Foundation Cost Variation For Nine Story Residential Building In Selected Zone Of Narsingdi District

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Section: 15C
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DECLARATION

It is hereby declared that this thesis/project or any part of it has not been submitted elsewhere for the award of any degree.

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Dedicated

to

"**The Father Of The Nation Bangabondhu Sheikh Mujibur Rahman**"

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ABSTRACT

The bearing farthest reaches of the soil is an important subject in the Design of Geotechnical Engineering, especially in the establishment of planning, as the intensity of any establishment is dependent on it. A structure with an incredibly delicate structure can collapse while remaining on weak and vulnerable soil with a low bearing limit. Numerous researchers have given their individual calculations based on individual diverse parameters and Impediments on various occasions in this paper are estimated has been done by based on different zone of soil condition.

It is required to know the probable cost of a construction known as estimation and costing for all engineering works. If it is seen that the estimated cost is greater than the money available, then attempts are made to reduce the cost by reducing the work or by changing the Specification. In this paper, estimation and costing was done for nine story of residential building in Narsingdi district using BNBC 2020. The rates in the estimation provided for the complete work consists of the cost of materials, cost of transport, cost of labor, cost of Scaffolding, cost of tools and paints, cost of establishment and supervision and reasonable profit of contractor etc. In Bangladesh, the general practice of estimating and costing is done by manually and due to improper way of the process, several mistakes remain in costing, therefore, the proper forecasting cannot be done.

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CHAPTER 1
INTRODUCTION

1.1Background and Motivations

Cost is one of the three main challenges for the construction manager, where the success of a project is judged by meeting the criteria of cost with budget, schedule on time, and quality as specified by the owner. In which, poor strategy or incorrect budget or schedule forecasting can easily turn an expected profit into loss. Therefore, effective estimating is one of the main factors of a construction project success. Accordingly, cost estimate in early stage plays a significant role in any construction project, where it allows owners and planners to evaluate project feasibility and control costs effectively. In addition, the cost of a building is significantly affected by decisions made at the early phase. While this influence decreases through all phases of building project. Due to this prominence of cost estimate in early stage and limited availability of information during the early phase of a project, construction managers typically leverage their knowledge, experience and standard estimators to estimate project costs. As such, intuition plays a significant role in decision-making. Inasmuch the essential needs of project owners and planners to a tool to help them in their early decisions; researchers have worked hard to develop cost estimate technique that maximize the practical value of limited information in order to improve the accuracy. One of the key factors in construction industry is estimating and costing. Accurate estimation is very important as the success and quality of a construction or project depend on it. And cost analysis of a construction is generally developed at all of the stages of the investment process. The loss and profit of a construction or project is strictly dependent on proper estimating and costing. Slight variation of the construction cost can hamper the overall success of a real estate enterprise and it can also hamper the financial stability of the developer. In this paper, a complete guideline for estimating of projects is provided with respect to architectural, structural, electrical and plumbing design. The item wise estimation and costing based on different zone of soil condition of nine story residential building of foundation in Narsingdi district is performed in the spread sheet analysis and the discussion of result and recommendations are provided.

The study has been accomplished based on: Engineering

1. General surveys

2. Design and drawing collection

3. Spread sheet analysis based on soil property or SPT

1.2 Research Objectives and Overview

The aim of this research is to study the foundation cost variation for nine story residential building in selected zone of Narsindi district.

The specific Objectives of this research study are :

1. Compare the foundation cost of nine story residential building depending on soil condition in selected zone of Narsingdi district.

2. Estimate change of foundation cost due to swimming pool at the rooftop

1.3 Outcomes/Benefits of the Study

The benefits which could be derived from the research are as follows:

1. The foundation when developed is going to facilitate the method of predicting pre-design construction cost for anybody who have no or little knowledge about the foundation process. Probably it is going to establish the first ever initial cost predicting foundation for construction cost in Bangladesh by an econometric approach, basing on which other researchers can develop other cost predicting foundation.
2. The research is going to unveil some of the factors that affect foundation cost, and hence will draw estimator's attention to inculcate the effects of those factors in their initial estimates to nullify or reduce the end effects.
3. The research findings also serves as the researcher's contribution to existing knowledge, and should form the basis for other related further research works.
4. The expected outcome of the present study would be beneficial to estimate the probable cost of foundation per square meter during inception phase by the stakeholders (constructors, developers, land owner, government agencies, researcher etc.).
5. To identify the design variables (numeric and non numeric) those have the largest effect or have no or little effect on total cost.

1.4 Activity

The research is planned the foundation cost variation for nine story residential building in selected zone of Narsingdi district almost 3 building projects data with more than 6 variables were collected. However after scrutiny, only 3 variables have finally been considered for the study. The data were sorted in spread sheet and finally 3 data sets have been selected for the research. Multiple regression analysis has been adopted as it is most suitable for analyzing these types of data set. The statistical software ETABS, SAFE 2016, Auto CAD 2007, and MS Excel 2007 were used as the tools for this research. In the proposed study primary cross-sectional data were collected from different developers who construct residential building at Narsingdi. Initially a pilot project was carried out to identify the issue and finally a full survey was conducted. At first all probable cost elements were identified by the pilot project and from that, final survey questionnaires were prepared. There are both qualitative and quantitative variables. Few of the potential variables are price of construction materials, total plinth area, foundations types.

1.5 Scope of the study

The specific objectives of the study are:

- To prepare estimation pile of nine storied residential building.
- To compare the foundation cost with PWD rates.
- To compare the foundation cost according to decorative structure load.
- To analyze the costing of the study with recent rates.

All of the objective well based on different zone of soil property's

1.6 Origination of the thesis

The thesis was presented in five (5) chapters as follows:

Chapter one: Gives the introduction which also includes background of the research,

outlines the aims and objectives. It also states the benefits, scope and method of the

research briefly.

Chapter two: Gives on overview of literature related with this work.

Chapter three: Methodology. This chapter describes the methodology adopted to carry out the research.

Chapter four: Gives the general overview of the principle of regression analysis. This chapters also shows the research data analysis process, discussion and finding.

Chapter five: Contains the conclusions drawn from the research, the researcher's contribution to knowledge and recommendations for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Pile foundation, a kind of deep foundation, is actually a slender column or long cylinder made of materials such as concrete or steel which are used to support the structure and transfer the load at desired depth either by end bearing or skin friction. (1) Pile foundations are deep foundations. They are formed by long, slender, columnar elements typically made from steel or reinforced concrete, or sometimes timber. A foundation is described as 'piled' when its depth is more than three times its breadth. (2)

2.2 Use of Pile Foundation

Following are the situations when using a pile foundation system can be

1. Groundwater table is high.

2. Heavy and un-uniform loads from superstructure are imposed.

3. Other types of foundations are costlier or not feasible.

4. The soil at shallow depth is compressible.

5. Scouring possibility due to its location near the river bed or seashore etc.

6. Canal or deep drainage systems near the structure.

7. Soil excavation is not possible up to the desired depth due to poor soil condition.

It becomes impossible to keep the foundation trenches dry by pumping or by any other measure due to heavy inflow of seepage.

2.3 Types of Pile Foundation

Pile foundations can be classified based on function, materials and installation process, etc. Followings are the types of pile foundation used in construction:

1. Sheet Piles

2. Load Bearing Piles

3. End bearing Piles

4. Friction piles

5. Soil compactor piles

6. Based on materials and construction method

7. Timber piles

8. Concrete piles

9. Steel piles (3)

2.4 Foundation

A foundation is the lowest and supporting layer of a structure. (1).Foundations are generally divided into two categories shallow foundations and deep foundations.

2.5 Types of foundation

There are two types of foundation

1. Shallow foundation

2. Deep foundations

2.6 Shallow foundations (sometimes called 'spread footings') include pads ('isolated footings'), strip footings and rafts

2.7 Deep foundations include piles, pile walls, diaphragm walls and caissons shallow foundations

a) Pad foundations

b) Strip foundations

c) Raft foundations.

2.8 Pad foundations

Pad foundations are used to support an individual point load such as that due to a structural column They may be circular, square or rectangular They usually consist of a block or slab of uniform thickness, but they may be stepped or hunched if they are required to spread the load from a heavy column. Pad foundations are usually shallow, but deep pad foundations can also be used.

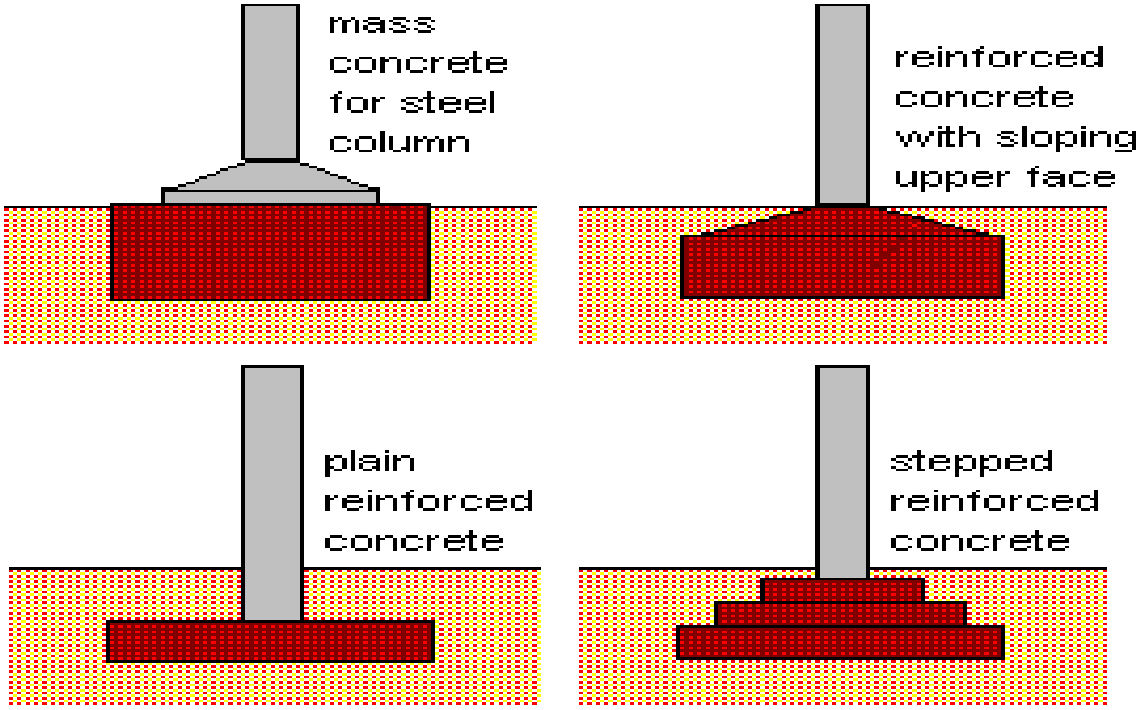

Figure 2.1: Pad Foundation (4)

2.9 Strip foundations

Strip foundations are used to support a line of loads, either due to a load-bearing wall, or if a line of columns need supporting where column positions are so close that individual pad foundations would be inappropriate.

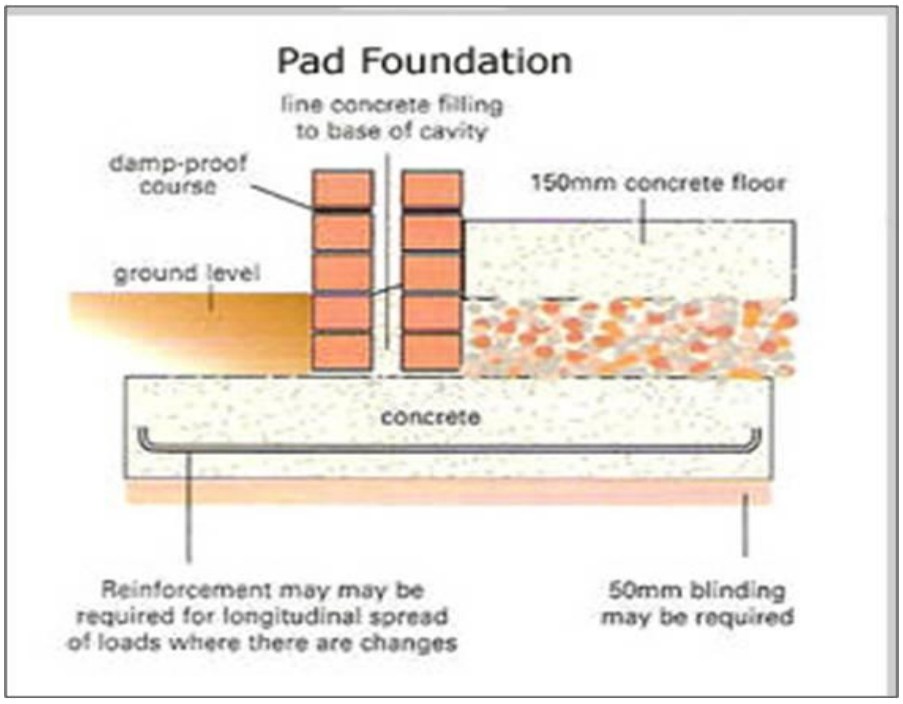

Figure 2.2: Strip Foundation (5)

2.1.0 Raft foundations

Raft foundations are used to spread the load from a structure over a large area, normally the entire area of the structure. They are used when column loads or other structural loads are close together and individual pad foundations would interact.

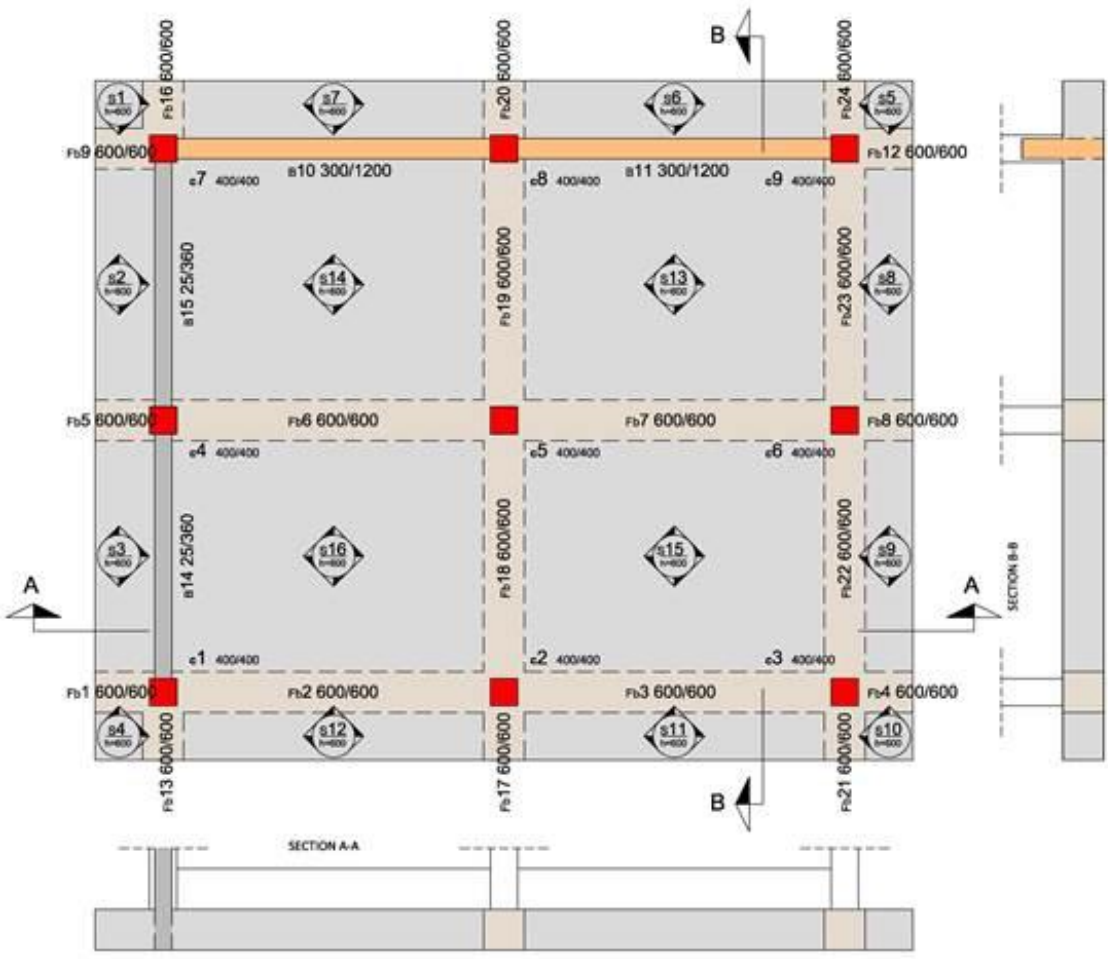

Figure 2.3: Raft Foundation (6)

2.1.1Deep foundations

Deep foundations are those founding too deeply below the finished ground surface for their base bearing capacity to be affected by surface conditions, this is usually at depths >3 m below finished ground level. They include piles, piers and caissons or compensated foundations using deep basements and also deep pad or strip foundations. Deep foundations can be used to transfer the loading to a deeper, more competent stratum at depth if unsuitable soils are present near the surface.

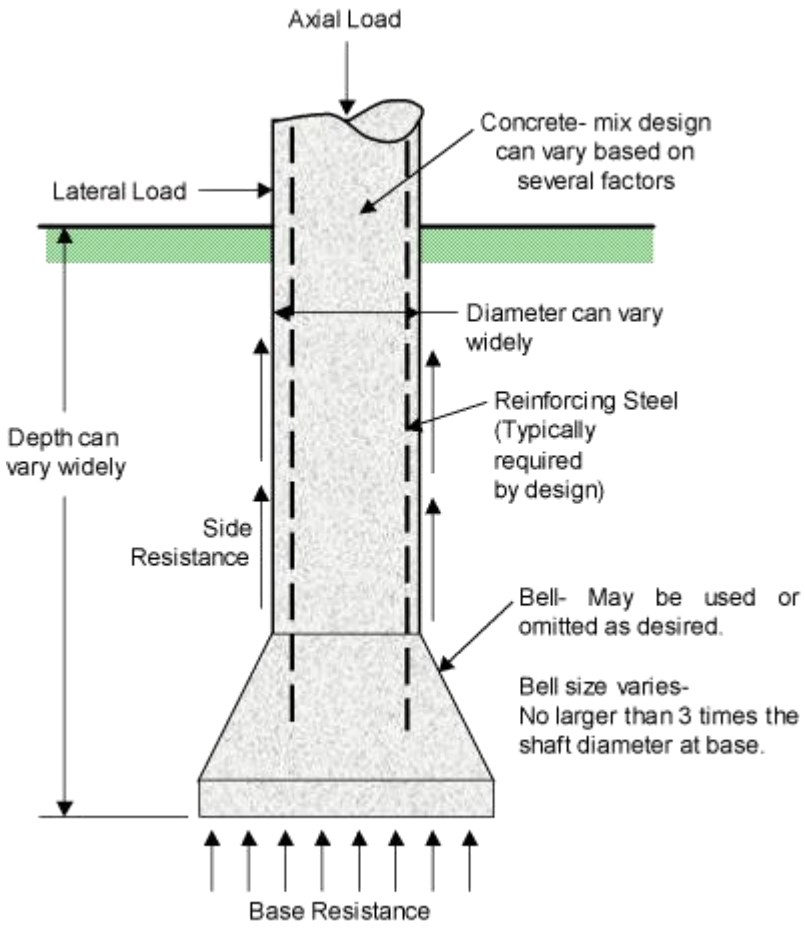

Figure 2.4: Deep foundation (7)

2.1.2 Structure

Structural Engineering is concerned with the research, planning, design, construction, inspection, monitoring, maintenance, rehabilitation and demolition of permanent and temporary structures, as well as structural systems and their components. It also considers the technical, economic, environmental, aesthetic and social aspects of structures. Structures can include buildings, bridges, in-ground structures, footings, frameworks and space frames, including those for motor vehicles, space vehicles, ships, aero planes and cranes. They can be composed of any structural material including composites and novel materials. Structural engineering is a creative

profession that makes a significant contribution to infrastructure, industry, as well as residential and recreational developments. Structural engineers carry out strength calculations and prepare drawings of structures to ensure they are strong enough to avoid collapse when loaded. The most common structures dealt with are buildings and bridges, but tunnels, walls to hold back earth embankments, oil drilling platforms and associated infrastructure, shipbuilding and aircraft design Structural engineers generally work in teams and look at the way a structure is to be built. They ensure buildings are strong enough to withstand natural forces and loads imposed by the nature of its use. Through research and the testing of both form and material, new solutions are developed which promote safer, more environmentally friendly buildings and structures.

2.1.3 Types of Structure

There are two types of structures

1 Super structure and

2 Sub Structure

2.1.4 Super Structure

A superstructure is an upward extension of an existing structure above a baseline. This term is. applied to various kinds of physical structures such as buildings, bridges, or ships having the degree of freedom zero.

There are many characteristics involved in super structures:

1. A physical or conceptual structure extended or developed from a basic form.
2. The part of a building or other structure above the foundation
3. The parts of a ship's structure above the main deck
4. The rails, sleepers, and other parts of a railway.
5. In matrix theory, the ideologies or institutions of a society as distinct from the basic processes and direct social relations of material production and economics.

2.1.5 Sub-structure

A substructure is a word that can be used in various disciplines but in almost all the usages it means the basic or supporting component of a whole for example in building and construction, it

means the supporting structure popularly known as the framework. In algebra, a substructure is a component that lies within another one that contributes to the overall structure or domain.

There are many characteristics involved in sub structures:

1. The supporting part of a structure, the foundation.

2. The earth bank or bed supporting railroad tracks

3. A structure, pattern, etc. that forms the basis of anything

4. A structure forming a foundation or framework for a building or other construction sub structure.

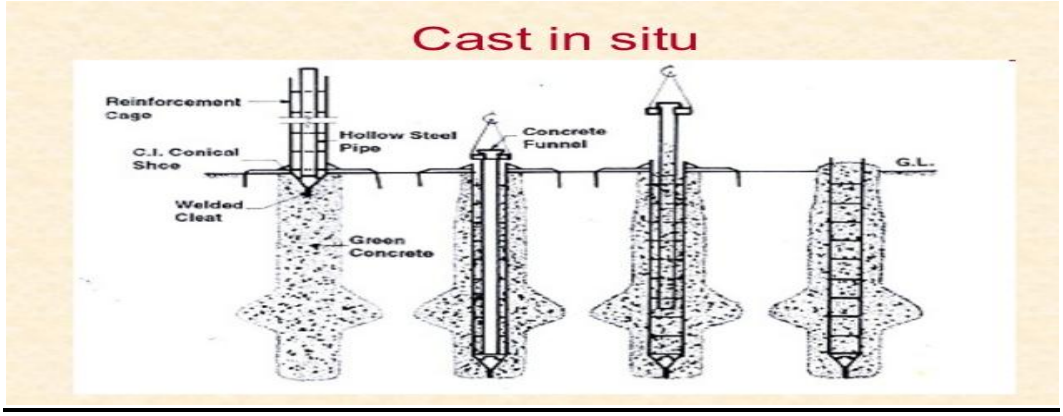

Figure 2.5: Cast in Situ pile (8)

2.1.6 Other factors

Here are the factors that affect foundations, plus pricing and build considerations.

2.1.7 Climate Required

Some house foundation types aren't suitable for specific climates. For example, environments that experience extreme temperatures aren't ideal for slab foundations. As the water freezes and thaws, the concrete can crack from the pressure. In contrast, warmer climates may not benefit from wood foundations since termites can pose a threat. (9)

Climate is a crucial influence over your build plans, so don't get too attached to a particular foundation type until you see what will work where you live.

2.1.8 Lot Grade and Soil Type

You might be fortunate enough to live in an area with a mild climate, but that doesn't mean you can choose any foundation. The grade of your lot and where you decide to put your home can affect the compatibility of certain house foundation types.

The soil can also affect the foundation construction. If there is rock below your build site, for example, you might need a structural engineer to examine the lot and figure out a plan for building over it. In other cases, unstable soil could mean you need to select a different build site.

Lot grading can also impact your ability to have a specific foundation build. You might want a daylight basement, but if the lot isn't graded just so or if you don't have modifications in your budget you might only be able to choose a traditional basement.

2.1.9 Utilities and Accessibility

With some types of house foundations, it's easy to get in and fix things when they break. For example, you might need to enter a crawlspace to service your home's plumbing. But in a poured concrete foundation, for example, the pipes might lie under inches of concrete.

How accessible your home's internal structures depend on the type of foundation and the layout of the features underneath or inside it.

2.2.0 Other Pricing Considerations

A foundation also depends on materials costs, extra features, and transportation cost.

For example, installing radiant heating in the floor, which can save on heating and burst pipe costs, adds a significant bump to the bottom line. If you need additional waterproofing or sealant due to climate or site drainage issues, those can also add up.

2.2.1 Site Considerations

Depending on your home building site and layout, one type of foundation may work better than another. Here are the natural factors that impact your site.

2.2.2 Water Tables

A groundwater table is a boundary between unsaturated and saturated soil. Water tables rise and fall with the seasons, and depending on your lot, they may impact drainage at the building site. Water can even seep out of the ground and affect your foundation.

2.2.3 Soil Conditions

Soil conditions such as the type of soil, different layers, and hardness also influence the type of foundation that's suitable for your building. More stable ground, for example, means you don't need as robust a foundation as if the soil is soft.

A drilled pier foundation, for example, is ideal for ensuring your home rests on the hard rock rather than in soft surface dirt. The type of backfill you use also influences the stability of your foundation. Most people choose store-bought filler material such as limestone or aggregate to backfill the foundation.

2.2.4 Local Climate

Your local climate can also influence what type of foundation is best. Frost, for example, is a significant factor. If you live in an area where the ground frequently freezes and melts, you could see cracks in your home's monolith slab foundation. In that case, a post and pier foundation might be a better solution.

Or, if you live somewhere with a high risk of tropical storms, a foundation that can withstand flooding is preferable. Again, a post and pier option may work better than a full basement or slab. Then again, in more moderate climates, a monolith slab is often sufficient and a budget-friendly choice.

2.2.5 Foundation Purpose

The purpose of a mono slab is very different than that of a daylight basement. Knowing what purpose you want your foundation to serve is vital since it affects how you'll use your home

2.2.6 Stability

Most homeowners want stability in their foundations. But for people who live in floodplains, a stable foundation is the top priority when building. Elevated slab foundations are one innovative solution to flood issues.

An elevated slab foundation, like Tella Firma's, combines a slab foundation with a pier and beam system. The elevated foundation takes a little longer to build and is more expensive than standard foundations but it can save you money if water damage is a concern.

The suspended foundation is ideal for clay soils, which expand and contract throughout the seasons, and wetter conditions. (10)

CHAPTER 3

METHODOLOGY

3.1 Introduction

At first we have selected land area (4000 sft which in appendix B) and collected soil report (appendix C) from selected zone of Narsingdi district (Madhabdi,Narsingdi,Narsingdi).Then we done the work by the ETABS and AUTO CAD. Then we apply the load for normal and decorative structure according to BNBC 2020 by using ETABS 2016. The structure have been failed causes of assuming section (Appendix B) then we changes our section according to our failure structure data and finally we got stable structure after doing the analysis from the information of ETABS we did foundation design and then we made load comparisons and we try to find out variation in foundation, and also find out cost variation between other structure according to PWD rate.

3.2 Map

A site vicinity Google Map closer image:

Location:Gangpar ,Madhabdi, Narsingdi

Location:Satirpara, Narsingdi

Location: Velanagar,Narsingdi

3.3 Methodology Overview

1. Data Collection

At first we have collected soil report (appendix C) from selected zone of Narsingdi district and basis on this report we try to stable a structure.

2. Information about the availability and cost of the required construction material.

All of the materials are available and cost of the materials has nearly limited range to develop this project.

3. Cost variation study

Cost variation of this study is very negligible.

3.4 Model Summery (Normal structure)

The model is done by using ETABS according to BNBC 2020, after applied load we get vertical load on pile then SPT of the site from the soil test have been collected and number of piles has been chosen from load consideration.

3.5 Model Summery (Decorative structure**)**

The model is done by using ETABS according to BNBC 2020, after applied extra load for decorative structure (swimming pool) we get vertical load on pile then SPT of the site from the soil test have been collected and number of piles has been chosen from load consideration.

3.6 Specification of materials

The full specifications of the materials for the construction of the building are given

Below:

3.6.1 Cement

Cement is Ordinary Portland cement conforming to the requirements of the Standard Specifications for Portland cement Type-I. ASTM C-150 r BDS 232: 1993. BNBC 2.4, 5.2.1unless otherwise specified. Cement was delivered in bags by the manufacturer with the brand name, type of cement and weight of each bag marked on the bag. Sample test of cement was done from the laboratory designated by the Engineer for every consignment of cement. Bulk cement which partially set or which contains lumps of caked cement was rejected. The use of cement reclaimed from discarded or used bags was not permitted.

3.6.2 Water

The water used in mixing and curing concrete was tested by methods described in AASHTO test Method T-26. Water was clean and free from salt, oil, acid, vegetable or other substance injurious to the finished product. Water used in construction work was portable.

3.6.3 Fine Aggregate: Sand

Fine aggregate was conformed to BDS 243:1963, ASTM C40-92.C87-83 (1990). Fine aggregate was natural sand, composed of clean, hard, durable uncoated particles resulting from the disintegration of siliceous. Fine Aggregate was free of injurious amounts of organic impurities.

Deleterious substances were not exceeding the following percentages by weight:

1. Clay lumps and friable particles: 3%

2. Coal and Lignite: 0.25%

3. Material passing the 0.075 mm (No 200) sieve: 2%

4. Shale, coal, soft or flaky fragments: 11%

5. Sulfur compounds: 0.3%

6. Organic material content: 5%

3.6.4 Coarse Aggregate: Stone Chips

For all types of concrete with the exception of blinding concrete was consists of hard durable crushed stone boulder and conform to BDS 243:1963 (Coarse and fine aggregate for natural sources for concrete 1: ASTM C 33: concrete aggregates). Coarse aggregate was clean, free from dust and other deleterious materials.

The amount of deleterious substances was not exceeding the following limits:

1. Soft fragments; by 2% by mass

2. Clay lumps; 0.25% by mass

3. Material passing the 0.075 mm sieve: 0.5% by mass if clay. 1.5% by mass if fracture

dust.

3.6.5 Coarse Aggregate: Brick chips

It was made from brick and conformed to the following requirements:

1. It was made of first class and picked Jhama bricks.

2. Nominal size: same as stone aggregate.

3. Appearance was completely non-plastic and free from all organic and other deleterious materials.

4. Unit weight was less than 1100 kg/cum.

5. Water absorption as a percentage of the dry weight did not exceed 14%.

6. Percent wear did not exceed 40% tested by Los Angeles Abrasion Test. (11)

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The analysis are showing the cost variation of foundation depend on soil condition for nine story residential building select zone in Narsingdi district. From this analysis we are getting an idea about the cost estimating are a little bit of variation.

(a) Conventinonl residential structures

Gangpar,Madhabdi,Narsingdi

Pile Depth = $85^{/}$ Allowable Load=164 kip Pile dia = $20^{//}$

Table 4.1 : Pile selection for $85^{/}$ depth

Pile cap no	Vertical load on pile	Nos of pile
PC-1	250	2
PC-1	252	2
PC-1	310	2
PC-1	312	2
PC-1 (combine)	600	4
PC-3	902	6
PC-3	900	6
PC-3	962	6
PC-3	968	6
PC-4	1164	8
PC-2	360	3
PC-2	363	3
PC-2	392	3
PC-2	397	3

Satirpara,Narsingdi

Pile Depth = 80/ Allowable Load=104 kip Pile dia = 20//

Table 4.2 : Pile selection for 80/ depth

Pile no	**Vertical load on pile**	**Nos of pile**
2	103	1
6	188	2
8	255	3
4	98	1
20	172	2
14	266	3
22	156	2
12	270	3
24	372	4
10	134	2
28	101	1
18	253	3
16	194	2
26	92	1

Velanagar,Narsingdi

Pile Depth = 75′ Allowable Load=118 kip Pile dia = 20″

Table 4.3: Pile selection for 75′ depth

Pile no	**Vertical load on pile**	**Nos of pile**
PC-1	145	2
PC-1	149	2
PC-1	146	2
PC-1	142	2
PC-1	156	2
PC-1	158	2
PC-3	259	3
PC-3	265	3
PC-3	260	3
PC-3	266	3
PC-2	368	4
PC-2	370	4
PC-2	400	4
PC-2	402	4
PC-2	408	4
PC-5	1160	10

(b) **Structural loading with Swimming pool at roof top**

Gangpar,Madhabdi,Narsingdi

Pile Depth = 85/ Allowable Load=164 kip Pile dia = 20//

Table 4.4: Pile selection for 85/ depth

Pile no	**Vertical load on pile**	**Nos of pile**
PC-1	270	2
PC-1	255	2
PC-1	320	2
PC-1	321	2
PC-1 (combine)	605	4
PC-3	905	6
PC-3	912	6
PC-3	964	6
PC-3	968	6
PC-4	1164	8
PC-2	360	3
PC-2	363	3
PC-2	392	3
PC-2	397	3

Satirpara,Narsingdi

Pile Depth = 80/ Allowable Lode=173 kip Pile dia = 20//

Table 4.5: Pile selection for 80/ depth

Pile no	**Vertical load on pile**	**Nos of pile**
2	110	1
6	190	2
8	270	3
4	110	1
20	178	2
14	270	3
22	160	2
12	270	3
24	372	4
10	134	2
28	101	1
18	253	3
16	194	2
26	92	1

Velanagar,Narsingdi

Pile Depth = 75/ Allowable Lode=118 kip Pile dia = 20//

Table 4.6: Pile selection for 75/ depth

Pile no	**Vertical load on pile**	**Nos of pile**
PC-1	145	2
PC-1	149	2
PC-1	146	2
PC-1	142	2
PC-1	156	2
PC-1	158	2
PC-3	268	3
PC-3	275	3
PC-3	270	3
PC-3	275	3
PC-2	368	4
PC-2	370	4
PC-2	400	4
PC-2	402	4
PC-2	408	4
PC-5	1160	10

4.4 The findings and results described below

[Cost variation of foundation depend on soil condition for nine story residential building selected zone of Narsingdi district**]**

1. Normal Structure

Total Cost for Madhabdi Foundation Work = 5319037tk

Per Unit cost for Madhabdi Foundation Work = 1329.76tk

Total Cost for Satirpara Foundation Work = 2851928tk

Per unit cost for Satirpaara Foundation Work = 648.47 tk

Total Cost for Velanagar Foundation Work = 4155035tk

Per unit Cost for Velanagar Foundation Work = 1038.76tk

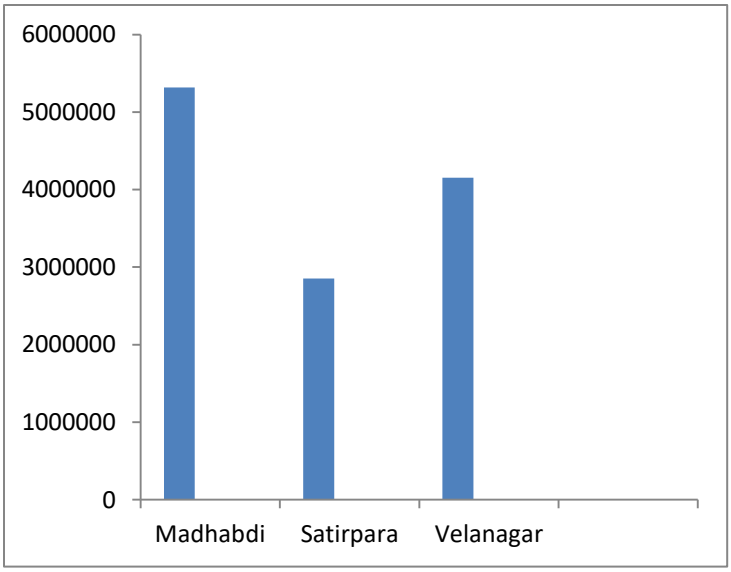

Figure 4.1: Variation cost for Normal Structure

2. Decorative Structure

Total Cost for Madhabdi Foundation Work = 5394207tk

Per Square Cost for Madhabdi Foundation Work = 1347.51tk

Total Cost for Satirpara Foundation Work = 2744224tk

Per Square for Satirpara Foundation Work = 685.53tk

Total Cost for Velanagar Foundation Work = 4267790tk

Per unit Cost for Velanagar Foundation Work = 1066.12 tk

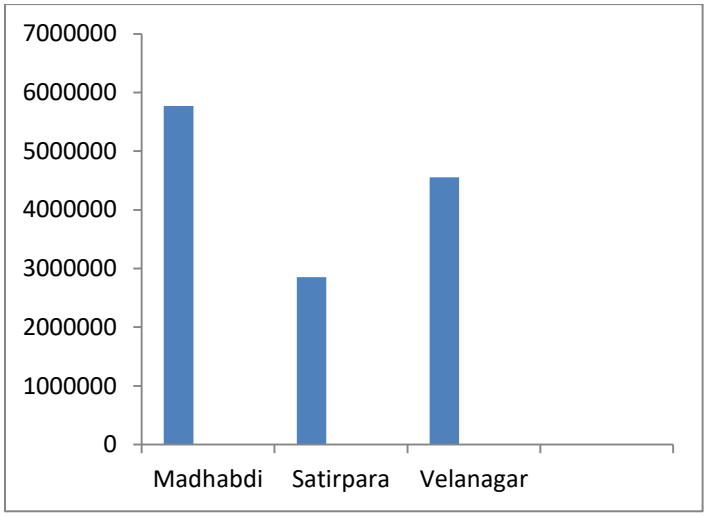

Figure 4.2 : Variation cost for decorative structure

4.5 Variation

Variation of cost in our nine story building foundation with PWD Rate in nine story building foundation which is given appendix.

1. Cost variation for Normal Structure

Table 4.5: Cost variation

Zone	Our Research (tk)	PWD rate	Variation
Madhabdi	5319037	5171036	148001
Satirpara	2851928	5171036	-2319108
Velanagar	4155035	5171036	-1016001

2. Cost Variation for Decorative Structure

Table 4.6: Cost variation

Zone	Our Research (tk)	PWD rate	Variation
Madhabdi	5770057	5171036	599021
Satirpara	3212744	5171036	-1958292
Velanagar	4553436	5171036	-617600

CHAPTER 5

CONCLUSIONS AND FUTURE WORKS

5.1 Conclusions

Estimation of a residential building foundation is very important. In this research we tried to present about the cost variation between decorative and normal structure nine storied building foundation. We tried to compare the cost of foundation in selected zone of Narsingdi District and with PWD rate and we have seen our foundation work as per rate very close to PWD rate. Depending on soil condition the cost variation of foundation in selected zone is negligible because our selected area is situated in same zone.

5.2 Recommendations

For future study in this field the following recommendations can be put forward:

1. More sites may be selected for future research for validation of present results
2. Rate based on PWD rate schedule 2018. Future analysis may be done based recent PWD rate and market rate also.

5.3 Limitation

We had faced some problems during this work

• People were reluctant to provide information

• Site visit is required to get better details.

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APPENDIX -A

Cost Analysis

Design Data

LL = 50 psf

FF= 25 psf

PW = 80 psf

SDL = 120 psf

f'c = 4000 psi

f'y= 72500 psi

Cost analysis for General Structure

Total volume of pile, $V = \frac{\pi}{4} x\ l\ x\ d^2$

Total volume of pile cap, v= b*d*l

Location: Gangpar,Madhabdi

Pile Depth 85$^{/}$ Allowable Load=164 kip Pile dia = 20$^{//}$

Table 5.1: The cost affective table for pile

Total number of pile (nos.)	Total volume of pile (m3)	Per unit cost of pile according to PWD (Tk)	Total amount(Tk)
56	289	13463	3890807

Table 5.2: The cost affective table for pile cap

Total number of pile cap(nos.)	Total volume of pile cap (m3)	Per unit cost of pile according to PWD (Tk)	Total amount(Tk)
14	190	7517	1428230

Location: Satirpara,Narsingdi

Pile Depth = 80/ Allowable Load=104 kip Pile dia = 20//

Table 5.3: The cost affective table for pile

Total number of pile (nos.)	**Total volume of pile (m3)**	**Per unit cost of pile according to PWD (Tk)**	**Total amount (Tk)**
30	156	13463	2100228

Table 5.4: The cost affective table for pile cap

Total number of pile Cap (nos.)	**Total volume of pileCap (m3)**	**Per unit cost of pile according to PWD (Tk)**	**Total amount(Tk)**
14	100	7517	751700

Location:Velanagar,Narsingdi

Pile Depth = 75/ Allowable Load=164 kip Pile dia = 20//

Table 5.5: The cost effective table for pile

Total number of pile (nos.)	**Total volume of pile (m3)**	**Per unit cost of pile according to PWD (Tk)**	**Total amount (Tk)**
54	250	13463	3365750

Table 5.6: The cost effective table for pile cap

Total number of pile Cap (nos.)	Total volume of pile Cap (m3)	Per unit cost of pile according to PWD (Tk)	Total amount (Tk)
16	105	7517	789285

Cost analysis for Decorative Structure

Location: Gangpar,Madhabdi,Narsingdi

Pile Depth = 85/ Allowable Load=164 kip Pile dia = 20//

Table 5.7: The cost effective table for pile

Total number of pile (nos.)	Total volume of pile (m3)	Per unit cost of pile according to PWD (Tk)	Total amount (Tk)
56	289	13463	3890807

Table 5.8: The cost effective table for pile cap

Total number of pileCap (nos.)	Total volume of pile Cap (m3)	Per unit cost of pile according to PWD (Tk)	Total amount(Tk)
14	250	7517	1879250

Location: Satirpara,Narsingdi

Pile Depth = 80/ Allowable Load=104 kip Pile dia = 20//

Table 5.9: The cost effective table for pile

Total number of pile (nos.)	**Total volume of pile (m3)**	**Per unit cost of pile according to PWD (Tk)**	**Total amount (Tk)**
30	156	13463	2100228

Table 5.1.0 : the cost effective table for pile cap

Total number of pile Cap (nos.)	**Total volume of pile Cap(m3)**	**Per unit cost of pile according to PWD (Tk)**	**Total amount (Tk)**
14	148	7517	1112516

Location: Velanagar,Narsingdi

Pile Depth = 75/ Allowable Load=164 kip Pile dia = 20//

Table 5.1.1: The cost effective table for pile

Total number of pile (nos.)	Total volume of pile (m3)	Per unit cost of pile according to PWD (Tk)	Total amount (Tk)
54	250	13463	3365750

Table 5.1.2: The cost effective table for pile cap

Total number of pile Cap (nos.)	**Total volume of pile cap (m3)**	**Per unit cost of pile according to PWD (Tk)**	**Total amount (Tk)**
16	158	7517	1187686

APPENDIX -B

RELATED DRAWING

(A) Failed structure

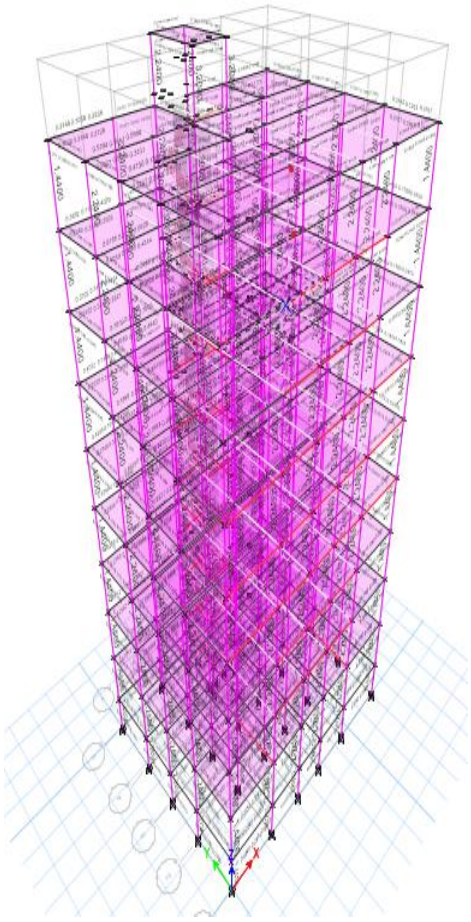


Figure 5.1: Typical 3D design

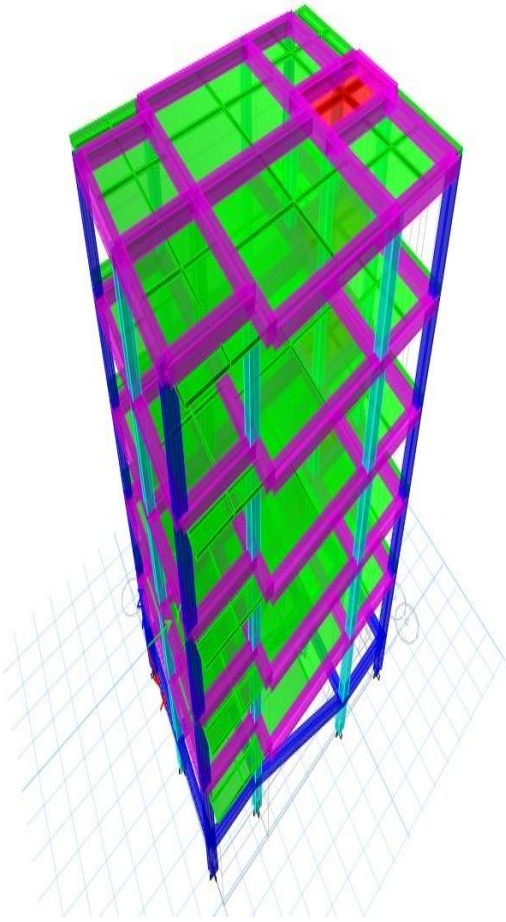


Figure 5.2: Typical 3D design

(B) Stable structure

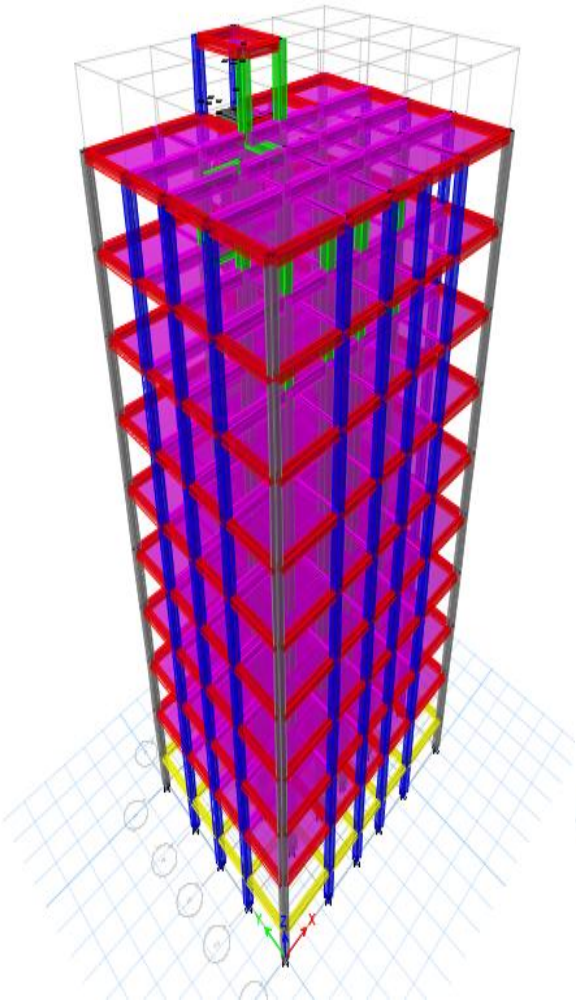


Figure 5.3: Typical 3D design

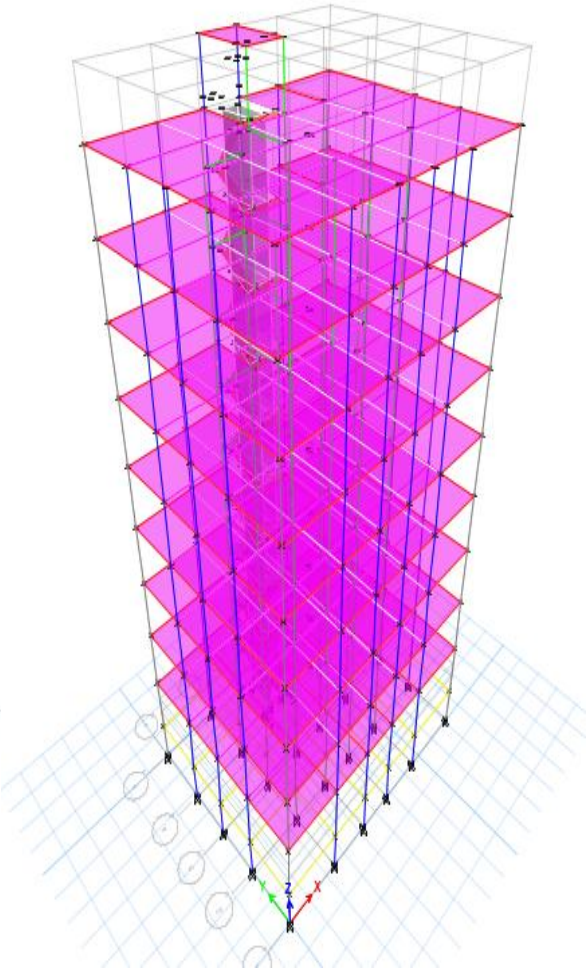


Figure 5.4: Typical 3D design

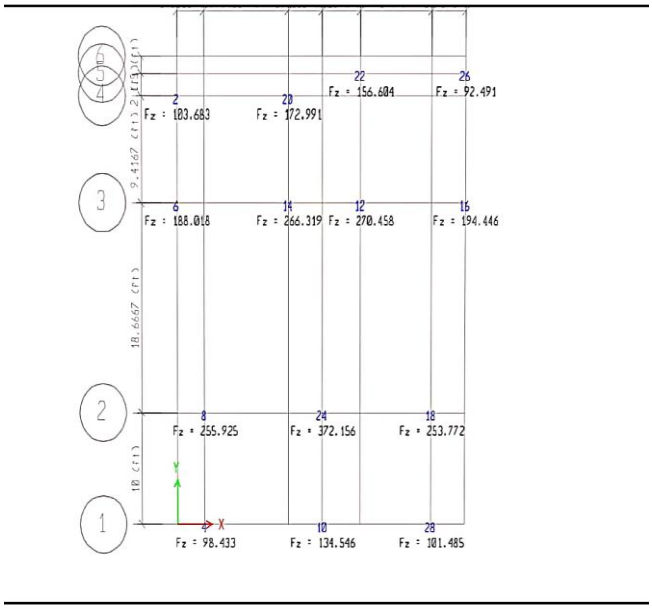


Figure 5.5: Pile design load of Satirpara site

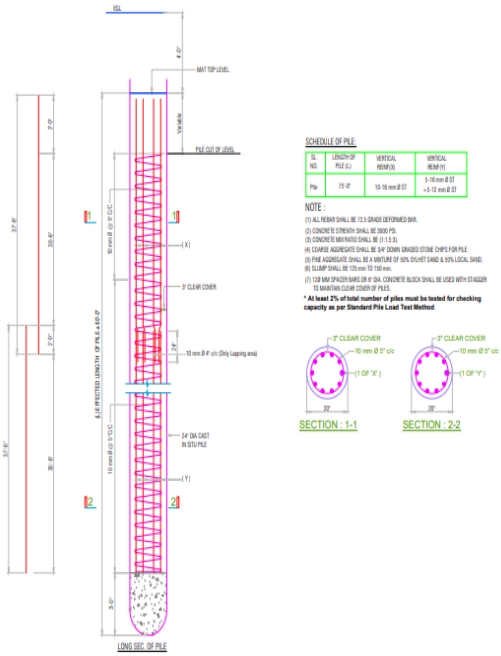


Figure 5.6: Pile section for 75′

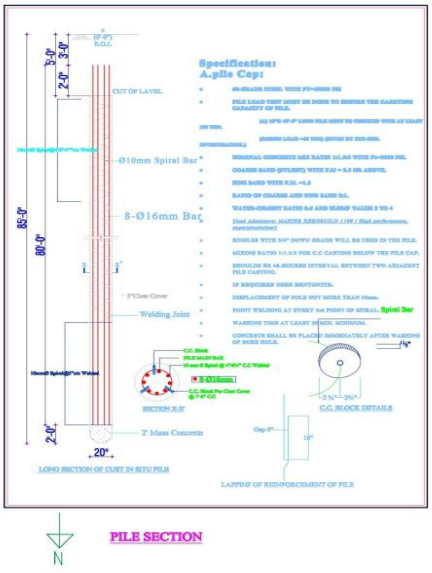


Figure 5.7: Pile section for 85′

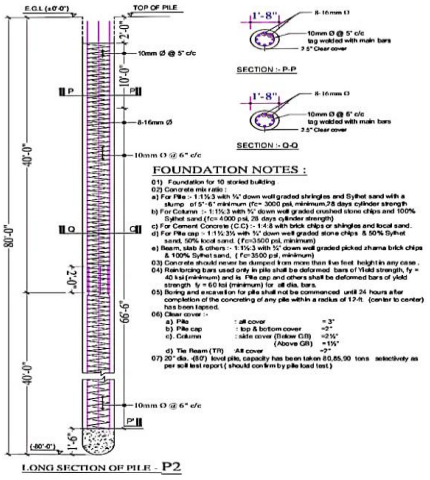
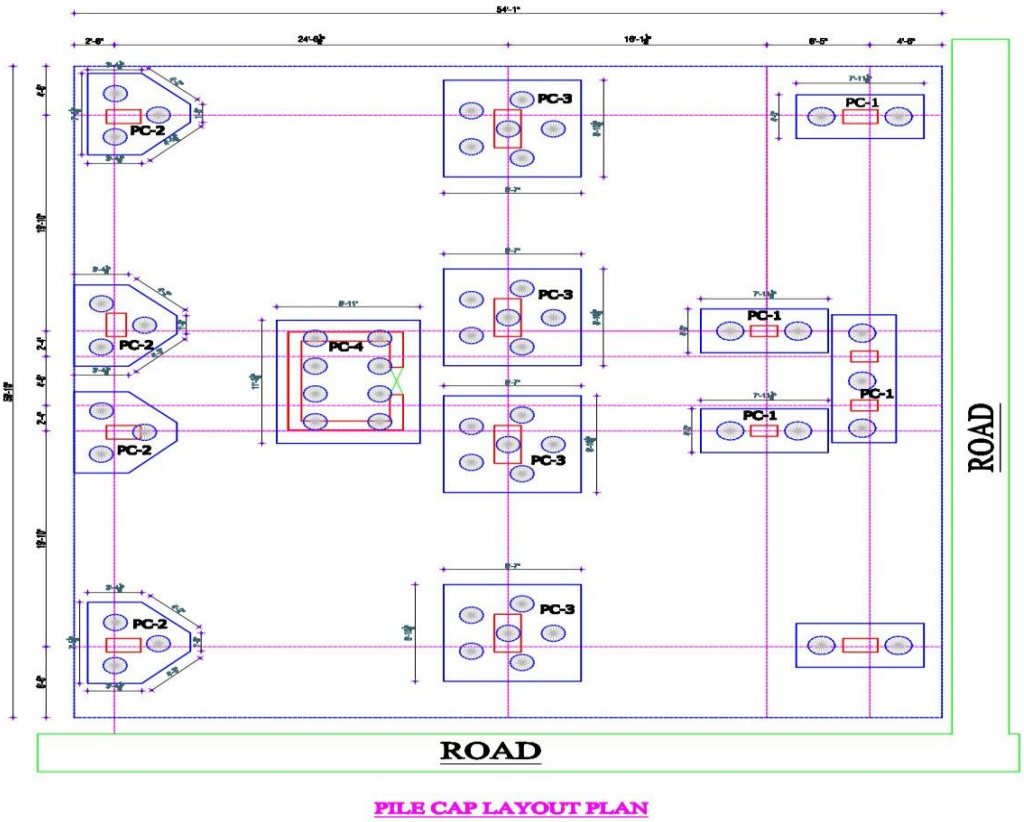


Figure 5.8: Pile section for 80′



PILE CAP LAYOUT PLAN

Figure 5.9: Pile cap layout of Madhabdi site

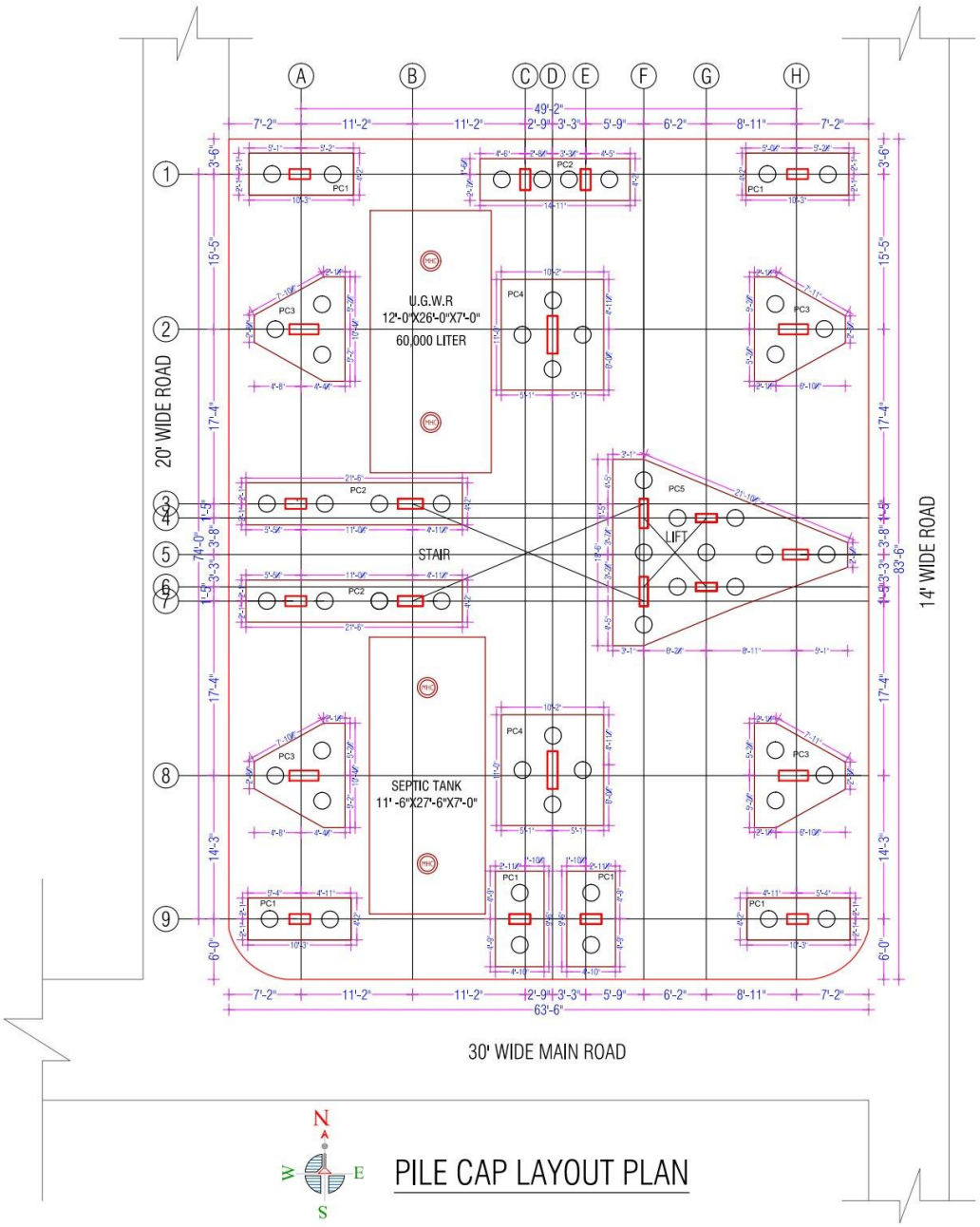


Figure 5.10: Pile Cap Layout Of Velanagar Site

Appendix C

Soil report

5.0 CONCLUSION AND RECOMMENDATION:

CONCLUTION:
The Overall investigation results of the site defines that Pile foundation is suitable for the best economic and structurally safe of the Project.

RECOMMENDATION:
This Report Is Prepared On The Basis Of Supplied SPT & Samples Visual Classification For Construction Of Proposed 10 (Ten) Storied Residential Building At Mouza- Choto Madhabdi, Dag No. R.S- 140, 141, Khatian No. R.S- 1693, Kashipur, P.S- Madhabdi, Dist.- Narsingdi, Bangladesh.

The R.C.C. Cast in situ pile may be used with following category (F.S.=3.0):

Length of Pile from E.G.I.	Allowable load bearing of 20" dia R.C.C. cast in situ pile. (F.S.=**3.0**)	Allowable load bearing of 24" dia R.C.C. cast in situ pile. (F.S.=**3.0**)
90'-0"	**82.80 Ton Per Pile**	**114.44 Ton Per Pile**
95'-0"	**86.80 Ton Per Pile**	**116.44 Ton Per Pile**

Note :-

a. *1Tsf= 1.094 kg/cm² = 10.25 kn/m², 1 Ton = 2000lbs. =1000kgs = 9.96kn, 1m = 3.28 ft. E.G.L. = Existing ground level. & Fs. = Factor of safety.*
b. *Foundation base Must be kept dry during construction period.*
c. *Pile load test Must be performed if pile load test is not performed then value of pile capacity Must be considered half.*
d. *In nature, soils are neither homogeneous nor isotropic.*

However, The designer may select any other alternatively type of foundation as the bearing capacity of the foundation to this requirement in the light of information provided in the report.

05.02.22
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5.0 CONCLUSION AND RECOMMENDATION:

CONCLUTION:
The Overall investigation results of the site defines that Shallow & Pile foundation is suitable for the best economic and structurally safe of the Project.

RECOMMENDATION:
This Report is prepared on the basis of SPT & Sample collected from field for the construction of Proposed **10 (TEN)** Storied Residential Building at. **MOUZA-SATIRPARA,DAG NO-R.S-11513,KHATIAN NO-16040,JL NO-48,P.S-NARSINGDI SADAR,DIST-NARSINGDI.**

The R.C.C. Cast in situ pile may be used with following category (F.S.=3.0):

Length of Pile from E.G.I.	Allowable load bearing of 18" dia R.C.C. cast in situ pile. (F.S.=**3.0**)	Allowable load bearing of 20" dia R.C.C. cast in situ pile. (F.S.=**3.0**)	Allowable load bearing of 24" dia R.C.C. cast in situ pile. (F.S.=**3.0**)
90'-0"	**47 Ton Per Pile**	**52 Ton Per Pile**	**62 Ton Per Pile**

Note:

a. 1Tsf= 1.094 kg/cm² = 10.25 kn/m², 1 Ton = 2000lbs. =1000kgs = 9.96kn, 1m = 3.28 ft. E.G.L. = Existing ground level. &Fs.= Factor of safety.
b. Foundation base should be kept dry during construction period.
c. Pile load test should be performed if pile load test is not performed then value of pile capacity should be considered half.
d. In nature, soils are neither homogeneous nor isotropic.

However, The designer may select any other alternatively type of foundation as the bearing capacity of the foundation to this requirement in the light of information provided in the report

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Scanned with CamScanner

-14-

8.0 DISCUSSION AND COMMENT :

8.1 The proposed ***10-Storied Residential Building*** is going to be constructed in the explored area where the location of 8nos. of bore hole points are shown on the site plan attached in this report.

8.2 The net allowable bearing capacity of soil for square footing at 5ft, 7ft, 8.5ft, 10ft, 12ft, 13.5ft and 15ft depth below the existing ground level of the bore holes has been furnished in this report considering a factor of safety of 3 for necessary utilization.

8.3 The field exploration data, SPT values and the net allowable bearing capacity of soil for square footing represent that the underlying subsoil stratum within the load bearing zone up to a maximum 57ft depth (BH-5) below the existing ground level in the explored area is very soft, soft, loose, medium stiff and erratic where placing of shallow foundation for construction of the proposed structure is not feasible.

8.4 Therefore, transmission of superimposed load of the proposed structure to a deeper and resistive stratum by means of RCC piling as commented below.

8.5 In view of the above discussion and observation supported with exploration data and the laboratory test results the following suggestion has been furnished for founding the proposed ***10-Storied Residential Building*** in the explored area.

18" dia. or 20" dia. cast-in-situ RCC pile of suitable length may be provided for construction of the proposed structure. The allowable carrying capacity of RCC pile of said dimension of different lengths has been furnished in this report for necessary utilization. A factor of safety of 3.0 and the pile cut-off length of 5ft depth below the existing ground level have been used for computation of allowable carrying capacity of RCC pile.

**Finally, it is noted here that the design engineer will take the appropriate decision about the type, depth and extent of foundation considering the economy and safety of the proposed structure based on geological condition of the site and physical properties of the underlying subsoil stratum as furnished in this report.*

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Figure 6.1: Soil Report

PWD Rate Schedule for Nine Storey Building Foundation

WORKED OUT EXAMPLE ON PREPARATION

OF PRELIMINARY ESTIMATE

Building Type **:**Residential.

Building Category **:**Supper (1800 sft/flat,2 flats per floor).

Type Of Structure **:**R.C.C frame structure with 1:1.5:3 concrete (Stone Chips).

Soil Type **:**Bearing Capacity of soil =3ksf.

Foundation **:**Shallow foundation 9 storeys.

Plinth Area **:**4003.93sft(371.97sqm).

Ground Floor **:**Parking.

Site **:**Other than coastal area

A.FOUNDATION COST

		Quantity/ Amount	Unit Rate(TK.)	Total Amount (Tk.)
1.	Soil investigation :L.S or actual cost (BH Nos. as primary, say)	5(Nos.)	Tk. 26,675.00(/No.)	Tk. 133375.00
2.	Foundation Cost: From Plar Table-1(For B.c qa=3ksf) 371.97sqm @ Tk. 13904.00 per sqm	371.97(sqm)	Tk. 13,904.00(/sqm.)	Tk. 5171036.64

Fig 6.2: PWD rate (12)