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Analysis of Multi-Storey Building in Different Seismic Zones of India

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Abstract: Todays world facing some of the major problems causing by the nature.One of the major natural disaster is the Earthquake.We never know the Direction of the attack and magnitude of the Earthquake,so it will be the challenge the science and Technology.Past few years research done on the various issues of Earthquake.Now a Days people lives in Multi-storey Buildings such case when Earthquake hit the populated areas it will be cause huge loss of Damage.Hence Earthquake analysis get importance to analyse the structure safe against the collapse and Design the structure to safe against Earthquake occur during the life time of the structure.In this study model a G+7 Structure in staadPro and analysed the Earthquake analysis of the Structure in Different seismic zones(II,III,IV,V) of india.The present study gives Base shear,Floor Displacements,support Reactions and variation of steel quantity from zone to zone.In this study fill the void of IS:1893-2002 doesn't provide the variations steel quantity from zone to zone.In this study consider the all basic parameters of earthquake effected Multi-storey building and analysed with Different Load combinations.

Index terms: Base shear, Deflection, Floor Displacement, Seismic zones, support reactions.

1. INTRODUCTION

Earthquakes:

The earth Shape is spheroid and it consists of the three layers such as crust,mantle and core. The earthquakes are occur in the crust layer only,crust layer dived into two parts Lithosphere and asthenosphere. Lithosphere is a rigid plate and it can be divide into seven major parts and several minor parts.Asthenosphere is a semi rigid part and Lithosphere is float on the Asthenosphere, Because of the convection currents plates of Lithosphere plates are movements takes place,when two plates are hit each other the large amount of energy is released in the form of waves. The waves are hit the earth surface in the form of vibrations that vibrations lead to Earthquakes.Eartquake vibrations are formed at the point of initiation of rupture to in all directions in the form of elastic waves, ,these waves are mainly divide into primary waves or p waves,secondry waves or s waves and surface waves. Generally Earthquakes are formed due to the rupture in the plates,where rupture takes place that is place for origin of the earthquake that place is called as the focus or Hypocenter. The place just above the earth surface is called as the Epicenter.The Distance from focus to Epicentre is known as the focal depth. Earthquake size can be determined by both magnitude and Intensity,magnitude means the amount of Energy is released during the rupture takes place.Intensity means the amount of Damaged occur due the Earthquake. Finally we never find out the where will be the earthquake occur and size of the of the earthquake,once Earthquake hit the populated areas it would be huge loss.So Analyse the structures based on the location of the structure and consider the all components.Desin the structure to resist the Earthquake. Mahmoud,SY[1] analysed 14 Storey flat slab-column building with shear wall system and conclude that Static analysis gives higher values for maximum Displacements of the stories rather than Dynamic RS method. RizawanSultan,M[2] he conclude that Irregular Buildings are severely effected to Earthquakes in Higher seismic zones specially c shaped. structures are vulnerable compare to all other Different shapes.Saikrishna,T.[3] analysed the G+7 Multistorey Building and Give the variations of the steel quantity from zone to zone. Venkatarao[4] it was reported has structure with shearwall at the corners is to be a better alternative for Building in Earthquake prone area. Satyanarayana,K[5] he replays that the Building with soft storey have more Lateral Displacement and it is the weak spot to Bhandarkr,R.[6] Studied the G+7 Structure and conclude that performance of Shear structure is better than the framed structure. Arvindkumar,G.[7] Observe that same Building Designed in seismic zone II,III,IV and V become expensive due to increase the Horizantal seismic forces and Increase in column moments. Pawade,c.[8]he observed that Irregular buildings are more vulnerable to the seismic effect. sylviya,B[9] It is observed that the shear walls should be provide throughout the height of building for best Earthquake performance,he conclude that shear walls are are placed at periphery of the Building is most effective.

2. EARTHQUAKE ANALYSIS

A. General introduction

In this study find out the variation of response of the multi-storey building in different seismic zones for that study consider a G+7 structure with proper Dimensions of structural elements. Analyse the Structure in Staad.Pro in all seismic zones and compare the results of Base shear, Floor Displacements, support Reactions and variation of steel quantity and Quantify the results of analysed structure.

B. Modal Generation

Proposed model is Generated in the staad.pro software and analysed.

