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Seismic Analysis of G+10 RCC Building with and without Shear Wall

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Abstract: *On day of 26th January 2001 India had face the immense calamity because of tremor happened in Bhuj with an extent of 7.7 richter scale and the field of structural design detects the noteworthiness of adjustment in the study of seismic behavior of structure. While conversing about the seismic design of structure, it ought to have the lateral force resisting system which will embraces the least dimension of structural member. So as to give the best possible lateral resisting system for high rise or tall structure, structural designer has to provide Special Moment Resisting frame or the shear wall with the group of Special Moment Resisting frame according to the suitability of structure and economy. The inspiration of this investigation is a usable utilization of shear walls with precise location in structure and to attest that the shear walls can be replaced to column without increasing the quantity of concrete, in order to achieve the economy. The study is confined up to the seismic analysis of a G+10 residential building according to the rules given in IS 1893 (Part 1):2002.The powerful utilization of shear walls studied with the three models in different zones of earthquakes ZONE II, ZONE III, ZONE IV, ZONE V with the parameters like Story drift, Base Shear, lateral Displacement, Overturning moment in all zones for all models by utilizing the product E-tabs 2016.*

Keywords*:* Shear wall, E-tabs, framed structure, seismic behavior

I. INTRODUCTION

Earthquake is one of the significant catastrophic events which cause huge damage to the humankind and the nature. From the behavior of structure amid past seismic earthquakes it has been proved that the structures which stand safe amid quakes are not working easily a short time later and afterward get demolished. To resist the lateral force amid seismic tremors and stays utilitarian a short time later, the structure ought to have the well enough stiffness and flexibility against lateral loads. As a structural engineer, the real need of time to make structure safe and economical against the lateral forces which are originating on the structure during earthquakes. The Reinforced concrete framed structure is having good strength to resist the lateral loads but in the case of tall or high rise structures, to make the structure safe against the lateral loads the worked out member size are too large which leads towards the un-economy and congestion in joints, to cast in situ. As the originated lateral forces are stand-in the centre of gravity of structure and in present practice to resist that lateral force the lift shear wall is located at the mid of building. Provided lift shear wall partially fulfills the stiffness requirement of structure against seismic waves, in order to fulfill the stiffness requirement of structure with the least dimensions of structural member during earthquakes, the structure should have the combination of structural members and structural walls. Shear walls are most regularly utilized structural system which improves the seismic response of multi-storyed structure, it is advantageous to support gravity loads. The performance of erection amid seismic tremors is governed by the factors like dissemination of weight, stiffness and strength in both horizontal planes of structure. In high rise or tall structure lateral force resisting system is overwhelming to guarantee the safety of structure. In order to ensure the stiffness of structure, the different kind of lateral force resisting system can be used by using the guidelines given in IS 1893(Part 1):2002,types of system adopted in structure for study of seismic behavior of structure: Bare R.C.C. Frame system, Dual System, Structural wall system.

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II. SOFTWARE MODELLING OF BUILDING

For this project, a G+10 storyed building of regular plan is modeled with 3 meters floor to floor height and keeping the ground floor height 3 meter by considering the plinth height 1m. loading and design of this structure in consistence to the IS code 875:1987 Part I, II, III and IS 456:2000 respectively. For Earthquake design criteria IS 1893:2002 is referred. The structure is thought to be fixed at the base and the floors performances as rigid diaphragms. The areas of structural members are kept square and rectangular and their sizes are varies with the change in model of structure. Story heights of structures are kept fixed including the ground story. The structures are modeled utilizing software ETABS-2016.Three different models are analyzed with different set of shear wall in building plan. Models are contemplated in every one of the four zones of seismic tremor to compare Storey drift, Base Shear, lateral Displacement, Overturning moment.

