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ANALYSIS AND DESIGN OF L-SHAPED BUILDING IN DIFFERENT SEISMIC ZONES

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ABSTRACT

It is very essential to consider the effects of lateral loads induced from earthquakes in the design of reinforced concrete structures, especially for high-rise and unsymmetrical buildings. The IS Code of Practice for Calculating Loads and Forces in Structural and Building Works, IS 456-2000 and IS 1893:2002 gives simplified methods for calculating such loads in different seismic zones. This depends on some seismic parameters defined by codes. In this research the effects will be studied and compared according to the IS 1893: 2002. The codes are reviewed for earthquake analysis and discussed to show some factors affecting the design like mode shape and displacement of structure. Emphasis is given on various stresses available for compare and the output like displacement, axial force etc. Authors are presenting the outcomes of their project at undergraduate level.

Keywords: Unsymmetrical design, zone comparison,

I. INTRODUCTION

With the application of new materials and advanced analysis technologies, modern tall buildings are becoming lighter and more slender than their predecessors, thus they are more sensitive to wind forces and earthquake forces.[1] In addition, along with the development of modern cities, a large number of tall buildings may be constructed in a small zone. The interference effects of wind loads and earthquake load responses on tall buildings depend largely on their relative location, building geometry, upstream terrain, building orientation, wind velocity & Earthquake zone etc.

The correct estimation of the earthquake forces acting on tall buildings is very essential for the safe design of structural elements. Such RCC buildings are analyzed and designed for earthquake under software environment. Structural design of buildings for seismic loading is s primarily concerned with structural safety during major earthquakes, but serviceability and the potential for economic loss are also of concern.[3] Seismic loading requires an understanding of the structural behaviour under large inelastic deformations. Behaviour under this loading is fundamentally different from wind or gravity loading, requiring much more detailed analysis to assure acceptable seismic performance beyond the elastic range.[2] Some structural damage can be expected when the building experiences design ground motions because almost all building codes allow inelastic energy dissipation in structural systems.

II. BUILDING INFORMATION

Sometime the plot area is having irregular shape. In that situation there is need of construct building according to shape of plot area. Our plot area is in L-shape, so to make complete use of plot area we have constructed L-shape building.Now a day there is craze of built buildings with initial letter of names Like I, L, W,V, T, O, E. This shape is challenging for earthquake study.

The building plan under study is in L-shape. It is G+10 story building. The building consists of alternate plans. The even no floors having same plan and odd no floors also have same plans but they are different than that of the even no floor plan. Each floor consists of total 7 no of flats. In which 5 flats are 1 BHK and 2 flats are 2 BHK. The area of 1 BHK 34.202flat is sq m. and the area of 2 BHK flat is55.441sq m. The parking is provided at ground floor.

III. DESIGN PARAMETERS

The four buildings can be compared as the building parameters are constant through. The sums of common parameters are as follow

Storey Height	3m
Number of storey	G + 10
Material	Fe 415, M25 & M30
Size of Column	0.60m x0.30m
Size of Beam	0.38m x0.15m
	0.50m x0.15m
	0.46m x0.15m
Slab Thickness	0.150m
No of columns	77
Building length in X	
Building length in Z	

Seismic Analysis Response Spectrum parameters [4]

Zone Factor (Z)	II, III, IV, V
Zone	Z value
Zone II	0.10
Zone III	0.16
Zone IV	0.24
Zone V	0.36
Important Factor (I)	1.0
Response Reduction Factor(R)	5
Damping Factor	0.05

