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DESIGN AND ANALYSIS FOR G+14 RCC STRUCTURE

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Abstract: Civil engineering is a field of great responsibility. The structures built by civil engineers are used by a lot of people. To ensure their comfort and safety is of the outmost importance. There is no scope for errors in this field as it may lead to catastrophic disasters. Improper design and analysis will lead to failure of the structure which will cause a huge loss of life and property. Hence proper analysis of the structure as per the safety factors and load combination is necessary for maintaining safety. In India, Bureau of Indian standard (BIS) is the apex body which is responsible to set the guidelines for engineering design, materials and working procedures. Design of all buildings must adhere to the 'National building Code of India' (NBC) published by the BIS. It provides the guidelines for all building requirements. For civil engineering activity it has been publishing the IS codes with the joint approval of civil engineering council. We ought to follow the IS guidelines while carrying out the construction activity. In this project we will deal with the design and analysis of a G+14 R.C.C. structure. We will be adhering to the guidelines mentioned in the NBC for the design of the building. We will use the guidelines mentioned in IS code 456-2000 for the analysis of the structure. Projects with presence of shear wall has been found to be more economic and safe as compared to brick masonry wall. Hence this project contains a design and comparison of shear wall with brick wall.
Keywords: BIS, NBC, IS 456-2000

I. INTRODUCTION

In the developing country like India, the objective of civil engineer is to serve humanity. Growing population persists to demand for new infrastructure by urbanization of rural regions. The need of proper design, analysis and estimation ensures safe and economic construction of the structure. In major metropolitan cities like Mumbai, we lack sufficient space for construction. Hence to provide maximum utility we have to go for high rise building. A proper design and planning should be done according to the principles of planning viz. aspect, prospect, privacy, sanitation, elegance, economy, etc. to provide maximum value to the project. Design of building can be done by manual designing or by use of softwares. Manual Design is now a day an outdated method as well as not accurate. Industry requires students who are good in using softwares. Hence, softwares will be used for the design purpose. This project involves design & analysis of G+14 RCC structure using softwares like AUTO CAD and STAAD PRO which will provide maximum optimization in terms of safety and expenditure. We have chosen STAAD Pro and AutoCAD because of its following advantages:

1. Easy to use interface,
2. Compatibility between softwares,
3. Conformation with the Indian Standard Codes,
4. Accurate and powerful tools,
5. Ability to work in layers,
6. Versatile nature of solving any type of problem,
7. Accuracy of the solution.

STAAD Pro features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification. AutoCAD is a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by Autodesk. AutoCAD is used across a wide range of industries, by architects, project managers, engineers, graphic designers, and many other professionals.

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II. NEED OF STUDY AND PROBLEM DEFINITION

It is important to make sure that a structure is going to bear the loads imposed on it during its use. For this structural analysis is has to be done by considering different load combinations and safety factors. Hence structural analysis is important. Designing a building with an original plan and to analyse it presents a challenge from the point of a student. There is a big gap between college centric theoretical study and industry based with respect to various softwares. Hence, all results will be generated using AutoCAD and STAAD Pro. Also design of 'shear wall' will be a great challenge as it is a new concept for a student. All the latest projects involves use of shear wall as it is faster to construct and helps in maximizing the carpet area. Comparison of the building with and without shear wall will give a great idea about the difference in the economy.

III. OBJECTIVES OF THE STUDY

1. Carrying out a complete design and analysis of main structural element of multi-storey building.
2. Study of typical floor plan, structural plan and general drawings of RCC.
3. To provide details of foundation.
4. To estimate the amount of raw material required for construction.
5. Getting familiar with structural softwares like STAAD PRO, AUTO CAD, etc.
6. To compare the effect of shear wall in construction with brick masonary.

IV. LITERATURE REVIEW

Preparing a literature review before starting up a new project is very beneficial. We get to know various information like merits and demerits of different methods, effect of shear wall, new technologies that could be used to design a building and many more. Some of the referred papers and journals are described below:

1.VVaralakshmi et al. (2014) used AutoCAD software to enhance the balance between economy and safety of G+5 building at Kukatpally, Hyderabad, India. The dead and live load calculations were done on the basis of Indian Standard 456-2000. The design of every structural element was done by limit state method.

2.M. D. Kevadkar et al. (2013) have used structural analysis to study the effect of shear wall to resist lateral load due to earthquake, wind, blast etc. They came to a conclusion that presence of shear wall in RCC structure can reduce the lateral displacement by 40 to 60%.

