COMPARISON AND ANALYSIS OF MULTI-STOREY BUILDING IN VARIOUS SEISMIC ZONES

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ABSTRACT

Structural analysis is mainly concerned with finding out the behavior of the structure when subjected to some action. In this project a residential of (G+5) multi-storey building is studied for earthquake loads using ETABS software. Assuming that the material property, the linear static analysis is performed. These linear static analyses are carried out by considering severe seismic zones (zone-II, zone-III, zone-IV, and zone-V) and the behavior is assessed by taking types II soil condition. Different responses like bending moment, axial forces of various load combination and zones are studied. The seismic load has significant impact on bending moment and axial force.

Key words: Axial force, Bending moment, Load combination, Linear Static analysis, ETABS Software, IS 1893(part 1):2002.

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INTRODUCTION

When an earthquake is take place, a building undergoes dynamic motion. This is because of building is subjected to inertia forces that acting in opposite direction to the acceleration of earthquake excitations. These inertia forces are called seismic loads, are usually dealt with by assuming forces external to the building. So apart from gravity loads, the structure will experience dominant lateral forces of considerable magnitude during earthquake shaking.

In India, based on past history of earthquake records the Bureau of Indian Standards have grouped the country into four seismic zones, as Zone-II, -III, -IV and –V. Out of these, Zone V is the most seismically active region, while zone II is the least.

This project is mainly concerned with the study of seismic analysis of multi-storey building. The structural analysis of G+5 storey building is done with the help of ETABS software. The Linear static analysis is done for all four zones and response like axial force, bending moment is compared.

LINEAR STATIC PROCEDURE

The linear static procedure of building is modeled with their linearly elastic stiffness of the building. The equivalent viscous damps the approximate values for the lateral loads to near the yield point. Design earthquake demands for the LSP are represented by static lateral forces whose sum is equal to the pseudo lateral load. When it is applied to the linearly elastic model of the building it will result in design displacement amplitudes approximating maximum displacements that are expected during the design earthquake. To design the earth quake loads to calculate the internal forces will be reasonable approximate of expected during to design earth quake.

PROBLEM FORMULATION

The structural analysis of G+5 multi-storey regular building is done with the help of ETABS software. The building is assumed as residential building. The plan of the building is shown in fig. The building is analysed in different zones with medium soil type. The buildings have approximately the plan area of 545m^2.

Table -1: Building Details:

SI NO	PARAMETER	TYPE/VALUE
1	Building type	G+5 Residential Building
2	Plan area	29.2mx18.65m
3	Beam size	0.2mx0.6m 0.2mx0.45 m 0.15mx0.15 m
4	Column size	0.2mx0.45m 0.2mx0.6m 0.2mx0.9m
5	Slab thickness:	0.15m
6	Typical storey height	3 m
7	Unit weight of RCC	25 kN/m^3
8	Unit weight of brick masonry	20Kn/m^3
9	Live load (LL)	2 kN/m^2
10	Wall load	12 kN/m
11	Floor finishing load(FL)	1.5 kN/m^2
12	Earthquake Direction	X
13	Seismic Zone	II, III, IV and V

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14	Soil type	Type II (Medium Soil)
15	Grade of concrete	M20 and M30
16	Grade of steel	Fe500
17	Modulus of Elasticity	2.5 x10^7 kN/m^2

