PLANNING, ANALYSIS, DESIGN AND ESTIMATION OF A RESIDENTIAL BUILDING

A Project Report Submitted in Partial Fulfillment of the Requirement for the Degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

By

S.VASAVI PRANATHI	(18095A0147)
M.JYOTHSNA	(17091A0125)
B.RAMA KRISHNA	(17091A0166)
M.RAMESH	(17091A0167)
V.SURENDRA	(17091A0190)
C.M.SIVA	(16091A0189)

Under the Esteemed Guidance of

Dr.G.SREENIVASULU Ph.D (IISC)

Professor of Civil Engineering

(ESTD-1995)

Department of Civil Engineering

R. G. M College of Engineering and Technology

(Autonomous),

Nandyal 518 501, A. P., INDIA

(Affiliated to J. N. T. University, A. P., INDIA)

(Approved by AICTE, Accredited by N.B.A, NewDelhi, NAAC-A^+ Grade)

2017 - 2021

R. G. M College of Engineering and Technology

(Autonomous),

Nandyal 518 501, A. P., INDIA

(Affiliated to J. N. T. University, A. P., INDIA)

(Approved by AICTE, Accredited by N.B.A, NewDelhi, NAAC-A+ Grade)

CERTIFICATE

This is to certify a Project Report entitled"PLANNING, ANALYSIS, DESIGN AND ESTIMATION OF A RESIDENTIAL BUILDING" that is being submitted by

S.VASAVI PRANATHI	(18095A0147)
M.JYOTHSNA	(17091A0125)
B.RAMA KRISHNA	(17091A0166)
M.RAMESH	(17091A0167)
V.SURENDRA	(17091A0190)
C.M.SIVA	(16091A0189)

in partial fulfillment of the requirement for the award of B.Tech in Civil Engineering in the **RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY,**Nandyal (Affiliated to J.N.T University, Anantapur) is a bonafide record of confide work carried out by them under our guidance and supervision. The results embodied in this technical report have not been submitted to any other university or institute for the award of any Degree.

Signature of the Project Guide
Dr.G.SREENIVASULU Ph.D (IISC)
Professor
RGMCET, NANDYAL

Signature of Head of the Department
Dr. G. SREENIVASULU Ph.D (IISC),
Professor and HOD
RGMCET, NANDYAL

Examiner:
Date:

Dedicated to my beloved parents, and teachers who have worked hard throughout my education.

Acknowledgements

We deem it a great pleasure and privilege to express our profound deep sense of gratitude to my project guide **Dr.G.SREENIVASULU,** for his able guidance ,scholarly advice ,imparting illuminating ideas, benevolent attitude, a perennial source of inspiration, instinct moral support ,and encouragement for successful completion of our project work .He has also taught us the time sense ,discipline ,and punctuality, which indeed made us to accomplish this piece of work effectively, efficiently and on time for all these , we owe him profusely forever.

We take it as privilege to express our thanks to the head of the department **Dr. G. SREENIVASULU,** for his continuous help and encouragement.

We are highly grateful and gratitude to **Dr. T. JAYACHANDRA PRASAD,** Principal, R.G.M. college of Engineering and Technology, for his encouragement and inspiration at various points of time in the successful accomplishment of this project.

We shall remain grateful To **Dr. M. SHANTHIRAMUDU,** Chairmen, R.G.M, college of Engineering and Technology, who has been a constant source of inspiration throughout the project work and we also seek his blessings for a bright future.

We shall remain grateful to **Sri. M. SIVARAM,** M.D, R.G.M. College of Engineering and Technology who has been a constant source of inspiration throughout project work and we also seek his blessings for bright future.

We express our special thanks to the officers and other teaching and non-teaching staff members of this college who constantly cooperating in the completion of the project work.

Last but not least, our thanks to all those who helped us in the completion of this technical project report.

Batch - 12

S.VASAVI PRANATHI

M.JYOTHSNA

B.RAMA KRISHNA

M.RAMESH

V.SURENDRA

C.M.SIVA

Abstract

One of the major problems that the country facing rapidly growing population, which necessities more facilities in the restricted availability of land this can be solved to a certain extent with the construction of residential building. A residential building is defined as a building which provides accommodation like individual houses or private dwellings, apartments, dormitories, hotels etc.,

In this project Analysis and Design a G+5 residential building in the area of 40ft x 60ft with 3 bed room, one hall and kitchen will be follow the municipal rules and regulations and also follow the rules of local guide lines. For analysis and design using STAAD pro software by giving gravity loads like dead loads and live load as per IS 875 (part-1),IS 875 (part-2) and IS 875 (Part-3) -1987. Finally estimate the total cost of building.

Key words: Residential Buildings,Auto CAD 2014,STAAD Pro V8,IS 875 (Part-1),IS 875 (Part-2) and IS 875 (Part-3) - 1987.

Contents

List of Figures

List of Tables

Chapter 1

INTRODUCTION

1.1 General

The basic needs of human existences are food, clothing and shelter. The man has been making efforts in improving their standards of living. The points of his efforts are to provide economic and efficient shelter. The possession of shelter gives a feeling of security, responsibility and shows the social status of man. Every human being has an inherent liking for a peaceful environment needed for his pleasant living, it can be achieved by having a place of living situated at the safe and convenient location.

The engineer has to keep in mind the municipal conditions, building byelaws, Environment, financial capacity, water supply, sewage arrangement, provision of future, aeration, ventilation, vaastu etc., in suggestion to a particular type of plan.

The residential building has proper ventilation, it is provide with sufficient doors, windows. Structural analysis means determination of the general shape and all the specific dimensions of a particular structure so that it will perform the function for which it is created and will safely withstand the influences which will act on it throughout its useful life.

Due to concentration and increase of population into urban cities, there is a need to accommodate the influx in urban cities. However, due to rapid increase of land cost and limited availability of land, constructions of multistoried buildings is taking part in our daily life.

1.2 Demand of Houses and practical consideration

Demand of Houses:

The house is the first unit of the society and its primary unit of human habitation. The house is built to grant the protection against wind, weathers, and to give insurance against physical insecurity of all kind.

The special features of the demand for housing consists of in its unique nature and demand on the following factors,

1. Availability of skilled labour.
2. Availability of finance.
3. Availability of transport facility.
4. Cost of labours and material of construction.
5. Predictions of future demand.
6. Rate of interest on investment e.g., low rates of interest with facilities of long term payment may facilitate investment in housing.
7. Rate of population growth and urbanization.
8. Supply of developed plots at reasonable prices.
9. Taxation policy on real estates.
10. Town planning and environmental conditions.

Practical considerations:

- The elements of building should be strong and capable to withstand the likely adverse effects of natural agencies.
- Strength, stability, convenience and comfort of the occupants should be the first consideration in planning.
- Elevation should be simple but attractive. The number of doors and windows provided should be less for a bank building.
- The provisions of built-in furniture at proper places are useful from the point of view of utility.

- A place for comfortable and pleasant living requires considered and kept in a view.
- A peaceful environment.
- Safety from all natural sources and climatic conditions.
- General facilities for community of residential area.

1.3 Classification of buildings based on occupancy

1. **Residential buildings:** These buildings include any building in which sleeping accommodation provided for normal residential purposes, with or without cooking and dining facilities. It includes single or multifamily dwellings, apartment houses, lodgings or rooming houses, hotels, dormitories and residential hotels.
2. **Education buildings:** These include any building used for school, college, trainings centers or day care purposes involving assembly for instruction, education or recreation and which is not covered by assembly buildings.
3. **Institutional buildings:** These buildings are used for different purposes, such as medical or other treatment or care of persons suffering from physical or mental illness, diseases or infirmity, care of infant, aged persons and penal detention in which the liberty of the inmates is restricted. Institutional building ordinarily provides sleeping accommodation for the occupants.
4. **Assembly buildings:** These are the buildings where groups of people meet or gather for amusement, recreation, social, religious, assembly halls, city halls, marriage halls, exhibition halls, museums, places of worship etc.,
5. **Business buildings:** These buildings are used for transaction of business, for keeping of accounts, records and for similar purposes, offices, banks, professional establishments, court houses, libraries. The principal function of these buildings is transaction of public business and keeping of books and records.
6. **Mercantile buildings:** These buildings are used as shops, stores, market, for display an sale of merchandise either wholesale or retail office, shops, storage service facilities incidental to the sale of merchandise and located in the same building.

7. **Industrial building:** These are building where products or materials of all kinds and properties are fabrication, assembled manufactured or processed, as assembly plant, laboratories, dry cleaning plants, power plants pumping stations, smoke houses, etc.,

8. **Storage building:** These buildings are used primarily for the storage or sheltering of goods, wares or merchandise vehicles and animals, as warehouse , cold, storage , garages, trucks.

9. **Hazardous buildings:** These buildings are used for the storage, handling, manufacture or processing of highly combustible or explosive materials or product which are liable to burn with extreme rapidly and/or which may produces poisonous elements for storage handling, acids or other liquids or chemicals producing flames, fumes and explosive poisonous irritant or corrosive gases processing of any material producing explosive mixtures of dust which result in the division of matter into the fine particles subjects to spontaneous ignition.

1.4 Scope

- In this emerging world, the requirements of houses are more. To overcome that requirement, the houses are built by proper utilization of area.
- By constructing the residential house, the consumption of area is less, it leads to enhance the opportunities for both agriculture and residential purpose.
- The design plans and specifications contain no errors and meet the appropriate code as well as owner requirements.

1.5 Objectives

The specific objectives of the present investigation are listed below:

- To know various design aspects of planning, analysis and design of a residential building.
- To estimate the cost of the building considering various activities involved in the construction of a building.
- To evaluate each and every activity involved in construction of a building.
- To manually analyze the problem frame, under vertical loading conditions.

