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ANALYSIS AND DESIGN OF G+4 RESIDENTIAL BUILDING USING ETABS

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Abstract- ETABS stands for Extended Three-Dimensional Analysis of Building Systems. ETABS is commonly used to analyze: Skyscrapers, concrete structures, low and high rise buildings, and portal frame structures. The case study in this paper mainly emphasizes on structural behavior of multi-storey building for different plan configurations like rectangular, C, L and I-shape. Modelling of 15-storeys R.C.C. framed building is done on the ETABS software for analysis ETABS issue, for analysis and design for building systems. ETABS features are contain powerful graphical interface coupled with unmatched modeling, analytical, and design procedures, all integrated using a common database. STAAD and ETABS both of the software are well equipped and very much capable of handling different shape of the structures, static and dynamic loadings and different material properties.

Keywords- Etabs, Seismic loads, Deflections, wind loads, Reinforced concrete

I. INTRODUCTION

The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings .ETABS offers unmatched 3D object based modeling and visualization tools , blazingly fast linear and nonlinear analytical power , sophisticated and comprehensive design capabilities for a wide-range of materials and insightful graphic displays , reports and schematic drawings that allow users to quickly and easily decipher and understand analysis and design results. ETABS is engineering software which is used to analysis and design multi-storey building. ETABS stands for Extended Three-Dimensional (3D) Analysis of Building Systems. CAD drawings can be converted directly into ETABS models or used as templates in which ETABS objects may be overlaid. Report is generated directly in the software with complete reinforcement details. Many of the floor levels in buildings are similar which reduce modelling and design time. Fast model generation using the concept of similar stories. Different materials can be assigned to the structural elements

within the same model such as steel, RCC, composite or any other user-defined material. CAD drawings can be converted directly into ETABS models or used as templates in which ETABS objects may be overlaid. Report is generated directly in the software with complete reinforcement details. Many of the floor levels in buildings are similar which reduce modelling and design time. Fast model generation using the concept of similar stories. Different materials can be assigned to the structural elements within the same model such as steel, RCC, composite or any other user-defined material.

II. METHODOLOGY

2.1 Overview of Plan and Structure

The generated model is the type of multi storey residential building of symmetrical plan. This model consist of ground floor and four storey. As per IS1893:2002, this area's soil type is medium stiff, comer under zoning V with the zone factor of 0.36. Following figure shows the plan of the building. This is a G+4 residential building on which each floor has 2 Flats with 2 Bedrooms, Hall and Kitchen. The house is well built and is spacious. The main door is headed towards East. The Master-Bedroom with attached toilet is in the south-west, kitchen is in the South-East which is most superior. Each flat has 2 toilets which makes it more advantageous.



Fig1:- Plan view of the structure

2.2 Loads and Loads Combination

As per table given below, it has been seen that the building has dead load as self-weight which is automatically and already assigned in the software, Floor Finish of 1.5kN/m² has been considered. According to IS codes IS875- part 2 live load of 2 KN/m² has been allotted & SDL for inner and outer wall loads are 6.21 KN/m² and 12.45 KN/m² respectively.

TABLE 1 Load values and their configuration

Types of loads	Load values	IS Code Confirmation
Dead Load	Self-weight	IS875 Part-1
Live load	2KN/m ² -all places	IS875 Part-1
Floor finish	1.5KN/m ²	IS875 Part-1
Super dead load	6.21KN/m ² -inner wall loads	IS875 Part-1
Super dead load	12.45KN/m ² - outer wall loads	IS875 Part-1

In seismic prone zones, Engineers follow latest construction techniques in the modelling or making of high-rise buildings with the help of different kinds of bracing and base isolators. Seismic zones are considered from zone II to zone V. The model in this project is from zone V. As per the location of the site, Seismic zones are marked from the particular code book. The structure has been modelled according to limit state method, Limit state method is commonly used for design method all over the world, and this structure has been examined under the below mentioned load cases & Load combination. The analysis of building has been done by the

Software, the advantage of this Etabs is that it gives error-free result for RCC design as contrast to the other software

2.3 Material Type

Strength, resistance, ductility, hardness and toughness are the main and important properties judged. Materials like concrete and rebar are allotted in the software. Its strength and material properties are induced automatically as the software follows IS 456:200 which is inbuilt in the software.

All the supports to the columns are made fixed at the base which reduces the moment occurring in the structure.

TABLE 2 Dimensions of particulates

Sr. No.	PARTICULAR	DIMENSIONS
1	Grade of concrete	M30
2	Grade of steel	Fe500
3	Thickness of slab	0.15 m
4	Zone V	Z. F.= 0.36
5	Area of building	190 m ²
6	Typical storey height	3 m
7	Main Beam Elements	0.35 m × 0.35 m
8	Main Column Elements	0.45 m × 0.45 m

