PLANNING, DESIGN & ESTIMAION OF A G+2 RESIDENTIAL APARTMENT WITHIN A COMPLEX AT PIPULPATI MORE, HOOGHLY

Raja Saha[1], Rabi Das[2], Minhaj Aktar Mollah[3], Abhirup Sadhukhan[4], Jhilik Das[5], Shayantani Dutta[6]

[12]*Lecturer, Department of Civil Engineering, Technique Polytechnic Institute, Hooghly, India*
[3456] *Student, Department of Civil Engineering, Technique Polytechnic Institute, Hooghly, India*

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Abstract - *The structural planning and design requires both imagination and conceptual thinking along with sound knowledge of science of structural engineering, recent design codes by laws, intuition and proper judgment.*

In this present study G+ 2 residential apartment for a residential complex at Pipulpati More, Hooghly. Using AUTOCAD and STAAD-Pro software. Also the estimation of various items of works along with rate analysis with recent schedule of PWD is done.

The framing arrangement and column location of the building were provided based on architectural and structural requirements. This report covers the design process in the following order.

The bearing capacity of soil of that particular site at Pipulpati was found to be 150kN/m². The geographical map of that site is also given in this study.

*Key Words***:** Apartment Design at Pipulpati, G+2 residential project

1.INTRODUCTION

Buildings are the living structures which comes in a wide amount of shapes and functions the design and estimation process entirely depends on the type of building, it's complexity and number of stories. It not only requires imagination and conceptual thinking but also sound knowledge of science of structural engineering. Here in this report, the design of each structural element is done on the basis of the clauses given by Indian standard to ensure safety and economy. In this present study all the concerned drawings of AUTOCAD and STAAD Pro are given. Also the layout and the screenshot of the geographical position of the site is given. Firstly, the architectural drawings of the buildings are studied, and then depending upon the calculated amount of Dead Load and Live Load combination, the sectional sizes and reinforcement are designed.

2. AREA STATEMENT

- Area of Plot – 2200 m²
- Area of each building unit – 210 m²
- Floor-Area ratio - 0.38

3. SURVEY DATA

- RL of Point A=7.592 m above MSL
- RL of Point B=7.625 m above MSL
- RL of Point C=7.765 m above MSL
- RL of Point D=7.766 m above MSL
- Length of AB =70.52m
- Length of DC =72.36m
- Length of DA=67.69m
- Length of BC=56.70m

Area of plot=1/2 X AB X{(DA+CB)/2}

   =1/2 X 70.52 X{(67.69+56.70)/2} =2192.99m²
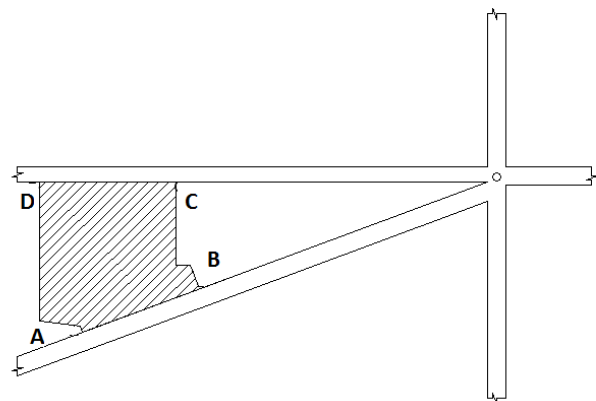

Fig -1: Plot area of the land

4. GEOGRAPHICAL SYSTEM OF THE PLOT

Fig -2: Geographical layout of the plot

5. GEOMETRY OF THE BUILDING

The building is regular in plan with curved surface at the two side ends and in elevation having storey height of 3.3m where all storey's are of the same height. The ground floor is used as the parking space for the users. The building consist of four bays along the two horizontal directions of varying bay length. The building consist of square and circular columns, straight and curved beams of width 0.25m and slab thickness of 100mm. the size of column is constant throughout all storey and the size of beam is constant throughout each storey.
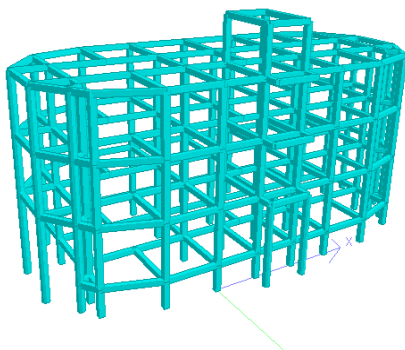

