DESIGN OF SLAB OF RESIDENTIAL BUILDING FOR WIND LOADING G+10 STOREYS

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ABSTRACT

Wind loads are randomly applied dynamic loads. The intensity of the wind pressure on the surface of a structure depends on wind velocity, air density, orientation of the structure, area of contact surface, and shape of the structure. Because of the complexity involved in defining both the dynamic wind load and the behavior of an indeterminate steel structure when subjected to wind loads, the design criteria adopted by building codes and standards have been based on the application of an equivalent static wind pressure. In this project we are going design G+10 residential building (with parking) considering wind load in Ambikapur, Surguja by considering Wind load along with dead and live load in designing the high rise building because wind load exerts horizontal load on building. This load on the structure induces large dynamic motions, including oscillations. We have IS CODE-456:2000, IS CODE 875:1987 and Stadd Pro Software for the design.

Keywords: - Wind intensity, Wind pressure, High rise structure, Bending moment, Reinforcement, slab design

1. INTRODUCTION

All building has to bear certain loads which are compulsory to act on structure. We do not give due importance to some of them by just neglecting their effect as they have nearly zero value at certain place while designing any building. But they have their impact on structure on long term basis.

Wind is the motion of air. At earth surface it has very low velocity but as we move higher up the velocity increases as well as wind pressure also. At certain height wind velocity has no or nearly very less effect.

Due to uneven heating of earth hot air rises up as on heating they expand and create a pressure difference due to which air move from high pressure to low pressure area causing wind to blow. Trade wind, polar wind, monsoon wind has its high intensity. Cyclone, tornado is the worst case of moving wind. These high velocity winds create vibration effect on the upper portion of high rise building whereas the lower portion is stationary which has to bear all the loads of structure.

Ambikapur is situated at $23.1355\,^0N$ & $83.1818\,^0E$ in surguja district of Chhattisgarh state it is surrounded by mountain terrain from all sides. The Average wind speed is 7.5 mph and Basic wind speed is 35 Km/h according to meteorological office Ambikapur.

Slab are the most important portion of the building it covers the structure from top portion and act as floor for the subsequent storey's it has to bear the weight of upper floors as well as live and impact load. Flat slab and normal beam column slab are two types of slab mainly designed for structure. Here we will perform the designing of normal beam column slab for the wind load of Ambikapur area.

2. METHODOLGY AND DESIGN DATA

The building drawing is constructed in AutoCAD software and the designing is done in STAAD.Pro software. The drawing of building is imported from AutoCAD to STAAD.Pro For analysis and designing in the software for finding out the concrete design.
IS CODES used in the designing are IS 456:2000 for RCC design, IS 875:1957 part I, II, III, V for Dead load, Live load, Wind load and loading combination