3.D. R. Deshmukh et al. (2016) have analyzed G+19 structure using STAAD Pro and compared the results with manual calculations. It was found that analysis using STAAD is much faster and efficient. When the structure is analyzed under various action such as axial, flexure, torsion, etc. the software provides accurate results confirming to Indian Standard.

4.M. S. Aainawala et al. (2014) have compare the design of building with different types of shear wall. Also, it was found that when shear wall is provided, the dimensions of columns and beams can be reduced resulting in providing economical structure.

5.R. Mohan et al. (2011) have focused on different methods of seismic analysis namely static and dynamic analysis. Dynamic analysis was found to be more accurate with Time History method being the most accurate as compared to Response spectrum method.

V. METHODOLOGY AND DATA COLLECTION

A. Proposed Methodology

1. The project began with selecting a site for development of G+14 structure.
2. The site was located at 'Sahar Plaza Complex, Chakala' in Andheri east.
3. Plot area of the site found to be 24000 sq.ft. with the FSI of 1.33
4. The plan designed has a built up area of 31920 sq.ft
5. A site visit was arranged to collect soil investigation report.
6. The responsible engineer Mr. Jayesh Mehta helped us to understand the soil report that was done back in 2011.
7. The planning work on the basis of brick masonry has been completed in this semester.
8. The analysis of shear wall and its comparison of structural effect and economy with brick masonry wall will be done in the final semester.

B. Data Collection

The following data was obtained from the above- mentioned site visit.

- Plot area = 24000 sq.ft

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- FSI=1.33
- Water wells completed at the site did not encounter ground water even up to 40 m below ground.
- Allowable Soil Bearing Capacity = 100 t/m3

VI. SOIL INVESTIGATION

Soil Investigation was done on the proposed site and following anlysis was done.

A. Foundation Recommendations

• Hard bedrock was encountered at depths between
1.85 m and 3.00 m below ground surface.
•Raft foundation for the proposed building can be designed for a maximum net bearing pressure of
100 t/m2
•Maximum settlement of foundation will be less than 10mm.
•A modulus of subgrade reaction of 10,000 t/m3 can be utilized for design of foundation.
•Ground Water was not encountered in the borehole.

B. Foundation Protection

•A 'moderate' exposure condition was assigned to this site.
•Following normal precautions are recommended to protect subsurface R.C.C.

Table 4.1 Recommended Precautions

Type of Cement	OPC
Minimum Grade of Reinforced Concrete	M20
Maximum water cement ration	.55
Minimum Cover	50mm

C. Data analysis of Allowable Bearing Capacity

Allowable Capacity = qend = Nj x Qu
Where,
Nj = Emperical coefficient = 0.1 to 0.4 (Conservatively adopted as 0.2 for bedrock).
Qu = Compressive Strength of rock = 490 t/m2
Allowable Capacity = 0.2 x 490
= 98 t/m2
We may use 100 t/m2 as allowable capacity.

D. Test Results of Rock Cores

Tests for determining strength and all index properties of soil are the most important for further procedure. We have studied various test like field density test; compaction test; shear strength test; consistency limit tests for liquid limit, plastic limit and shrinkage limit in geological engineering
Following are some tables for analysed data

Table 4.2 Sample Size

SR. No.	Bore Hole no	Core No.	Depth m	Diameter cm	Height cm
1	BH-01	44	12.0-13.50	5.5	11.1
2	BH-01	86	16.5-18	5.6	11
3	BH-02	75	10.0-11.50	5.9	11.7
4	BH-02	93	13.0-14.50	5.4	11.2