Table 1. Load calculation of proposed model

Size of the beam	0.6m×0.35m
Size of the column	0.45m×0.45m
Slab thickness	150mm
Height of floor	3m
Exterior wall	350mm
Interior wall	200mm
Parapet wall	100mm
Load Details:	
Dead Loads	
Self weight of exterior wall	0.35×2.55×20 =17.85KN/m
Self weight of partition wall	0.2×2.55×20 =10.2KN/m
Self weight of parapet wall	0.1×1×20 =2KN/m
Plastering	0.02×2.55×18×2 = 1.84KN/m
Total self weight of Exterior wall	17.85+1.84 = 19.69KN/m
Total self weight of Interior wall	10.2+1.84 = 12.04KN/m
Total self weight of Parapet wall	2+1.84 = 3.84KN/m
Live Loads	
Floor Load	4KN/m^2
Roof Load	2KN/m^2

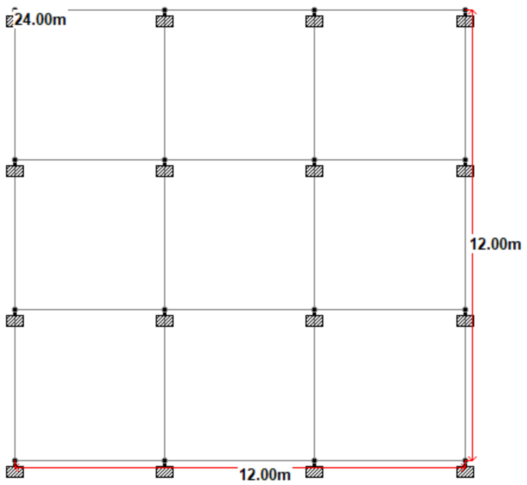


Figure 1. Plan of proposed structure

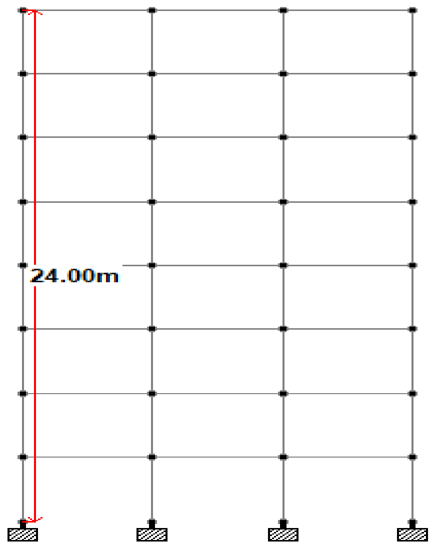


Figure 2. Elevation of proposed structure

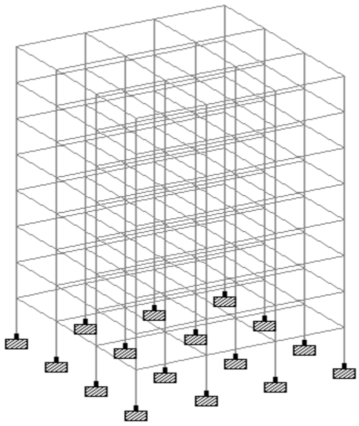