Fig -3: 3-D modeling view of STAAD-Pro

6. DESIGNING OF CRITICAL SLAB PANEL (S1)

In this present paper two types of slabs are designed namely roof slab and floor slab. Roof slab is a continuous slab on the top of the building which is also known as terrace. Generally terrace has less live load and it is empty in most of the time except at some occasions. In designing the roof slab dead loads (i.e., due to water proofing=2.5KN/m2, self-weight of the slab= 0.1x1x25 = 2.5KN/m²) and live loads

(roof=1KN/m2) are considered. For roof slab main steel is provided along the short span only and the load is transferred to two opposite supports only. The steel along the long span just acts as distribution steel and is not designed for transferring the load but to distribute the load and to resist shrinkage and temperature stresses. For floor slab live load is more when compared to the roof slab. Therefore in designing of floor slab dead loads (i.e., due to floor finish = 1KN/m2, sanitary blocks including filling = 2KN/m² and self-weight of the slab = 0.1×1×25) and Live loads (i.e., Sanitary blocks public = 3KN/m²) are considered. The designing is followed IS:456-2000. The details of reinforcement provided in slabs are given table.1

Table.1 Details of reinforcement provided in critical slab panel for G+2 Apartment

Sl. No	Short Span Steel	Long Span Steel	Slab Thickness	Remarks
S1	8mm Ø @ 250mm c/c alternate cranks	8mm Ø @ 250mm c/c alternate cranks	100mm	Two-Way

7. DESIGNING OF CRITICAL BEAM (FB2)

A reinforced concrete beam should be able to resist tensile compressive and shear stresses induced in it by the loads on the beam. Firstly, the DL and LL from the slab is calculated assuming the trapezium-triangular distribution of the primary load. Secondly, the geometrical diagram is generated using STAAD Pro software and the BMD is taken out finally depending upon the BMD value of the critical beam & then reinforcement is designed as per the clauses of IS:456-2000. The reinforcement arrangement of the critical beam is shown in Fig 4.
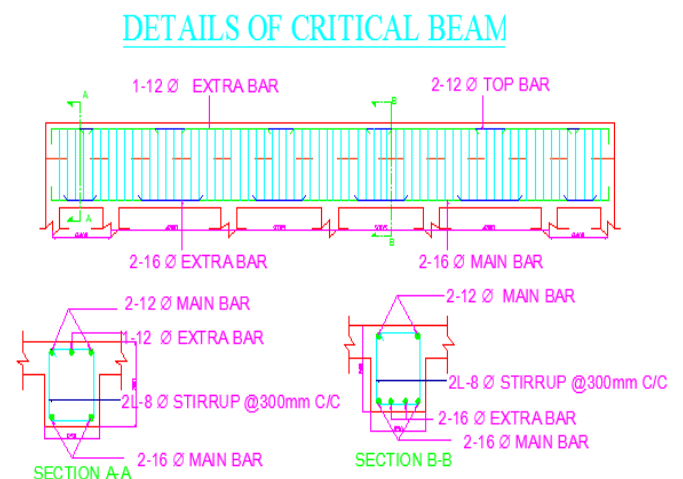

Fig -4: Reinf. Detailing of critical beam FB2

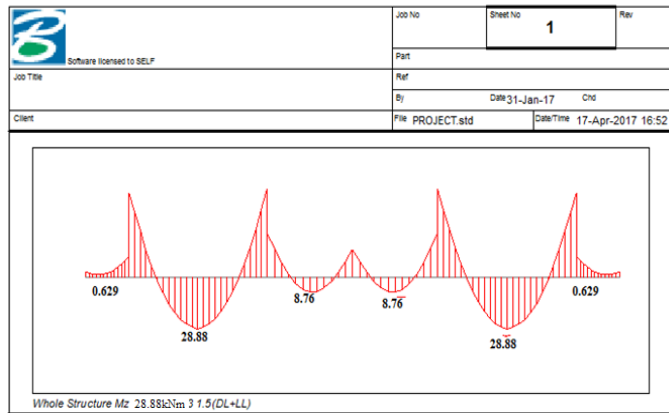## 8. BENDING MOMENT VALUES OF CRITICAL BEAM FROM STAAD Pro.