Table 4.3 Strength Properties

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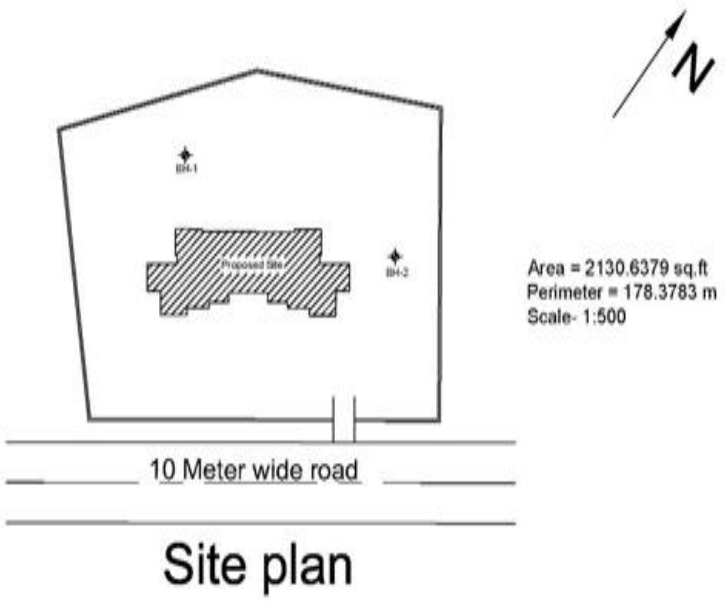
SR. No.	Bore Hole no	Core No.	Correction factor	Condition of test	Failure Load KN	Uniaxial Compressive Strength Kg/cm2
1	BH-01	44	1.00	Soaked	134	576
2	BH-01	86	1.00	Soaked	157	653
3	BH-02	75	1.00	Soaked	31	117
4	BH-02	93	1.00	Soaked	11	49

Table 4.4 Index Properties

SR. No.	Bore Hole no	Core No.	Porosity%	Water Absorption	Dry Density
1	BH-01	44	5.12	2.19	2.34
2	BH-01	86	4.28	1.83	2.34
3	BH-02	75	14.37	6.82	2.11
4	BH-02	93	14.42	7.12	2.02



Site plan

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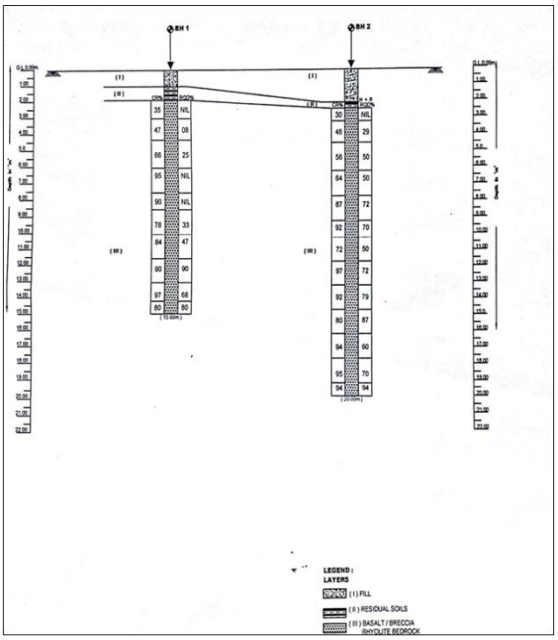


VII. BUILT-UP AREA CALCULATION AND PROPOSED PLANS

A. Area Calculation

Following are the calculations for built-up area and deciding area for each flat.

1. Built-up area Calculation:

Total Built-up area = Plot area x FSI

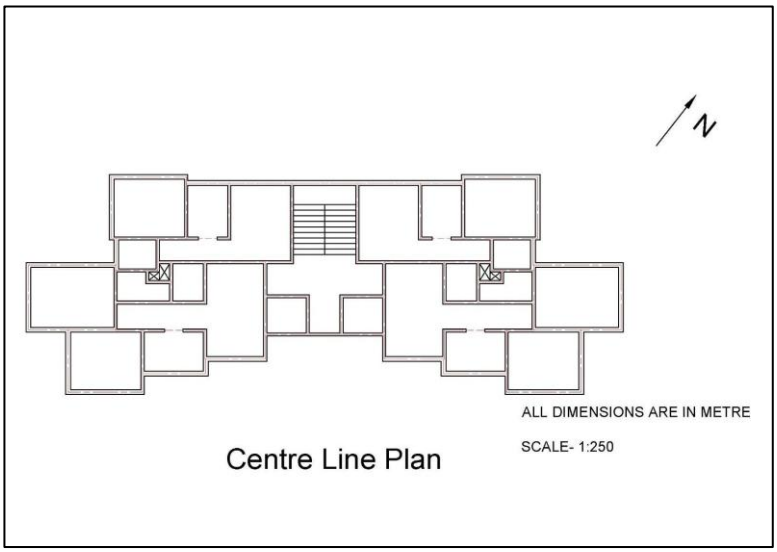
= 24000 x 1.33

= 31920 sq.ft.

Built-up area of each floor = 31920/(G+14)

=31920/15

= 2130 sq.ft.