III. RESULTS

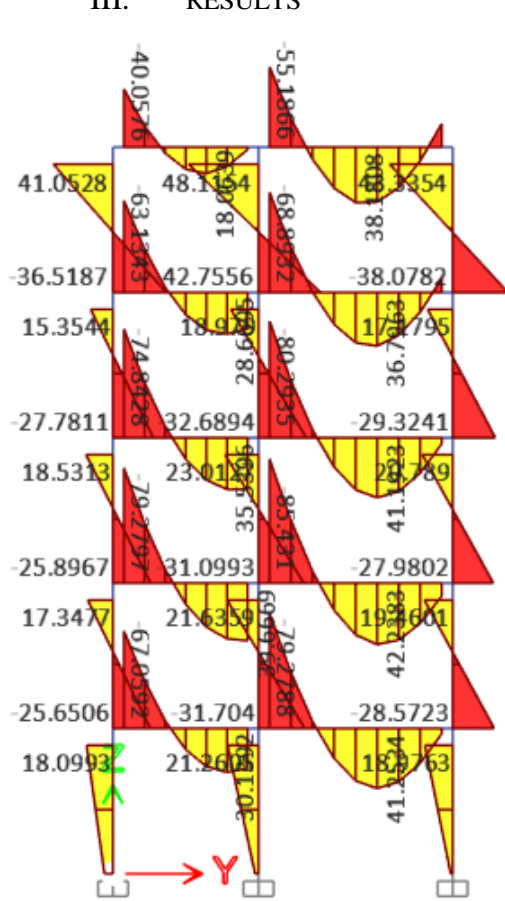


Fig 2: - Corner Beam and Column Bending Moment Diagram

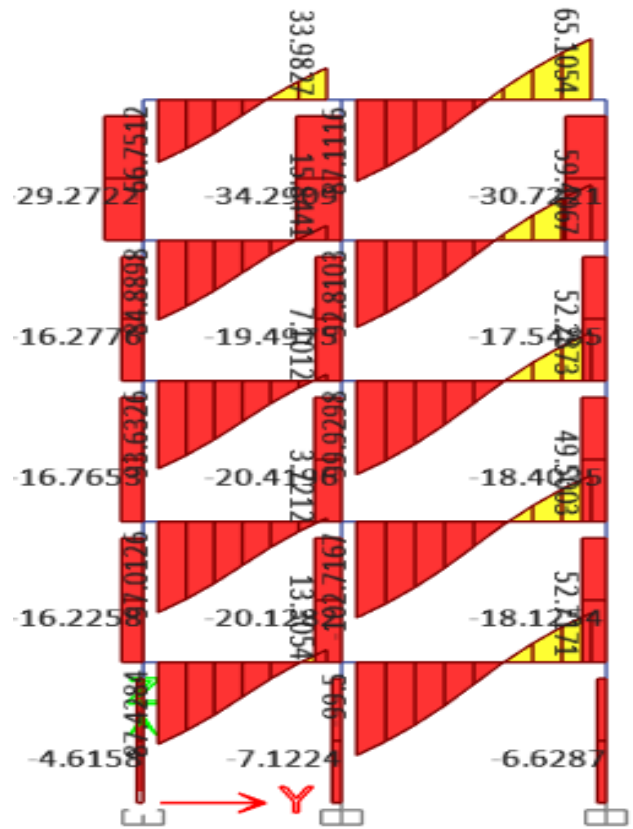


Fig 3: - Corner Beam and Column Shear Force Diagram

Story	Beam (kN)	Column (kN)
Ground	99.5	7.1224
1st Floor	102.7167	20.1282
2nd Floor	99.9298	20.4196
3rd Floor	92.8103	19.4975
4th Floor	87.116	34.2902

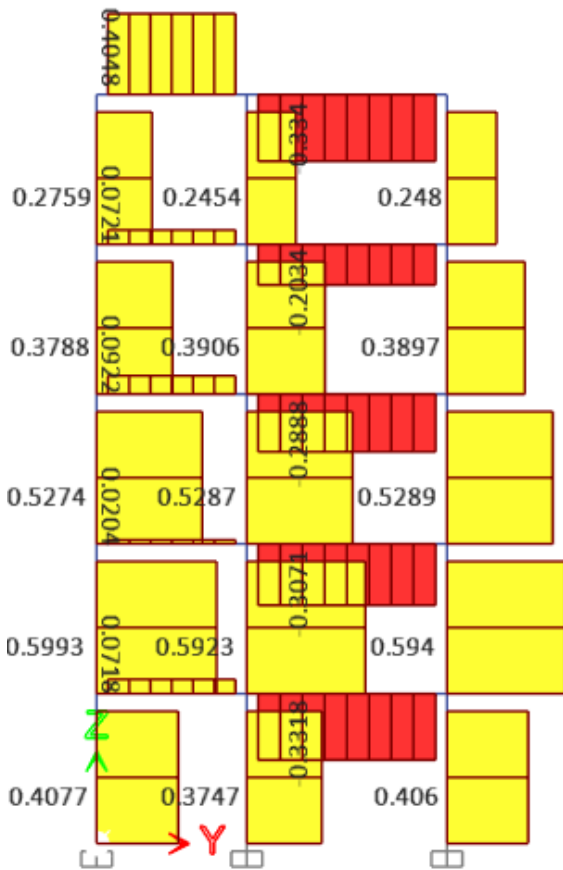


Fig 4: - Corner Beam and Column Torsion Diagram

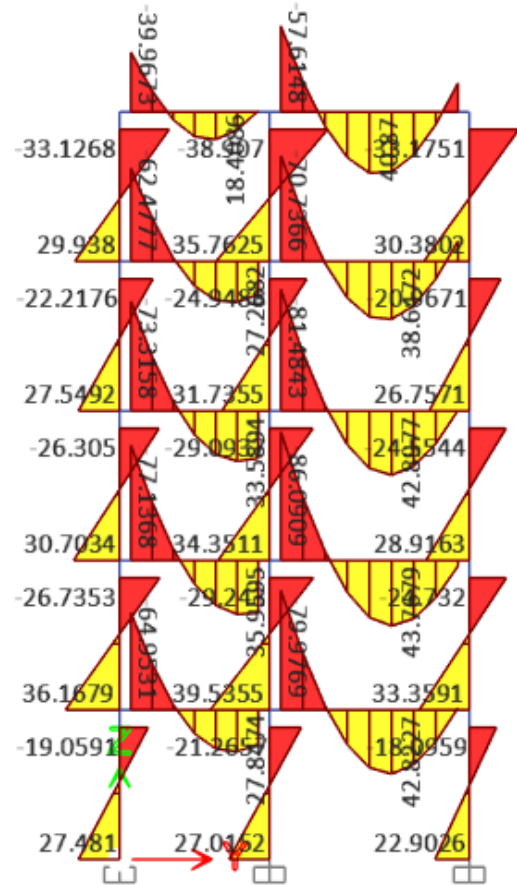


Fig 5: - Centre Beam and Column Bending Moment

Story	Beam (kN-m)	Column (kN-m)
Ground	0.3318	0.4077
1st Floor	0.3071	0.594
2nd Floor	0.2883	0.5289
3rd Floor	0.2034	0.3906
4th Floor	0.334	0.2759

Story	Beam (kN-m)	Column (kN-m)
Ground	79.9769	27.481
1st Floor	86.0909	39.5355
2nd Floor	81.4843	34.3511
3rd Floor	70.7366	31.7355
4th Floor	57.6148	35.7625

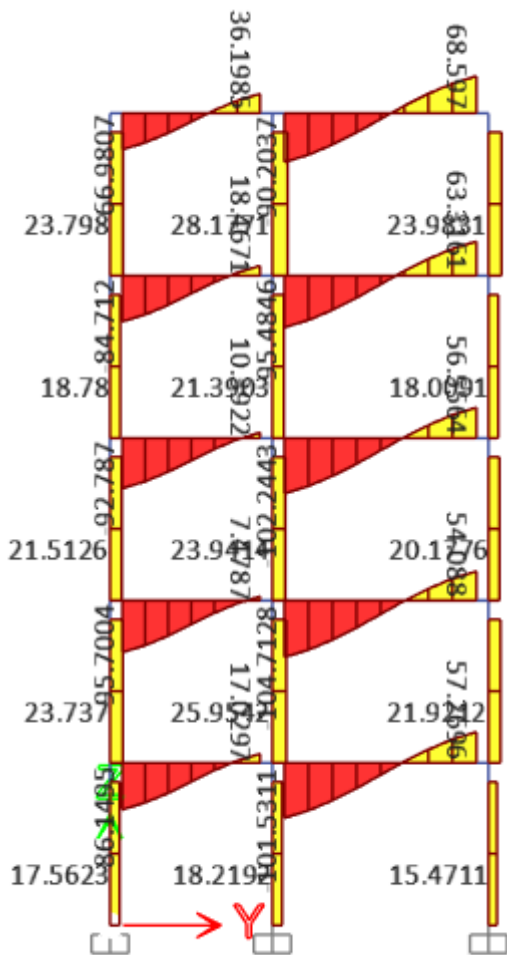


Fig 6: - Centre Beam and Column Shear Force Diagram

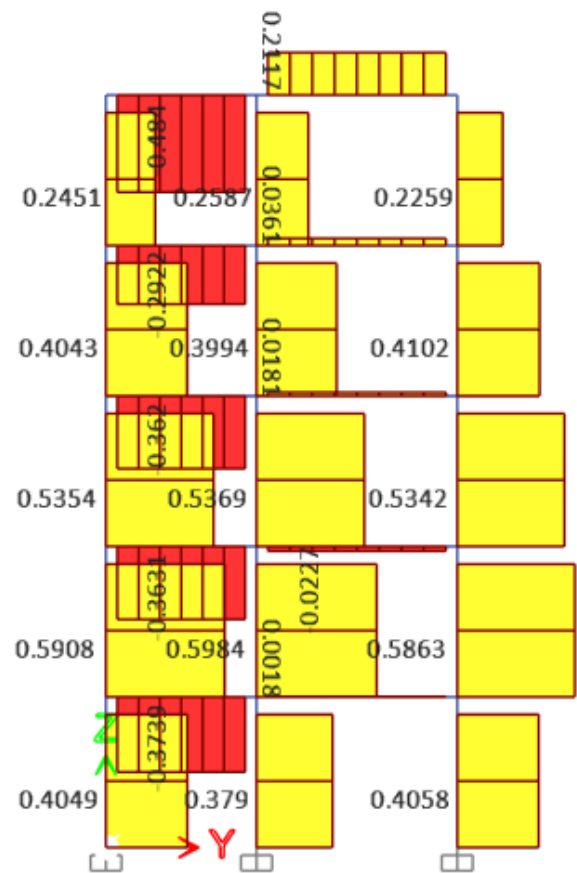


Fig 7: - Centre Beam and Column Torsion Diagram

Story	Beam (kN)	Column (kN)
Ground	101.5311	18.2192
1st Floor	104.7128	25.954
2nd Floor	102.2423	23.94
3rd Floor	95.4846	21.3903
4th Floor	90.2037	28.1771

Story	Beam (kN-m)	Column (kN-m)
Ground	0.3739	0.4058
1st Floor	0.3631	0.5908
2nd Floor	0.362	0.5369
3rd Floor	0.2922	0.4102
4th Floor	0.2587	0.2587

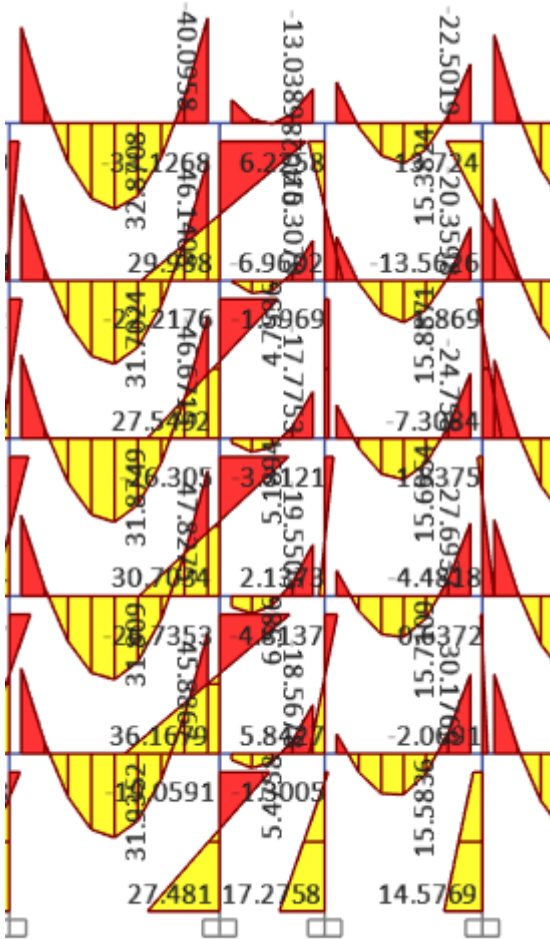


Fig 8: - Front Beam and Column Bending Moment

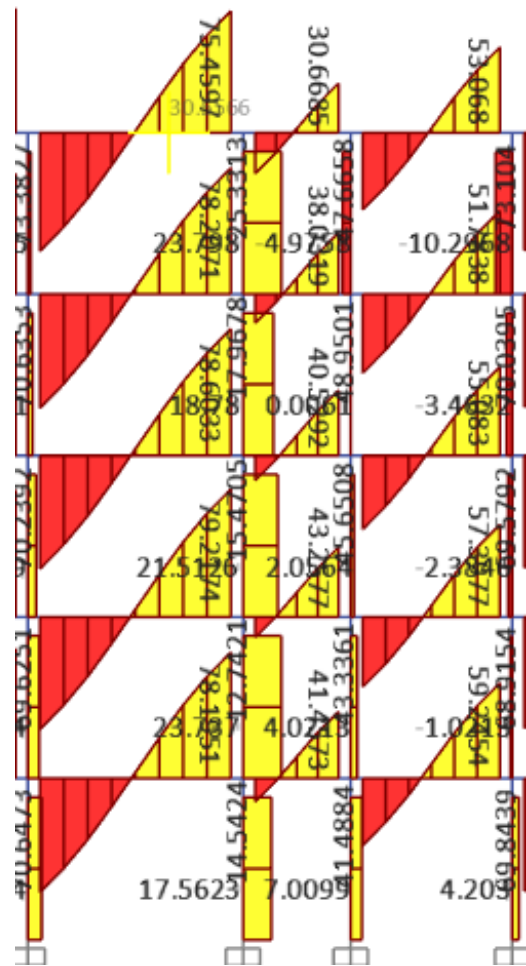


Fig 9: - Front Beam and Column Shear Force Diagram

Story	Beam (kN-m)	Column (kN-m)
Ground	79.9769	27.481
1st Floor	86.0909	36.1679
2nd Floor	46.6715	30.7034
3rd Floor	47.8275	27.5492
4th Floor	45.886	29.938

Story	Beam (kN)	Column (kN)
Ground	70.6473	17.5623
1st Floor	69.6251	23.737
2nd Floor	70.2392	21.5126
3rd Floor	70.6335	18.78
4th Floor	73.3827	23.798

