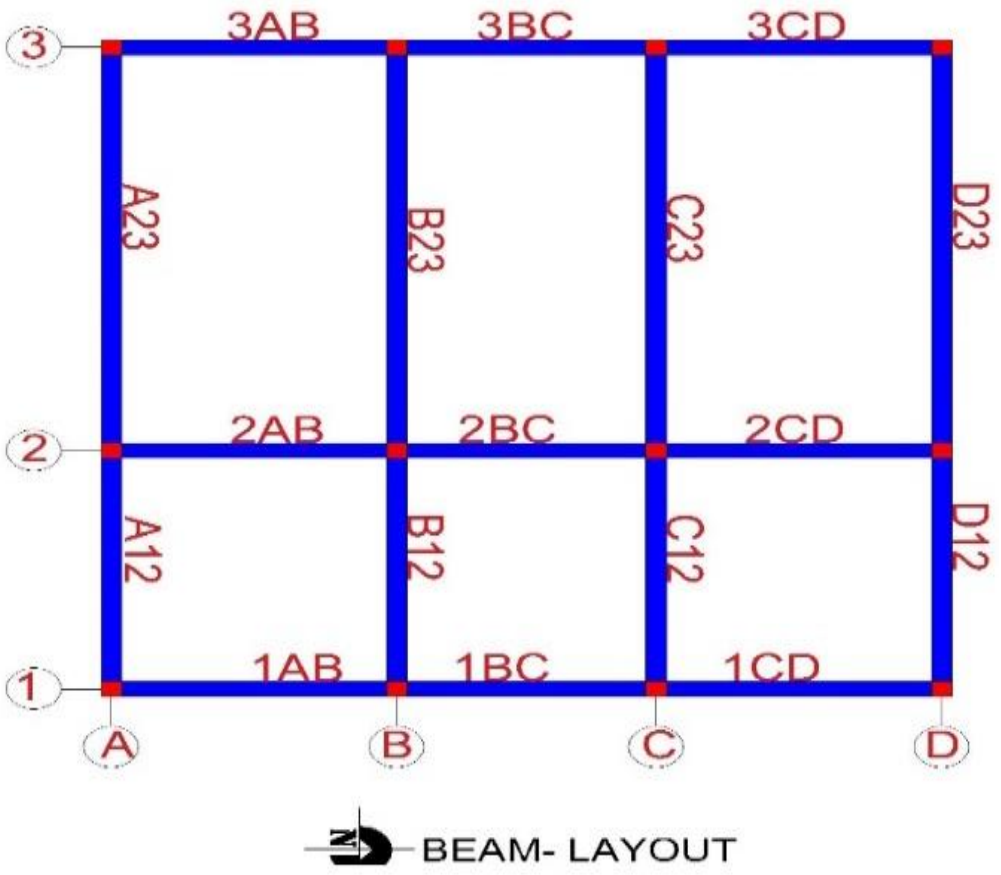


Fig: 3.6: Beam Column Layout

Table3.6: Beam design detail from GF to 1st Floor

Beam ID (Grid)	Required Top Reinforcement (in^2)			Required Bottom Reinforcement (in^2)		
	Left	Middle	Right	Left	Middle	Right
1AB	0.38	0.21	0.76	0.72	0.53	0.42
	0.76					
1BC	0.36	0.20	0.76	0.38	0.35	0.96
	0.96					
1CD	0.43	0.23	0.76	0.53	0.55	0.49
	0.76					
2AB	0.46	0.26	0.80	0.76	0.67	0.52
	0.80					
2BC	0.44	0.25	0.77	0.58	0.33	0.50
	0.77					
2CD	0.51	0.21	0.91	0.66	0.66	0.59
	0.91					
3AB	0.28	0.258	0.86	0.76	0.71	0.56
	0.86					
3BC	0.6	0.26	0.76	0.63	0.27	0.43
	0.76					
3CD	0.47	0.30	0.94	0.69	0.68	0.61
	0.94					
A12	0.21	0.15	0.36	0.25	0.37	.18
	0.37					
A23	0.13	0.25	1.43	0.79	1.42	0.85
	1.43					
B12	0.76	0.3471	1.0755	0.6872	0.6036	0.7015
	1.0755					
B23	1.5426	0.4905	1.5146	0.9743	1.746	1.0327
	1.746					
C12	0.76	0.352	1.0914	0.6966	0.6251	0.7116
	1.0914					
C23	0.76	0.3223	0.9963	0.7106	0.5291	0.6509
	0.9963					
D12	0.76	0.362	0.2024	0.4248	0.4546	0.288
	0.4546					
D23	0.76	0.4359	0.243	0.4073	0.5288	0.4894
	0.5288					

Table: 3.7: Beam design detail from 1st to 2nd Floor

Beam ID (Grid)	Required Top Reinforcement (in^2)			Required Bottom Reinforcement (in^2)		
	Left	Middle	Right	Left	Middle	Right
1AB	0.43	0.27	0.76	0.72	0.53	0.42
	0.76					
1BC	0.31	0.25	0.8	0.71	0.37	0.52
	0.71					
1CD	0.42	0.38	1.06	0.76	0.55	0.69
	1.06					
2AB	0.51	0.29	1.06	0.76	0.55	0.69
	1.06					
2BC	0.44	0.25	0.85	0.89	0.76	0.55
	0.89					
2CD	0.45	0.41	1.17	0.76	0.67	0.76
	1.17					
3AB	0.36	0.36	1.02	1.12	0.76	0.67
	1.12					
3BC	0.6	0.26	0.76	0.63	0.27	0.43
	0.76					
3CD	0.38	0.34	0.90	0.76	0.34	0.58
	0.90					
A12	0.21	0.15	0.36	0.25	0.37	.18
	0.37					
A23	1.25	0.53	1.68	0.86	1.45	0.85
	1.68					
B12	0.89	0.39	1.24	0.62	0.60	0.76
	1.24					
B23	1.61	0.57	1.04	1.82	1.76	1.04
	1.82					
C12	0.76	0.352	1.0914	0.6966	0.6251	0.7116
	1.0914					
C23	0.76	0.3223	0.9963	0.7106	0.5291	0.6509
	0.9963					
D12	0.99	0.38	1.18	0.85	0.53	0.76
	1.18					
D23	0.76	0.32	0.99	0.83	1.83	0.88
	1.83					

Table: 3.8: Beam design detail from 3rd to 4h Floor

Beam ID (Grid)	Required Top Reinforcement (in^2)			Required Bottom Reinforcement (in^2)		
	Left	Middle	Right	Left	Middle	Right
1AB	0.45	0.15	0.55	0.49	0.62	0.42
	0.62					
1BC	0.25	0.25	0.76	0.61	0.44	0.50
	0.76					
1CD	0.37	0.20	0.76	0.27	0.51	0.41
	0.76					
2AB	0.56	0.15	0.59	0.63	0.70	0.49
	0.63					
2BC	0.25	0.25	0.76	0.56	0.43	0.50
	0.76					
2CD	0.38	0.65	0.79	0.42	0.64	0.52
	0.79					
3AB	0.67	0.21	0.67	0.76	0.76	0.67
	0.76					
3BC	0.37	0.21	0.76	0.51	0.22	0.40
	0.76					
3CD	0.34	0.56	0.76	0.76	0.55	0.69
	0.76					
B12	0.76	0.56	0.76	0.53	0.61	0.58
	0.76					
B23	1.26	0.51	1.65	1.05	1.76	1.00
	1.64					
D12	0.76	0.25	0.76	0.56	0.54	0.45
	0.76					
D23	1.23	0.44	1.40	0.85	1.48	0.88
	1.48					

3.3.3 Design of Column

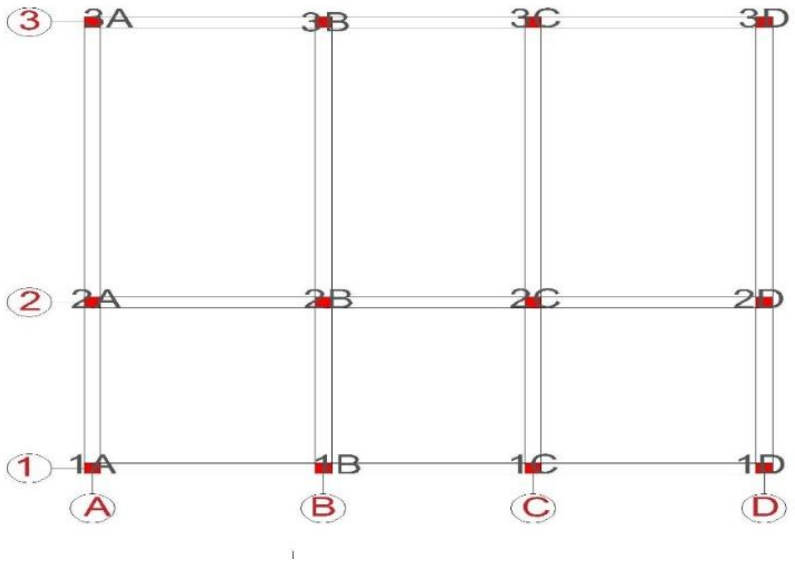


Fig: 3.7: Column layout

Table:3.9: Column design detail for flexure and axial load

Column Id	Colum Size (in)	Required reinforcement and design (in^2)					
		Base	1st	2nd	3rd	4th	5th
1A	12X16	1.92	1.92	1.92	1.92	1.92	1.92
		1.92				1.92	
1B	12X16	4.07	4.71	4.17	3.37	1.92	1.92
		4.71				1.92	
1C	12X16	3.01	4.14	4.17	3.21	2.71	2.71
		4.17				2.71	
1D	12X16	1.92	3.21	2.76	2.11	1.92	1.92
		2.76				1.92	
2A	12X18	2.95	3.14	2.6	2.22	3.01	2.6
		3.14				3.01	
2B	12X18	3.55	2.18	3.14	3.65	2.18	2.02
		3.65				2.18	
2C	12X18	4.26	3.25	3.11	2.98	2.65	2.17
		4.26				2.65	
2D	12X18	4.19	3.87	3.48	2.21	2.17	2.11
		4.19				2.17	
3A	12X18	4.40	3.02	3.95	2.1	3.38	3.22
		4.40				3.38	

3B	12X18	3.27	4.09	3.32	3.91	3.45	3.32
		4.09				3.45	
3C	12X18	3.51	3.19	3.98	3.61	3.61	2.31
		3.98				3.61	
3D	12X18	3.68	3.17	3.90	4.76	3.90	3.63
		4.76				3.90	

Table:3.10: Column design detail for shear

Column Id	Colum Size (in)	Base to 3rd Floor	4th Floor 5th Floor
1A	12X16	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
1B	12X16	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
1C	12X16	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
1D	12X16	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
2A	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
2B	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
2C	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
2D	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
3A	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
3B	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
3C	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''
3D	12X18	#3 bar 4'', 6'',4''	#3 bar 4'', 6'' 4''

3.3.4 Bearing Capacity for Deep Foundation

Based on the SPT (N) values supplied.