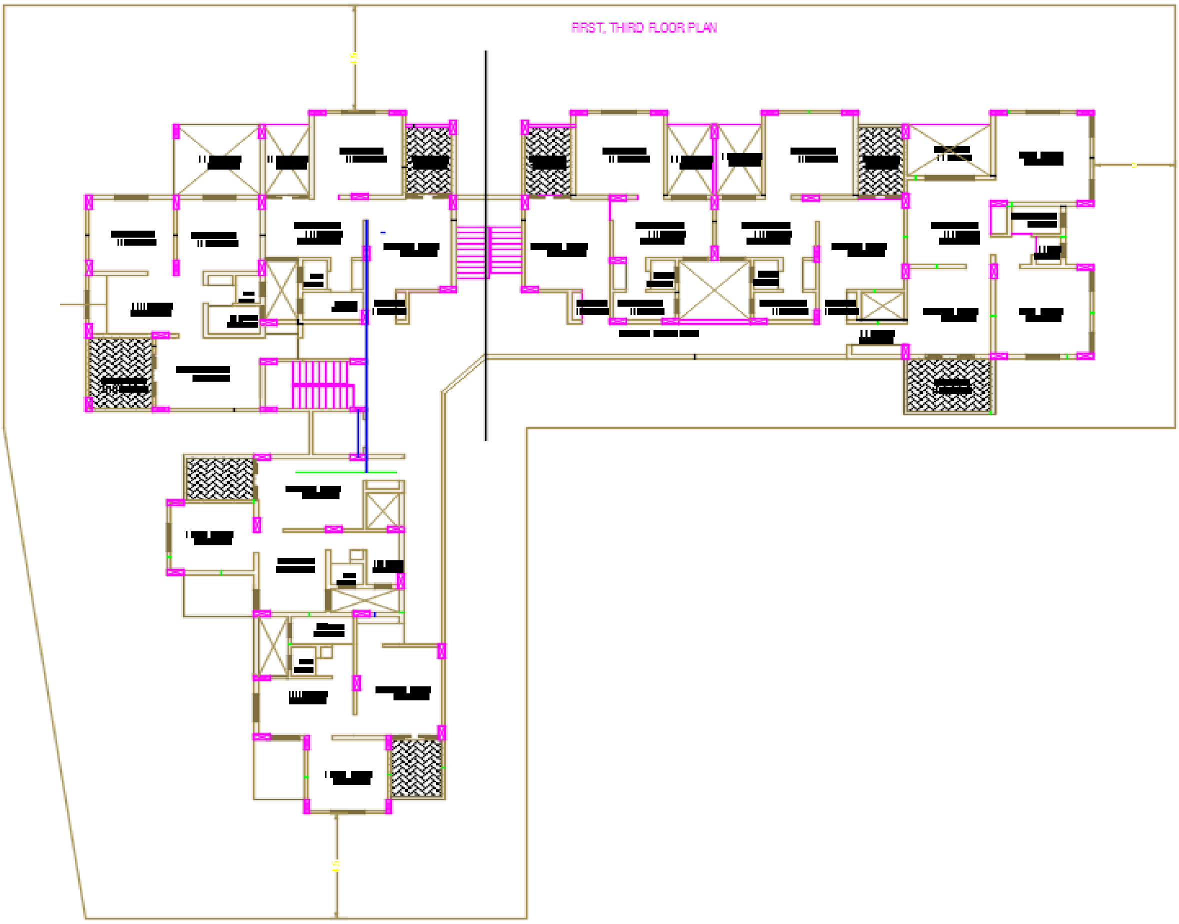

Fig 1. Plan of Building with plot boundary (Odd floor)

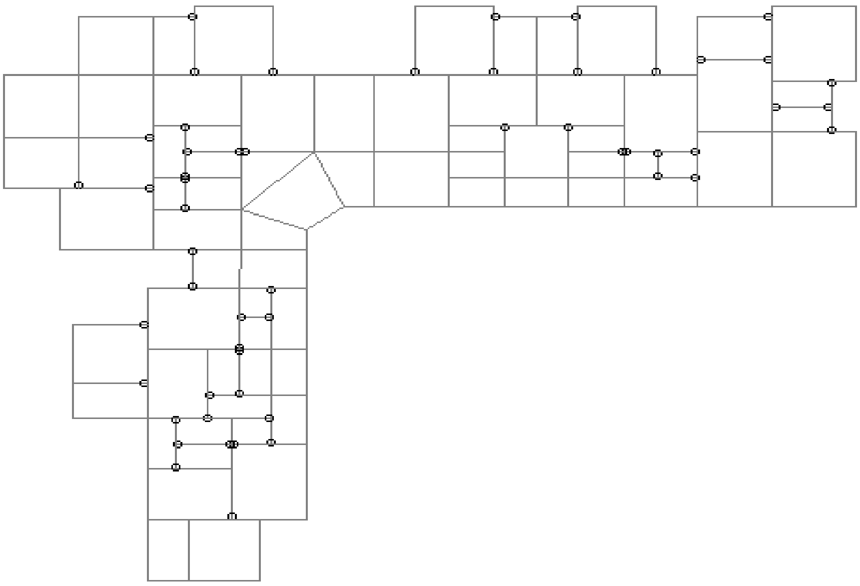

Fig. 2 Modelling line plan (even floor)