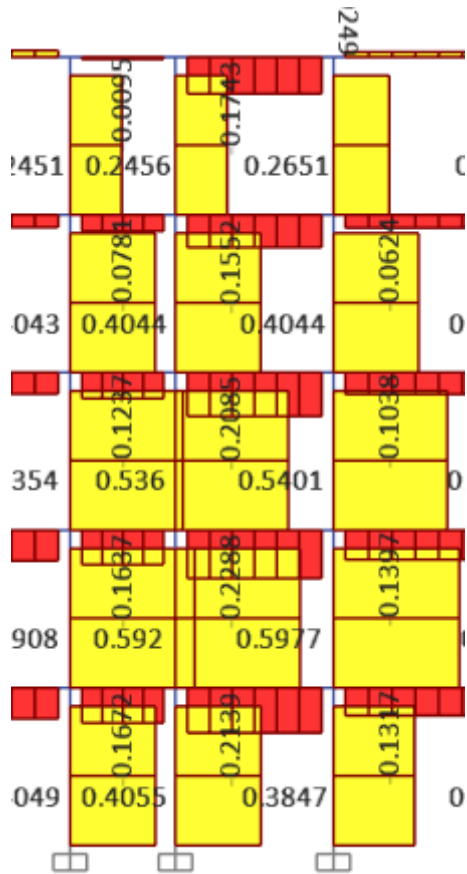
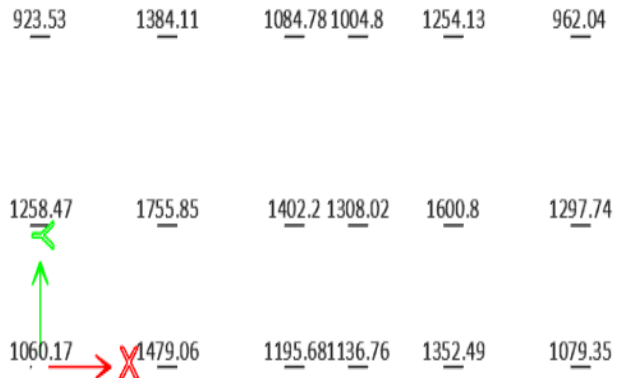
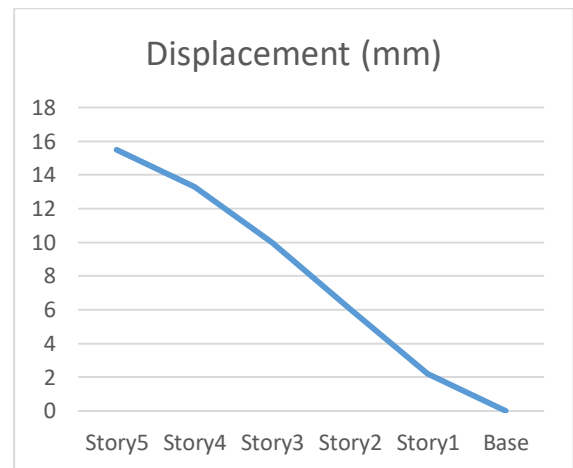


Fig 10: - Front Beam and Column Torsion Diagram



Displacement Graph

Intensity	Reaction (kN)
Maximum	1755.85
Minimum	923.53
At center columns	1402.2



IV. CONCLUSION

From the results we concluded about the variations / percentage increase in each floor of particular beams and columns.

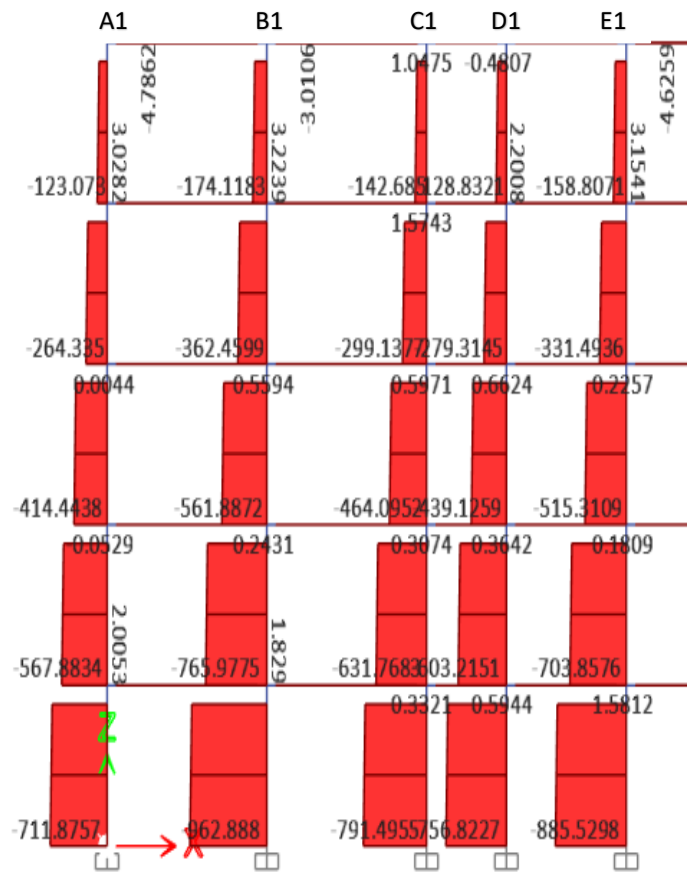
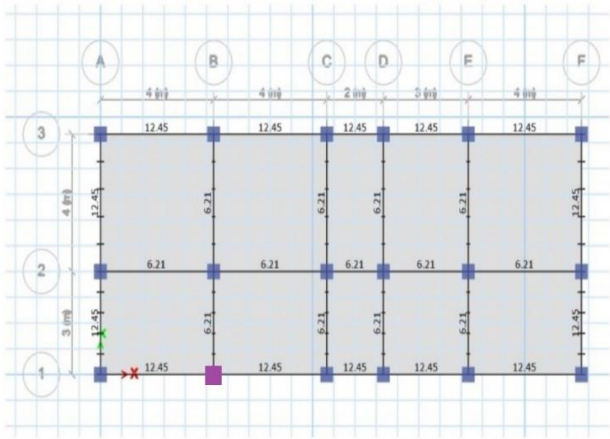
A. Axial Load