Fig -5: BMD from STAAD
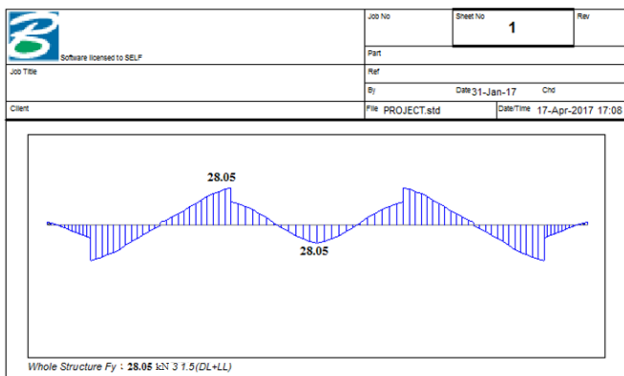
## 9. SHEAR FORCE VALUES OF CRITICAL BEAM

Fig -6: SFD from STAAD

10. DESIGNING OF CRITICAL COLUMNS (C2 & A1)

A column in general may be defined as a member carrying direct axial load which causes compressive stresses of such magnitude that these stresses largely control its design. Here square as well as circular section of column is designed. All the columns are designed as long column and the columns are designed on the basis of SP16. The design moment is followed IS456:2000 code. The schedule of columns are given in Table.2
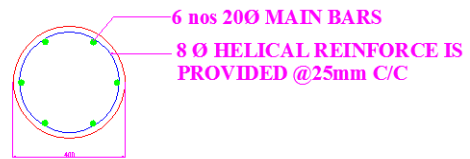
Table.2 Column schedule

Colum Type	Mix	Size	Main Steel	Tie Lateral/Spiral
C2	M-20	300x300	8Nos 20Ø bars	8mm Ø @200mm c/c
A1	M-20	400Dia	6Nos 20Ø bars	8mm Ø @25mm c/c

DETAILS OF CRITICAL COLUMN
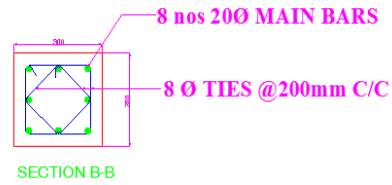
DETAILS OF CIRCULAR COLUMN

11. STOREY WISE NODAL LOAD ON CRITICAL COLUMN

Table.3 Column schedule

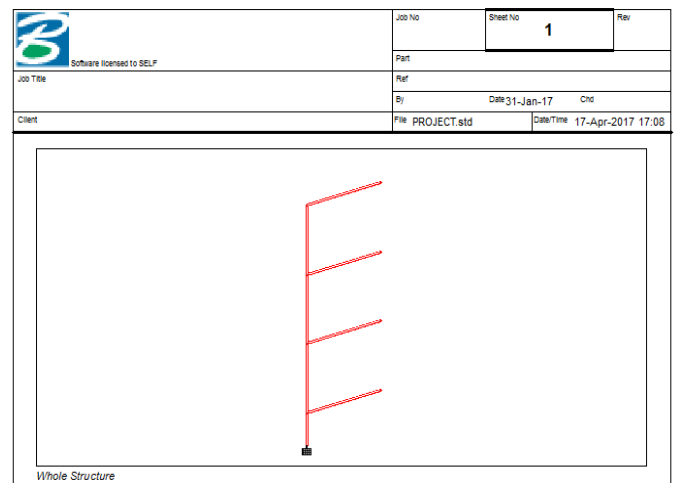| Beam	L/C	Node	Fx kN
354	3 1.5(DL+LL)	132	120.26
272	3 1.5(DL+LL)	101	507.69
190	3 1.5(DL+LL)	70	806.36
108	3 1.5(DL+LL)	32	1215.89