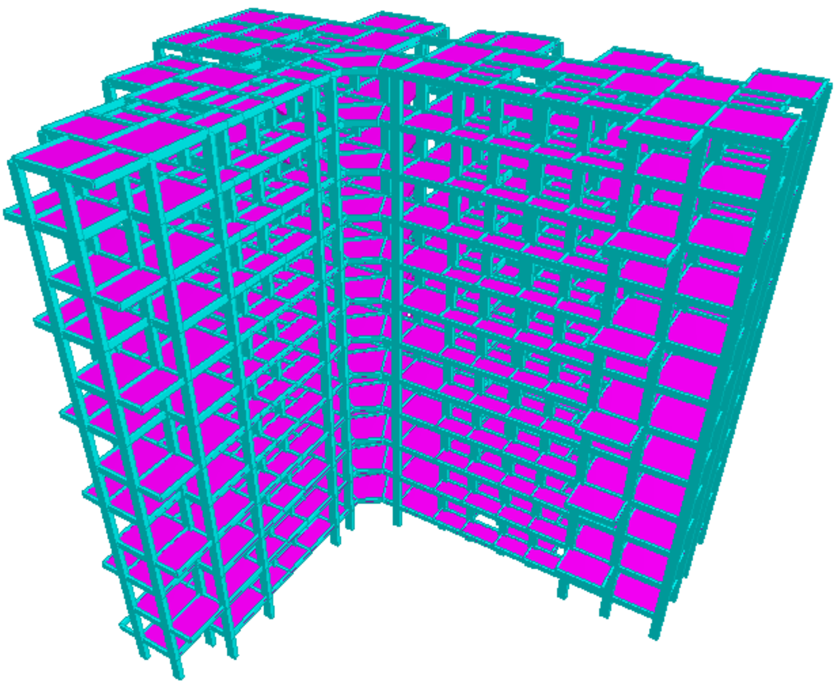

Fig 3.Full 3D view

III. RESULTS

TABLE 1 Frequencies Calculated by Software

CALCULATED FREQUENCIES FOR LOAD CASE		
MODE	FREQUENCY(CYCLES/SEC)	PERIOD(SEC)
1	0.408	2.45317
2	0.455	2.19849
3	0.525	1.90329
4	1.248	0.80110
5	1.411	0.70874
6	1.644	0.60845
7	1.671	0.59840
8	2.152	0.46476
9	2.224	0.44963
10	2.500	0.40005
11	2.985	0.33505
12	3.037	0.32929

TABLE 2. Peak Shear in X- Direction

STORY	LEVEL IN METER	PEAK STORY SHEAR IN KN PER ZONE			
	Zone	II	III	IV	V
12	33	149.68	239.48	359.23	484.21
11	30	286.52	458.43	687.64	944.15
10	27	392.72	628.36	942.53	1325.43
9	24	470.34	752.55	1128.83	1634.83
8	21	524.25	838.80	1258.20	1879.57
7	18	568.22	909.15	1363.72	2090.10
6	15	613.51	981.61	1472.42	2285.30
5	12	666.70	1066.72	1600.08	2478.35
4	9	722.31	1155.70	1733.55	2656.16
3	6	770.70	1233.13	1849.69	2800.03
2	3	800.28	1280.45	1920.68	2885.36
1	0	807.60	1292.15	1938.23	2906.38
BASE	-2	807.60	1292.15	1938.23	2906.38

TABLE 3. Peak Shear in Z- Direction

STORY	LEVEL IN METER	PEAK STORY SHEAR IN KN PER ZONE			
	Zone	II	III	IV	V
12	33	80.68	129.1	193.64	339.82
11	30	155.02	248.03	372.04	655.89
10	27	212.56	340.10	510.15	900.70
9	24	253.46	405.53	608.30	1075.81
8	21	280.35	448.56	672.84	1190.64
7	18	300.42	480.68	721.02	1276.89
6	15	321.09	513.74	770.61	1365.31
5	12	347.20	555.51	833.27	1477.17
4	9	377.18	603.48	905.23	1604.02
3	6	405.82	649.31	973.96	1723.79