1. Axial Load on Front column B1

Story	Beam (kN-m)	Column (kN-m)
Ground	0.1672	0.4055
1st Floor	0.1637	0.5977
2nd Floor	0.2085	0.5401
3rd Floor	0.1552	0.4044
4th Floor	0.1743	0.2651

Story	Displacement (mm)
Story5	15.503
Story4	13.28
Story3	9.993
Story2	6.049
Story1	2.185
Base	0

Base Reactions

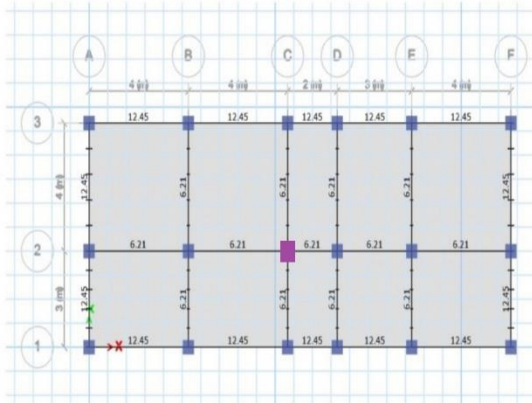


Storey	Axial load on Column B1 (KN-m)
Ground Floor	962.88
1 st Floor	765.97
2 nd Floor	561.88
3 rd Floor	362.459
4 th Floor	174.118

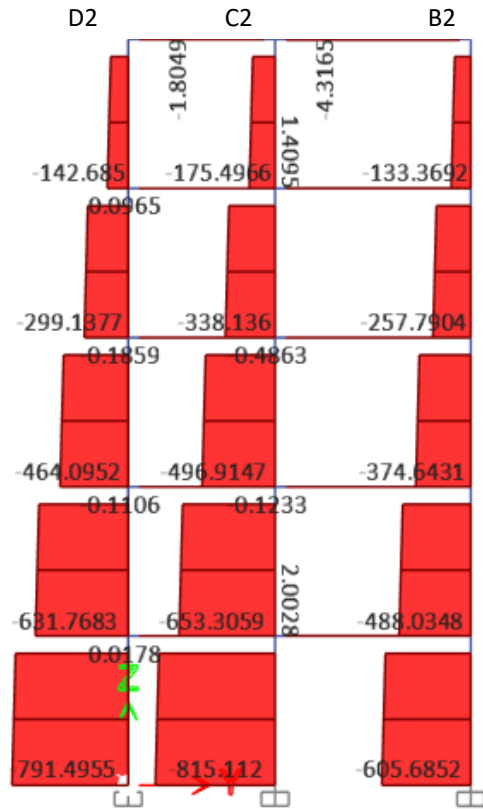
Floor	Axial load (KN/m ²)	Difference	Percentage increase
Ground floor	962.88		
First floor	765.97	-196.91	20.45%
Second floor	561.88	-204.09	26.64%
Third floor	362.459	-199.421	35.49%
Fourth floor	174.118	-188.341	51.96%



2. Axial Load on Centre Column C2



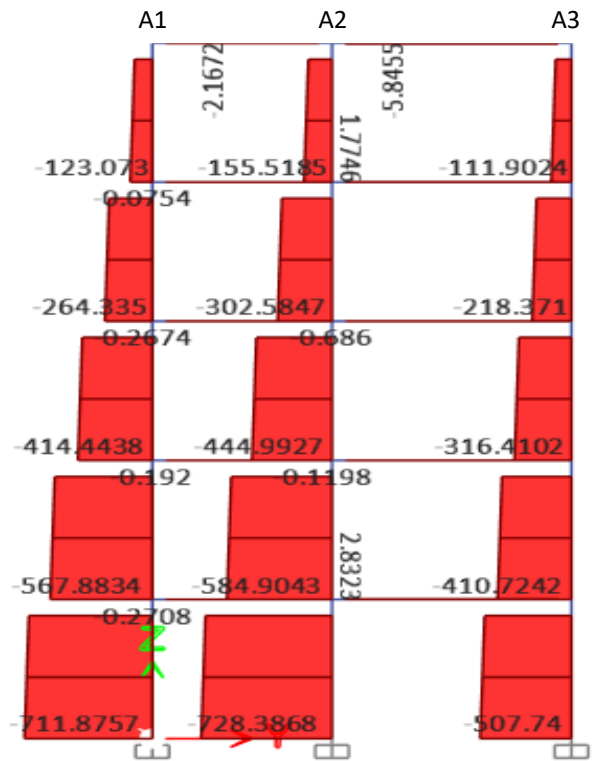
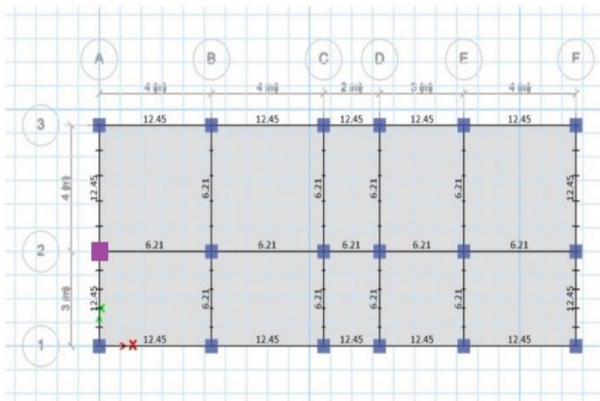
Storey	Axial load on column (KN-m)
Ground floor	815.112
1 st Floor	653.305
2 nd Floor	496.914
3 rd Floor	338.136
4 th Floor	175.496