2.1. Drawing detail-

Built-up area of building is 3700 Sq feet which comprises of 2 Bedroom, Hall and Kitchen. Four unit in each floor. Each unit has one common wash area and dining area separate. Each unit is constructed in 871 Sq. feet.
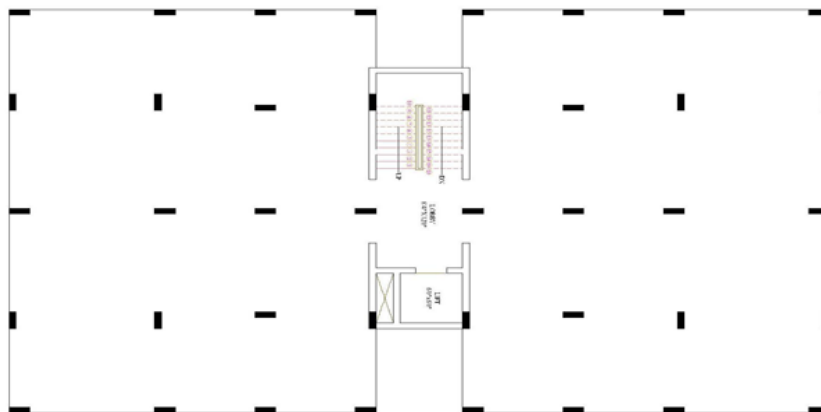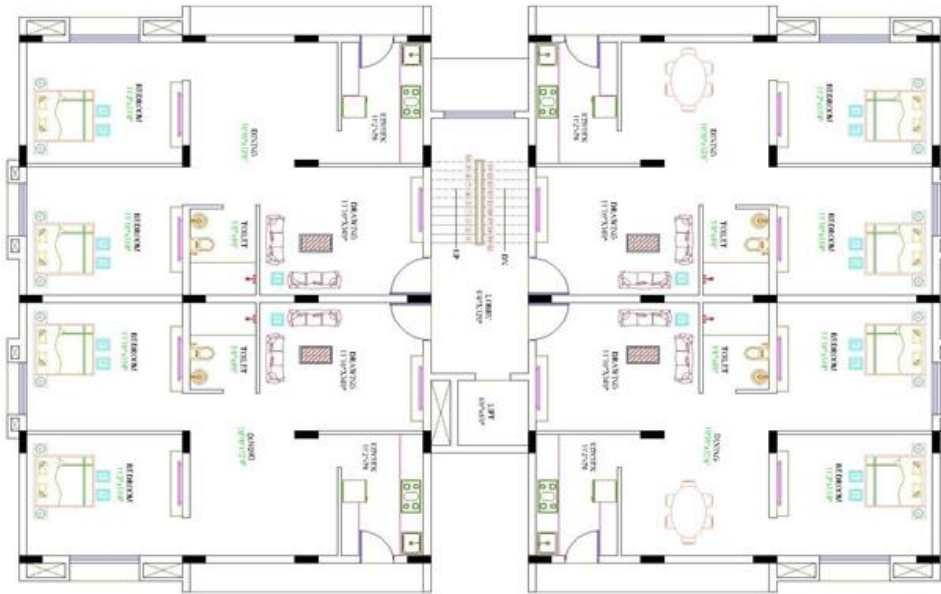

Figure 1 Basement plan of building

Figure 2 First to Tenth Floor plan

2.2. Data for Designing of building

2.2.1. For Slab design

Top cover-30 mm, Bottom cover=30 mm, Thickness of slab-15 cm, Aggregate size 20 mm, Strength of concrete-C25/30, Main reinforcement HYSD 500

2.2.2. For beam and column

Column size and beam size-300 mm X 450 mm, 450mm X 300 mm, Column Cover 40 mm, Beam cover 25 mm. Number of stories-11 (G+10),

2.2.3. Designing Case

Wind load and combination, Location- Ambikapur Surguja, Chhattisgarh, Type of soil-Medium Soil, Type of footing- Raft foundation, Concrete Grade –M25, Steel grade- HYSD 500 bar.

2.3. Procedure-

1) Planning of Multistory residential building is carried out in AutoCAD software, and hence decide the place of column and beams.
2) Importing AutoCAD file to Stadd pro software for modeling is carried out by Import command in file menu of Stadd pro.
3) Modeling is carried out using the plan layout which is imported from AutoCAD in 3D Form by grid setting.
4) Applying end condition as fixed one and defining the property of section along with dimensions selection and assigning the properties to member's column, beams and slabs.
5) Defining the loads and load combination as per IS Code 456:2000 and applying them in the structure.
6) Analyzing the structure for Wind loading and then processing the concrete designing to get the concrete design for the building.