Figure 3. Isometric view of proposed structure

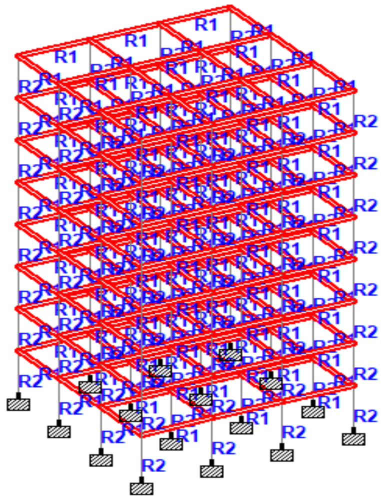


Figure 4. Assigning of Beam Elements

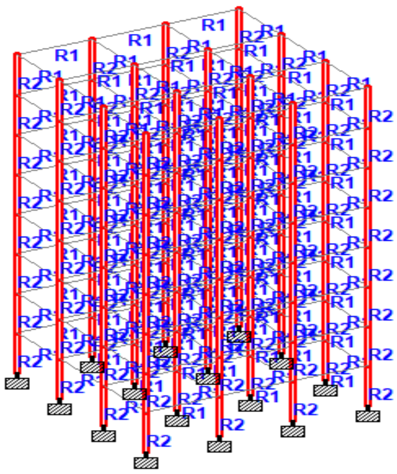


Figure 5. Assigning of Column Elements

C. Assigning of Loads

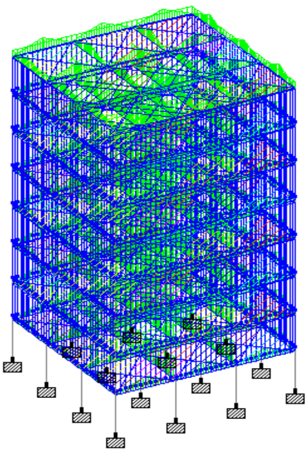


Figure 6.Assigning of Exterior Wall Load (19.69KN/m)

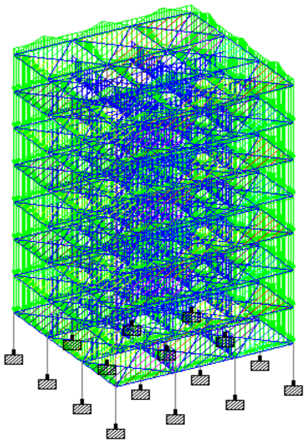


Figure 7.Assining of Interior Wall Load (12.04KN/m)

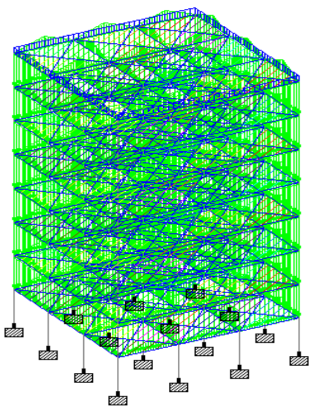


Figure 8.Assining of Parapet Wall Load Load (3.84KN/m)

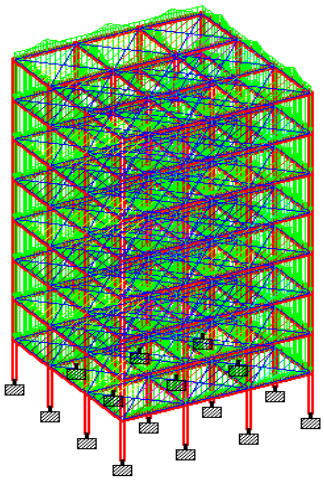


Figure 9.Assining of Self weight

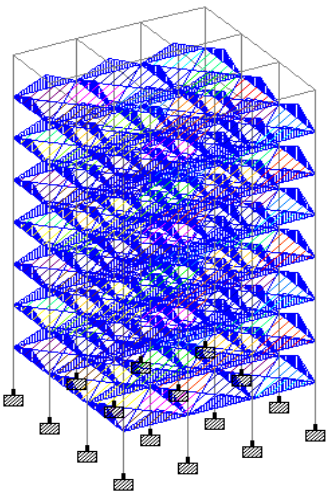


Figure 10.Assining of Floor Load (4KN/m^2)

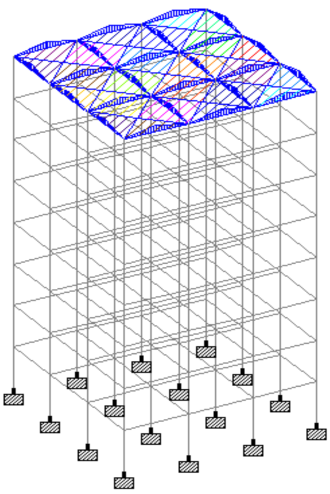
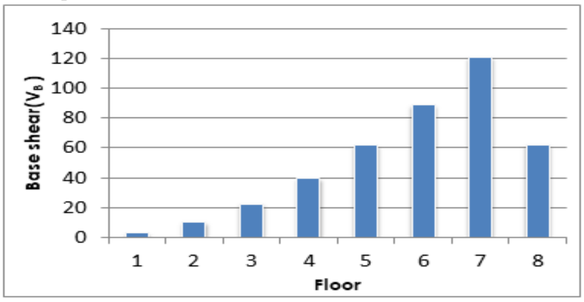


Figure 11.Assining of Roof Load (2KN/m^2)