- To perform the same analysis using standard analysis software Staad.Pro.
- Perform substitute frame analysis for the loading cases.
- Compare the accuracy of the substitute frame analysis with manual and Staad.Pro analysis and check its validity in lateral loading cases.
- Design the structural members of the residential buildings.

Chapter 2

PLANNING

2.1 Plan

Building plans are a graphical representation of what a building will look after construction. They are used by builders and contractors to construct buildings of all kinds. Building plans are also useful when it comes to estimating how much a project will cost, and preparing project budgets.

The creation of a set of building plans starts when an owner or developer approaches an architect with an idea for a new building, considering the detailing and complexity of a project, different types of drawings are issued by an architect for the easy understanding and smooth working of construction process.

2.2 Selection of plot and study

Selecting of plot is very important for building a house. Site should be in a good place where three is a community but service is convenient. But not so closed that becomes a source of inconvenience or noisy. The conventional transportation is important not only because of present need but for retention of property value in future which is closely related to are transportation, shopping, facilities also necessary. One should observe the road condition whether there is indication of future development or not in case of undeveloped area.

The factors to be considered while selecting the building site are as follows:

- Access to park and play ground.
- Agricultural polytonality of the land.
- Availability of public utility services, especially water, electricity and sewage disposal.

- Contour of land in relation the building cost. Cost of land.
- Distance from places of work.
- Ease of drainage.
- Location with respect to school, college and public buildings.
- Nature of use of adjacent area.
- Transportation facilities.

2.3 Vaasthu advice for building

Building is a structure with multiple floors that can be used as either for commercial or residential purpose by making shopping complex or apartment. Vaasthu of a building is necessary for the success and peace of people working or living here. The principles of Vaasthu-Shastra help making a plot into healthy building to promote health, wealth and well-being of people. Therefore it become essential to get vaasthu done for a building constructed for any purpose. A healthy building not only promotes health and wealth but keep stress and negative vibration at bay and helps making the people successful. Vaasthu works on underlying norms embedded in ancient text of vedas to render a peaceful and posper life to the mankind. That is why Vaasthu is necessary for every building whether it is residential or commercial purpose.

2.4 Vaasthu tips for building are as follows

- Plot chosen for a building shall be particularly square or rectangle while avoid any irregular shaped building which can bring bad fate for inmates.
- Avoid buildings having extension in south or west whereas cuts in North or East shall also be avoid.
- There should be more open space towards North, North-east and East where open lawns, parking, garden etc. can be constructed. But these important and vital directional areas must not be covered or constructed.
- Entrance or main door of building should essentially be constructed in East which has to be huge and bigger than other gates especially exit door.

- The height of the building should be more on South and West.
- Stair case should ideally be placed in South-west.
- Kitchen in the building is best to be place in South-east.
- By adding all the doors, windows and ventilators of a building should be in an even number and it should not end with zero.
- Balcony should be made in East or North.

2.5 Importance of North direction in construction

When we are making a land layout / building, we are using an instrument "compass", which is having needle in North-South direction. The accurate making of East, West, North and South directions are required to do the marking of roads, plots and buildings.
North side main door, window, French window, ventilator and roof top North light provision will bring more sunlight inside the house from morning to evening. So North direction is very important in building construction.

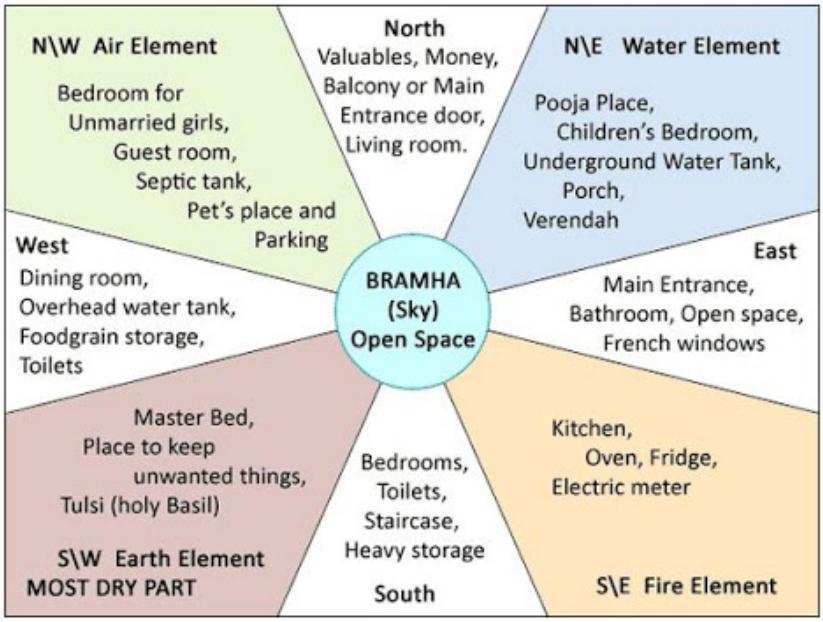

Figure 2.1: Bramha Sthana

Figure 2.2: Compass

2.6 Details of a structure

- Size of the structure = 40ft x 60ft
- No. of stories of building = 5
- Height of ground floor = 3.5m
- Height of each storey = 3m
- Total height of building = 18.5m

The plan of a building is drawn using Auto CAD software.

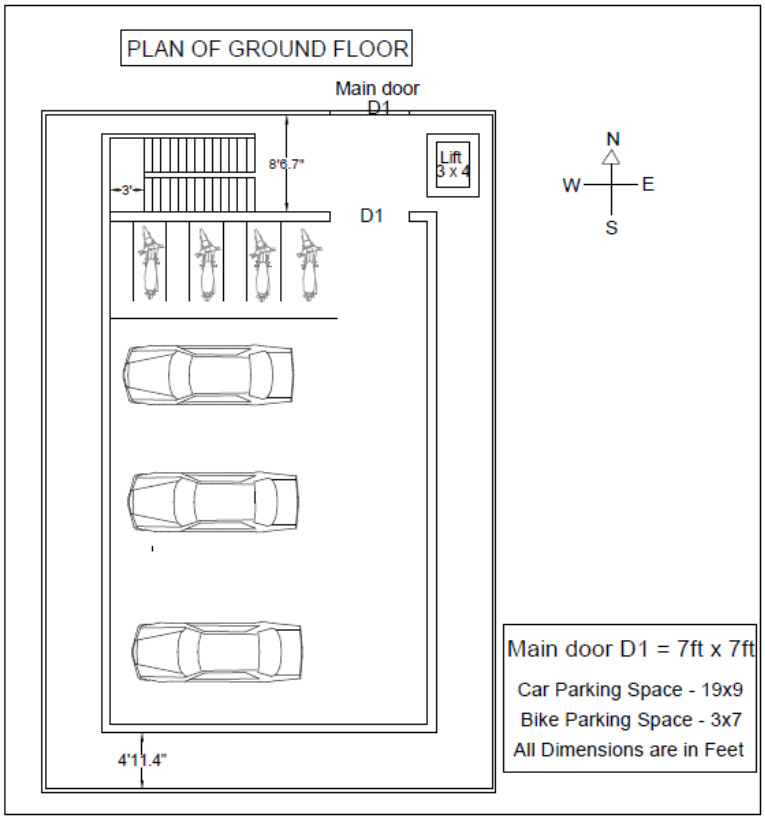

Figure 2.3: Ground floor Plan

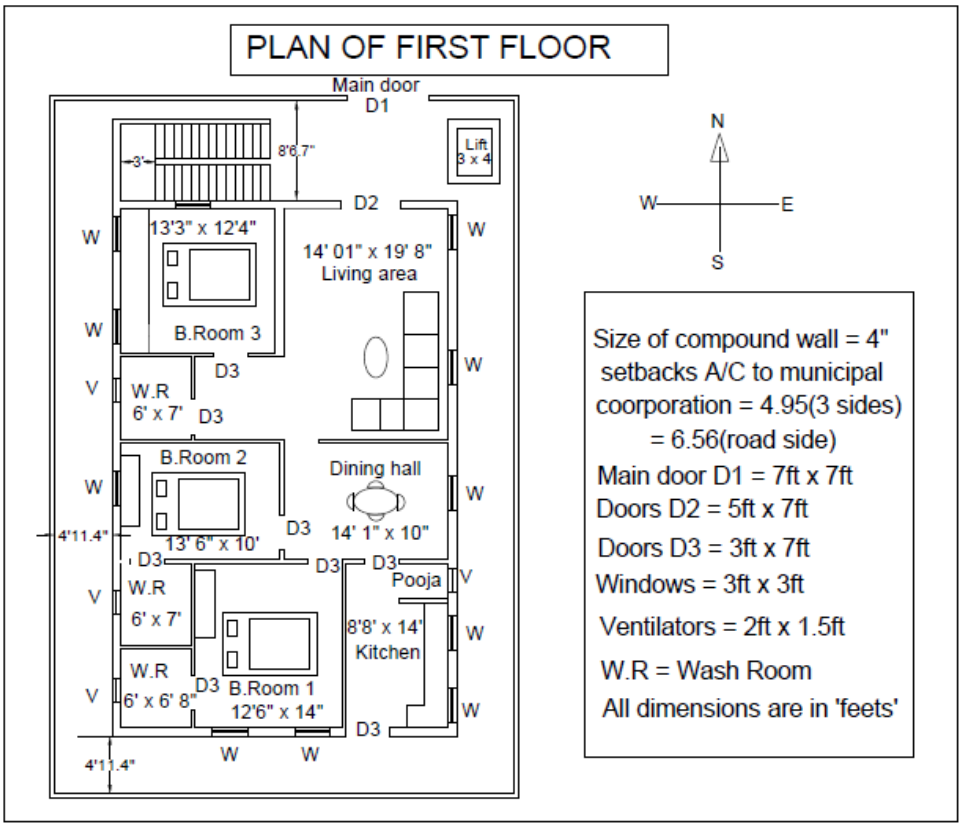

Figure 2.4: First floor Plan

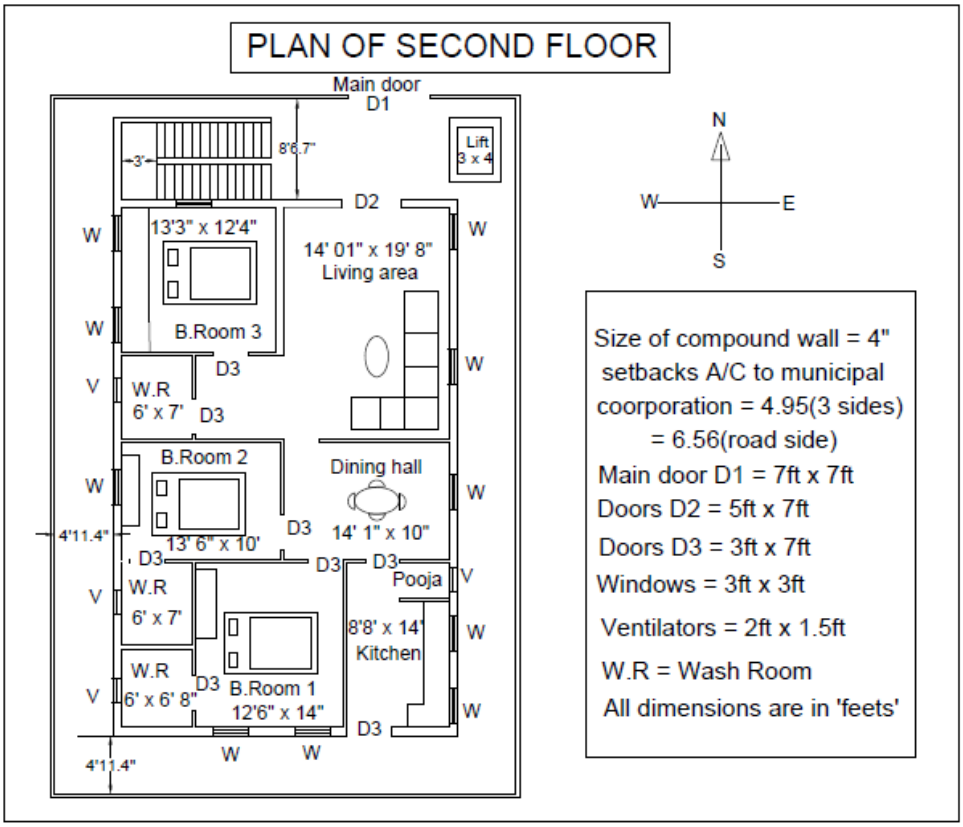

Figure 2.5: Second floor Plan

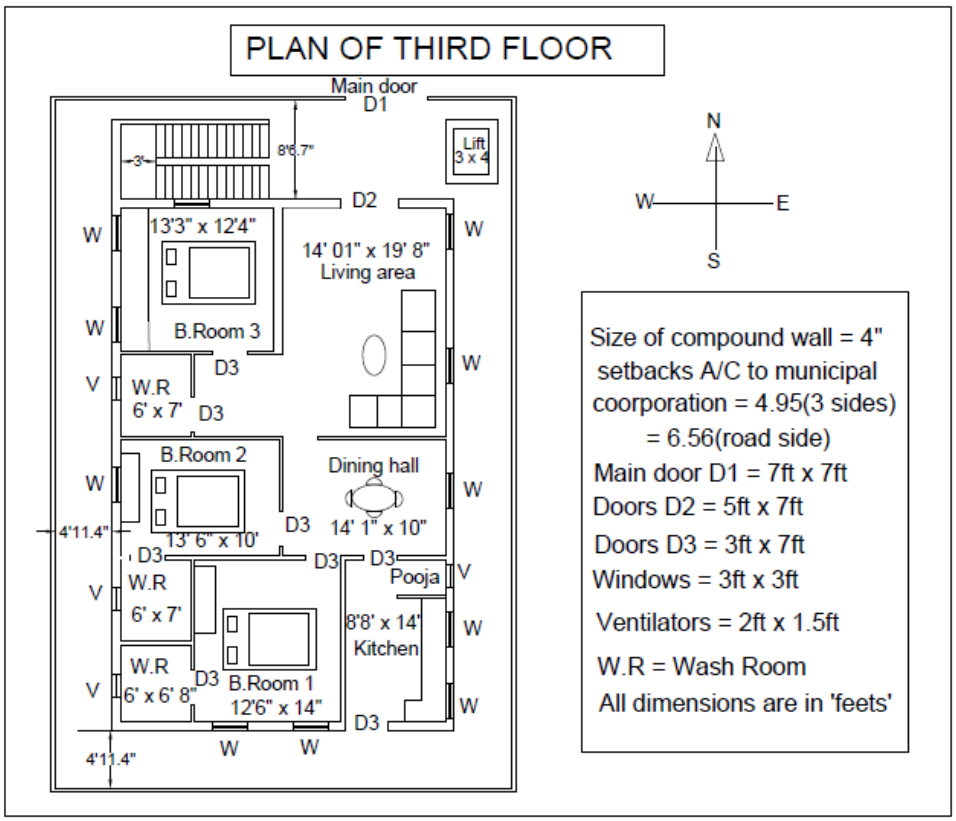

Figure 2.6: Third floor Plan

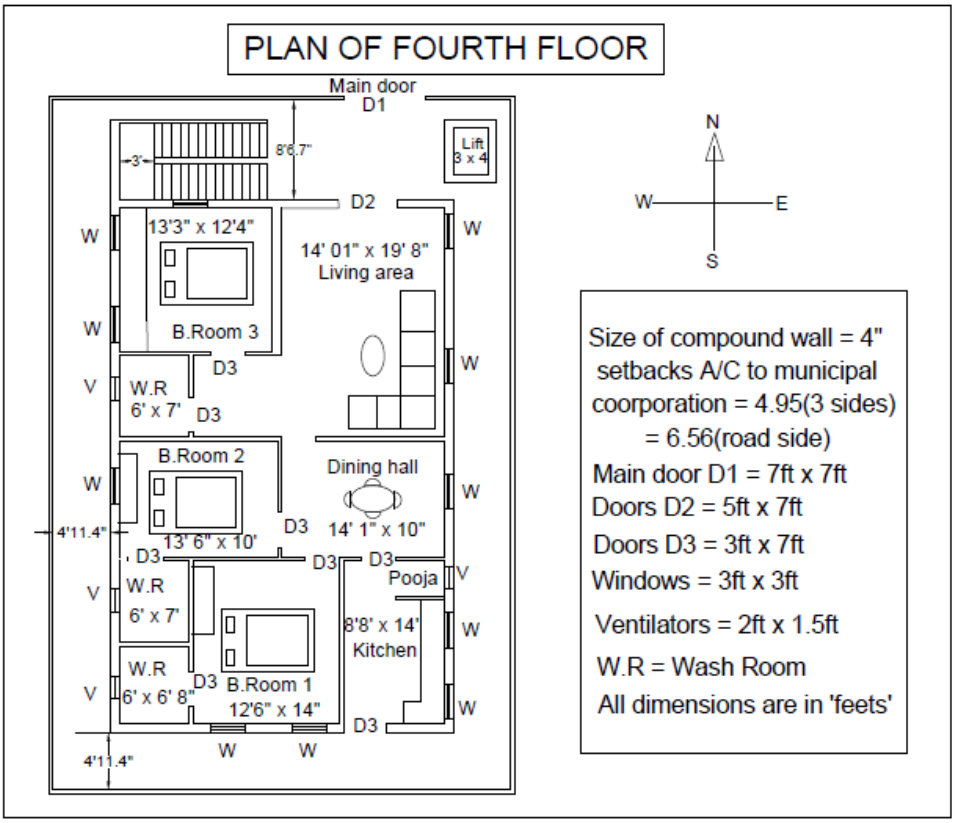

Figure 2.7: Fourth floor Plan

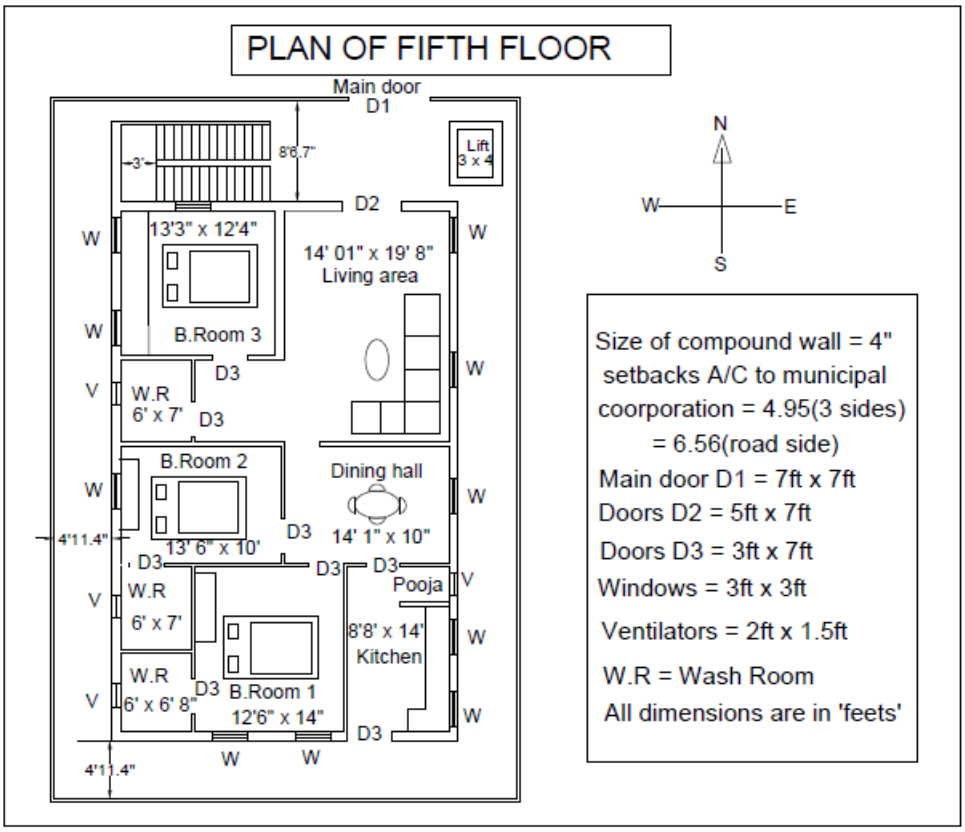

Figure 2.8: Fifth floor Plan

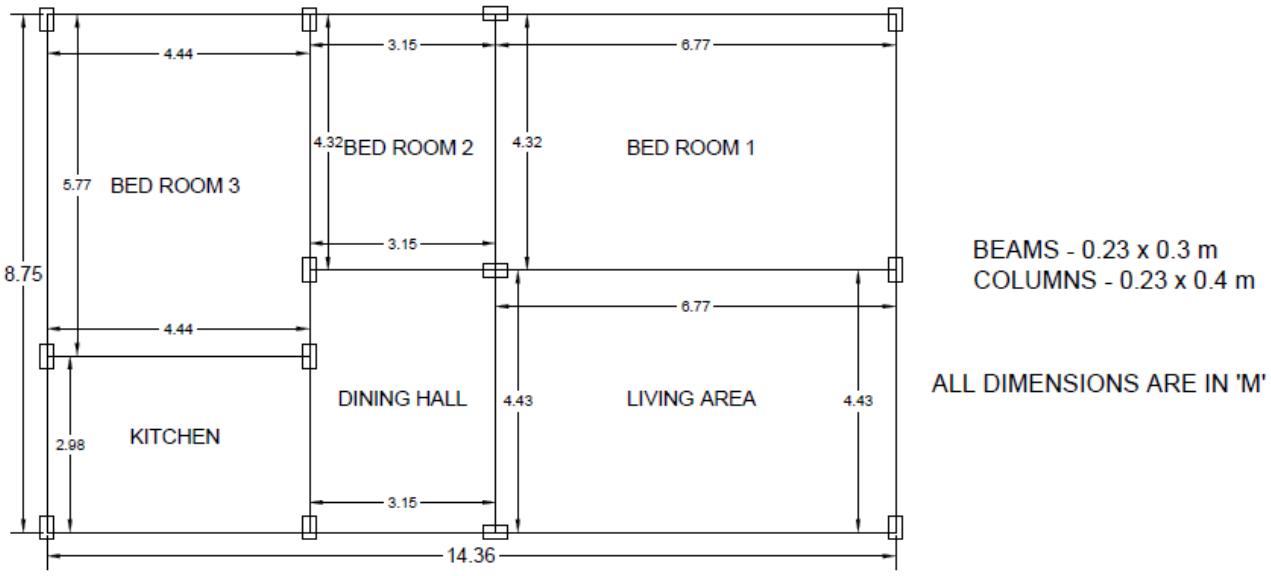

Figure 2.9: Grid line marking

2.7 Code books Used

- IS 456 : 2000
- IS 875 (Part-1) : 1987 (Dead loads)
- IS 875 (Part-2) : 1987 (Live loads)
- IS 875 (Part-3) : 1987 (Wind loads)

2.8 Softwares Used

- Auto CAD 2014
- STAAD PRO V8

Chapter 3

GRAVITY LOAD ANALYSIS

3.1 Introduction

Load Analysis is the process of determining forces in each element in a structure. Gravity load include "dead", or permanent load, which is the weight of the structure, including walls, floors, fnishes and mechanical systems and "live", or temporary load, which is the weight of structure's contents and occupants. The gravity loads as shown in fig..,

Figure 3.1: Gravity loads

3.2 Load calculations

- Assumed the thickness of the slab = 0.15 m
- Assumed dimensions of beams = 0.23 x 0.3 m
- Assumed dimensions of columns = 0.23 x 0.4 m
- Assumed Live load on slab = 2 kN/m^2
- Assumed Floor finish load = 1 kN/m^2
- Dead load = 0.15 x 25 = 3.75 kN/m^2
- Total load = W = 3.75+2+1= 6.75 kN/m^2

Load distribution on longer span = [[Wlx/6][3-[lx/ly]^2]]

Load distribution on shorter span = [Wlx/3]

Where,