3. RESULT

Slab design and Bending moment diagram obtained after designing in Stadd Pro

Table 1: Slab Design detail

Slab Region no	Area (mm²)	Maximum Moment (kNm)		Reinforcement (Dia. of bar)	
		Minor	Major	X axis	Y axis
1	9.728	1.13	3.737	12 mm	10 mm
2	11.822	0.818	1.745	12 mm	10mm
3	11.822	0.829	1.889	12 mm	10 mm
4	9.728	1.128	3.726	12 mm	10mm
5	17.123	0.62	2.378	12 mm	10 mm
6	14.09	1.649	3.37	12 mm	10mm
7	10.401	0.517	3.313	12 mm	10 mm
8	12.641	0.034	1.426	12 mm	10mm
9	12.641	0.032	1.437	12 mm	10 mm
10	10.401	0.519	3.324	12 mm	10mm
11	9.728	0.527	3.679	12 mm	10 mm
12	11.822	0.29	1.458	12 mm	10mm
13	11.822	0.289	1.446	12 mm	10 mm
14	9.728	0.525	3.668	12 mm	10 mm
15	9.728	1.128	3.726	12 mm	10mm
16	11.822	0.829	1.889	12 mm	10 mm
17	11.822	0.818	1.893	12 mm	10mm
18	9.728	1.13	3.737	12 mm	10 mm
19	9.728	0.527	3.679	12 mm	10mm
20	11.822	0.29	1.458	12 mm	10 mm
21	11.822	0.289	1.446	12 mm	10mm
22	9.728	0.525	3.668	12 mm	10 mm
23	14.09	1.649	3.37	12 mm	10mm
24	17.123	0.62	2.377	12 mm	10 mm
25	17.123	0.612	2.377	12 mm	10mm
26	14.09	1.651	3.382	12 mm	10 mm

Bending moment diagrams for hogging and sagging moment in slabs are shown below: -
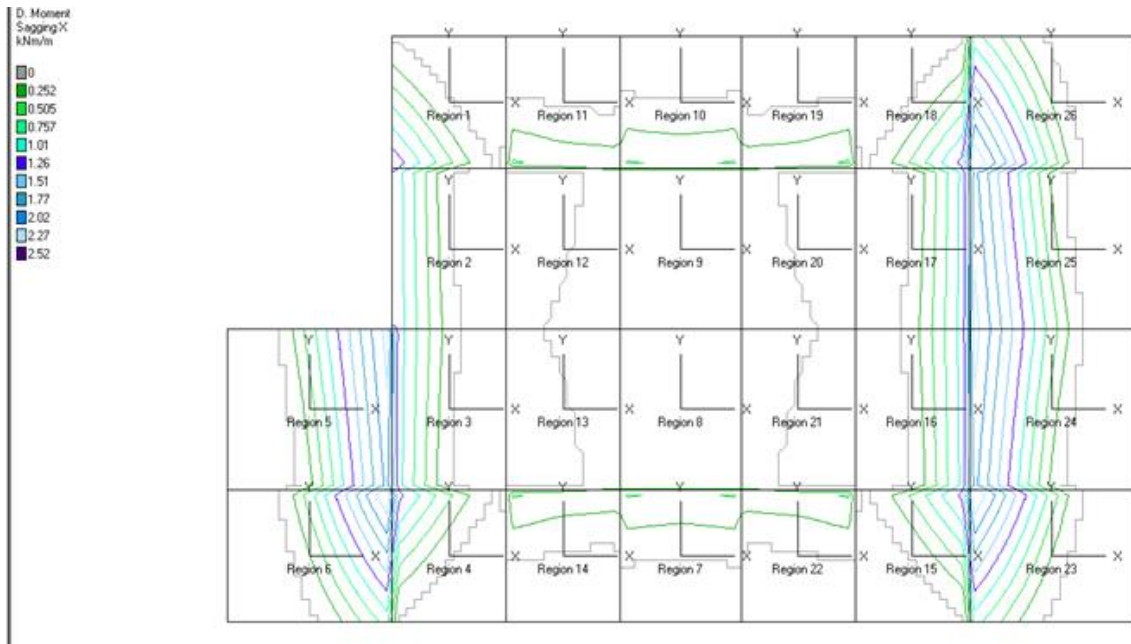
Figure 3 Sagging bending moment in Slab along X axis
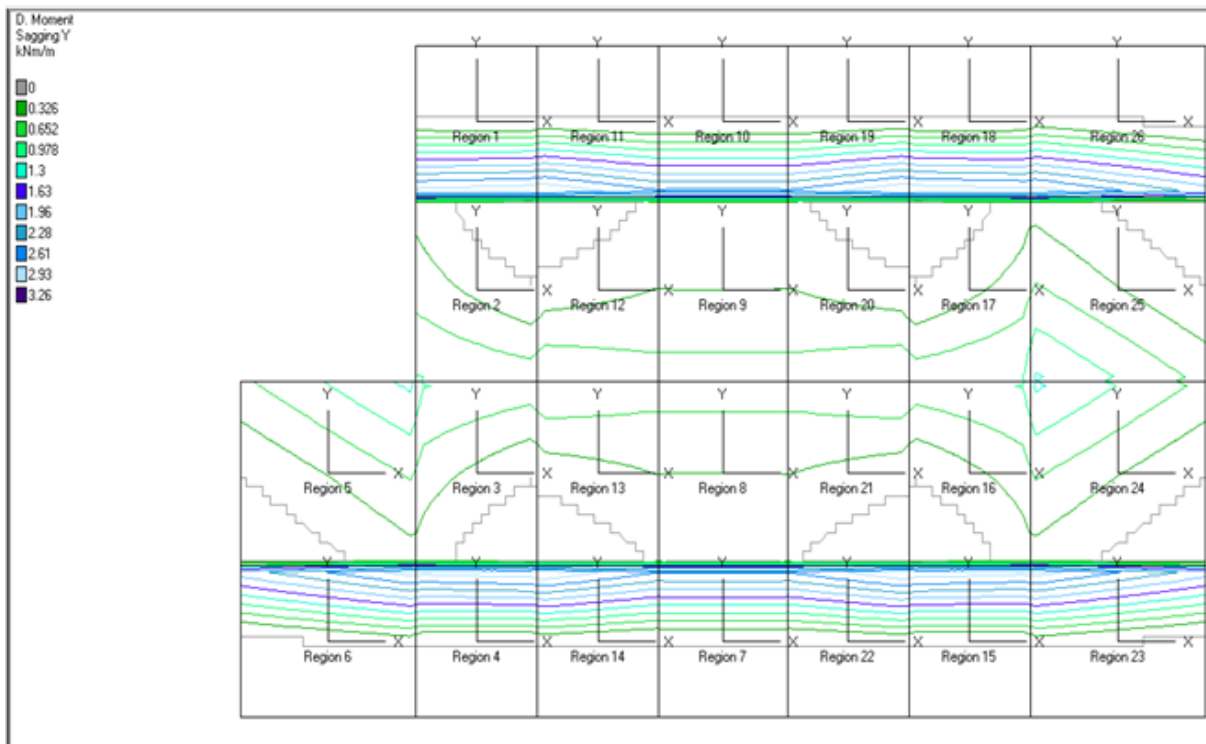
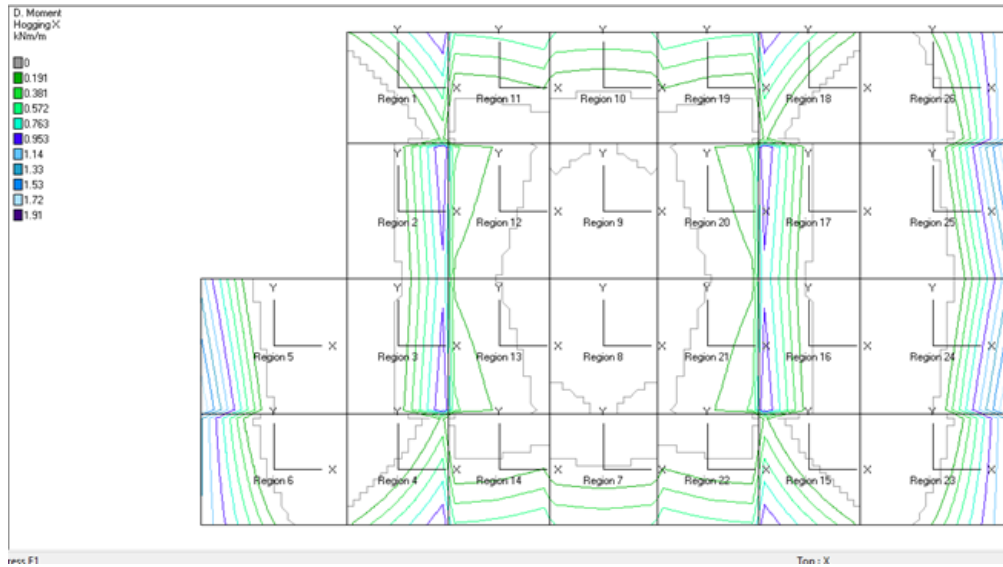**Figure 4** Sagging bending moment in Slab along Y axis

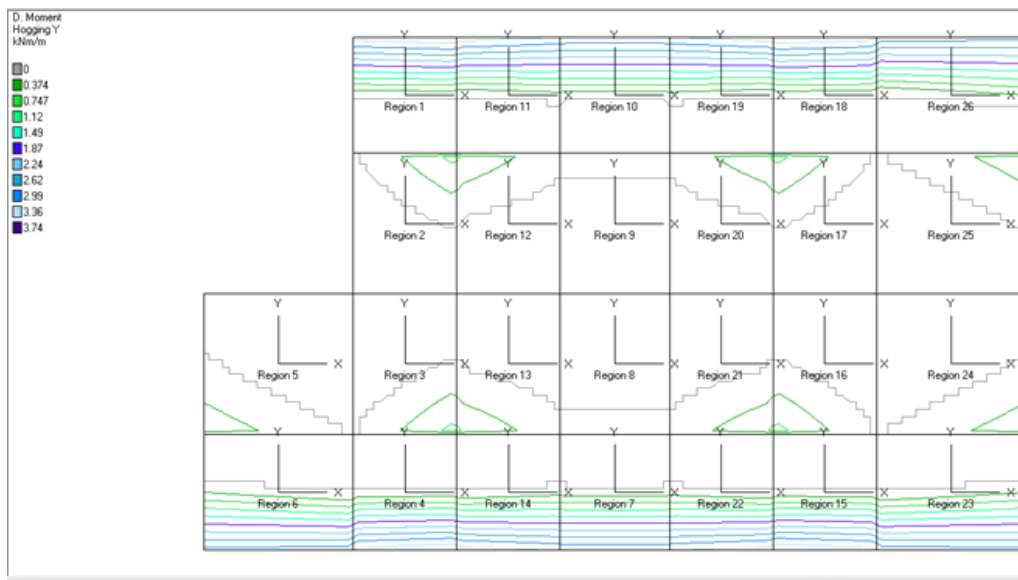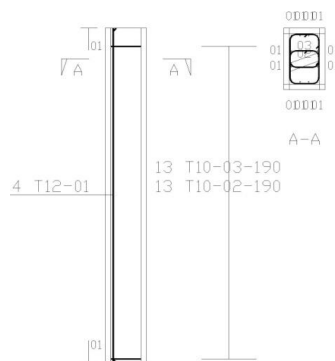**Figure 5** Hogging bending moment in Slab along X axis

Figure 6 Hogging bending moment in Slab along Y axis

3.1. Beam and Column Design

Column Detail

Beam Detail: - 2-12 mm Bar at top and 2-12 mm bar at bottom will be required along with curtailment as per design result.
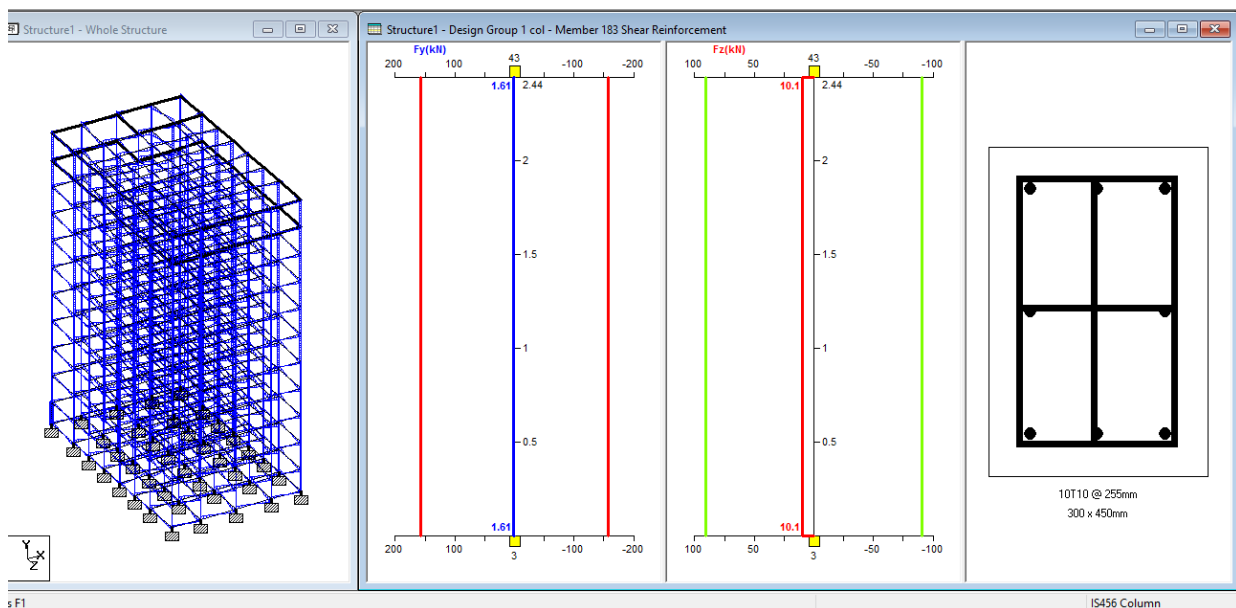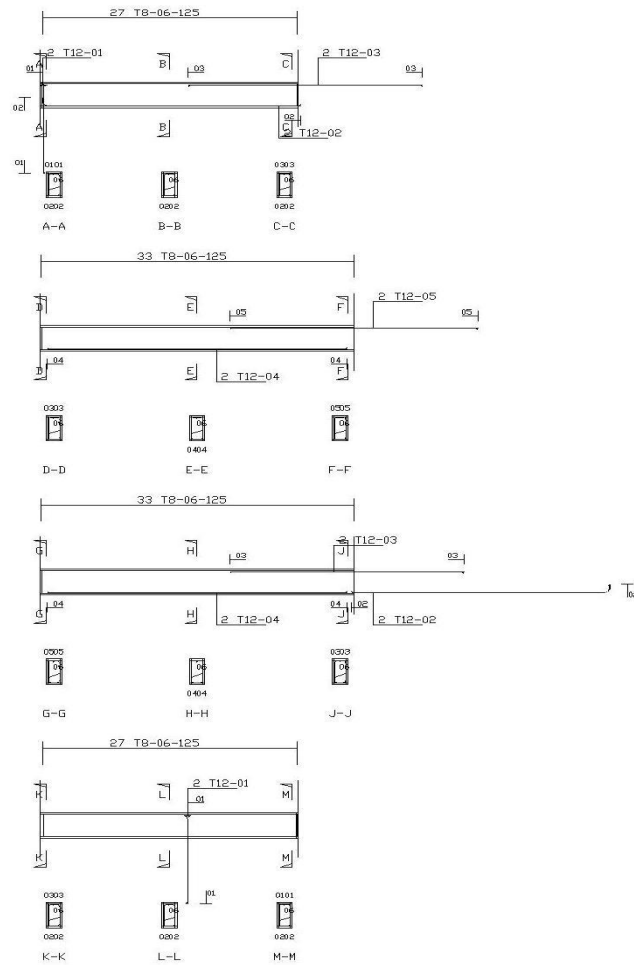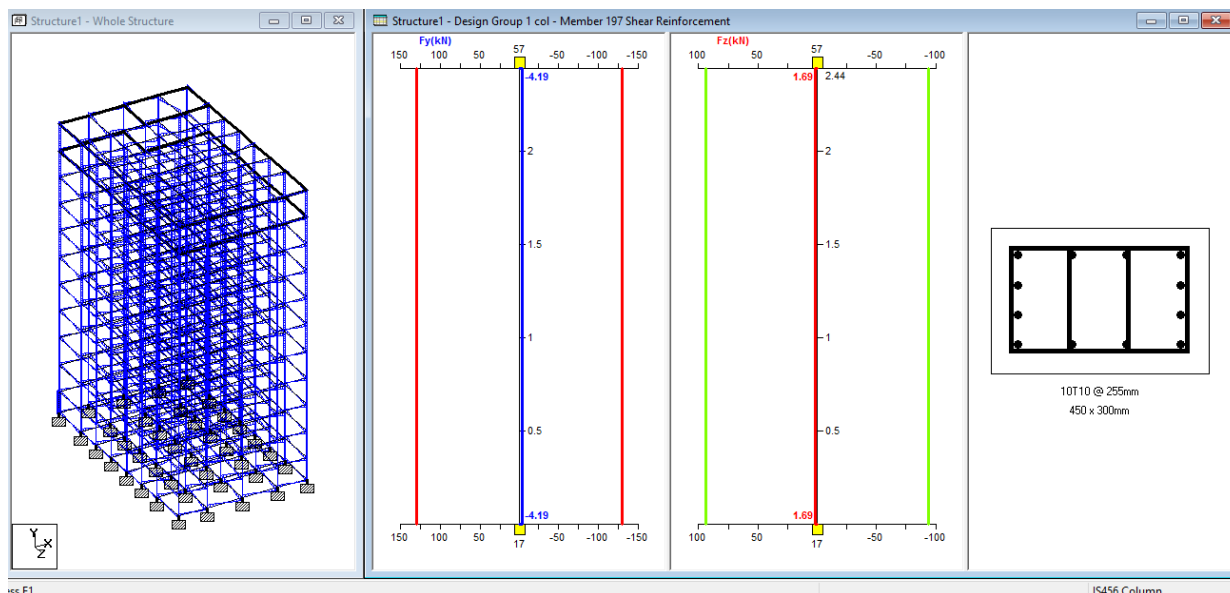

Figure 7 Shear force diagram and column detail for structure

Table 2 Reinforcement detail for column

Position	Distance to C/L (cm)	Size	No
Corner	9.2	16	4
Top	0	16	2
Side	0	16	2

Figure 8 Shear force diagram and column detail for structure

Table 3 Reinforcement detail for column

Position	Distance to C/L (cm)	Size	No
Corner	16.7	16	4
Top	08.3	16	4
Top	00	16	2
Side	4.6	16	4
Side	0	16	2
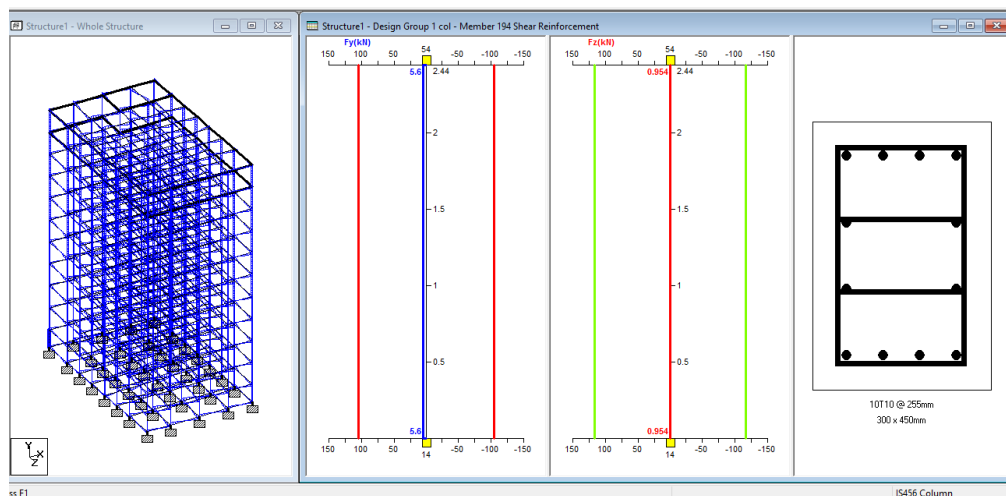
Figure 9 Shear force diagram and column detail for structure

Table 4 Reinforcement detail for column

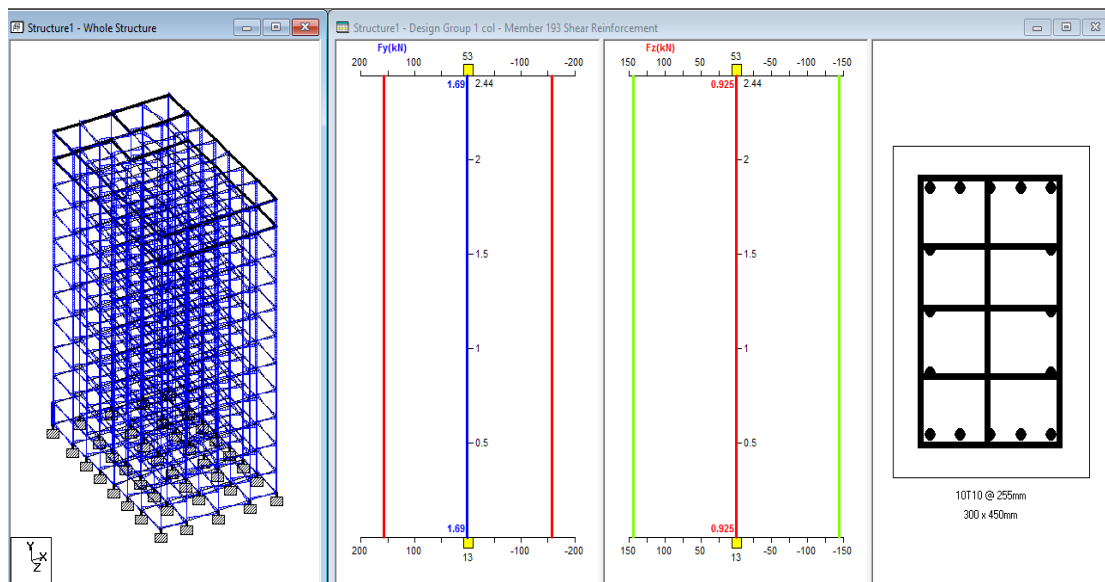| Position	Distance to C/L (cm)	Size	No
Corner	9.4	16/12	4
Top	3.1	16/12	4
Side	5.6	16/12	2

Figure 10 Shear force diagram and column detail for structure

Table 5 Reinforcement detail for column

Position	Distance to C/L (cm)	Size	No
Corner	16.7	16	4
Top	4.6	16	4
Top	0	16	2
Side	8.3	16	4
Side	0	16	2

4. CONCLUSION

The building is safe in all the aspect after designing. There will not be any effect of wind on the structure for such wind speed which is prevailing in Ambikapur. Slab is two-way slabs with 12 mm diameter reinforcing bar along x axis and 10 mm diameter bar along y axis. In spite of being 10th storey building the building did not fail in 300mm X450 mm column and beam dimension. But accordingly, the reinforcement of bar changes. The beam and column longitudinal reinforcement is of 16 mm, 12 mm and 10mm with 10- and 8-mm stirrups @ 350mm c/c.

5. SCOPE FOR FUTURE WORK-

We can design the same building using different software and check the results variation in all and also tally the same with analytical one.

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