3. RESULTS AND ANALYSIS

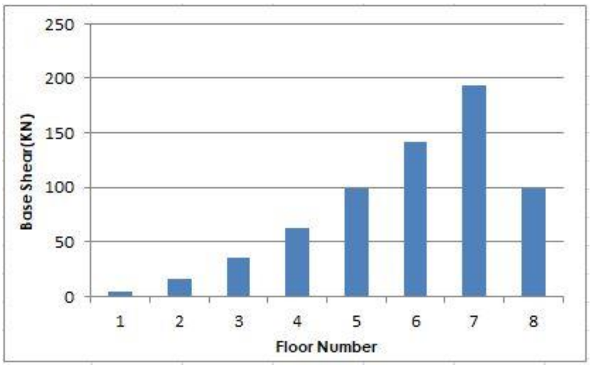
A. Base Shear:

Base Shear is the amount of external Lteral force acting on the base of the structure due to the earthquake,that external force is transmitted to the top floors because of the fixed nature of the supports that transmitted external force will be the cause to the floor displacements. The newly developed displacements may cause to failure of structure so that is the importance to the Base shear.So we Estimate the amount of Base shear acting on the floors and variation of Base shear from floor to floor and include the zone to zone variation. Mention the Details of the of the graph details in table format is just bellow the graph for better understand the behaviour the structure due to earthquake effect.



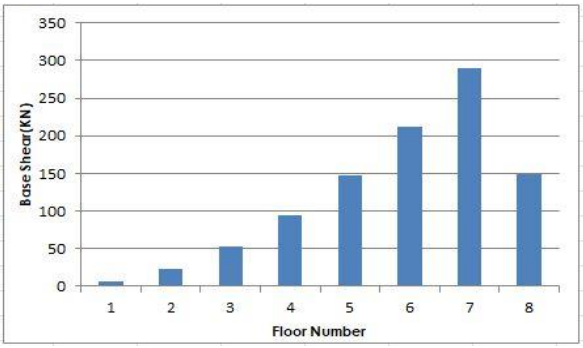
Floor	1	2	3	4	5	6	7	8
Base Shear(KN)	2.46	9.8	22.15	39.37	61.51	88.58	120.57	62

Figure 12. Floor - Base Shear Graph for Zone-II



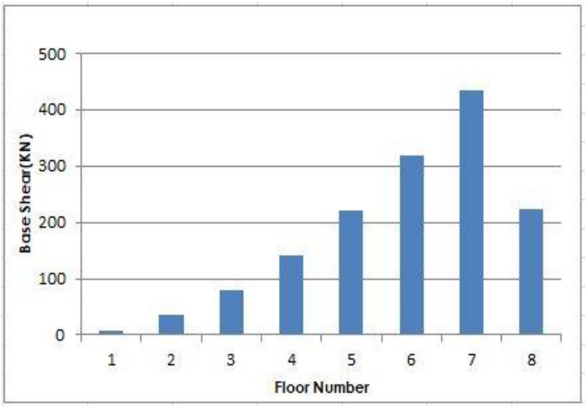
Floor Number	1	2	3	4	5	6	7	8
Base shear(Kn)	3.94	15.75	35.43	62.99	98.42	141.73	192.91	99.33

Figure 13. Floor - Base Shear Graph For Zone-III



Floor Number	1	2	3	4	5	6	7	8
Base shear(Kn)	5.91	23.62	53.15	94.49	147.63	212.59	289.36	149

Figure 13. Floor - Base Shear Graph For Zone-IV



Floor Number	1	2	3	4	5	6	7	8
Base shear(Kn)	8.86	35.43	79.72	141.73	221.45	318.89	434.04	223.5

Figure 14. Floor - Base Shear Graph For Zone-v

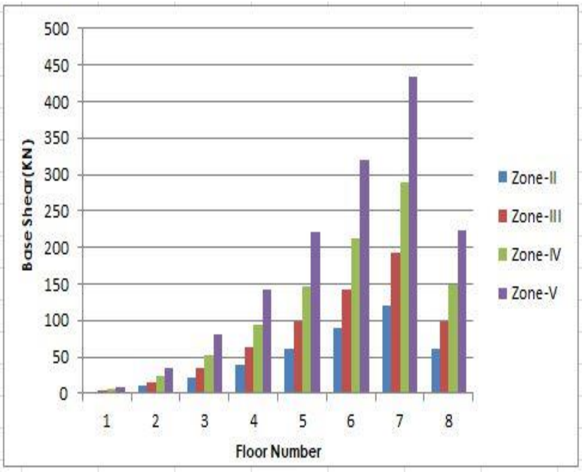
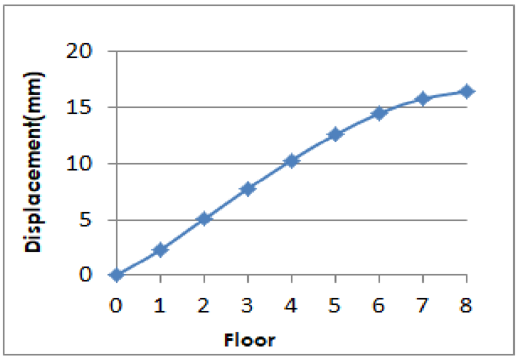