Table3.11: Bearing Capacity of Cast-in-Situ Pile For Bore Hole-1 (12''x12'')

Pile Depth (meter)	SPT	Qskin (KN)	Qend (KN)	Qtotal (KN)	Qall (KN)	Qall kips
1.5	3	30.861	14.11	44.971	15	3.37
3	5	43.237	32.779	76.016	25.34	5.62
4.5	15	75.694	172.89	248.58	82.86	18.63
6	32	127.07	568.01	695.08	231.69	52.09
7.5	23	188.01	343.84	531.85	177.28	39.85
9	29	268.36	639.01	907.37	302.46	68
10.5	34	363.59	745.51	1109.1	369.7	83.11
12	40	473.68	1136	1609.7	536.57	120.63
13.5	50	598.49	1278	1876.5	625.5	140.62
15	44	737.96	1420	2158	719.33	161.71

Table3.12: Bearing Capacity of Cast-in-Situ Pile For Bore Hole-2 (12''x12'')

Pile Depth (meter)	SPT	Qskin (KN)	Qend (KN)	Qtotal (KN)	Qall (KN)	Qall (Kips)
1.5	4	41.148	18.813	59.961	19.987	4.5
3	5	90.287	23.516	113.8	37.93	8.54
4.5	16	123.17	174.77	297.94	99.31	22.32
6	19	170.35	275.07	445.43	148.47	33.37
7.5	29	236.2	532.51	768.71	256.24	57.6
9	34	316.86	765.81	1083.7	361.23	81.15
10.5	50	412.12	994.02	1406.1	468.7	105.37
12	38	522.14	1022.4	1544.6	514.86	115.74
13.5	50	646.96	1278	1925	641.66	144.10
15	50	786.47	1420	2206.5	735.5	165.3

Table3.13: Bearing Capacity of Cast-in-Situ Pile For Bore Hole-3 (12''x12'')

Pile Depth (meter)	SPT	Qskin (KN)	Qend (KN)	Qtotal (KN)	Qall (KN)	Qall (Kips)
1.5	4	41148	18.813	59.961	20	4.49
3	5	90.287	23.516	113.8	37.93	8.52
4.5	26	126.9	316.51	446.41	148.80	33.44
6	20	174.17	275.07	449.24	149.75	33.66
7.5	33	240.19	639.01	879.2	293.07	65.88
9	34	320.85	766.81	1087.7	362.56	81.45
10.5	44	416.32	994.02	1410.3	470.1	105.67
12	50	526.37	1136	1662.4	554.13	124.54
13.5	50	651.17	1278	1929.2	643.07	144.57
15	50	790.7	1420	2210.7	736.9	165.66

For design safety we consider the lowest allowable load bearing capacity of soil for 50ft bore hole which is 161.71 kips.

3.3.5 Design of Foundation

We consider **18''** dia and **50ft** length pile for unfactored (dead+live) axial load of the structure.The pile design also based on 3 bore holes.Comparing the 3 bore holes we take the lowest allowable soil bearing capacity (**Qall=161.71 kips**) for foundation design.

Table 3.14: Foundation design detail for flexure and axial load.

Column Id	Column Size (in)	Axial Load (kip)	Foundation size or Pile No.	Foundation Depth (in)	Rebar in x-direction (in2/ft)	Rebar in Y-direction (in2/ft)
1A	12''x16''	239.55	18'' dia	30	7.2	7.2
1B	12''x16''	263.74	18'' dia	30	7.2	7.2
1C	12''x16''	222.28	18'' dia	30	7.2	7.2
1D	12''x16''	143.13	18'' dia	30	7.2	7.2
2A	12''x18''	381.73	18'' dia	30	7.2	3.2
2B	12''x18''	418.8	18'' dia	30	7.2	3.2
2C	12''x18''	377.02	18'' dia	30	7.2	3.2
2D	12''x18''	283.1	18'' dia	30	7.2	7.2
3A	12''x18''	235.04	18'' dia	30	7.2	7.2
3B	12''x18''	274.34	18'' dia	30	7.2	7.2
3C	12''x18''	273.63	18'' dia	30	7.2	7.2
3D	12''x18''	217.41	18'' dia	30	7.2	7.2

There are 24 piles required in foundation. Maximum axial force generated in column 2B and 2C. So here we provide 3 pile in each column. Column 1C and 1D generated less axial force so here 1 pile.

3.3.6 Detailing of Structural Members

In this section we have included Column, Beam, Slab and Foundation detailing.

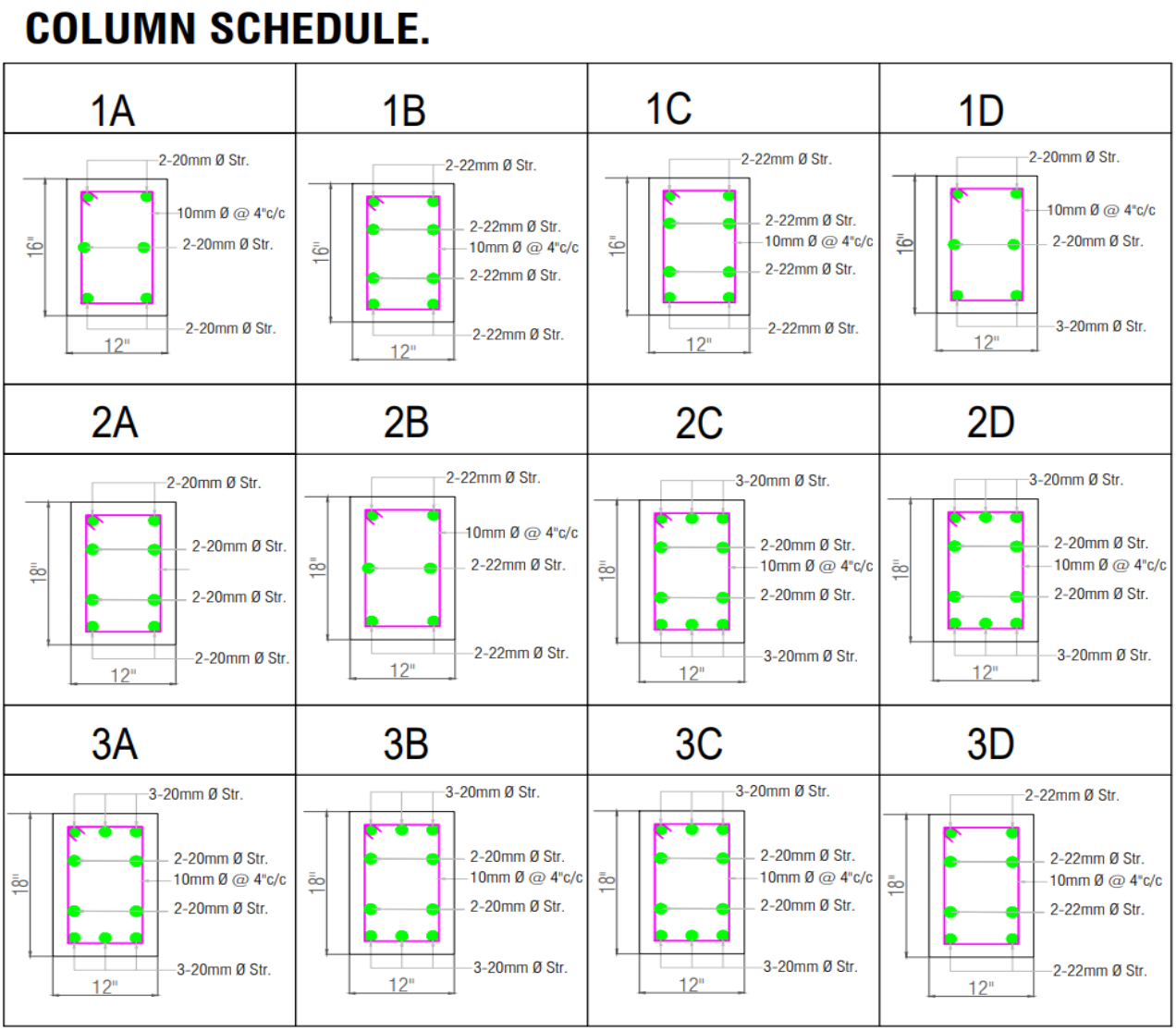


Fig:3.8: Column Detailing

Beam Detailing of Grade Beam(12''x22'')