2	3	425.83	681.33	1022.00	1804.58
1	0	432.24	691.58	1037.38	1828.08
BASE	-2	432.24	691.58	1037.38	1828.08

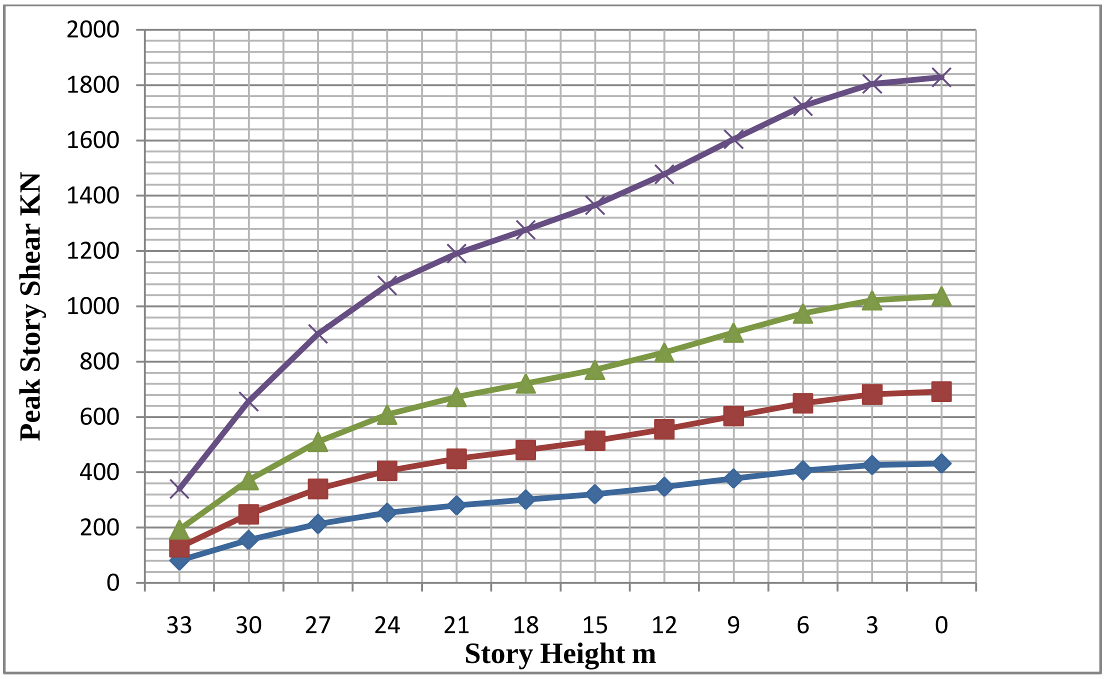

Fig 4. X Direction Peak Story Shear in kN