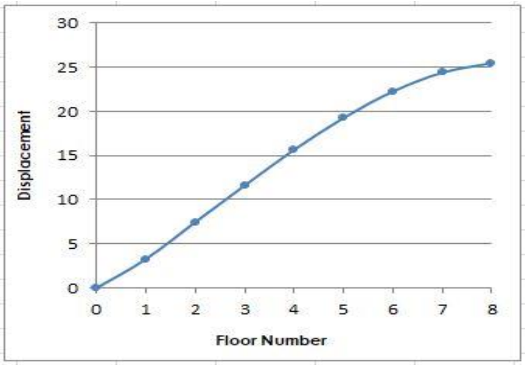
Figure 15.Comparasion of Base Shear in Different seismic zones

B. Floor Displacements:



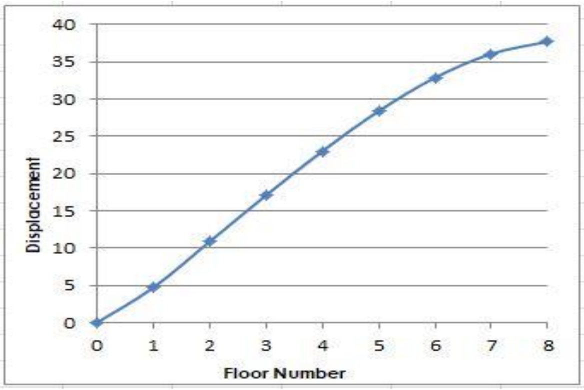
Floor	1	2	3	4	5	6	7	8
Displacement(mm)	2.28	5.01	7.73	10.28	12.57	14.46	15.79	16.45

Figure 16.Floor - Displacement curve for Zone-II



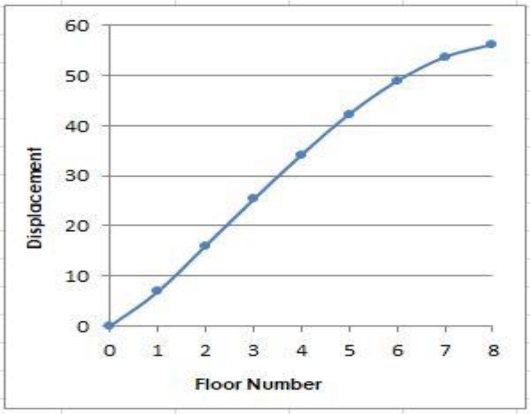
Floor Number	1	2	3	4	5	6	7	8
Displacement(mm)	3.28	7.47	11.62	15.66	19.26	22.26	24.39	25.47

Figure17.Floor - Displacement curve for Zone-III



Floor Number	1	2	3	4	5	6	7	8
Displacement(mm)	4.69	10.87	17.08	23.02	28.39	32.88	36.08	37.72

Figure18.Floor - Displacement curve for Zone-IV



Floor Number	1	2	3	4	5	6	7	8
Displacement(mm)	6.87	16.05	25.31	34.18	42.33	48.94	53.74	56.24

Figure19.Floor - Displacement curve for Zone-V

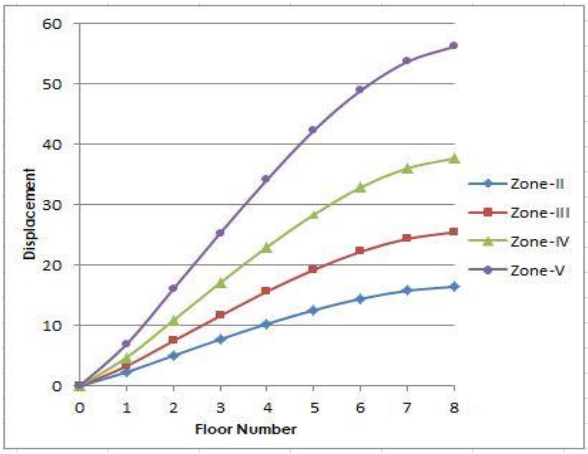


Figure20.Floor - Displacement for Different seismic zones

C. Support Reactions:

From the analysed results of support Reactions for Different supports are Divided into three Groups Groups based on the values. This Grouping helps to design of foundation of the Building from the Bellow Table is explain the variation of support reactions in Different seismic zones of India.

Table 2. Support reactions for proposed structure

Group	Joint	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Group-1	1	1946.08	2059.64	2222.9	2467.79
	4				
	109				
	112				
Group-2	2	2562.26	2562	2705.08	2952.1
	3				
	37				
	40				
	73				
	76				
	110				
	111				
Group-3	38	3137.86	3137.86	3137.86	3137.86
	39				
	74				
	75				

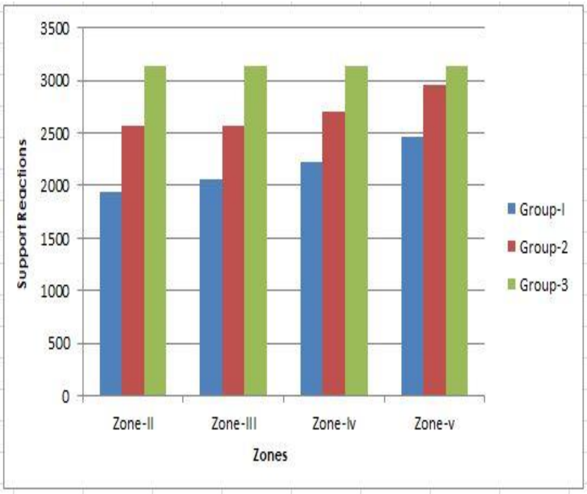


Figure 21. Zones - support reaction for Different seismic zones

2.4 Steel Quantity variation

Table 3. Steel Quantity Variation from zone to zone

ZONES	STEEL(Tons)
ZONE-II	14.78
ZONE-III	27.57
ZONE-IV	29.36
ZONE-V	32.02

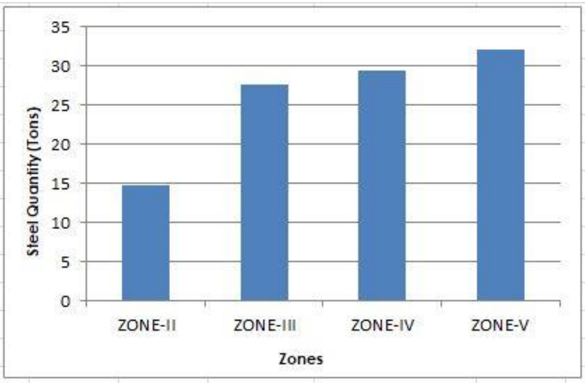


Figure 21. Zones - support reaction for Different seismic zones

4. CONCLUSIONS

1. The Structure analyzed in different seismic zones of India , than we find out the results in base shear of the building is more in seismic zone-V has compare to zone-II, zone-III and zone-IV.
2. Baseshear of seismic zone V is higher than 72.2%,55.56% and 33.33% as compared to zone-II,zone-III,zone-IV respectively.
3. Coming to Floor Displacements zone-v as higher displacements than zone-II,zone-III and Zone-IV.
4. In Maximum Floor Displacements seismic zone-V is higher than 39.79 mm,30.77 mm,18.52 mm as compared to zone-II,zone-III,zone-IV respectively.
5. Support reactions zone-V as higher value as compare to zone-II,zone-III,zone-IV.
6. Steel quantity of seismic zone-V is higher than 53.84%,13.89% and 8.31% as compared to zone-II,zone-III and zone-IV.
7. From the above results zone-V is critical for the G+7 structure.
8. seismic force acts on the structure it reflects additional force acting on the structure,Because of these addition forces structure behave different way than normal condition.
9. comes to seismic zones zone-v has higher zone factor than other zones.so zone-v values are more than as to compare other zones.
10. Base shear,Displacements,support reactions and steel quantity are Depends on zone factor,so these values are more in zone-v.

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