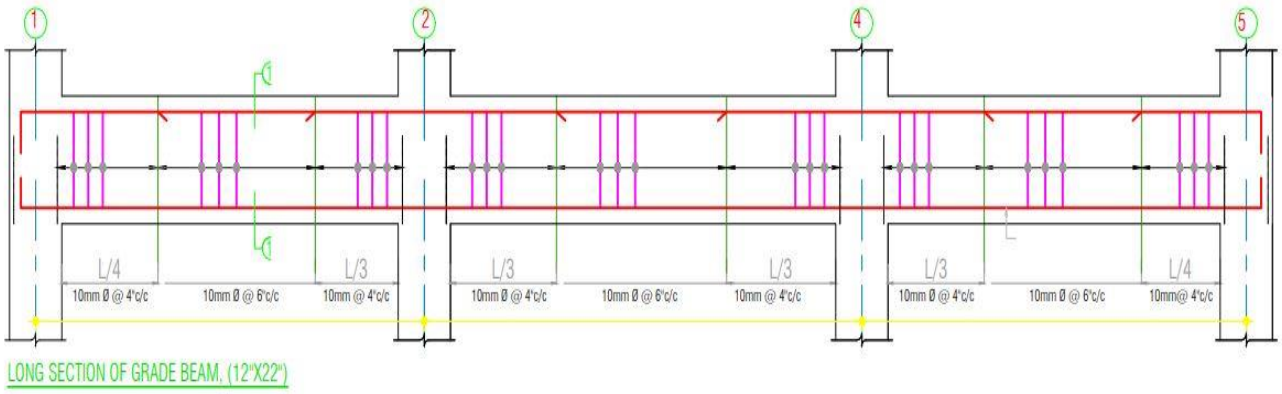


Fig:3.9: Long Section of Grade Beam

Grade beam of crosee-sectional detailing for different side of the structure are showing in the following in the figure.

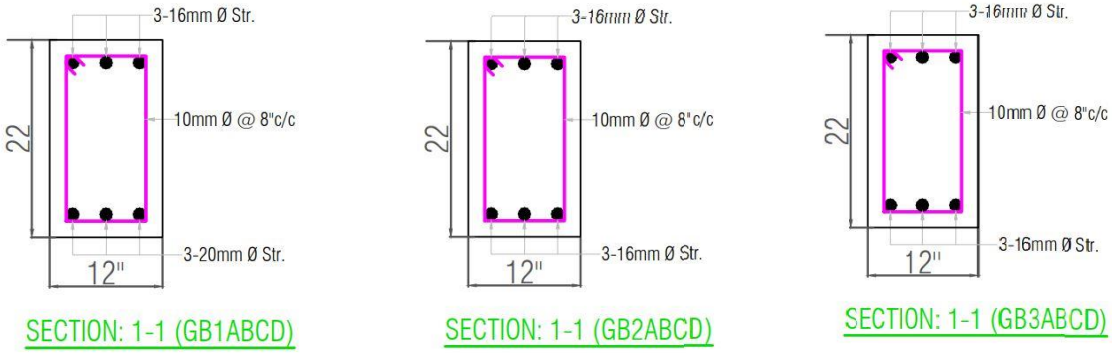


Fig:3.8: Cross-sectional of GB

Beam Detailing of Grade Beam(12''x22'')

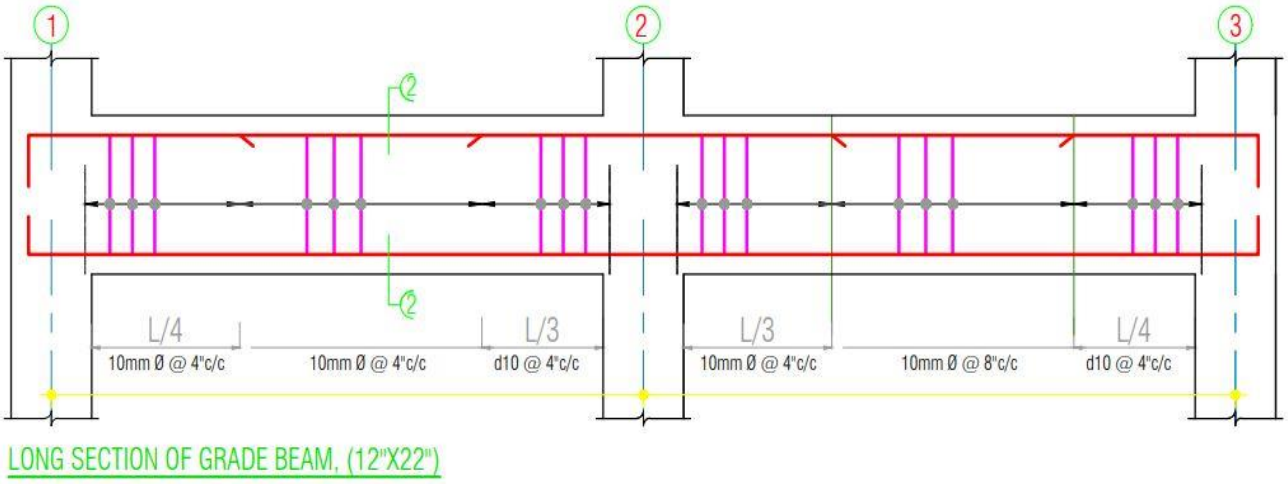
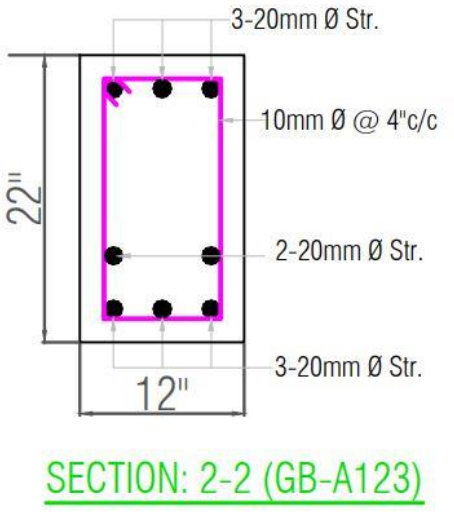
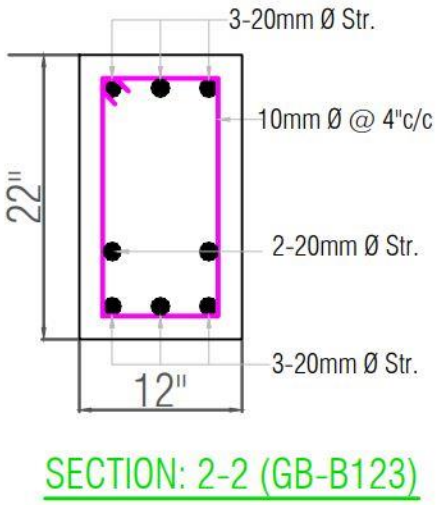


Fig:3.10: Long Section of Grade Beam

Grade beam of crose-sectional detailing for different side of the structure are showing in the following in the figure.





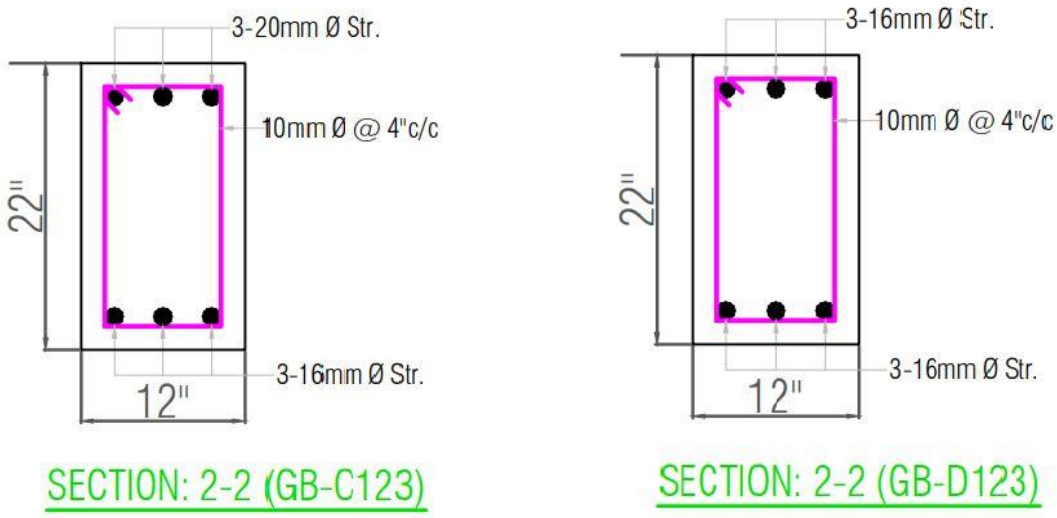


Fig:3.11: Cross-sectional of GB

Beam Detailing of Critical Floor (12''x20'')

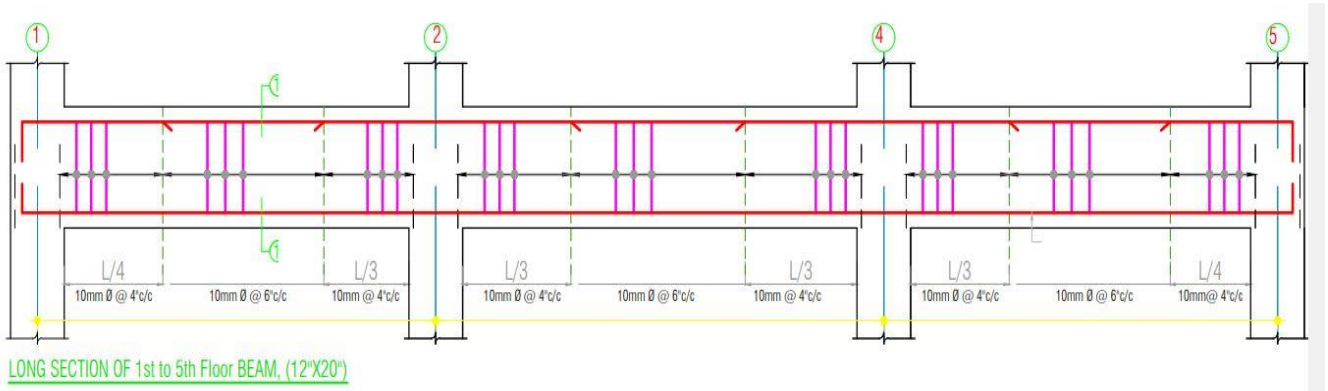


Fig:3.12: Long Section of Critical Beam

Critical beam of crosee-sectional detailing for different side of the structure are showing in the following in the figure

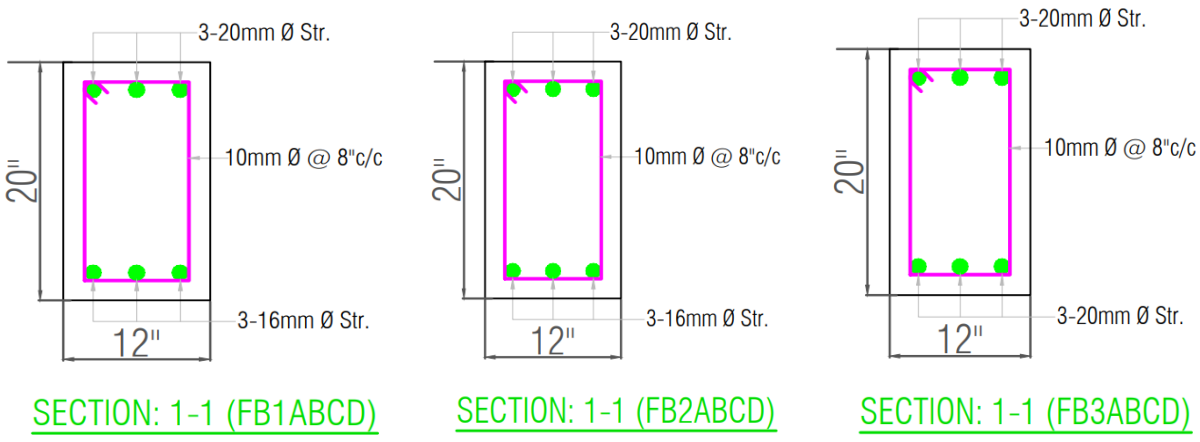


Fig:3.13: Critical Floor Beam Section

Beam Detailing of Critical Floor Beam(12''x22'')

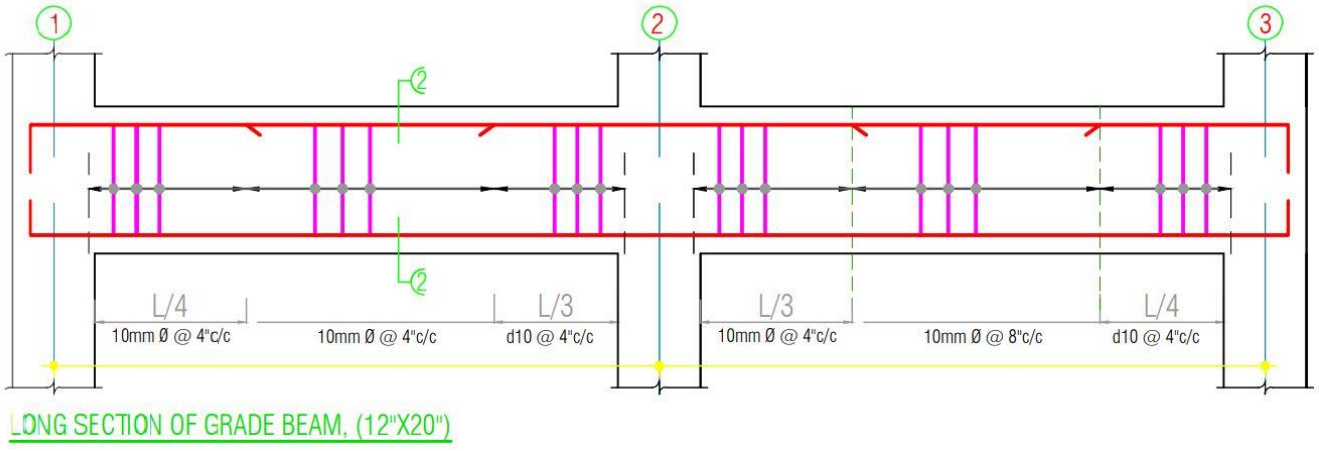


Fig:3.14: Long Section of Critical Beam

Critical beam of crosee-sectional detailing for different side of the structure are showing in the following in the figure.

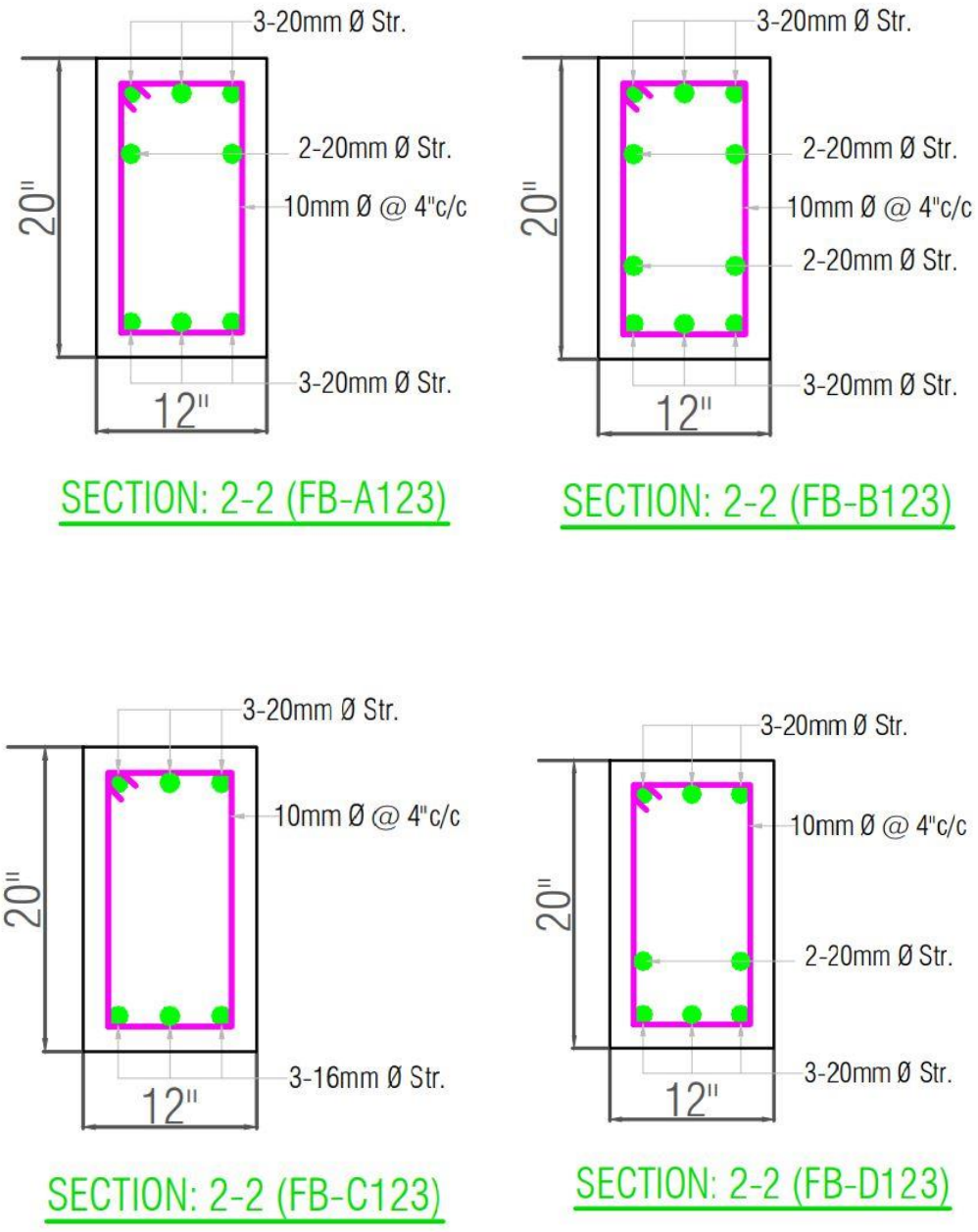


Fig:3.15: Critical Floor Beam Section

Drawing Detail of Slab

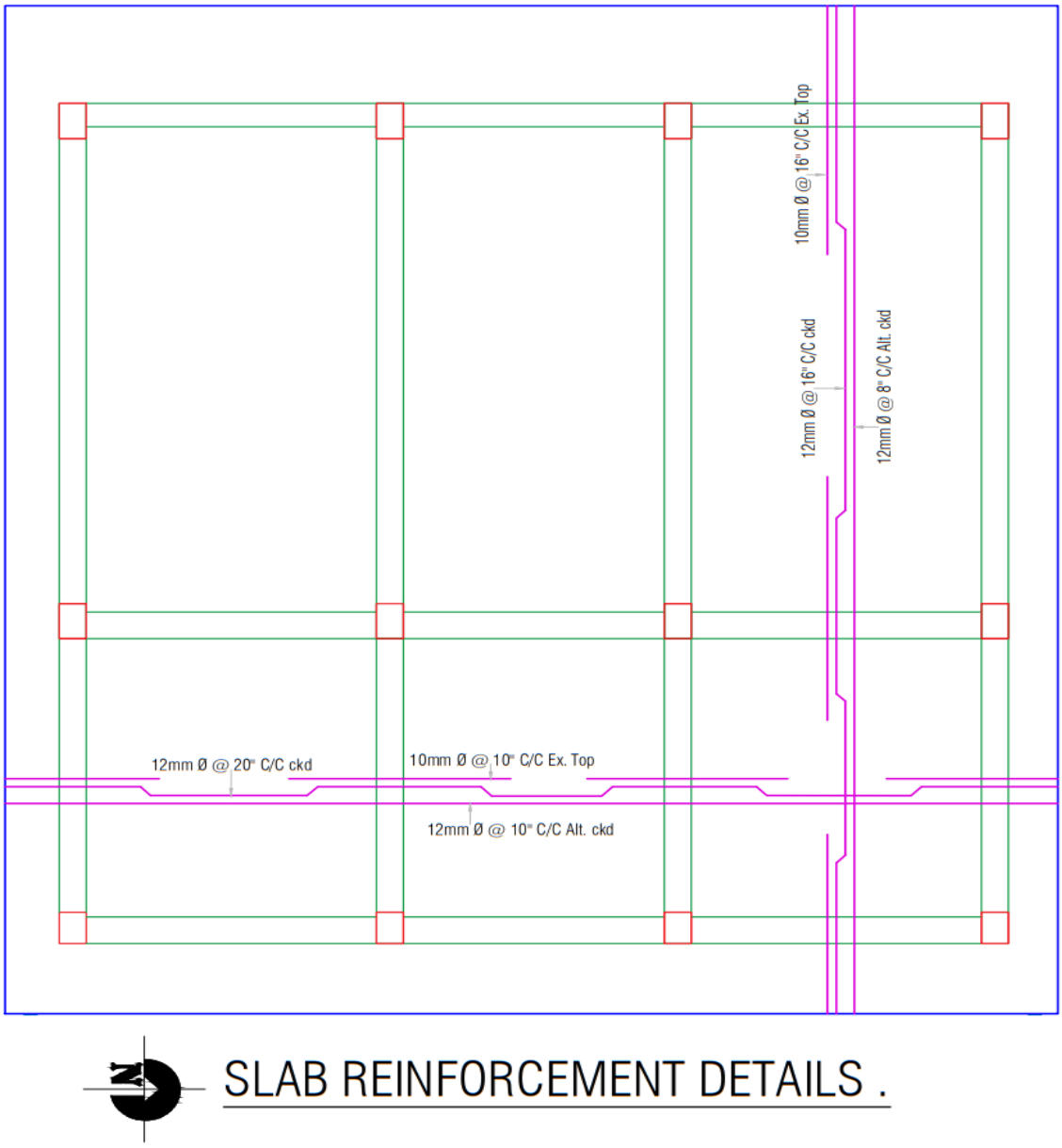


Fig:3.16: Slab Reinforcement Details

Drawing Detail of Foundation

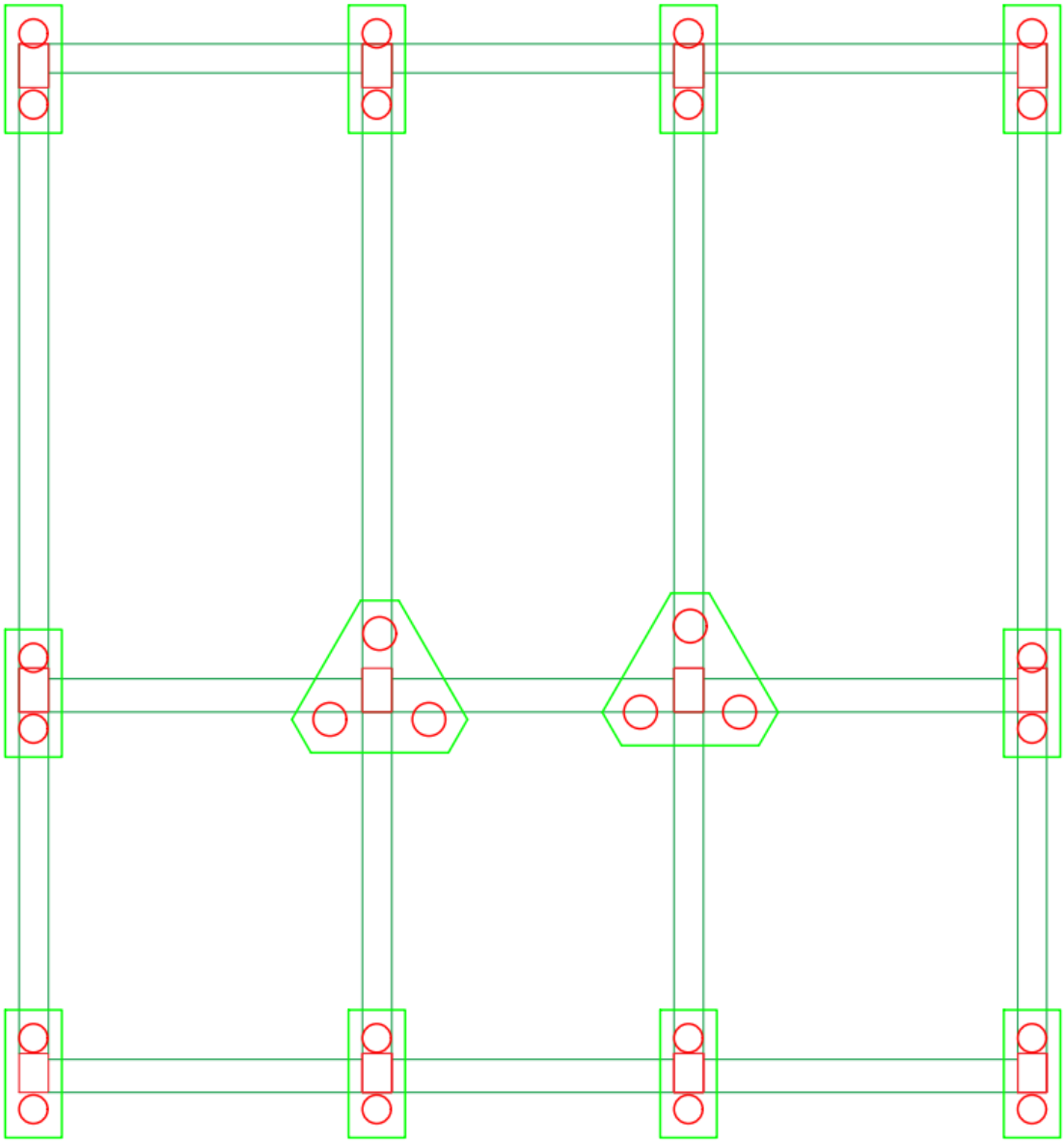


Fig:3.17: Pile detaling

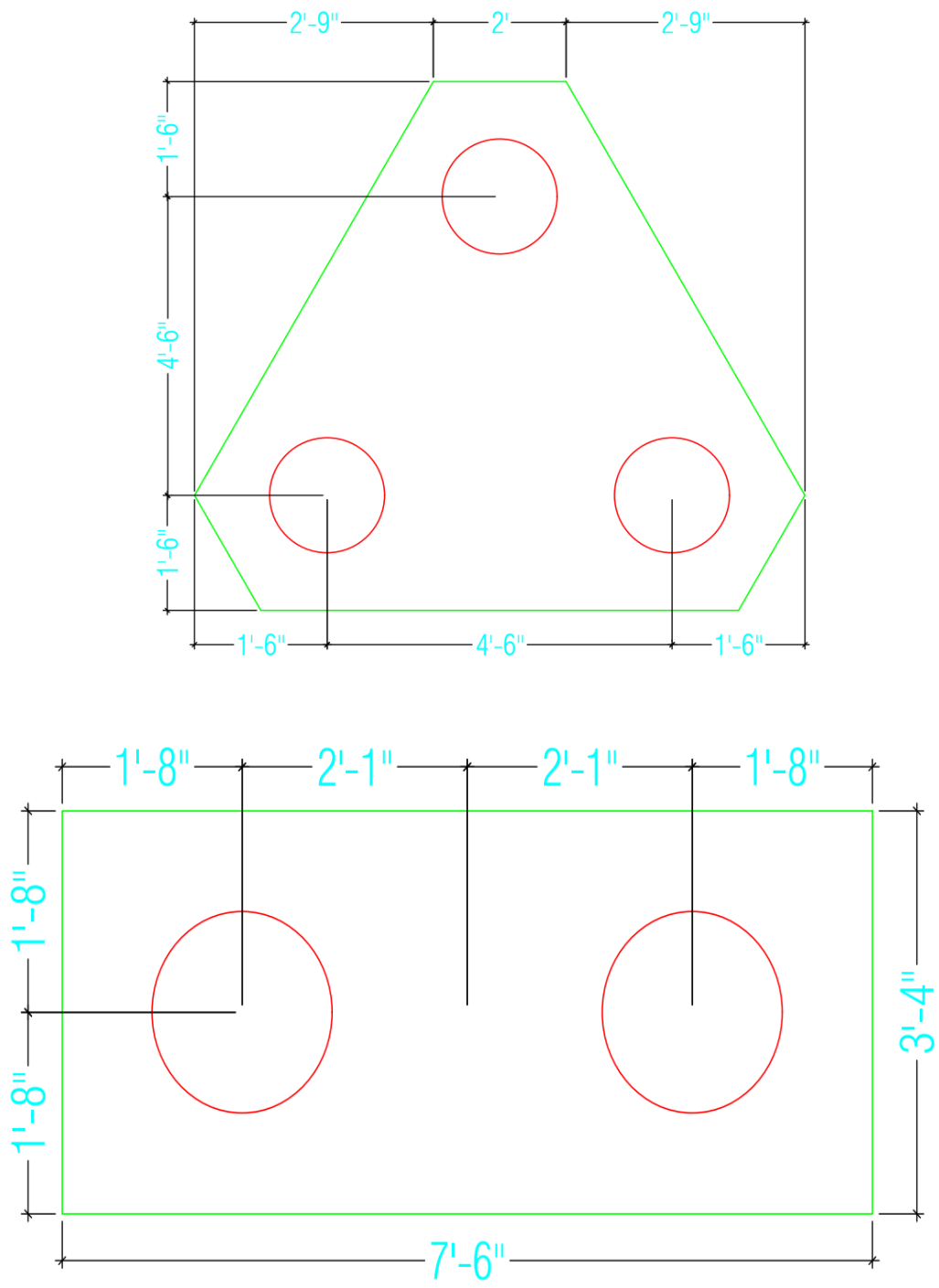


Fig:3.18: Pile Cap

3.4 DESIGN OF PLUMBING AND SANITARY

3.4.1 Design of Overhead Water Tank

Overhead Water Tank

Total no. of floor = G + 4

No. of unit in each floor = 1 unit

Total no. of Unit= (4 × 2) + 1=5

Per unit person = 150 person

Total no. of person = (150 × 5) = 750

From BNBC 2006,

Per day 8 liters of water are required for per person.

Total water requirement= (750 × 8) = 6000 liter

We know,

1 cft = 28.31 liter

Volume of water = (6000/28.31) = 211.9 cft

≈ 212 cft

Pumping 1 times per day = 212 cft

Design of Water Tank

Assume,

Length = 9 ft.

Width = 8 ft.

Water Capacity = 212 cft

Height = "h'' feet

Now,

Volume = Length × width × Height

Or, 212 = 9 × 8 × h

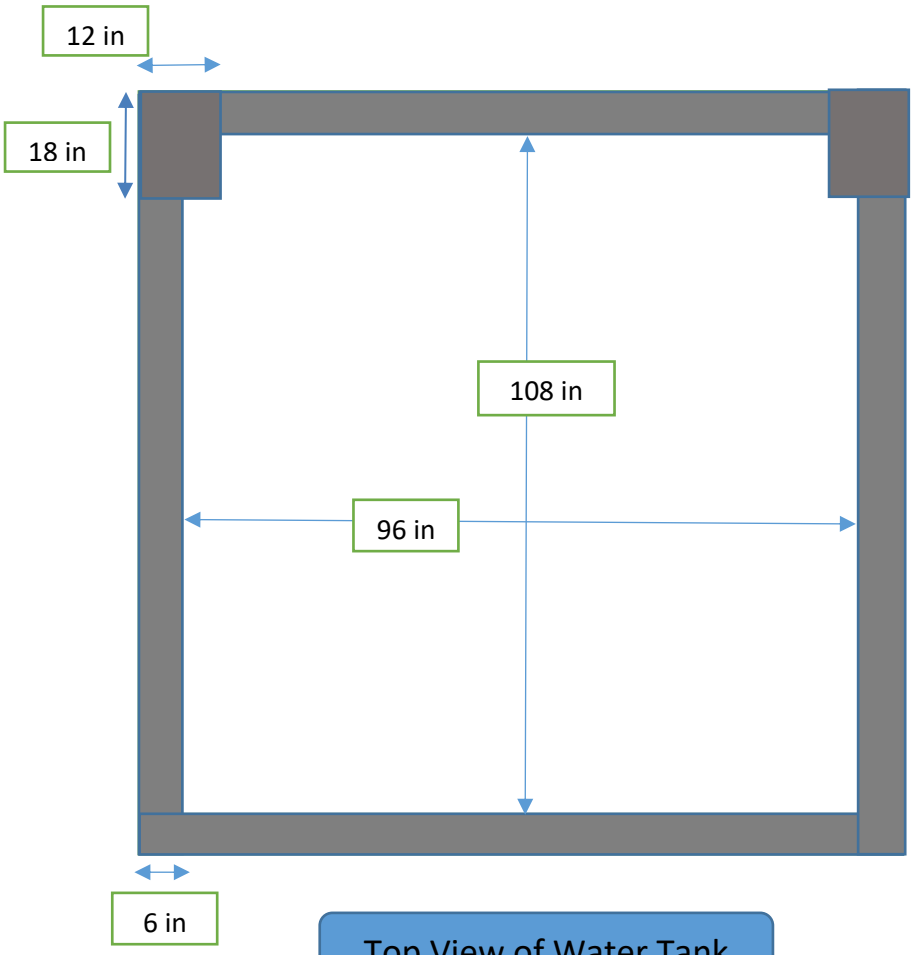
Or, h = 2.94 ft = 3 ft

Clear height = 1 ft

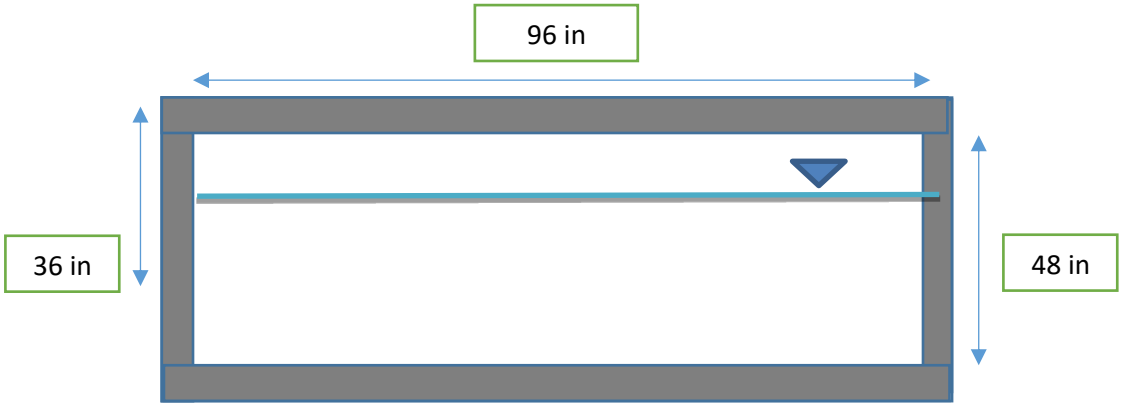
So, height = 3 + 1 = 4 feet

Tank Size = 9 ft × 8 ft × 4 ft.

Volume of Tank = 9 ft × 8 ft × 4 ft = 288 cubic feet



Top View of Water Tank



Front view

3.4.2 Design of Underground Water Tank

Underground Water Tank

Total no. of floor = G + 4

No. of unit in each floor = 1 unit

Total no. of Unit= (4 × 1) + 1 = 5

Per unit person = 150 person

Total no. of person = 5 × 150 = 750

From BNBC 2006,

Per day 8 liters of water are required for per person.

Total water requirement= 750 × 8 = 6000 liter

For 2 Days = 6000 × 2 = 12000 Liter

We know,

1 cft water = 28.31 liter

Volume of water = 12000/28.31 = 423.88 cft ≈ 424 cft

Design Underground Water Tank

Assume,

Length = 10 ft

Width = 6 ft

Depth = h

Volume of water = 424 cft

Volume = Length × Width × Depth

Or, 424 = 18 × 10 × h

Or , h = 7.06 ft ≈ 7 ft

Clear height = 1 ft

Total height = 7 + 1 = 8 ft

Tank Size = 10 ft × 6 ft × 8 ft

3.4.3 Design of Sewerage Tank

Septic Tank

Total no. of floor = G+4

No. of unit in each floor = 1 unit

Total no. of Unit= (4 × 1) + 1 = 5

Per unit person = 150 person

Total no. of person = 5 × 150 = 750

From BNBC 2006,

Per day 8 liters are required for per person.

Total requirement= 150 × 8 = 6000 liter

Volume = 6000/28.31 = 212 cft

Assume,

Depth = 6 ft

Length= L= 3B

Width, = B

Area = 212/6 = 35.5 cft

Now,

Length × width = Area

3B × B= 35.5

$3B^2$ = 35.5 ft.

$B = \sqrt{(35.5/3)}$

Width = 3.4 ft ≈ 3.5 ft

Length = 3 × 3.5 = 10.5 ft

Clear height = 1 ft

Total height = 6 + 1 = 7 ft

Septic Tank Size = 10.5 ft × 3.5 ft × 7 ft

CHAPTER – 4

PROJECT PLANNING

4.1 GENERAL

We calculated bill of quantities of structure because our client wanted to know the total cost of the project. So we approximately calculated total cost of this project and give an idea how much cost need to complete the project.

4.2 BILL OF QUANTITIES OF STRUCTURAL DESIGN

Prepare the details of bill of quantities of structural design. An example is given below,

Table: 4.1: Bill Of Quantities

PROJECT: G+4 Storied mosque Building					
Bill of Quantity With Specifications and Costing					
Item. No.	**Description**	**Quantity**	**Unit**	Rate	Amount
1	**SITE OFFICE & MOBILIZATION**				
1.1	**MOBILIZATION** Mobilization and cleaning site before commencing actual physical work and during contract period and demobilization after completion of the Works under contract accepted by Engineer. This work shall also covers clayey cleaning and clearing, cutting or filling, dressing the project area on and in the ground to an extent that all the events of works of the project can be executed smoothly in a working environment with a particular attention on safety and security in all respects, and to stockpile the end outcome to a place for disposal agreed by the Engineer, where, payments are to be based on ground area determined by the Engineer and be proportionate to the percentage progress of work under contract as a whole in all respects and approved by the Engineer.	323	Sq.m	169	54,587
1.2	**SITE OFFICE** Engineer's site office made of corrugated sheet 20 sqm plinth area furniture, first aid-box, safety helmet, consumables, stationeries etc.	1	L.S		440,718.00
2	**EARTH WORK**				
2.1	**LAYOUT AND MARKING FOR EARTH WORK** Giving layout, providing center lines, setup local bench-mark pillars, fixing wooden spikes and marking layout with chalk powder, etc. complete as per instruction of Engineer-in-charge.	323	Sqm.	15	4,845
2.2	R.C.C DISMENTLING (ROAD)	0	Cum.	0	0

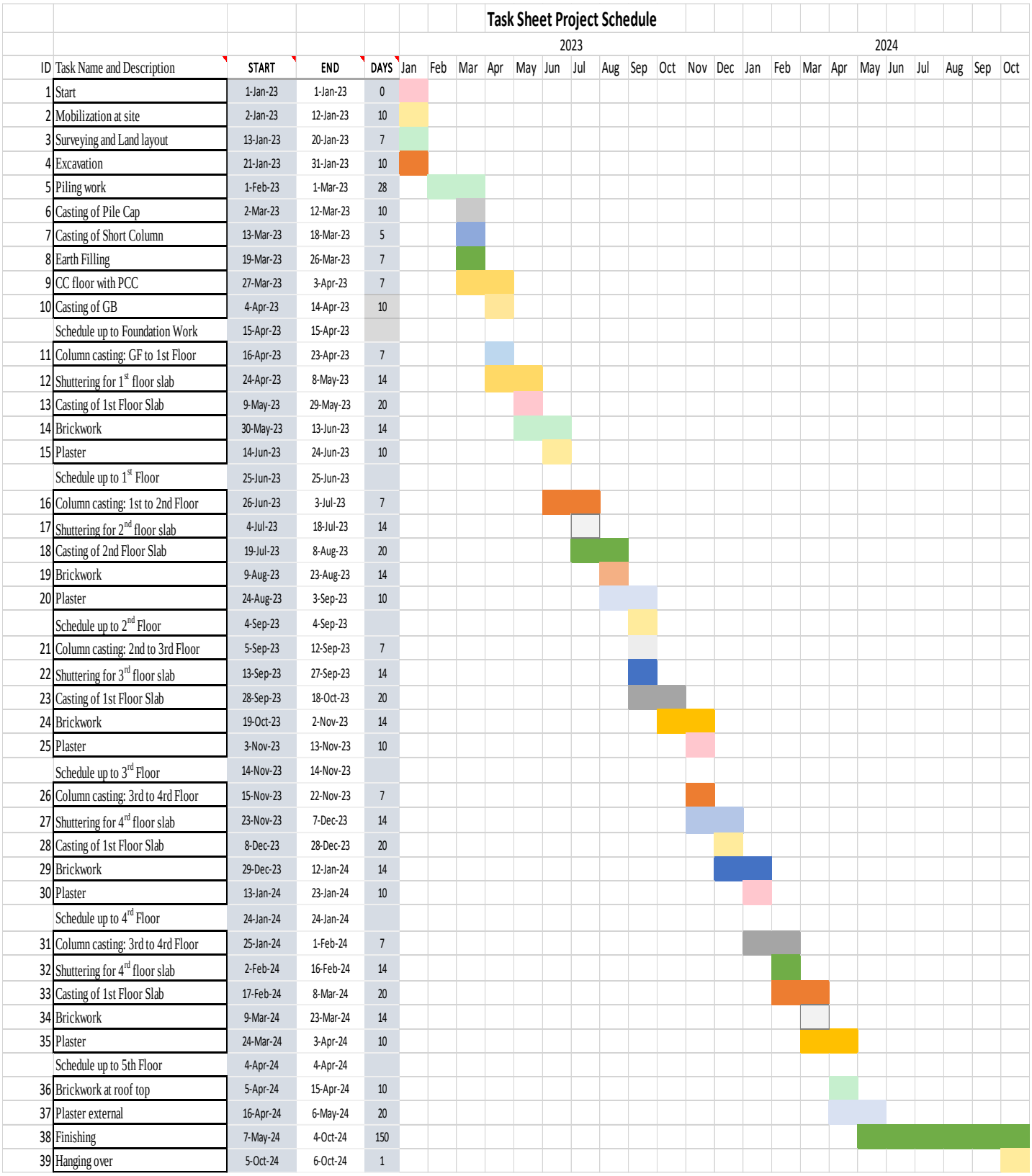
2.3	**EARTH EXCAVATION** Earth work in excavation in all kinds of soil for foundation trenches including. layout, providing center lines, local bench-mark pillars, leveling, ramming and preparing the base, fixing bamboo spikes and marking layout with chalk powder, providing necessary tools and plants, protecting and maintaining the trench dry etc., stacking, cleaning the excavated earth at a safe distance out of the area enclosed by the layout etc. all complete and accepted by the Engineer, subject to submit method statement of carrying out excavation work to the Engineer for approval. However, Engineer's approval shall not relieve the contractor of his responsibilities and obligations under the contract. Extra rate for each additional 0.05 m depth exceeding 1.5 m.	70	Cum.	217	15,190
2.4	**BACK FILLING WORK** Back filling in foundation trenches with sand in 150mm layers including supply of filling sand (FM 0.8) and leveling, watering and compaction by frog hammer/plate vibrator to achieve minimum dry density of 90% with optimum moisture content (Modified proctor test) by ramming each layer up to finished level all complete as per instruction of Engineer-in-charge.	45	cum	635	28,575
2.5	**DISPOSAL** Clearing and disposing of excavated earth from the construction site by truck or any other means to a place within 30 km radius of the city area including loading, unloading at both ends, leveling and dressing the carried earth etc. complete accepted by the Engineer.	30	cum	539	16,170
2.6	**BORING/DRILLING OF CAST-IN-SITU PILE** Installing bored cast-in-situ reinforced cement concrete end bearing piles using Hydraulic Rotary Rig (Concrete & reinforcement paid separately); driving temporary steel casing with necessary stiffener bands and sharp edge at bottom; casing shall be provided up to non-collapsible strata from the existing ground level (Minimum depth 6.0 Meter), boring in over-burden and through all type of strata encountered up to the founding level as described in the specification; socketing in approved strata, using bentonite slurry, including disposal of all bored materials etc. Completing as per drawings and specifications. (The boring depth shall be measured and paid from cut off level of pile only. If additional fill is placed for convenience of vehicle movement, the additional boring through this fill will not be paid extra.) Contractor shall submit the method statement of cast-in-situ pile work including sequence of boring and casting, disposal of spoils, test result of materials to the engineer for approval. However, Engineer's approval shall not relieve the Contractor of his responsibilities and obligations under contract.				
	500mm dia pile upto 23m depth	115	meter	794	91,310
2.7	**Removing of spoils/mud** Accumulated during boring for cast in situ pile by wash boring from working site to a safe distance by contractors own arrangement i.e with container set in truck or on cart including loading. Unloading everything complete as per standard practice (quantity should be given three times of solid volume of boring)	115	cum	557	64,055

2.8	**Cast-in-situ pile** with reinforced cement concrete works of high slump by adding high range water reducing admixture (ASTM C494 Type A or F complying item 7.20.1 or 7.20.6)with minimum cement content 390 Kg/Cum. compressive strength f'c=25 Mpa at 28 days on standard cylinders as per standard practice of code ACI/BNBC/ASTM & cement conforming to BDS EN-197-1CEM1,52.5N (52.5 mpa)/ASTM-c 150 Type -1 best quality coarse sand(Sylhet sand or coarse sand of equivalent F.M=2.2),20 mm down well graded crushed stone chips conforming to ASTM C-33, including breaking chips, screening through proper sieves, making, placing re-bar cage in position placing and removing tri-pod as per requirement, pouring the concrete in bore-hole with the help of a trimie pipe, maintaining the trimie pipe immersed in concrete by at least 1 meter throughout the period of concreting, maintaining required slump, etc. mixing the aggregates with standard mixer machine with hoper, casting in forms, all complete including water, electricity, testing of materials and concrete etc. and other charges as per design, drawing etc. all complete approved and accepted by the engineer.(Rate is excluding the cost of reinforcement and its fabrication, binding, welding, placing and admixture (approx. doses 150 to 250 liter per bag of cement which to fix by mix design)	191	cum	13463	2,571,433
2.9	Providing and **making point welding** at contact point of spiral binders at responsible intervals with the main reinforcements by electric arc welding for construction of cast in situ bored pile carefully with highly oxidized electrodes making the points prominent and accepted by the engineer.(rate is inclusive of al materials labour, tools and plants, electricity and all equipment)	3,000	point	3	9,000
2.1	Providing and making welded splice over two sides of contact by welding of minimum 300mm length at the lap of main reinforcement in re-bar cage to be placed in bore-hole where necessary by electric are welding with highly oxidized electrodes making the joint prominent and accepted by the Engineer.	50	Rm.	570	28,500
2.11	BOUNDARY WALL DISMENTLING & REPAIRING	1	job	0	0
2.13	**PILE HEAD BREAKING:** Labour for breaking head of hardened cast in situ bored pile/pre-cast pile up to a required length by any means but without damaging the rest and removing the dismantled materials such as concrete toa sfe distance including scraps and cleaning concrete from steel/M.S. rods, straightening and bending of pile bars, preparation and making platform where necessary, carrying, all shorts of handling, stacking the same properly after cleaning, leveling and dressing the situ and clearing the bed etc. complete in all respects and accepted by the Engineer. (Measurement will be given for the actual pile head volume to be broken)	9	cum	4673	42,057

3	**Reinforced cement concrete works using steel shutter with minimum cement** content relates to mix ratio 1:1.5:3 having minimum f'cr = 30 Mpa, and satisfying a specified compressive strength f'c = 25 Mpa at 28 days on standard cylinders as per standard practice of Code ACI/BNBC/ASTM & Cement conforming to BDS EN-197-1- CEM1, 52.5N (52.5MPa) / ASTM-C 150 Type – I, best quality Sylhet sand or coarse sand of equivalent F.M. 2.2 and 20 mm down well graded stone chips conforming to ASTM C-33, making, placing shutter in position and maintaining true to plumb, making shutter water-tight properly, placing reinforcement in position; mixing with standard mixer machine with hopper, fed by standard measuring boxes, casting in forms, compacting by vibrator machine and curing at least for 28 days, removing centering-shuttering after specified time approved; including cost of water, electricity, additional testing charges of materials and cylinders required by engineer, other charges etc. all complete approved and accepted by the Engineer. (Rate is excluding the cost of reinforcement and its fabrication, placing and binding etc.) .				
3.1	**In foundation**				-
	RE-BAR WORK	25055	Kg.	95	2380225
	(i)Concrete	160	cum	12154	1,944,640
	(ii)Formwork/shuttering, prop and necessary supports etc. (steel shutter)	115	sqm	380	43,700
4	**FAIR FACE RED CONCRETE** **Reinforced cement concrete works using steel shutter with minimum cement** content relates to mix ratio 1:1.5:3 having minimum f'cr = 30 Mpa, and satisfying a specified compressive strength f'c = 25 Mpa at 28 days on standard cylinders as per standard practice of Code ACI/BNBC/ASTM & Cement conforming to BDS EN-197-1- CEM1, 52.5N (52.5MPa) / ASTM-C 150 Type – I, best quality Sylhet sand or coarse sand of equivalent F.M. 2.2 and 20 mm down well graded stone chips conforming to ASTM C-33, making, placing shutter in position and maintaining true to plumb, making shutter water-tight properly, placing reinforcement in position; mixing with standard mixer machine with hopper, fed by standard measuring boxes, casting in forms, compacting by vibrator machine and curing at least for 28 days, removing centering-shuttering after specified time approved; including cost of water, electricity, additional testing charges of materials and cylinders required by engineer, other charges etc. all complete approved and accepted by the Engineer. Colour of the concrete and mix ratio as per sample. Imported pigment preferabily from European Origin (white cement gray cement, red pigment, black pigment etc.) (Rate is excluding the cost of reinforcement and its fabrication, placing and binding etc)	154	cum	15486	2384844
4.1	(i)Concrete	70	cum	15185	1062950
	(ii)Formwork/shuttering, prop and necessary supports etc. (steel shutter)	278	sqm	532	94696
	(iii) Scaffolding Work	300	sqm	9	2700

5	**RE-BAR WORK** Supplying, fabrication and fixing to details as per design: deformed bar reinforcement in concrete in accordance with BDS ISO 6935-2 : 2009 under Ductility Class D only, including straightening and cleaning rust, if any, bending and binding in position including supply of G.I. wires splices(laps) etc. complete in all respects and accepted by the Engineer.(Measurement shall be recorded only on standard Mass per Unit length of bars while dia of bars exceeds its standard)				
5.1	**HIGH YIELD DEFORMED BAR GRADE 60** Supplying of re-bar including cost of straightening, cleaning rust, fabrication as per design drawing bending, carrying to work site, placing and binding in position including supply of Gl. wires etc. complete in all respects as per instruction of Engineer-in-charge.	8520	Kg.	95	809400
6	**MASONRY WORK**				
6.1	**SINGLE LAYER BRICK FLAT SOLING** Single layer brick flat soling In foundation /loor with 1st class bricks, including preparation of bed and filling the interstices with local sand, leveling etc. complete as per instruction of Engineer-in-charge.	200	sqm	420	84000
6.2	**125 mm ORDINARY BRICK WORK:** Providing 250 mm brick work with 9.5" x 4.5" x 2.75" first class bricks of approved quality in cement sand (F.M. 1.2) mortar (1:4), including racking out joints, cutting the bricks to required size wherever necessary including high class recessed pointing, cleaning and soaking the bricks at least for 24 hours before use and washing and screening of sand, necessary scaffolding, curing at least for 7 days including cost of water, electricity and other charges etc. all complete and accepted by the Engineer. (Cement: CEM-II/A-M)				
	1st floor	165	cum	948	156420
	Total per floor cost				2210166
	Total cost G+4				**1,10,50,830**
	Foundation and other cost				**1,01,19,849**
	GRAND TOTAL =				**2,11,70,679**

4.4 PROJECT SCHEDULE



ID	Task Name and Description	START	END	DAYS
1	Start	1-Jan-23	1-Jan-23	0
2	Mobilization at site	2-Jan-23	12-Jan-23	10
3	Surveying and Land layout	13-Jan-23	20-Jan-23	7
4	Excavation	21-Jan-23	31-Jan-23	10
5	Piling work	1-Feb-23	1-Mar-23	28
6	Casting of Pile Cap	2-Mar-23	12-Mar-23	10
7	Casting of Short Column	13-Mar-23	18-Mar-23	5
8	Earth Filling	19-Mar-23	26-Mar-23	7
9	CC floor with PCC	27-Mar-23	3-Apr-23	7
10	Casting of GB	4-Apr-23	14-Apr-23	10
	Schedule up to Foundation Work	15-Apr-23	15-Apr-23	
11	Column casting: GF to 1st Floor	16-Apr-23	23-Apr-23	7
12	Shuttering for 1st floor slab	24-Apr-23	8-May-23	14
13	Casting of 1st Floor Slab	9-May-23	29-May-23	20
14	Brickwork	30-May-23	13-Jun-23	14
15	Plaster	14-Jun-23	24-Jun-23	10
	Schedule up to 1st Floor	25-Jun-23	25-Jun-23	
16	Column casting: 1st to 2nd Floor	26-Jun-23	3-Jul-23	7
17	Shuttering for 2nd floor slab	4-Jul-23	18-Jul-23	14
18	Casting of 2nd Floor Slab	19-Jul-23	8-Aug-23	20
19	Brickwork	9-Aug-23	23-Aug-23	14
20	Plaster	24-Aug-23	3-Sep-23	10
	Schedule up to 2nd Floor	4-Sep-23	4-Sep-23	
21	Column casting: 2nd to 3rd Floor	5-Sep-23	12-Sep-23	7
22	Shuttering for 3rd floor slab	13-Sep-23	27-Sep-23	14
23	Casting of 1st Floor Slab	28-Sep-23	18-Oct-23	20
24	Brickwork	19-Oct-23	2-Nov-23	14
25	Plaster	3-Nov-23	13-Nov-23	10
	Schedule up to 3rd Floor	14-Nov-23	14-Nov-23	
26	Column casting: 3rd to 4rd Floor	15-Nov-23	22-Nov-23	7
27	Shuttering for 4rd floor slab	23-Nov-23	7-Dec-23	14
28	Casting of 1st Floor Slab	8-Dec-23	28-Dec-23	20
29	Brickwork	29-Dec-23	12-Jan-24	14
30	Plaster	13-Jan-24	23-Jan-24	10
	Schedule up to 4rd Floor	24-Jan-24	24-Jan-24	
31	Column casting: 3rd to 4rd Floor	25-Jan-24	1-Feb-24	7
32	Shuttering for 4rd floor slab	2-Feb-24	16-Feb-24	14
33	Casting of 1st Floor Slab	17-Feb-24	8-Mar-24	20
34	Brickwork	9-Mar-24	23-Mar-24	14
35	Plaster	24-Mar-24	3-Apr-24	10
	Schedule up to 5th Floor	4-Apr-24	4-Apr-24	
36	Brickwork at roof top	5-Apr-24	15-Apr-24	10
37	Plaster external	16-Apr-24	6-May-24	20
38	Finishing	7-May-24	4-Oct-24	150
39	Hanging over	5-Oct-24	6-Oct-24	1

CHAPTER-5

CONCLUSIONS

5.1 OVERVIEW

Our project will start on January 2023 and end on October 2024. We reviewed our architectural drawing and analysis our Dhaka Imarat Nirman Bidhimala 2008. We satisfied on our reviewed and analysis results. For design our super structure and sub structure, we follow BNBC 2020. We calculated all the cost and prepared a BOQ Bill and project schedule according to PWD Schedule of Rates 2018.

5.2 CONCLUSIONS

Chapter-1: In this chapter, we discussed the background of the project, site visiting information, environmental and social impacts of the project etc. Our client wants to build a G+4 storey mosque on 5 kata (3600 sq ft) of land. According to the soil report, our soil type is silt-clay. We also reviewed architectural drawings and analyzed Dhaka Imarat Nirman Bidhimala, MGC, FAR rules etc. Our project satisfied the FAR and MCG rules.

Chapter–2: In this chapter, we discuss codes and standards, material properties, loading and design method. We follow BNBC 2020, Dhaka Imarat Nirman Bidhimala and ACI 318 code. We consider the concrete strength of 4000 psi for both the superstructure and substructure. Our use of a 1:1.5:3 concrete ratio.

Chapter-3: In this part, we design and analyze our structure by using etabs and AutoCAD software. We briefly discuss and analyze each structural component, such as the beam column slab foundation.We provide beam column slab foundation detailing in this chapter.

Chapter- 4: Here, we calculate Bill of Quantity (BOQ) for our project.

REFERENCES:

1) ACI Committee 318. 2014. ACI 318-14/ACI 318R-14, building code requirements for structural concrete and commentary. Farmington Hills, MI: American Concrete Institute; 2014.
2) ASCE/SEI 7-10. 2010. Minimum design loads for buildings and other structures. Reston, VA: American Society of Civil Engineers; 2010.
3) Bangladesh National Building Code (BNBC)-1993. Housing and Building Research Institute, Bangladesh Standards and Testing Institution; 2020.
4) PWD Schedule of Rates 2018 for Civil Works. Public Works Department, fifteenth edition, 01 May 2018.