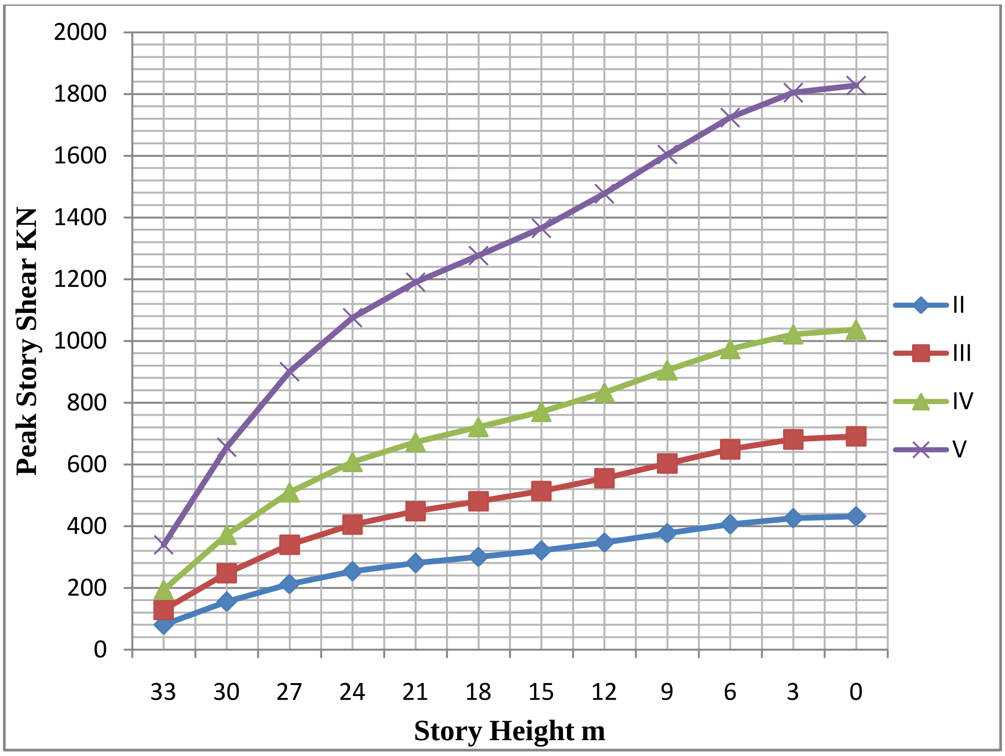

Fig 5. Z Direction Peak Story Shear in kN

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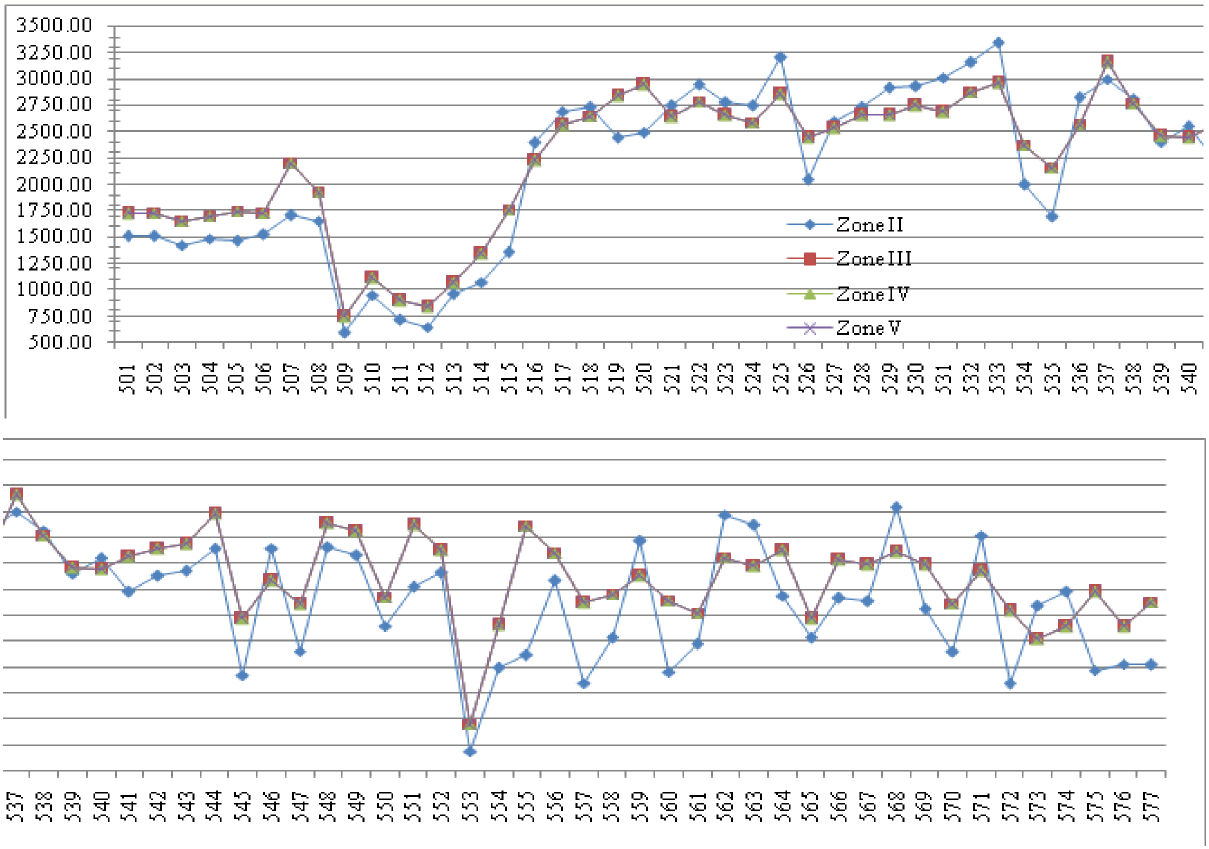