2. Total Number of Flats on each floor = 4

- 2 Flats of 2 BHK each with 650 sq.ft.
- 2 Flast of 1 BHK each with 400 sq.ft

B. Prepareds Plans

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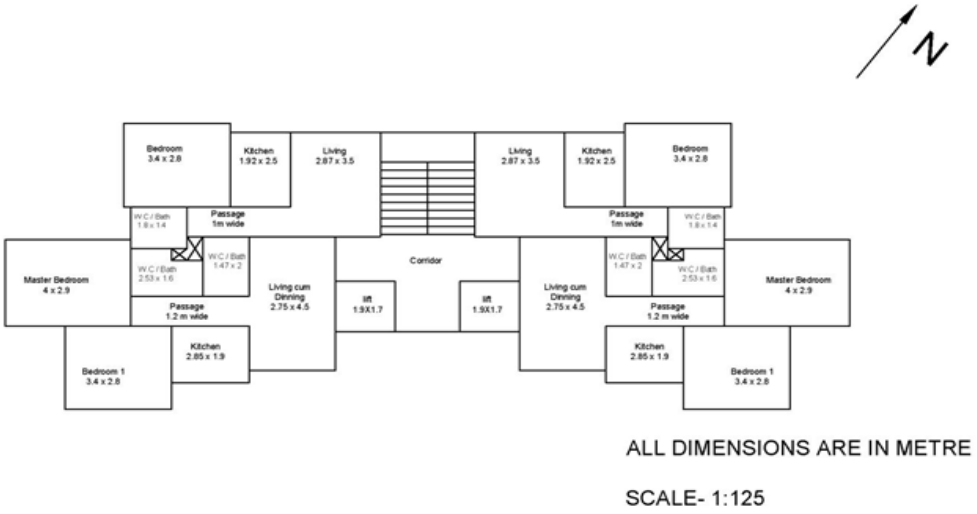
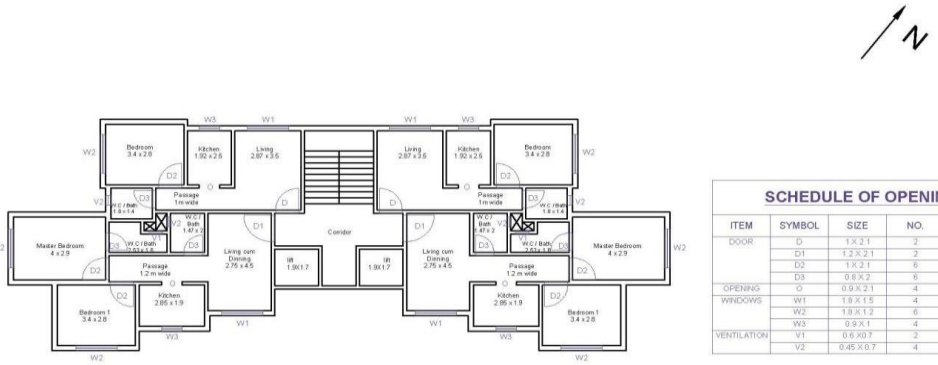
1. Line Plan
2. Centre Line Plan
3. Developed Plan



ALL DIMENSIONS ARE IN METRE

SCALE- 1:125

Line Plan



SCHEDULE OF OPENINGS

ITEM	SYMBOL	SIZE	NO.	DESCRIPTION
DOOR	D	1 X 2.1	2	PANELLED DOOR
	D1	1.2 X 2.1	2	PANELLED DOOR
	D2	1 X 2.1	6	FLUSH DOOR
	D3	0.6 X 2	6	FLUSH DOOR
OPENING	O	0.9 X 2.1	4	
WINDOWS	W1	1.8 X 1.5	4	SLIDING WINDOW
	W2	1.8 X 1.2	6	SLIDING WINDOW
	W3	0.9 X 1	4	SLIDING WINDOW
VENTILATION	V1	0.6 X 0.7	2	LOUVERED
	V2	0.45 X 0.7	4	LOUVERED

ALL DIMENSIONS ARE IN METRE

SCALE- 1:200

Developed Plan

VIII. EXPECTED OUTCOMES

1. Implementation of knowledge of the subjects like Building drawing and design, Structural Analysis and others during the course of study.
2. Implementation of knowledge of soft wares for planning and design purpose using AutoCAD and STAAD Pro.
3. From the various paper referred, it is expected that the design of building using shear wall is more economical than building with brick masonry.
4. Shear walls helps to reduce the size of columns which in turn results in increasing the room size.

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