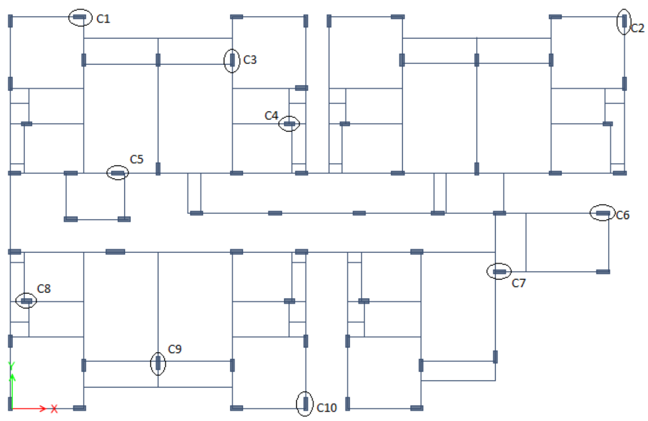

Fig -1: Plan of building

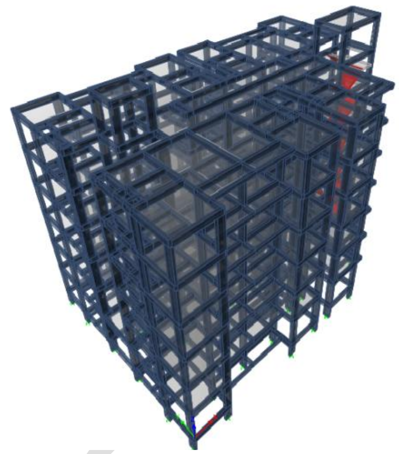

Fig2. 3-D view of building

LOAD COMBINATIONS

According to IS 1893(part 1): 2002 Clause no. 6.3.1.2, the following Earthquake load combinations are considered for analysis.

i. 1.5(DL+LL) Load case-1
ii. 1.5(DL+EL) Load case-2
iii. 1.2(DL+LL+EL) Load case-3
iv. 0.9DL+1.5EL Load case-4

RESULT AND DISCUSSION

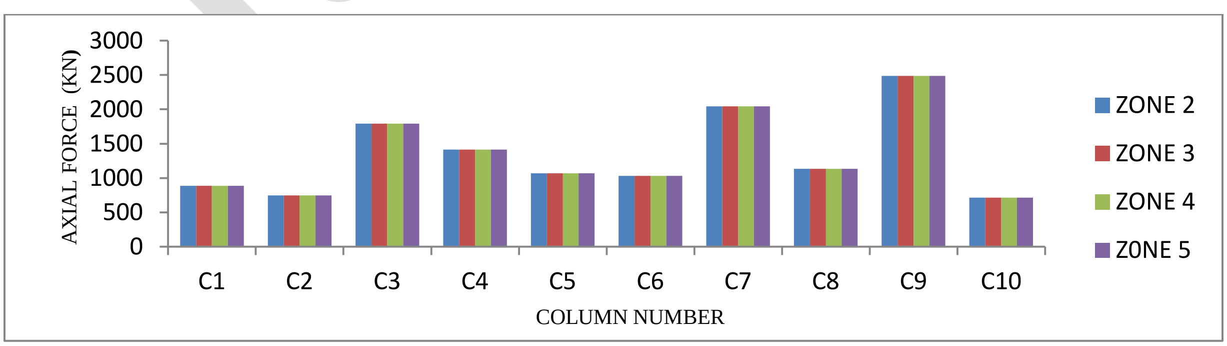

Fig. 3: Variations of axial force with column number in different seismic zones [1.5(DL+LL)]

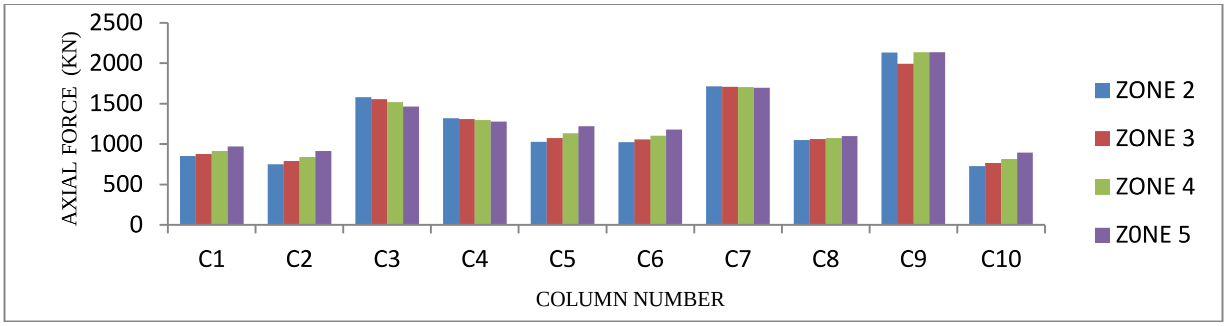

Fig. 4: Variations of axial force with column number in different seismic zones [1.5(DL+EL)]

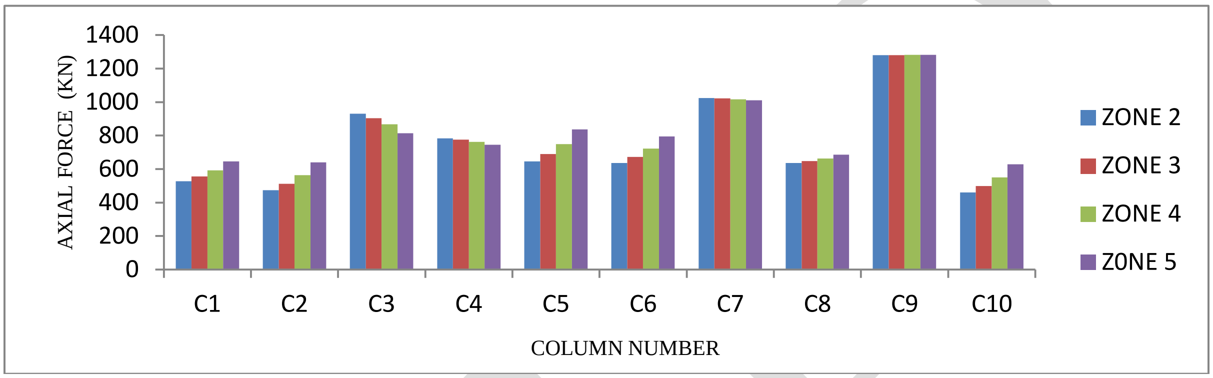

Fig. 5: Variations of axial force with column number in different seismic zones [1.2(DL+LL+EL)]

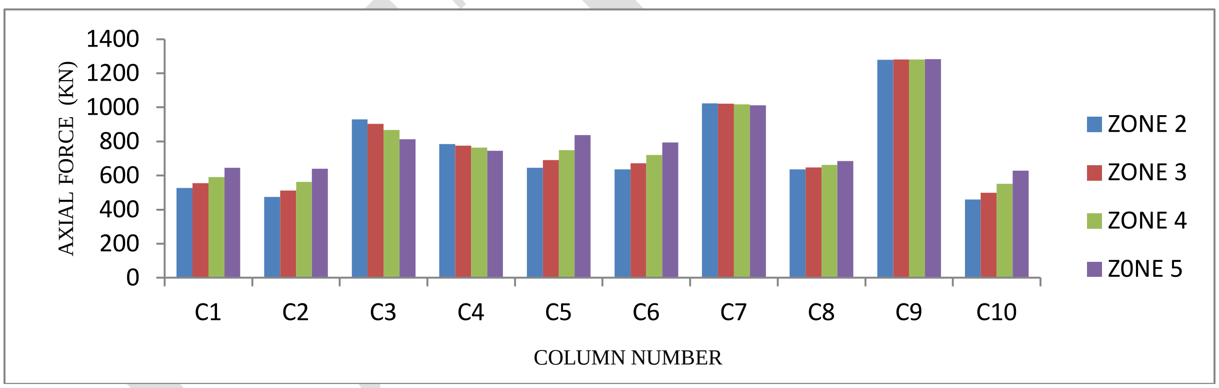

Fig. 6: Variations of axial force with column number in different seismic zones [0.9DL+1.5EL]

Fig 3 to 6 shows the variation of axial force with column number in different seismic zones. The axial force dye to earthquake effect in same irrespective of various zones in gravity load case. The seismic effect in load case LC2, LC3 and LC4 is not predominant for all seismic zones; the axial force is less compared to gravity load. However as the zone varies with different load cases there is gradual decrease in the axial force in load case LC2, LC3 and LC4.

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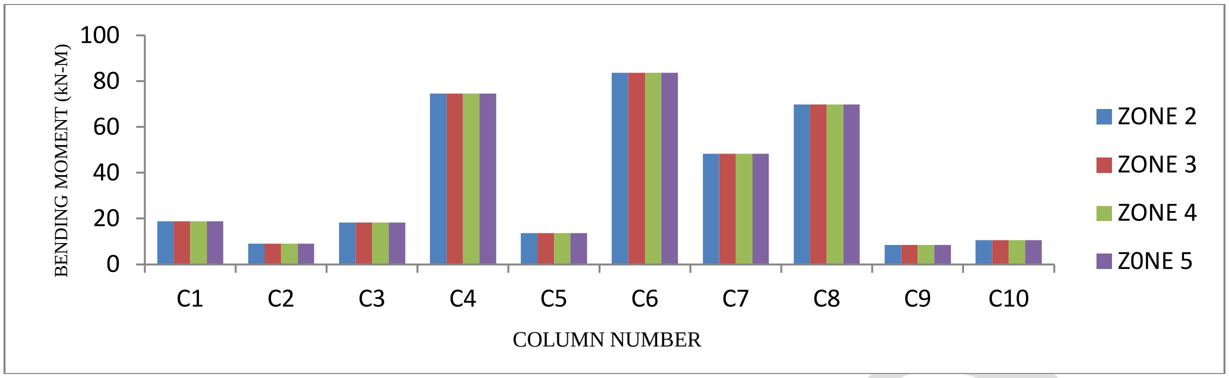

Fig. 7: Variations of Bending moment with column number in different seismic zones [1.5(DL+LL)]

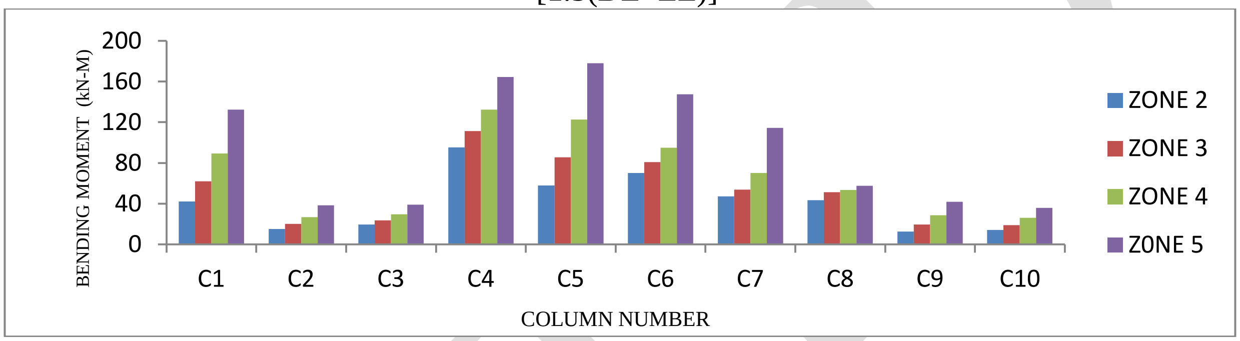

Fig. 8: Variations of Bending moment with column number in different seismic zones [1.5(DL+EL)]

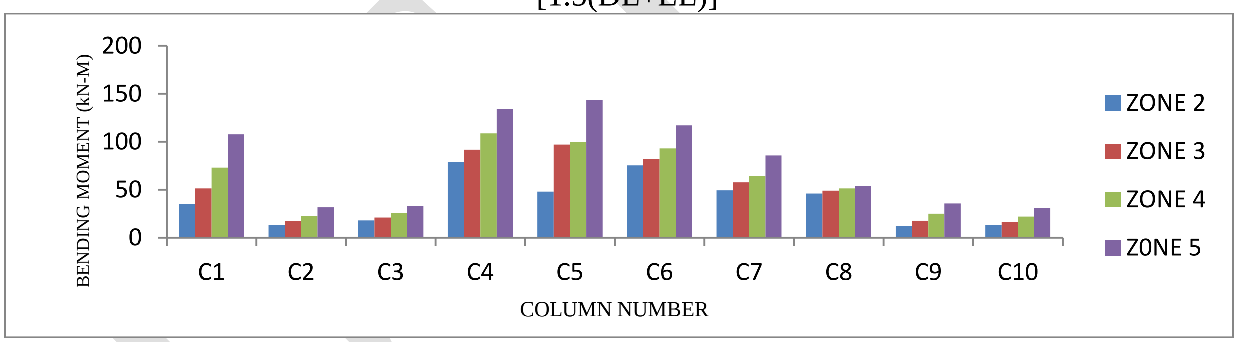

Fig. 9: Variations of Bending moment with column number in different seismic zones [1.2(DL+LL+EL)]

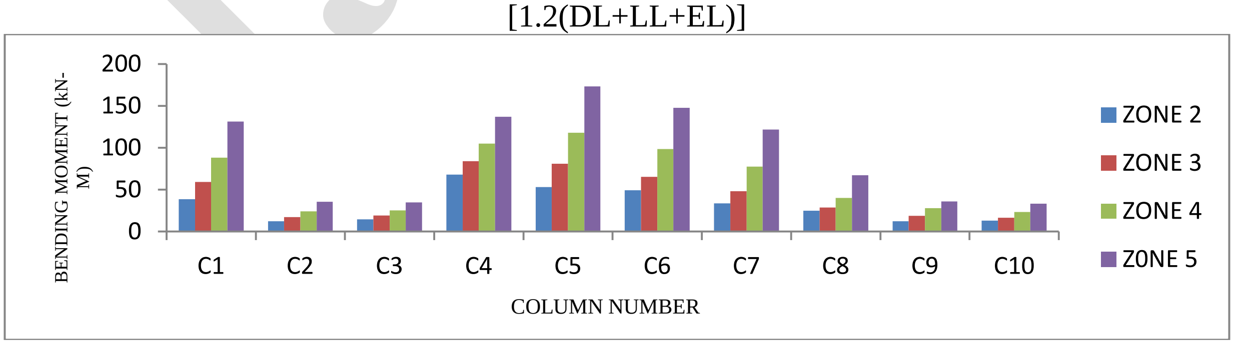

Fig. 10: Variations of bending moment with column number in different seismic zones [0.9DL+1.5EL]

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To understand the variation of Bending moment in columns due to the effect of seismic on structures, the seismic zones 2, 3, 4 and 5 shows the variation of Bending moment in different columns(from C1 to C10) for load cases LC1, LC2, LC3and LC4. The moment due to seismic effect increases in load case LC2 compared to other cases. The Bending moment due to seismic zone varies (shown in Fig 7 to 10) with respect to load cases.

CONCLUSION

- In seismic zones, maximum bending moment is seen in zone-V and minimum in zone-II for load case LC2, LC3, LC4 that means zone-II provide better stability.
- In seismic zones, maximum axial force is seen in zone-V and minimum in zone-II for load case LC2, LC3, LC4 that means zone-II provide better stability.
- Intensity of earthquake has significant impact on axial force and bending moment.
- In all columns, axial force is more in case of LC2 than LC3 and LC4.
- For LC1 the axial force and bending moment are same for all seismic zones.

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