Floor	Axial load (KN/m ²)	Difference	Percentage increase
Ground floor	815.112		
First floor	653.305	-161.807	19.85%
Second floor	496.914	-156.391	23.93%
Third floor	338.136	-158.778	31.95%
Fourth floor	175.496	-162.64	48.098%



3. Axial Load on Corner Column A2

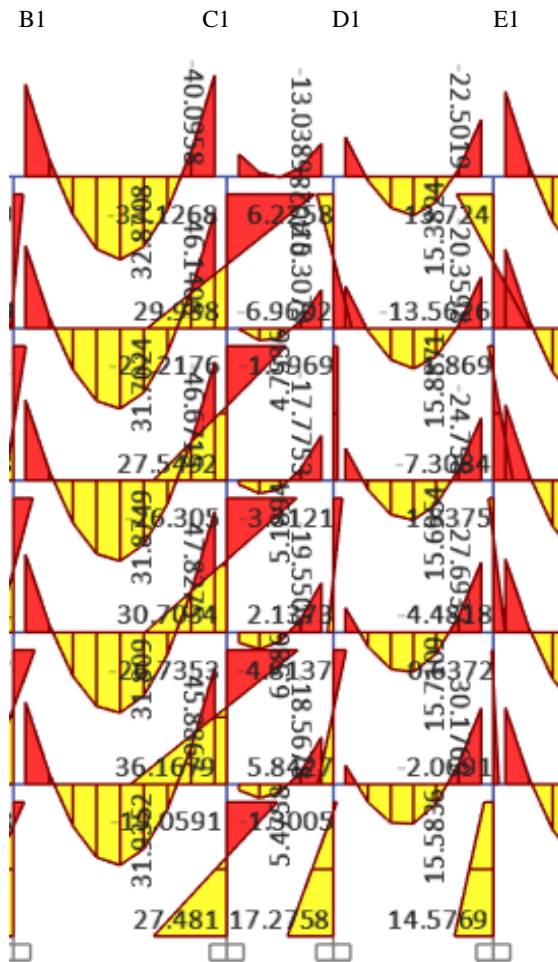
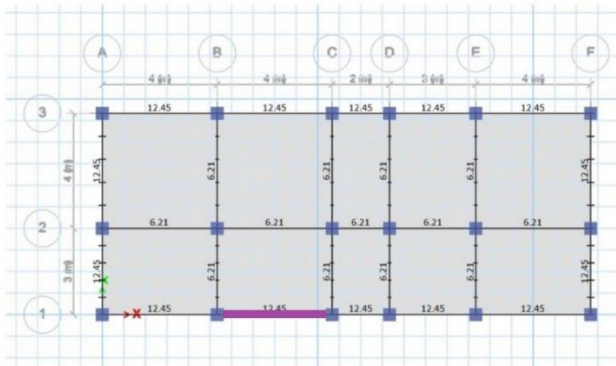


Storey	Axial load on column (KN-m)
Ground Floor	728.3868
1 st Floor	584.904
2 nd Floor	444.99
3 rd Floor	302.58
4 th Floor	155.518

Floor	Axial load (KN/m ²)	Difference	Percentage increase
Ground floor	728.386		
		-143.482	19.698%
First floor	584.904		
		-139.914	23.921%
Second floor	444.99		
		-142.41	32.002%
Third floor	302.58		
		-147.062	48.602%
Fourth floor	155.518		

B. Bending Moment

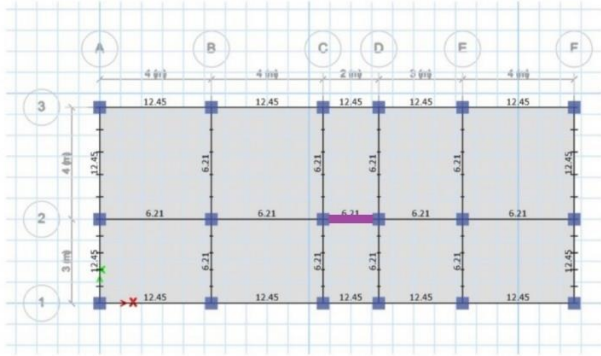
1. Bending Moment on Front Beam B1C1



Story	Beam (kN-m)
Ground	79.9769
1st Floor	86.0909
2nd Floor	46.6715
3rd Floor	47.8275
4th Floor	45.886

Floor	Bending Moment	Difference	Percentage Increase
Ground	79.9769		
First Floor	86.0909	6.114	7.6447%
Second Floor	46.6715	-39.4194	45.7881%
Third Floor	47.8275	1.156	2.4768%
Fourth Floor	45.886	-1.9415	4.0593%

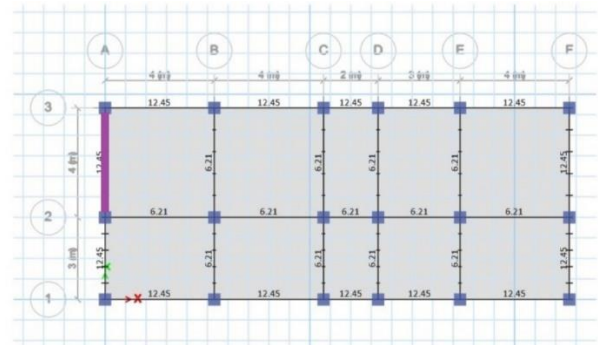
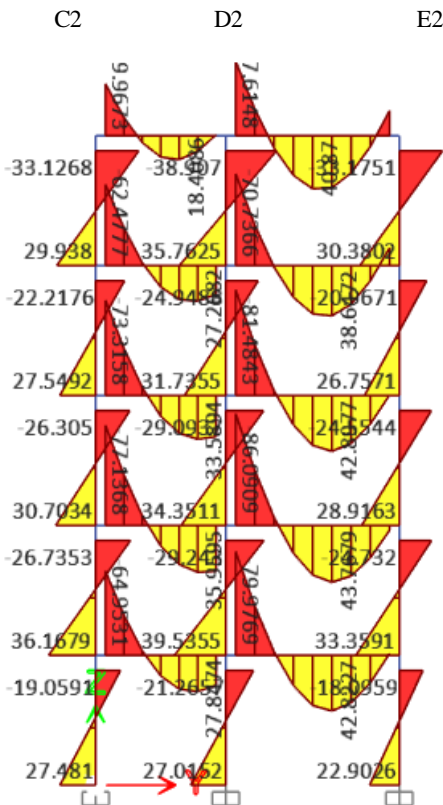
2. Bending Moment on Centre Beam C2D2



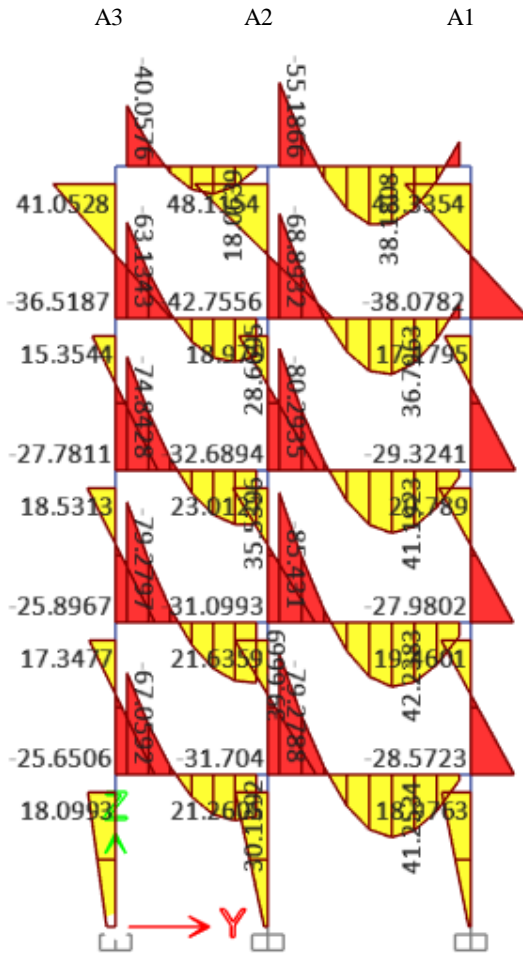
3. Bending Moment on Corner Beam A23

Floor	Bending Moment	Difference	Percentage Increase
Ground	101.5311		
		3.1817	3.1337%
First Floor	104.7128		
		-2.4705	2.359%
Second Floor	102.2423		
		-6.7577	6.609%
Third Floor	95.4846		
		-5.2809	5.530%
Fourth Floor	90.2037		

Story	Beam (kN)
Ground	101.5311
1st Floor	104.7128
2nd Floor	102.2423
3rd Floor	95.4846
4th Floor	90.2037



Story	Beam (kN-m)
Ground	79.2788
1st Floor	85.4341
2nd Floor	80.2935
3rd Floor	68.8932
4th Floor	55.1866



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Floor	Bending Moment	Difference	Percentage Increase
Ground	79.2788		
		6.1553	7.76415
First Floor	85.4341		
		-5.1406	6.01705
Second Floor	80.2935		
		-11.4003	14.1982%
Third Floor	68.8932		
		-13.7066	19.8954%
Fourth Floor	55.1866		

After concluding the above tables, it can be said that the variation does not exceed **10%** and hence the analysis is safe.



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