Fig -7: Storey details from STAAD

12. DESIGNING OF FOUNDATION

Foundation design involves a soil study to establish the most appropriate type of foundation and a structural design to determine footing dimensions and required amount of reinforcement. Because compressive strength of the soil is generally much weaker than that of the concrete, the contact area between the soil and the footing is much larger than that of the columns and walls. The present study indicates that the site is located in granite rock which is suitable for strong foundation. To determine the bearing capacity of soil, samples of soil are tested in the laboratory and found that the Safe bearing capacity of soil is 150KN/M^2 at a depth of 1.2m. Depending on the bearing capacity of soil and designing of structure isolated square footings and combined footing of M-20 mix and reinforced with HYSD bars of Fe-500 is designed as per IS :456-2000. Therefore the footing is isolated rectangular sloped footing with pedestal. The slope is provided to decrease the concrete in the construction which results into economic construction. A pedestal is used to carry the loads from metal columns through the floor and soil to the footing when the footing is at some depth in the ground. And an isolated column footing transfers the loads from a single column to the supporting soil. The footing is designed for flexure, punching or two-way shear, and flexural or one-way shear. The allowable soil bearing pressure determines the size of the footing, and the punching shear governs the depth of the footing. The schedule of footings in the site are listed in Table.3 and general footing plan and pedestal footing plan is shown in Fig.8.

Table.4 Schedule of isolated column footing

Footing Type	Mix	Size	Main Steel
F1	M-20	300x300	12 Ø @ 250mm c/c bothways

DETAILS OF FOOTING
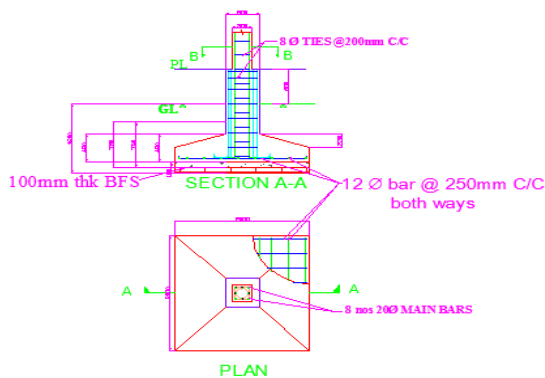
Fig -8: Reinf. Detailing of footing

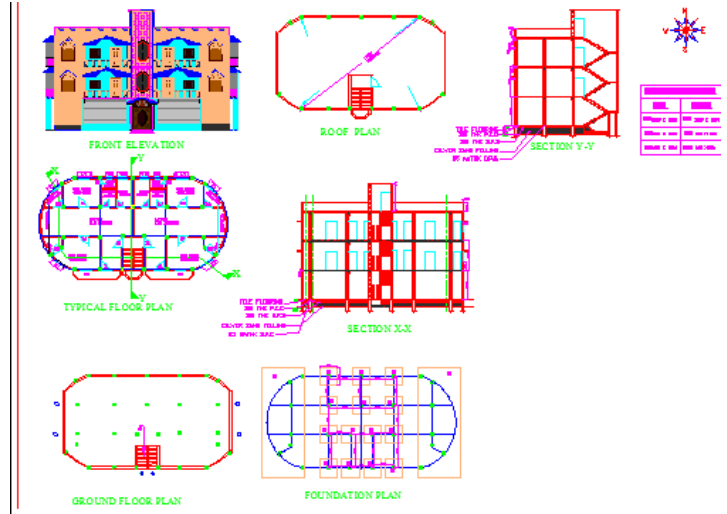## 13. OTHER NECESSARY DRAWINGS

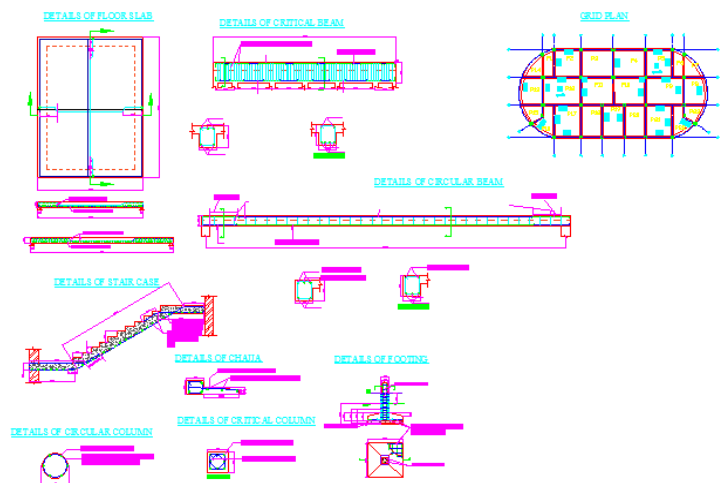**Fig -9**: Architectural drawing sheet
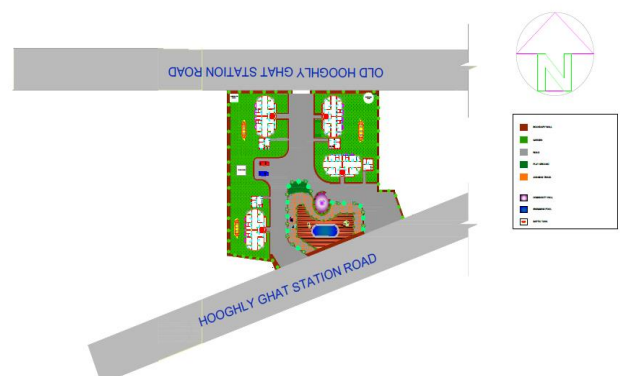

Fig -10: Structural drawing sheet

Fig -11: Layout plan

14. ABSTRACT OF ESTIMATES AND RATE ANALYSIS

Table.5

Item No	Quantities	Total Amount
Concrete	296 cuM	Rs. 1042861/-
Steel	24M	Rs. 1206909/-

15. CONCLUSION

While analyzing and executing our project "Planning, Designing and Estimation of G+2 residential apartment Building" one will be able to learn the proper application of all "Engineering Subject" studied till now along with this one will also be able to learn the effective use of IS: 456-2000, IS: 875(part-1), SP: 16, SP: 34, Building bye laws, PWD schedule for various building materials, with this project. We have learned the various aspects of planning a building, we were able to understand how to locate the position and fix the standard dimension of various component parts of a building keeping the building bye laws of area in vicinity intact, application of AUTO-CAD also the comparative analysis is done by STAAD Pro.

We have learned the design of various structure parts of a building using limit state method of design and following the proper specifications required from IS:456, IS:875, SP:16, SP:34. We were also able to get familiar with the standard dimensions of above items adopted in actual field practice.

We were able to learn the procedure of estimating the total expenditure of any building project by calculating quality of individual work done and individual building material used and there by applying the PWD scheduled price.

REFERENCES

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[2] IS:456-2000

[3] Estimating, Costing, Specification & Valuation in Civil Engineering by M. Chakraborti.

[4] Building Material & Construction by Gurucharan Singh

[5] Design of R.C.C structure by Nilam Sharma

[6] SP:34

[7] SP:16

[8] Revised rate schedule of PWD of building works.

BIOGRAPHIES

Live in Kolkata, west Bengal. Passed B. Tech in Civil Engineering in the year of 2012 from Camellia School Of Engineering & Technology . Presently associated with Technique Polytechnic Institute (Hooghly) as a Lecturer in Civil Engineering Department.

Live in Kolkata, west Bengal. Passed B. Tech in Civil Engineering in the year of 2015 from Narula Institute Of Technology. Presently associated with Technique Polytechnic Institute (Hooghly) as a Lecturer in Civil Engineering Department.

Live in Hooghly, west Bengal. Pursuing diploma in Civil Engineering from Technique Polytechnic Institute. Year of passing 2017.

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