Fig 6.Axial Forcein KN Considering Dead and Live Load

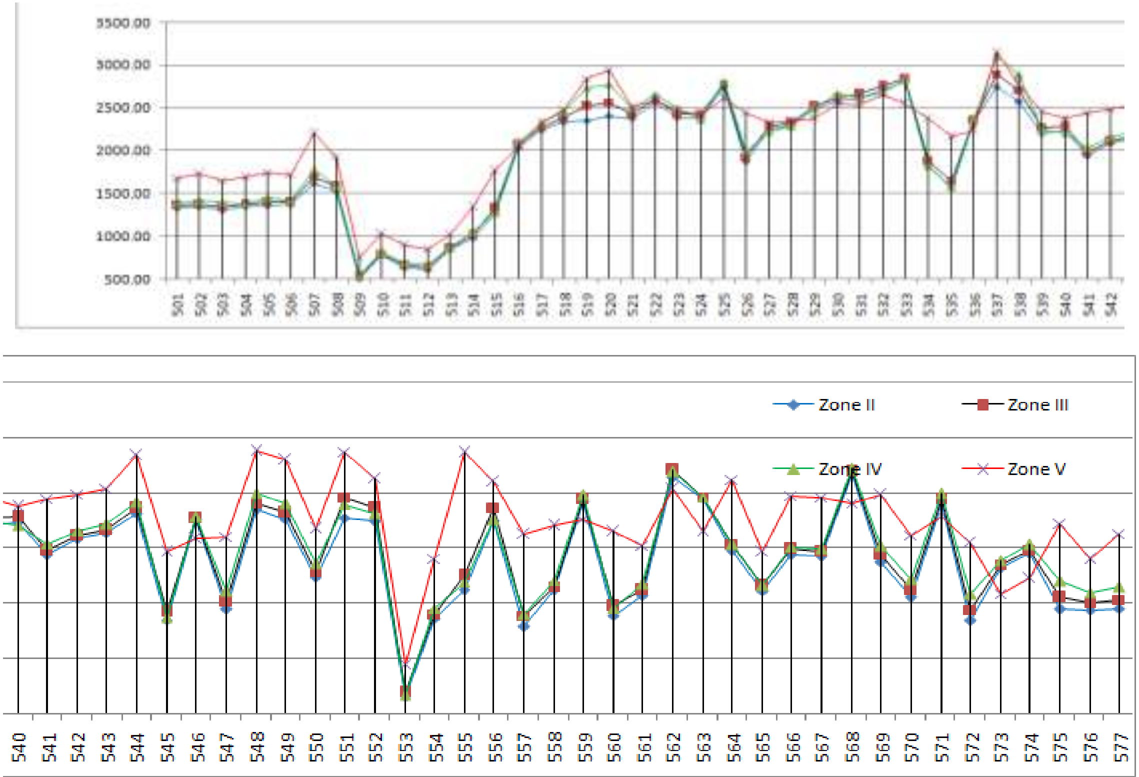

Fig 7.Axial Forcein KN Excluding Dead and Live Load

TABLE 4. Peak Shearand Displacement

zones	II	III	IV	V
Peak story shear in x direction (KN)	807.6	1292.15	1938.23	2906.38
Peak story shear in z dirction (KN)	437.24	691.58	1026.38	1828.08
Resultant Displacement (MM)	29.002	39.088	53.013	60.880

TABLE 5.Steel Used and Relative percentage

zones	Total concrete (M^3)	Total steel (Tone)	Percentage of steel
Zone I	694.9	74.767	10.76%
Zone II	694.9	77.280	11.12%
Zone III	694.9	78.995	11.37%
Zone IV	694.9	83.955	12.08%

IV. CONCLUSION

As the building is same it has been seen that zones have incremental values from zone II to zone V.

1. Peak Shear in X and Z direction increases as we move from Zone II to Zone V.
2. Displacement in X and Z direction increases as we move from Zone II to Zone V.
3. Percentage of Steel is increasing from zone II to Zone II is 2.51 tons, zone III to Zone IV is 1.72 tons & zone IV to Zone V is 4.96 tons. And the percentile increment is 0.25% to 0.71%.
4. Dead Load plays a very significant role to counter balance the uplifting earthquake forces. Hence the force in fig. 6 and Fig. 7 shows the axial forces with dead load and without dead load respectively.

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[4.] IS 1893:2002 - CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES.