Dynamic Analysis of RCC Structure with Plan Irregularities using X bracing and Chevron bracing

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Abstract: In recent years there has been significant rise in usages of different shape structures in plan. High rise Irregular buildings constitute large portion of modern urban infrastructures. Such irregular structures needs to be taken care by structural engineers particularly in high seismic zones. Asymmetry in the plan increases stresses of certain structural elements. The control of the dynamic response of the multi-storey building can be achieved by increasing stiffness through the use of bracing system. In present study comparison the Influence of X bracing and Chevron Bracing in high rise structure by Response Spectrum and Time History Analysis will be carried out. Structure Have T and Rectangular in shape with G+49, G+59 height is considered with soil Medium and seismic zone II, III , IV and V. Response of structure will be identify by dynamic parameters such as Lateral Displacement, Base shear.

Index Terms **–RCC Structure, Plan Irregularities, X Bracing, Chevron Bracing, Time History Analysis, Response Spectrum Analysis, Dynamic Wind Analysis, ETABS – 2016.**

I. INTRODUCTION

The aftermath of an earthquake manifests great devastation due to unpredicted seismic motion striking extensive damage to innumerable buildings of varying degree, i.e. either full or partial. This damage to structures in turn causes irreparable loss of life with a large number of casualties. Strengthening of structures proves to be a better option catering to the economic considerations and immediate shelter problems rather than replacement of buildings. Moreover it has been often seen that retrofitting of buildings is generally more economical as compared to demolition and reconstruction. Therefore, seismic retrofitting or strengthening of building structures is one of the most important aspects for mitigating seismic hazards especially in earthquake prone areas.

To perform well in earthquake, a building should possess four main attributes, namely simple and regular configuration, and adequate lateral strength, stiffness and ductility. Building having simple regular geometry and uniformly distributed mass and stiffness in plan as well as in elevation, suffer much less damage than buildings with irregular configurations.

II. OBJECTIVES

- To evaluate the dynamic analysis of RCC structure with plan irregularities using X bracing and Chevron bracing
- To considering the Seismic Response (Zone II, III, IV and V), using Response Spectrum and Time History (Bhuj).
- To analysis the structure with and without bracings
- To identify the various dynamic parameters such as Lateral Displacement and Base Shear.

III. LITERATURE REVIEW

[5]Mohd Abdul Aqib Farhan, Jagadeesh Bommisetty, investigated that the Asymmetric building has maximum drift and displacement values but the maximum storey shear is more in regular building.

[7]Pratik Patel, Sandip Patel, Tejasvee Patel, Kamlesh Damdoo, investigated that the X bracing system have good performance as a compared to the other bracing system.

[9]Supriya, Ramkrishna Hegde, Ravi Kiran, investigated that the storey displacement values without bracing gradually increases.

[10]Yogita K. Kalambe, Sanjay Denge investigated that the T shape building has lesser base shear than regular and C shape.

IV. METHODOLOGY

In present work the analysis of following structure with different location of link has been carried out.

i) Regular Building Rectangular in plan without X and Chevron bracing
ii) Irregular Building T - Shaped in plan without X and Chevron bracing
iii) Regular Building Rectangular in plan with X and Chevron bracing
iv) Irregular Building T - Shaped in plan with X and Chevron bracing

The plan areas of the all structures are same for the analysis; also, the beam and column dimensions are same. The material properties such as Poisson ratio, Density of RCC, Density of Masonry, Young's modulus, compressive strength of steel and concrete etc. are kept constant in all buildings.

- For the Dynamic wind condition gust factor analysis is considered.
- The Response Spectrum Analysis for Zone II, III, IV & Zone V is considered.
- The Time History of 2001- Bhuj Earthquake is considered.
- The result parameter includes the Base Shear and Storey Displacement.

❖ **Structure and Section details:**

Storey	50 Storey and 60 Storey
Plan Dimension (Rectangular and T shaped)	42m X 30m
Bays in X-Direction	7
Bays in Y-Direction	5
Bay Width in X-Direction	6m
Bay Width in Y-Direction	6m
Floor Height	3m
Slab Thickness	150mm
Bracing size	300mm X 300mm
Beam Dimension	300mm X 550mm
Column Dimension	600mm X 600mm
Live Load on Roof	2 KN/m^2
Live Load on Floors	3 KN/m^2
Floor Finish	1.5 KN/m^2
External Wall Load	13.8 KN/m^2
Internal Wall Load	6.9 KN/m^2
Parapet Load	2.3 KN/m^2
Concrete Grade	M30
Steel Grade	Fe500

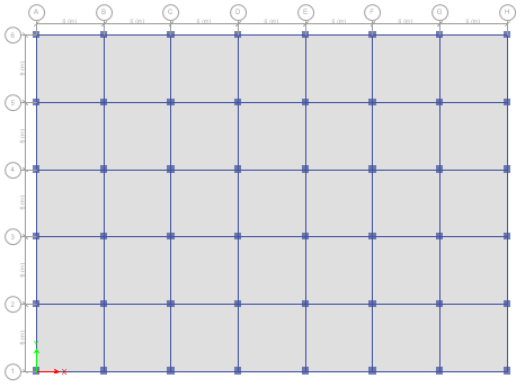


Fig 1. Plan View of Rectangular Shape

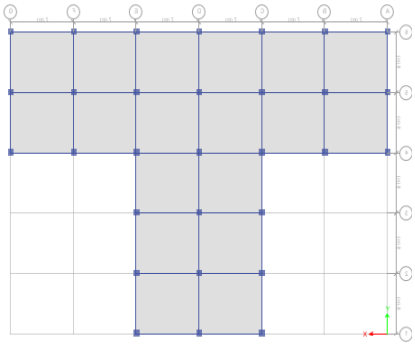


Fig 2. Plan View of T- Shape Building

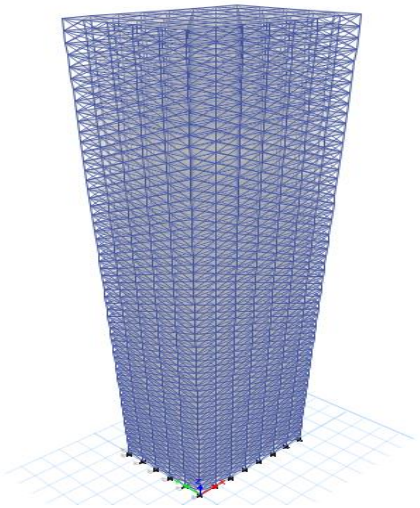


Fig 3. Elevational View of Rectangular Shaped X Bracing Building

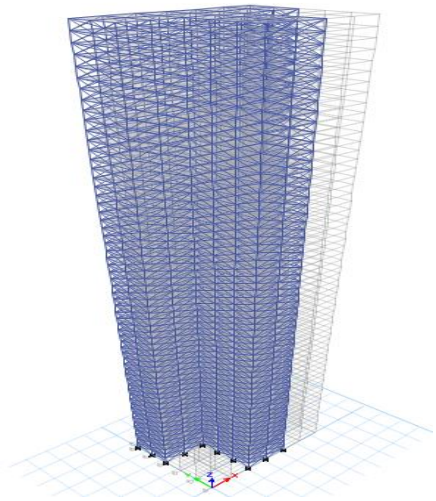


Fig 4. Elevational View of T- Shaped X Bracing Building

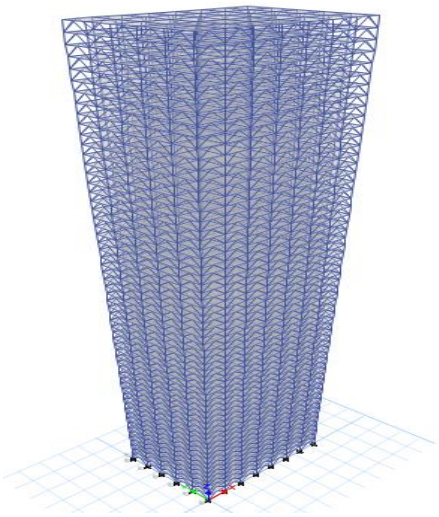


Fig 5. Elevational View of Rectangular Shaped Chevron Bracing

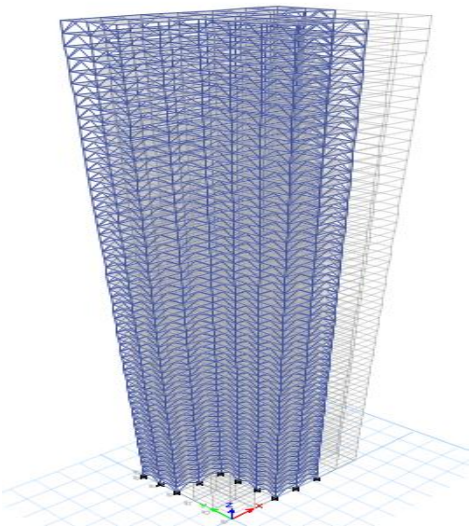
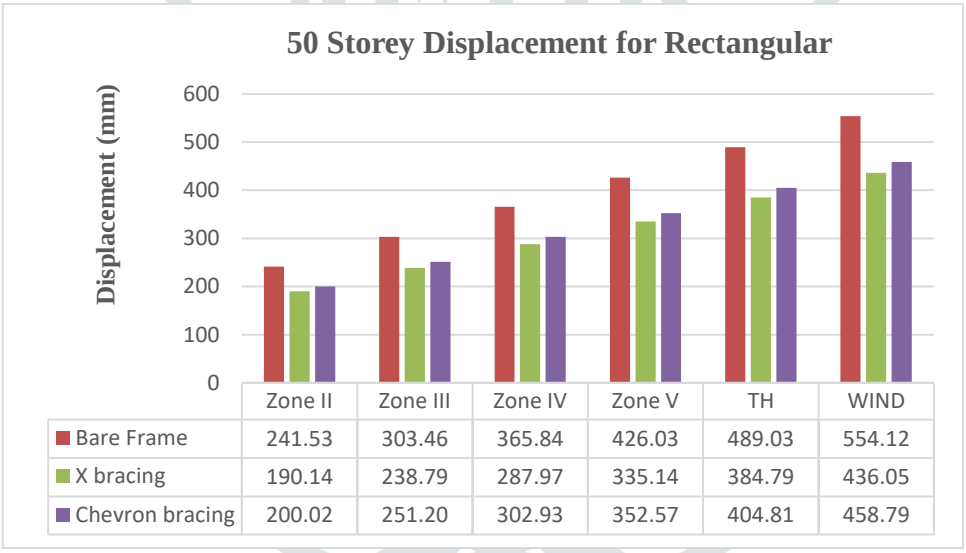


Fig 6. Elevational View of T Shaped Chevron Bracing

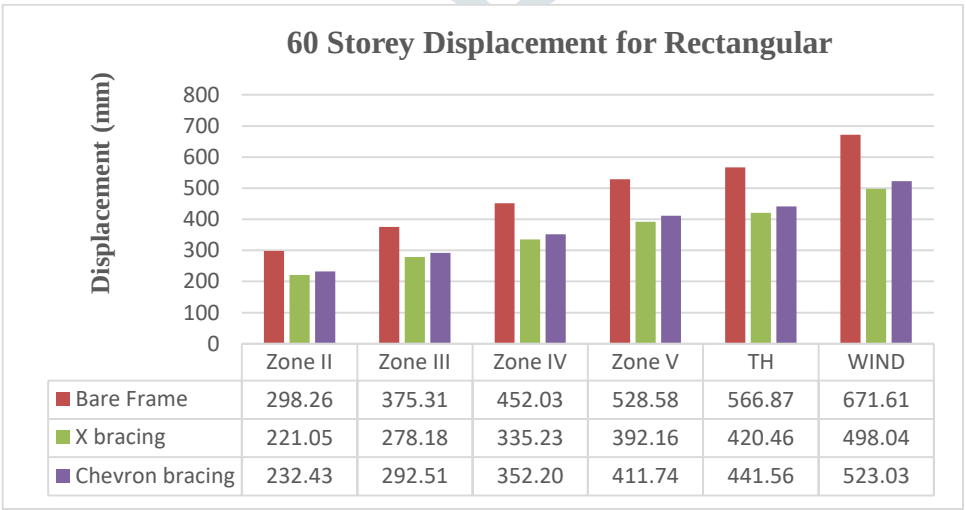
V. RESULTS

Maximum Storey Displacement



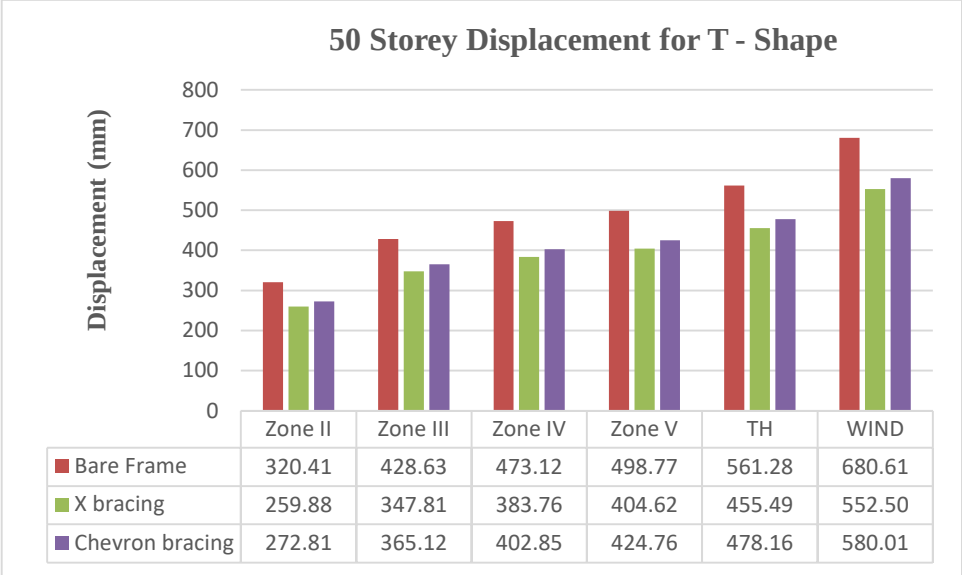
	Zone II	Zone III	Zone IV	Zone V	TH	WIND
Bare Frame	241.53	303.46	365.84	426.03	489.03	554.12
X bracing	190.14	238.79	287.97	335.14	384.79	436.05
Chevron bracing	200.02	251.20	302.93	352.57	404.81	458.79

Maximum Displacement of 50 Storey for Rectangular Shape



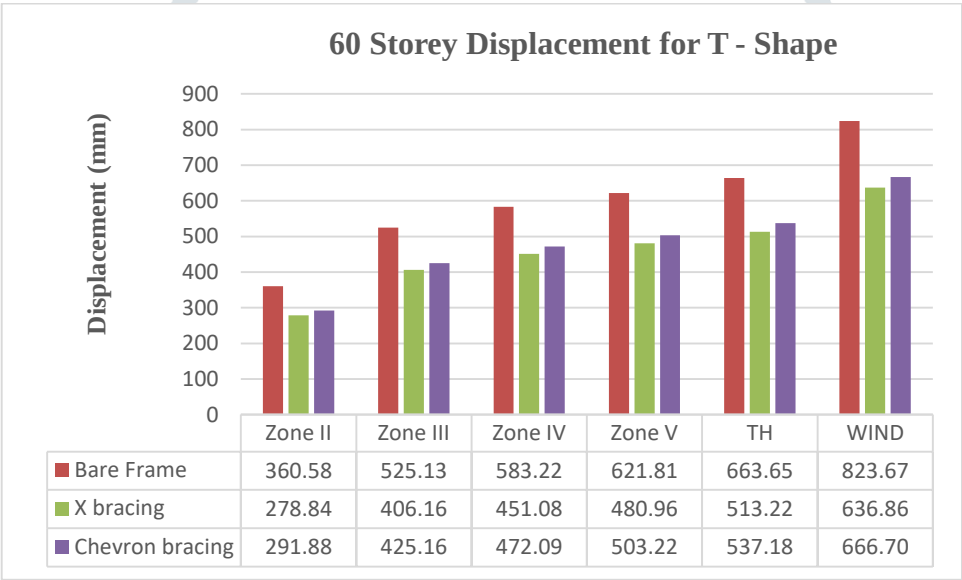
	Zone II	Zone III	Zone IV	Zone V	TH	WIND
Bare Frame	298.26	375.31	452.03	528.58	566.87	671.61
X bracing	221.05	278.18	335.23	392.16	420.46	498.04
Chevron bracing	232.43	292.51	352.20	411.74	441.56	523.03

Maximum Displacement of 60 Storey for Rectangular Shape



	Zone II	Zone III	Zone IV	Zone V	TH	WIND
Bare Frame	320.41	428.63	473.12	498.77	561.28	680.61
X bracing	259.88	347.81	383.76	404.62	455.49	552.50
Chevron bracing	272.81	365.12	402.85	424.76	478.16	580.01

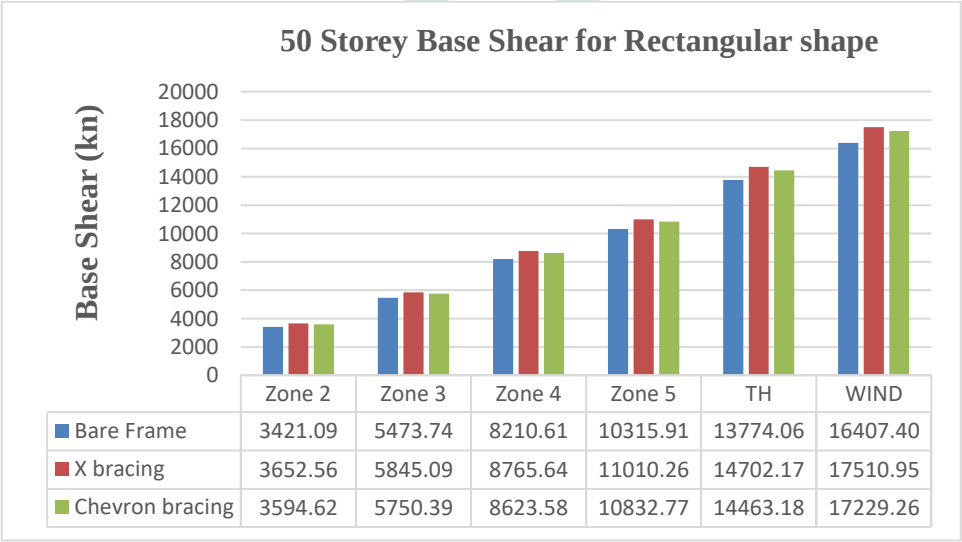
Maximum Displacement of 50 Storey for T – Shape



	Zone II	Zone III	Zone IV	Zone V	TH	WIND
Bare Frame	360.58	525.13	583.22	621.81	663.65	823.67
X bracing	278.84	406.16	451.08	480.96	513.22	636.86
Chevron bracing	291.88	425.16	472.09	503.22	537.18	666.70

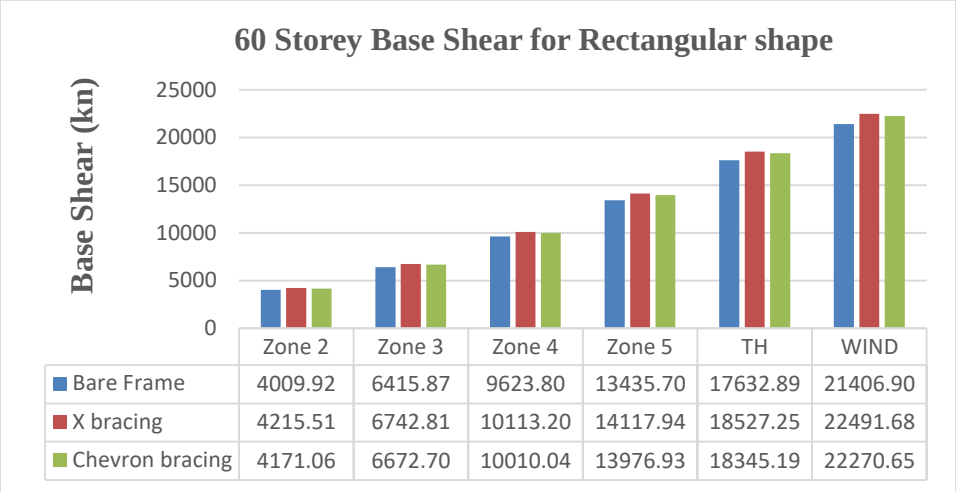
Maximum Displacement of 60 Storey for T – Shape

- **Base Shear**



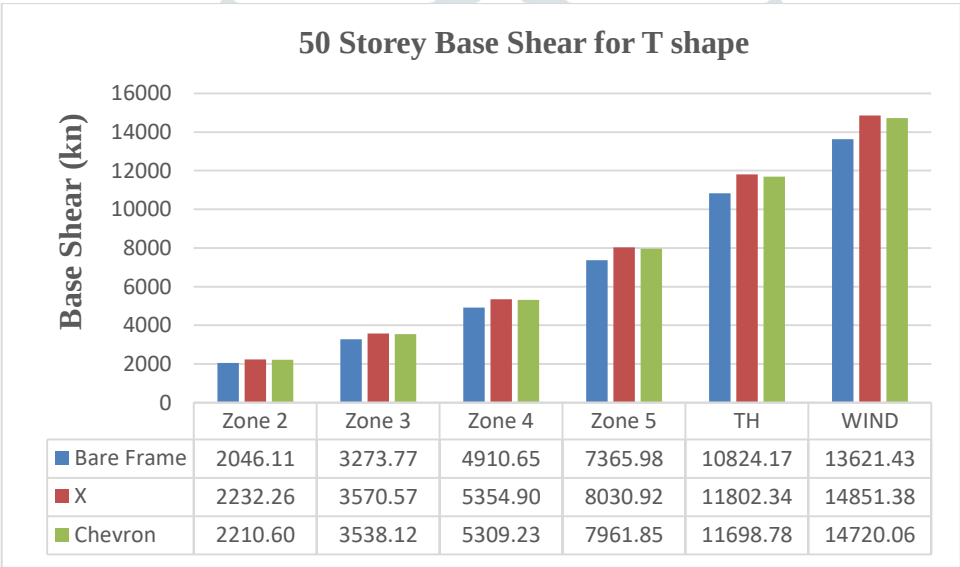
	Zone 2	Zone 3	Zone 4	Zone 5	TH	WIND
Bare Frame	3421.09	5473.74	8210.61	10315.91	13774.06	16407.40
X bracing	3652.56	5845.09	8765.64	11010.26	14702.17	17510.95
Chevron bracing	3594.62	5750.39	8623.58	10832.77	14463.18	17229.26

Base Shear of 50 Storey for Rectangular shape



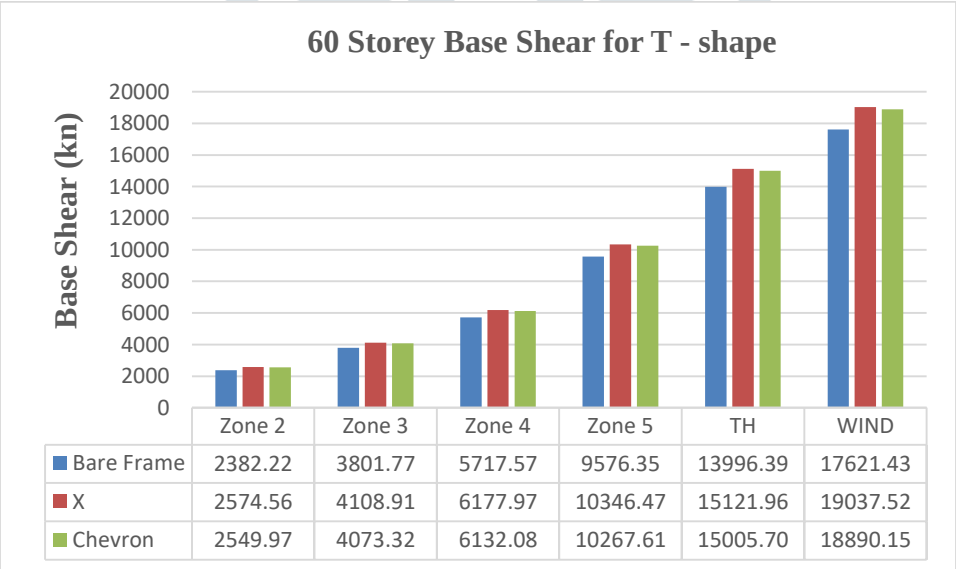
	Zone 2	Zone 3	Zone 4	Zone 5	TH	WIND
Bare Frame	4009.92	6415.87	9623.80	13435.70	17632.89	21406.90
X bracing	4215.51	6742.81	10113.20	14117.94	18527.25	22491.68
Chevron bracing	4171.06	6672.70	10010.04	13976.93	18345.19	22270.65

Base Shear of 60 Storey Rectangular shape



	Zone 2	Zone 3	Zone 4	Zone 5	TH	WIND
Bare Frame	2046.11	3273.77	4910.65	7365.98	10824.17	13621.43
X	2232.26	3570.57	5354.90	8030.92	11802.34	14851.38
Chevron	2210.60	3538.12	5309.23	7961.85	11698.78	14720.06

Base Shear of 50 Storey for T- shape



	Zone 2	Zone 3	Zone 4	Zone 5	TH	WIND
Bare Frame	2382.22	3801.77	5717.57	9576.35	13996.39	17621.43
X	2574.56	4108.91	6177.97	10346.47	15121.96	19037.52
Chevron	2549.97	4073.32	6132.08	10267.61	15005.70	18890.15

Base Shear of 60 Storey for T- shape

VI. Conclusion

- It is Observed that Storey Displacement Value without Bracing is More Compared to the X bracing and Chevron bracing.
- The X Bracing is Considering Lesser Displacement Compared to the Chevron Bracing.

- The Irregular T Shape Structure has More Displacement value than Rectangular Structure.
- Base Shear increase while using X bracing and Chevron bracing.
- X bracing subjected to higher base shear value than Chevron bracing.
- The Irregular T Shape Structure is subjected to less Base Shear than Rectangular Structure.

VII. REFERENCES

1. B. Preethi, A.Mallika, "Comparative Study of Different Bracing Patterns for Different Plan Irregularities of the Buildings", Journal of Civil Engineering and Environmental Technology, Vol-2, Number-14, July-September – 2015 pp.36-41
2. Bharat Patel, Rohan Mali, Prataprao Jadhav, G. Mohan Ganesh, "Seismic Behaviour of Different Bracing Systems in High Rise RCC Structure", International Journal of Civil Engineering and Technology, Vol-8, Issue-3, March – 2017.
3. Girish Hombal, Akshay Umare, Shruti Neeralagi, "Analysis of G+20 RCC bare Framed Structure with Different types of Bracing System in Different Seismic Zones" International Research Journal of Engineering & Technology, Vol-6, Issue-07, July – 2019.
4. Milind V. Mohod, "Effect of Shape and Plan Configuration on Seismic Response of Structure", International Journal of Scientific andTechnology Research Vol-4, Issue-9, September– 2015.
5. Mohd Abdul Aqib Farhan, Jagadeesh Bommisetty, "Seismic Analysis of Multi-storied Rcc Building Regular and Irregular in Plan" International Journal of Engineering Research & Technology, Vol-8, Issue-11, November – 2019.
6. Om Prakash Mahato, M. Anil Kumar "Study on Effect of Geometry on RC Multistory Building under Seismic Load" International Journal of Recent Technology & Engineering, Vol-7, Issue-6C2, April – 2019.
7. Pratik Patel, Sandip Patel, Tejasvee Patel, Kamlesh Damdoo, "Comparative Study of Different Bracing System in Rcc Buildings" International Research Journal of Engineering & Technology, Vol-6, Issue-04, April – 2019.
8. Rishi Mishra, Abhay Sharma, Vivek Garg, "Analysis of RC Building Frames for Seismic Forces using Different types of Bracing Systems", Vol-3, Issue-7, July – 2014.
9. Supriya, Ramkrishna Hegde, Ravi Kiran, "Comparative Study of Different types of Bracing and Regular Rcc Structure" International Research Journal of Engineering & Technology, Vol-6, Issue-05, May – 2019.
10. Yogita K. Kalambe, Sanjay Denge, "Seismic Analysis of RCC Building with Plan Irregularities", International Journal for Scientific Research & Development, Vol-5, Issue-6, June – 2019.