Lx = Length of shorter span

Ly = Length of longer span

3.3 Load calculations on Beams

For Slab 1

B2, B4 are shorter beams = 2.81m

B1, B3 are longer beams = 4.44m

- Thickness of slab = 0.15m
- Density of concrete = 25 kN/m^3
- Dead load = 3.75 kN/m^2 (IS 875-1978 Part - 1)
- Live Load = 2 kN/m^2 (IS 875-1978 Part - 2)
- Floor load = 1 kN/m^2 (IS 875-1978 Part - 3)
- Total load = W = 6.75 kN/m^2

Load distribution on shorter span = [6.75 x 2.81/3] = 6.32 kN/m^2

Load distribution on longer span = [6.75 X 2.81/6] [3-(2.81/4.44)^2] = 8.22 kN/m^2

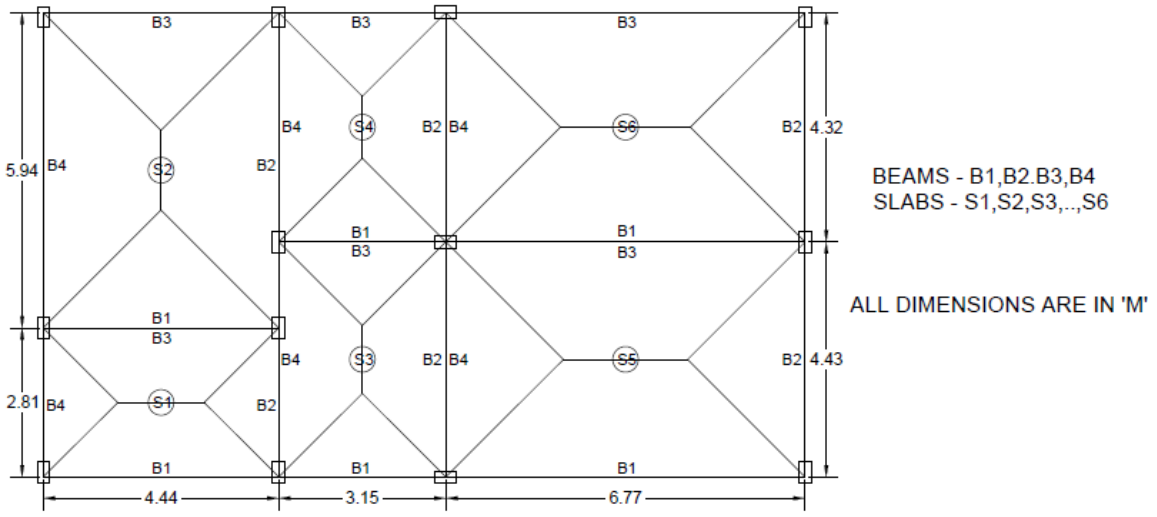

Figure 3.2: Load distribution on beams

Table 3.1: Load Distribution on Beams for Ground floor

For Ground Floor L0

Slab	**Dead load**	**Floor load**	**Live load**	**Total load**	**Lx**	**Ly**	**B1**	**B2**	**B3**	**B4**
S 1	3.75	2	1	6.75	2.81	4.44	6.32	8.22	6.32	8.22
S 2	3.75	2	1	6.75	4.44	5.94	9.99	12.19	9.99	12.19
S 3	3.75	2	1	6.75	3.15	4.43	7.09	8.84	7.09	8.84
S 4	3.75	2	1	6.75	3.15	4.32	7.09	8.75	7.09	8.75
S 5	3.75	2	1	6.75	4.43	6.77	9.97	12.82	9.97	12.82
S 6	3.75	2	1	6.75	4.32	6.77	9.72	12.60	9.72	12.60

Table 3.2: Load Distribution on Beams for First floor

For First Floor L1

Slab	**Dead load**	**Floor load**	**Live load**	**Total load**	**Lx**	**Ly**	**B1**	**B2**	**B3**	**B4**
S 1	3.75	2	1	6.75	2.81	4.44	6.32	8.22	6.32	8.22
S 2	3.75	2	1	6.75	4.44	5.94	9.99	12.19	9.99	12.19
S 3	3.75	2	1	6.75	3.15	4.43	7.09	8.84	7.09	8.84
S 4	3.75	2	1	6.75	3.15	4.32	7.09	8.75	7.09	8.75
S 5	3.75	2	1	6.75	4.43	6.77	9.97	12.82	9.97	12.82
S 6	3.75	2	1	6.75	4.32	6.77	9.72	12.60	9.72	12.60

Table 3.3: Load Distribution on Beams for Second floor

For Second Floor L2

Slab	**Dead load**	**Floor load**	**Live load**	**Total load**	**Lx**	**Ly**	**B1**	**B2**	**B3**	**B4**
S 1	3.75	2	1	6.75	2.81	4.44	6.32	8.22	6.32	8.22
S 2	3.75	2	1	6.75	4.44	5.94	9.99	12.19	9.99	12.19
S 3	3.75	2	1	6.75	3.15	4.43	7.09	8.84	7.09	8.84
S 4	3.75	2	1	6.75	3.15	4.32	7.09	8.75	7.09	8.75
S 5	3.75	2	1	6.75	4.43	6.77	9.97	12.82	9.97	12.82
S 6	3.75	2	1	6.75	4.32	6.77	9.72	12.60	9.72	12.60

Table 3.4: Load Distribution on Beams for Third floor

For Third Floor L3

Slab	**Dead load**	**Floor load**	**Live load**	**Total load**	**Lx**	**Ly**	**B1**	**B2**	**B3**	**B4**
S 1	3.75	2	1	6.75	2.81	4.44	6.32	8.22	6.32	8.22
S 2	3.75	2	1	6.75	4.44	5.94	9.99	12.19	9.99	12.19
S 3	3.75	2	1	6.75	3.15	4.43	7.09	8.84	7.09	8.84
S 4	3.75	2	1	6.75	3.15	4.32	7.09	8.75	7.09	8.75
S 5	3.75	2	1	6.75	4.43	6.77	9.97	12.82	9.97	12.82
S 6	3.75	2	1	6.75	4.32	6.77	9.72	12.60	9.72	12.60

Table 3.5: Load Distribution on Beams for Fourth floor

For Fourth Floor L4

Slab	**Dead load**	**Floor load**	**Live load**	**Total load**	**Lx**	**Ly**	**B1**	**B2**	**B3**	**B4**
S 1	3.75	2	1	6.75	2.81	4.44	6.32	8.22	6.32	8.22
S 2	3.75	2	1	6.75	4.44	5.94	9.99	12.19	9.99	12.19
S 3	3.75	2	1	6.75	3.15	4.43	7.09	8.84	7.09	8.84
S 4	3.75	2	1	6.75	3.15	4.32	7.09	8.75	7.09	8.75
S 5	3.75	2	1	6.75	4.43	6.77	9.97	12.82	9.97	12.82
S 6	3.75	2	1	6.75	4.32	6.77	9.72	12.60	9.72	12.60

Table 3.6: Load Distribution on Beams for Fifth floor

For Fifth Floor L5

Slab	**Dead load**	**Floor load**	**Live load**	**Total load**	**Lx**	**Ly**	**B1**	**B2**	**B3**	**B4**
S 1	3.75	2	1	6.75	2.81	4.44	6.32	8.22	6.32	8.22
S 2	3.75	2	1	6.75	4.44	5.94	9.99	12.19	9.99	12.19
S 3	3.75	2	1	6.75	3.15	4.43	7.09	8.84	7.09	8.84
S 4	3.75	2	1	6.75	3.15	4.32	7.09	8.75	7.09	8.75
S 5	3.75	2	1	6.75	4.43	6.77	9.97	12.82	9.97	12.82
S 6	3.75	2	1	6.75	4.32	6.77	9.72	12.60	9.72	12.60

3.4 Wind load analysis

Design of Wind loads

As per IS 875 (Part-3) - 1987 clause 5.3

Design Wind Speed (Vz) = (k1x K2 x K3 x Vb)

Where,

K1 = Probability Factor = 1.0 (As per IS 875 (Part-3) - 1987 clause 5.3.1 Table 1, for Basic wind speed - 39 m/s and Design life of structure 50 years)

(Hence, Assumed Basic Wind Speed as 39 m/s for the location Kurnool from IS 875 (Part - 3) 1987 Fig 1)

K2 = Terrain and Structure size factor = 0.8

(As per IS 875 (Part - 3) - 1987 clause 5.3.3.2 Table 2 for Terrain Category 4 (Class A) Building and Height 20 m)

K3 = Topography Factor = 1.0 (Assumed)

Vb = Basic wind speed = 39 m/s

(As per IS 875 (Part - 3) - 1987 fig 1 Assumed Zone as Kurnool)

Vz = 1.0 x 0.8 x 1.0 x 39 = 31.2 m/s

Design Wind Pressure Pd = 0.6 x $(Vz)^2$

Pd = (0.6 x (31.2)2)/1000 = 0.584 kN/m^2

Chapter 4

ANALYSIS OF BUILDING IN STAAD Pro V8i

4.1 Introduction

Buildings are an important indicator of social progress of the country. A building frame is a three dimensional structure or space structure consist of a column, beams and slabs. Now-a-days, high rise buildings are in high demand due to the world population boon. Earlier, modeling and structure analysis of a building were carried out using hand calculation method based on simplified assumptions and understanding the whole behavior of the structure. But it seems to be time consuming and complicated for high rise buildings. At present, computer hardware's and software's for modeling and analysis of a structure is widely available. We need to know how the knowledge secured in the class room are applied in these practical sides of the work.

4.2 Analysis of Building

1. Step-1: Creation of nodal points. Based on the column positioning of plan we entered the node points into STAAD file.

2. Step-2: Representation of beams and columns. By using add beam command we had drawn the beams and columns between the corresponding node points.

3. Step-3: 3D view of structure. Here we have used the Transitional repeat command in Y direction to get the 3D view of a structure.

4. Step-4: Supports and property assigning. After the creation of structure the supports at the base of structure and specified as fixed. Also the materials were specified and cross sections of beams and columns members were assigned.

5. Step-5: Assigning of Dead loads

6. Step-6: Assigning of Live loads for every floor which are calculated manually using IS-875 PART2

7. Step-7: Analysis. After the completion of all the above steps we have performed the analysis and checked for errors

4.3 Building Data for Analysis

1	Type of Building	Residential Building (G+5)
2	No. of Stories	G+5
3	Floor height Ground Floor Remaining floors	 3.5m 3.0m
4	Material	Concrete (M20) and reinforcement of steel (FE415)
5	Size of beam	230mm x 300mm
6	Size of column	230mm x 400mm
7	Size of wall	300mm

Table 4.1: Building data for Analysis

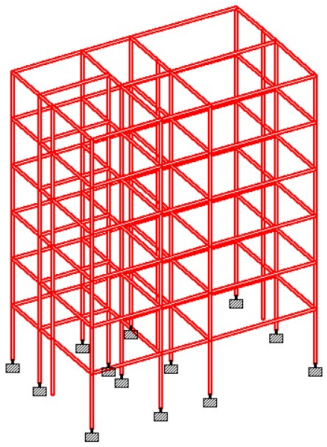

Figure 4.1: Three dimensional rendered view of the building from STAAD Pro

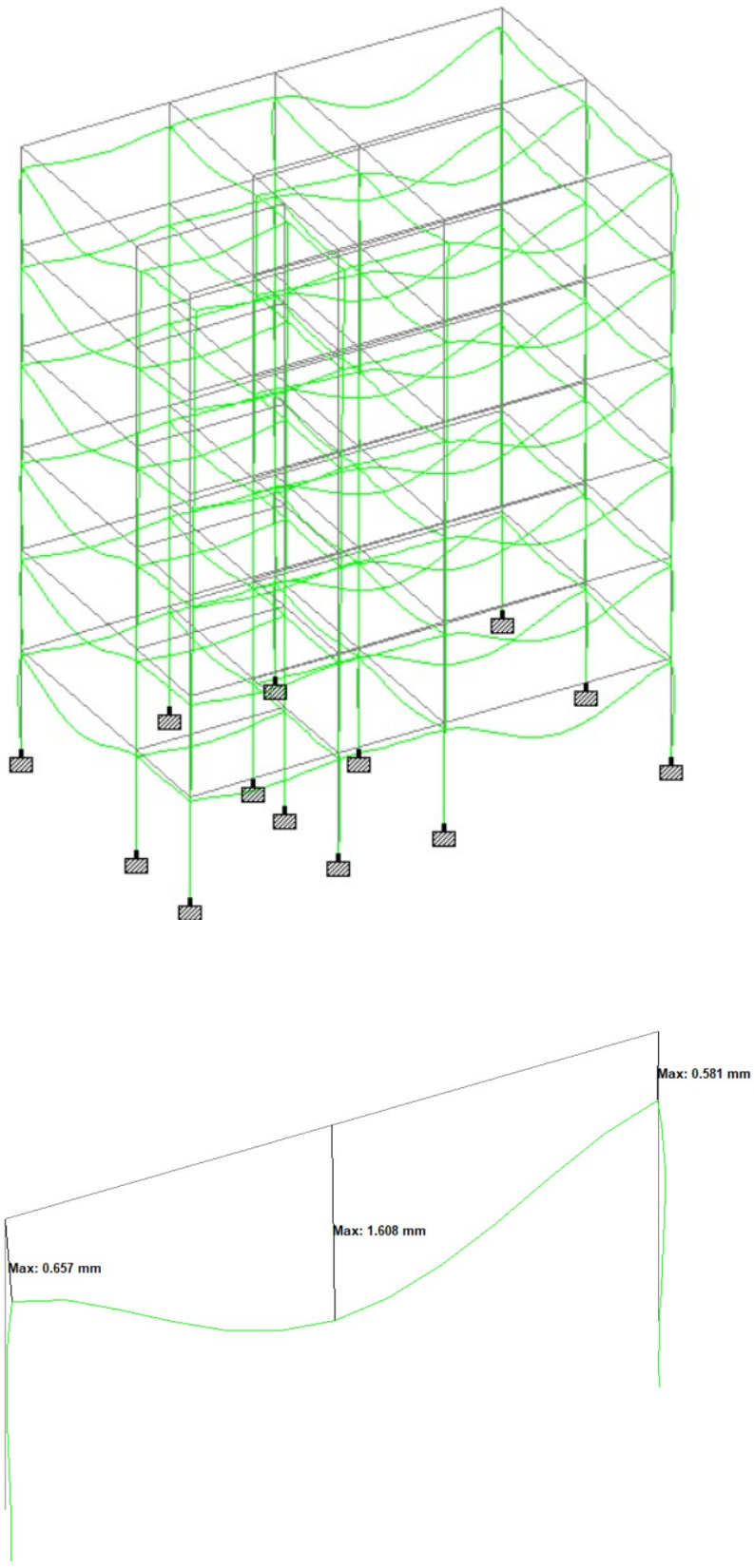

Figure 4.2: Deflection of Building

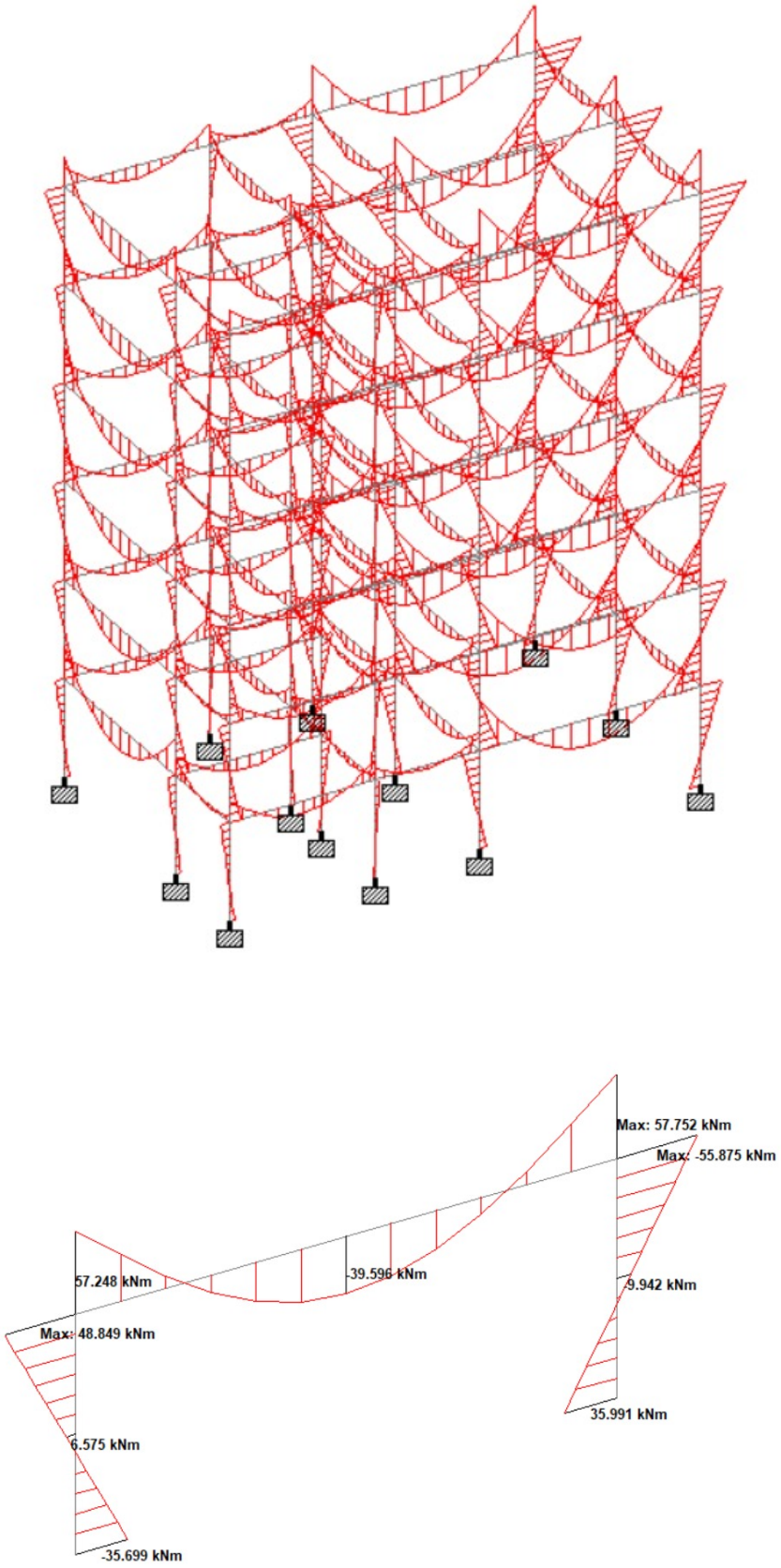

Figure 4.3: Bending Moment of Building

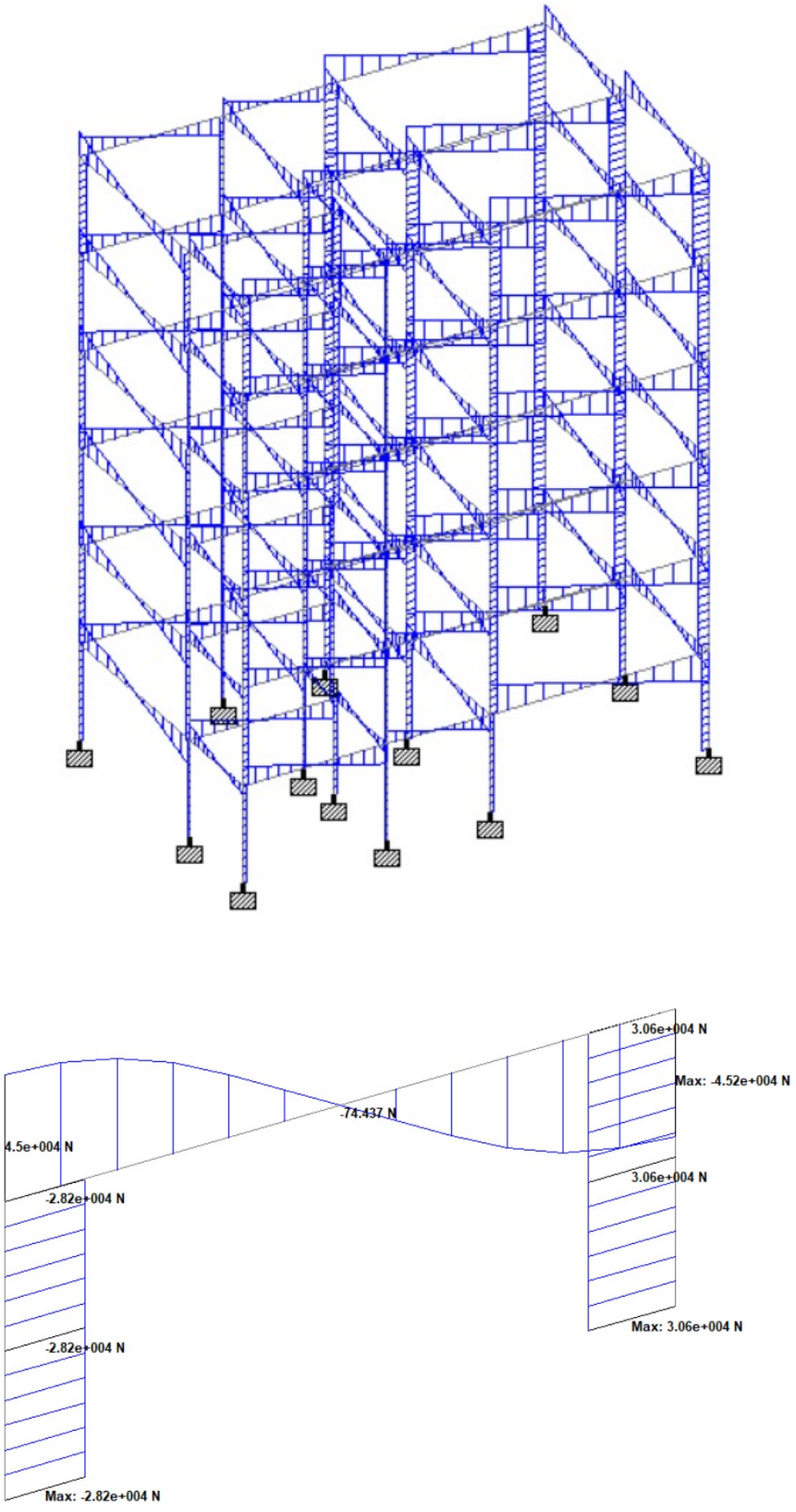

Figure 4.4: Shear Force of Building

Chapter 5

DESIGN OF BUILDING

After analysis we start doing design of concrete is performed as IS 456:2000 by defining suitable design commands for different structural components. After the assigning of commands again we performed analysis for any errors.

5.1 Design of Column

A vertical member whose effective length is greater than 3times its least lateral dimension carrying compressive loads is called as Column. Column transfers the loads from the beams or slabs to the footings and foundations. The inclined member carrying compressive loads as in case of frames and trusses called as struts. Pedestal is a vertical compression member whose effective length is less than 3 times its least lateral dimension. Generally the column may be square, rectangular or circular in shape.

5.1.1 Necessity of reinforcement in columns

Even though concrete is strong in compression, longitudinal steel bars are placed in the column to reduce the size of the column or to increase the load carrying capacity and to resist any tension that might develop due to bending of column due to horizontal loads, eccentric loads or moments.

To resist any tensile stresses likely to develop, the reinforcement should be placed as near the surface as possible and should evenly distributed ensuring the minimum cover.

Transverse reinforcement in the form of lateral ties or spiral reinforcement are provided to resist longitudinal splitting of the column or splitting concrete due to development of transverse tension and to prevent buckling of longitudinal bars.

5.1.2 Types of columns

1. **Based on type of Reinforcement :** Depending upon the type of reinforcement used, reinforced columns are classified into

   (a) Tied column: When the main longitudinal bars of the column are confined with in closely spaced lateral ties, it is called as Tied column.

   (b) Spiral column : When the main longitudinal bars of the columns are enclosed with in closely spaced and continuously wound spiral reinforcement, it is called as Spiral column

2. **Based on type of Loading :** Depending upon the type of Loading used, columns are classified into

   (a) Axially loaded column : When the line of action of the resultant compressive force coincides with the center of the gravity of the cross section of the column, it is called as Axially loaded column.

   (b) Eccentrically loaded column : When the line of action of the resultant compressive force doesn't coincide with the center of gravity of the cross section of the column. Eccentrically loaded columns have to be designed for combined axial force and bending moments.

3. **Based on slenderness ratio :** Depending upon the type of slenderness ratio used, columns are classified into

   (a) Short column : When the ratio of effective length of the column to the least lateral dimensions is less than 12. A short column fails by crushing.

   (b) Long column : When the ratio of effective length of the column to the least lateral dimensions is greater than 12. A long column fails by buckling.

5.1.3 Design of column

Size of column = 230mm x 400mm

Length of column = 3000mm

Effective length = 0.65 x l = 0.65 x 3000 = 1950mm

Slenderness ratio = l/b = 1950/230 = 8.47 ¿ 12

Hence, it may be designed as short column.

Minimum eccentricity, e = l/500 + D/30 = 3000/500 + 400/30 = 19.33 ¿ 20

Hence, emin = 20mm

Load = 23.32kN

Factored load (Pu) = 1.5 x 23.32 = 34.98kN

Gross area Ag = 230 x 400 =92000mm^2

Ac = Ag - Asc

Pu = 0.4 x fck x (Ag - Asc) + 0.6 x fy x Asc

34.98 x 106 = 0.4 x 25 x (92000 - Asc) + 0.6 x 415 x Asc

Asc = 846 mm^2

Minimum reinforcement = 0.8/100 x 230 x 400 = 736 mm^2

Hence, provide minimum reinforcement = 846 mm^2

Provide 12mm dia of bars

No.of bars = 846/[(Π/4)x12^2] = 8 no's

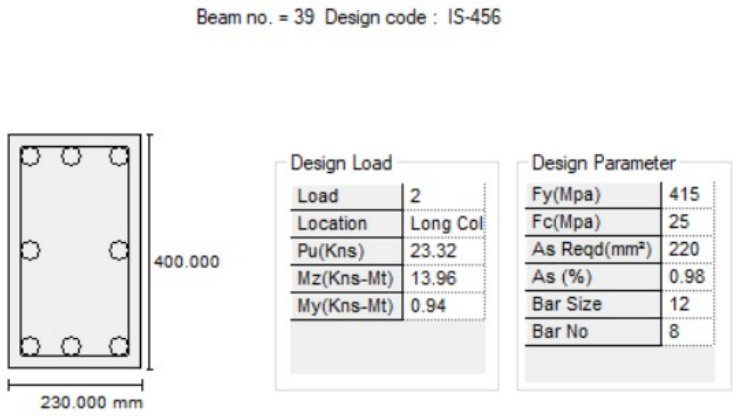

Figure 5.1: Reinforcement details of Column

5.2 Design of beam

In most of the reinforced concrete structures, beams and slabs are always cast monolithically. Form works are erected for beams and slabs together and concrete is poured in one operation form bottom of the beam to the top of the slab. Stirrups and bentup bars are also extended into the slab. Stirrups and bentup bars are also extended into the slab. Due to this, certain portion of the slab acts along with the beam in resting compression of the beam and it acts like a flange of the beam. The total resulting section is known as flanged section.

fck = 25 N/mm^2

fy = 415 N/mm^2

Support width = 300mm

Length = 4440mm

1. Depth of beam:

   Selecting depth in range of (1/12) to (1/15) based on stiffness

   d = 4440/15 = 300mm

   D = 350mm (cover 50mm)

   Width (b) = 230mm

   Effective span = It is the least of c/c of supports = 4.44 + 0.23/2 + 0.23/2 = 4.67

2. Loads:

   Self-weight of beam = 0.23 x 0.35 x 1 x 25 = 2.127 KN/m^2

   Imposed load = 6.75 KN/m^2

   Total load = 8.877 KN/m^2

   Factored load = 1.5 x 8.77 = 13.31 KN/m^2

   Factored bending moment (Mu) = [(wu x l^2)/8] =36.28 KN-m

3. Depth required:

   Minimum depth required (Mu) = 36.28 x 106 = 0.138 x 25 x 230 x x^2

   X = 213.82mm <300mm

   d = 300m

   Hence, provide depth is adequate

4. Tension reinforcement:

   Mu lim = 0.87fyAstd (1- fyAst/fckbd)

   36.28 x 106 = 0.87 x 415 x Ast x 300 (1-415*Ast/25*230*300)

   Ast= 329.49 mm^2

   Provide 16mm Φ of bars

   No of bars = 329.49/[(Π/4)x16^2] = 4 no's

5. Check for deflection (stiffness):

   For SSB basic value of l/d = 20

   Modification factor for tension steel = 1.14

   Stress in steel under service or working loads fs = 193.76 N/mm^2

From fig of IS456-2000

Modification factor = 1.15

Maximum permitted = l/d = 1.15 x 20 = 23

l/d provided ratio = 4440/350 = 12.68 ¡ 23

Hence deflection is safe.

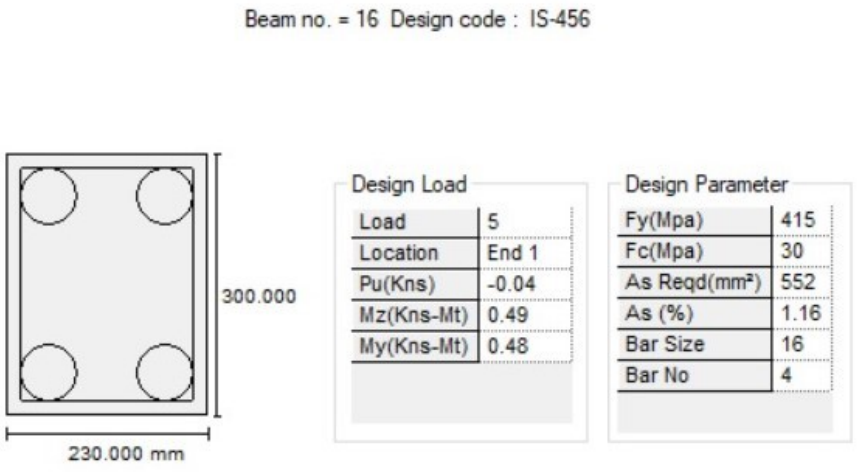

Figure 5.2: Reinforcement details of Beam

5.3 Design of slab

Slabs are constructed to provide flat surfaces, usually horizontal, in building floors, roofs, bridges, and other types of structures. The slab may be supported by walls, by reinforced concrete beams usually cast monolithically with the slab, by structural steel beams, by columns, or by the ground.

Flat slab:-

Flat slab is a reinforced concrete slab supported directly by concrete columns or caps. Flat slab don't have beams. They are supported on columns itself. Loads are directly transferred to columns. In this type of construction a plain ceiling is obtained thus giving attractive appearance from architectural point of view. The plain ceiling diffuses the light better and is considered less vulnerable in the case of fire than the usual beam slab construction. The flat slab is easier to construct and require less formwork. The thickness of Flat slab is minimum 8

inch or 0.2m. This is a one of the types of concrete slabs.

Where it is used:

1. To provide plain ceiling surface giving better diffusion of light.
2. Easy constructability with economy in the formwork.
3. Larger head room or shorter storey height and pleasing appearance.
4. This kind of slabs are provided in parking.
5. Flat slabs are generally used in parking decks, commercial buildings, hotels or places where beam projections are not desired.

Conventional slab:-

The slab which is supported with Beams and columns is called conventional slab. In this kind of slab the thickness of slab is small where as depth of beam is large and load is transferred to beams and form beams to columns. It requires more formwork when compared with the flat slab. And there is no need of providing column caps in conventional slab. The thickness of conventional slab is 4 or 10cm.5 to 6 inches is recommended if the concrete will receive occasional heavy loads, such as motor homes or garbage trucks. Normally it is square in shape and has a length of 4m. Reinforcement is provided in conventional slab and the bars which are set in horizontal are called Main Reinforcement Bars and bars which are set in vertical are called Distribution bars. These types of slabs are used in constructing floors of multi storeyed building.

Based on length and breadth of the slab Conventional Slab is classified into two types

1. One-way Slab
2. Two-way Slab

1. **ONE WAY SLAB:**

   One way slab is a slab which is supported by beams on the two opposite sides to carry the load along one direction. The ratio of longer span (l) to shorter span (b) is equal or greater than 2, considered as one way slab because this slab will bend in one direction i.e., in the direction along its shorter span. However minimum reinforcement known as distribution steel is provided along the longer span above the main reinforcement to distribute the load uniformly and to resist temperature and Shrinkage stresses.

   In general length of slab is 4m. But in one way slab one side length is 4m and other

side length is more than 4m. So it satisfies the above equation. In one way slab main reinforcement is provided in shorter span distribution reinforcement is provided in longer span. Distribution bars are cranked to resist the formation of stresses.

2. **TWO WAY SLAB:**

   Two way slab is a slab supported by beams on all the four sides and the loads are carried by the supports along both directions, it is known as two way slab. In two way slab, the ratio of longer span(l) to shorter span(b) is less than 2. The slabs are likely to bend along the two spans in this load is transferred in both the directions to the four supporting edges and hence distribution reinforcement is provided in both the directions.

   In this kind of slab the length and breadth of slab is more than 4m. So distribution bars are provided at both the ends in two slab. To resist the formation of stresses.

   These types of slabs are used in constructing floors of multi storied building.

Design of Slab:

1. Length to breadth ratio:

   Length of longer span of slab (Ly) = 2810 mm

   Length of shorter span of slab (Lx) = 4440 mm

   (Ly/Lx) = 0.63 ¡ 2 = two way slab (from IS456-2000 ANNEX D 1.11)

2. Effective depth:

   Span to effective depth ratio's for span upto 10m, continuous slab is 26 as per IS 456-2000 clause 23.2.1

   Longer span in slab (Ly) = 2810 mm

   (deff) = (span/26) = 108.077 mm

   Assume 10mm dia of bar with 15 mm cover

   d = (deff - bar dia - cover) = 176 mm

3. Effective span:

   In Y-direction Ly(eff) = 2986mm (Ly+d)

   In X-direction Lx(eff) = 4576mm (Lx+d)

4. Calculations of loads:

   Dead load = 1 x 0.15 x 25 = 3.75 kN/m^2

   Live load = 2 kN/m^2

Total load = 5.75kN/m^2

Factored load = 1.5 x 5.75 = 8.625 kN/m^2

5. Design bending moment (BM) and Shear force (SF):

   Maximum moment in both direction

   Mx = α_x x wl^2 , My = α_y x wl^2

   For edge strip $\alpha_x = 0.055$, $\alpha_y = 0.037$

   For mid span $\alpha_x = 0.041$, $\alpha_y = 0.028$

   Maximum Bending Moments at edge strip in the both directions

   For shorter span = Mx = 0.055 x 8.65 x $(4440/1000)^2$

   For longer span = My = 0.037 x 8.65 x $(2810/1000)^2$

   Maximum Bending Moments at mid span in the both directions

   For shorter span = Mx = 0.041 x 8.65 x $(4440/1000)^2$

   For longer span = My = 0.028 x 8.65 x $(2810/1000)^2$

6. Area of reinforcement:

   Take fe415 grade of steel for reinforcement

   In X-direction:

   Mx = 0.87 x fy Ast d (1- fyAst /fck x b x d) = 660000 mm^2

   Minimum reinforcement required is 0.12% = 792mm^2

   Cross sectional area of a 8mm dia of bar = 50.26 mm^2

   No.of bars = 16 No's

   Spacing = 275 mm

   Hence, use 16 no's of bars of 8mm dia @ 275mm spacing

   In Y-direction:

   My = 0.87 x fy Ast d (1- fy Ast /fck x b x d) = 421500 mm^2

   Minimum reinforcement required is 0.12% = 505.8 mm^2

   Cross sectional area of a 8mm dia of bar = 50.26 mm^2

   No.of bars = 11 No's

   Spacing = 281 mm

   Hence, use 11 no's of bars of 8mm dia @ 281mm spacing

Chapter 6

ESTIMATION

6.1 Introduction

Before the start of any work for its execution, the owner of the builder should have a thorough knowledge of the volume of work. The minutest details can help him understand if the work can be completed within the stipulated time frame and budget. It also enables him to understand the probable cost that may be incurred to complete the proposed work. Therefore, it is necessary to list the probable costs or develop an estimate for the proposed work from its plans and specifications.

An estimate is prepared by calculating the quantities from the drawings for various items and multiplying them with the unit cost of the item concerned. To prepare an estimate one requires

- Drawing:- The drawing is the basis from which quantities of various items for a work are calculated. The drawings consist of the plan, the elevations, and the sections through important points.
- Specifications:-
  - General Specification:- The general specification forms the general idea for the project. In this, the nature and class of work and the names of materials that should be used are described.
  - Detailed Specification:- Detailed specification describes every item of work in the estimate. This specification of work serves as a guide to execute the work to the owner's satisfaction.
- Rates:- Rates for different items of works are vital factors to determine the estimated cost.

- Standing circulars for taxes and insurance etc. are required to fix up rates of those item which are not in the schedule of rates.

6.2 Purpose of Estimation

Estimate for a work or project is necessary mainly for the following purposes:

1. To ascertain the necessary amount of money required by the owner to complete the proposed project. For public construction works, estimates are required in order to obtain administrative approval, allotment of funds, and technical sanctions.
2. Ascertain quantities of materials required to program their timely procurement.
3. Calculate the number of workers that are to be employed to complete the work within the scheduled time of completion.
4. Assess the requirements of tools and equipment required to complete the work according to the program.
5. Fix up the completion period from the volume of works involved in the estimate.
6. Draw up a construction schedule and program.
7. Justify the investment from the benefit-cost ratio.
8. Invite tenders and prepare bills for payment.
9. An estimation for an existing property is required for valuation.

TOTAL VOLUME OF CONCRETE = 107.7 CU.METER

BAR DIA (in mm)	WEIGHT (in New)
8	31643
10	8404
12	30788
16	26025
25	6141
*** TOTAL=	103001

Figure 6.1: Weight of concrete and steel from the STAAD PRO

S.No	Name of the work	Nos	Length (m)	Breadth (m)	Height (m)	Quantity (m^3)	Rate (perm^3)	Amount (Rs)
1.	Earth work Excavation and depositing of soil banks with an initial lead of 10m. and lift of 3 m complete for column footings	13	2.02	2.02	2.12	112.46	550	61,853
2.	P.C.C.(1:1:2) for column footings	13	1.50	1.50	1.20	35.1	1750	61,425
3.	Filling Basement with sand including cost and conveyance of all materials and labour charges etc.							
	a) Basement	1	8.97	16.7	0.90	134.81	550	93,451
	b) Under column footings	13	1.50	1.50	1.20	35.1		
						T=169.91		
4.	Brick masonry in CM (1:6) including and labour charges etc., superstructurer charges etc.							
	a) 9” walls	4	8.97	16.7	3.0	404.5	550	2,73,177
	b) 4” walls	8	16.7	0.23	3.0	92.184		
						T=496.68		
5.	Deductions							
	Doors D1	1	2.13	0.23	2.13	1.04		
	D2	1	1.52	0.23	2.13	0.75		
	D3	8	0.9	0.23	2.17	3.60	1750	13,493
	Windows (W)	11	0.9	0.23	0.90	2.05		
	Ventilator (V)	4	0.6	0.23	0.46	0.27		
						T=7.71		
6.	20mm thick plastering with CM (1:5) including cost and conveyance of all materials and labour					(m^2)	per (m^2) 550	2,11,420
	Inside of all rooms	1	37.84	-	3.00	113.52		
	Outside building	1	35.68	-	3.20	121.08		
	Ceiling	1	8.97	16.97	-	149.80		
						T=384.4		
7.	Flooring with marble stones over 10cm thick PCC (1:5:10) including cost and conveyance of all material and labour							
	of all rooms	1	8.97	16.7	-	149.80	3150	5,25,798

To Find Total Cost of Steel:-

We can estimate the cost of building by multiplying the weight of materials to cost of that material per kg.

"Total cost = weight of material in kgs x Rate of material"

- Total Weight Steel = 103001 N = 10503.17kg
- Rate of steel per Kg = Rs.54/-
- Total Cost = 10503.17 x 54
- Total cost of Steel = Rs.5,67,175/-
- Provision for Electrification arrangements = Rs.80,000/-
- Provision for Sanitary and water supply arrangements = Rs.1,50,000/-
- Provision for Cupboards = Rs.2,00,000/-
- Provision for RCC staircase with Ms railing = Rs.1,20,000/-
- Provision for Compound wall, Gate Sump = Rs.2,50,000/-
- Provision for Painting, Varnishing = Rs.80,000/-
- Provision for interior works, Elevation works = Rs.2,00,000/-
- Provision for Safety Grils, Doors = Rs.1,20,000/-
- Estimation charges for 1 floor without excavation charges = Rs.35,58,734/-
- Total estimation cost = Rs.1,77,93,670/-

Chapter 7

CONCLUSIONS

Based on the work carried out, the following conclusions were made:

1. In this project, PLANNING, ANALYSIS, DESIGNING AND ESTIMATION OF RESIDENTIAL BUILDING is carried out.

2. We all the members of our team has learned to plan a building with referring to National Building Code of India-2005. This project has made us to learn Drawing and Drafting the building plans using AUTO-CAD software.

3. The gravity load analysis performed manually as per IS code, through which the bending moments are obtained.

4. Using STAAD Pro software, the analysis has done as per IS codes. The design is safe in all aspects.

5. Finally, manually and software results are compared and observed that they are approximately equal.

6. The design of slab, beam, and column are design in limit state method, which is safe at control of deflection and in all aspects.

7. Finally, the structure is designed to withstand safely all loads liable to act throughout its life time, it shall also satisfy the serviceability requirements.

8. The major parameters that influence the cost excavation in construction industry are steel, cement, aggregate, bricks, composite materials, equipment's, electrical installations, plumbing works, sanitary works and labour costs are found. Thus, the objective of this project has been achieved and successfully evaluated.

Chapter 8

REFERENCES

- Dr. B.C.Punmia R.C.C Designs.
- Ashok. K.Jain, Reinforced concrete (limit state design), 6th edition.
- M.R.Dheerendrababu, Design of reinforced concrete Structures.
- N.SUBRAMANIAN Design of Reinforced Concrete Structures.
- S.S Bhavikathi Advanced Reinforced Concrete Structures.
- IS 456:2000 Plain and reinforced concrete code of practice.
- IS 875, Part-1 - (1987) Dead loads for buildings and structures.
- IS 875, Part-2 - (1987) Imposed loads for buildings and structures.
- IS 875, Part-3 - (1987) Wind loads for buildings and structures.
- National building code of India : 2005.