Table 01. Details of Structure

1.	Symmetry of structure	Symmetric
2.	No of storey	G+10
3.	All Floor Height	3.0 m
4.	Column Size	230 x 900mm
5.	Shear wall size	200 x 900 mm
6.	Beam Size	230 x 600 mm
7.	Thickness of Floor slab	120 mm
8.	Thickness of waist slab	180 mm
9.	Thickness of exterior wall	230 mm
10.	Thickness of internal wall	150 mm
11.	Fck&Fy	M25 & Fe 500

Types of Model:

Model 01: Moment Resisting Frame.

Model 02: Dual frame.

Model 03: Shear wall frame.

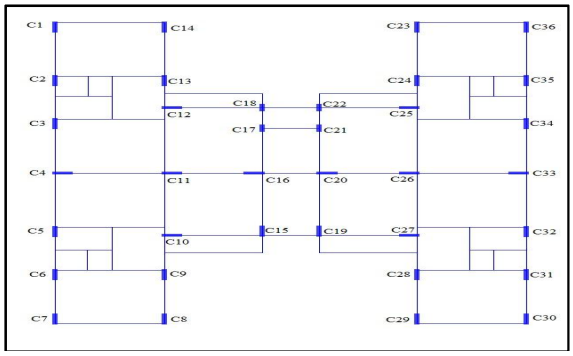

Fig.01: Model 01

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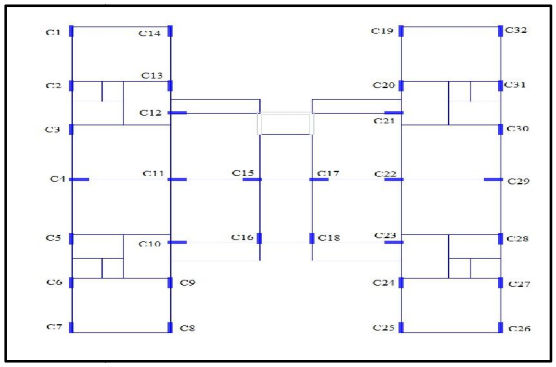

Fig.02: Model 02

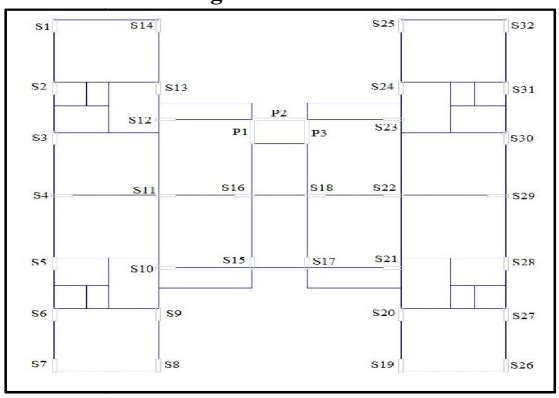

Fig.03: Model 03

III. RESULT AND DISCUSSION

Lateral Storey Displacement

Lateral storey displacement of all three models in all four seismic zones of India, are as shown below:

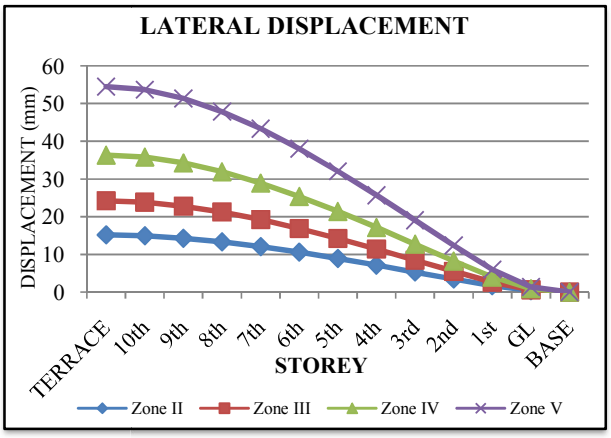

Fig.04: Lateral Displacement of Model 01

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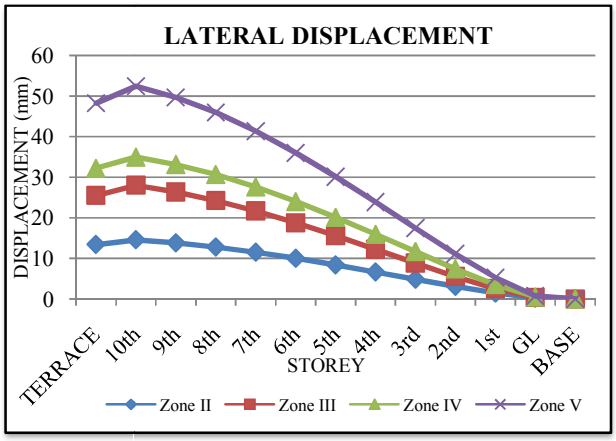

Fig.05: Lateral Displacement of Model 02

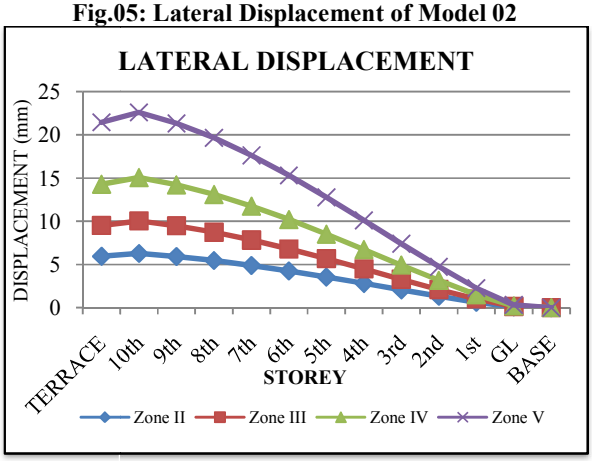

Fig.06: Lateral Displacement of Model 03

From the results it is observed that the lateral displacement in all the seismic zones of India has reduced up to 40% in Model 03.

Storey Drift Ratio

Story drift is the displacement of one floor levels to the relative other floor level above or below. Story drift ratio of all three models in all the zones of India are as follow:

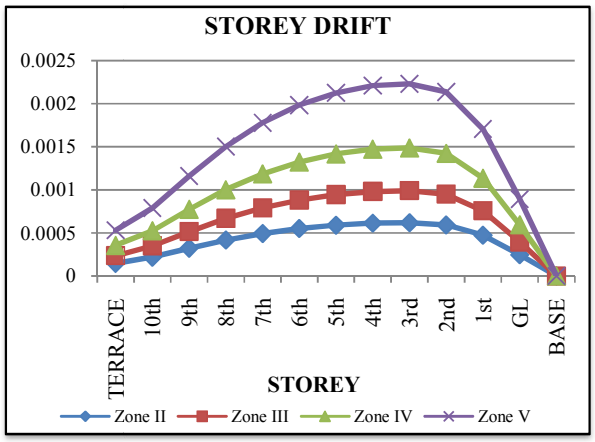

Fig.07: Storey Drift ratio of model 01

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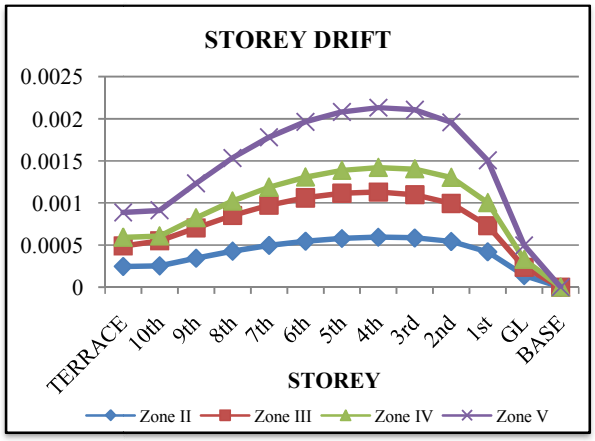

Fig.08: Storey Drift ratio of model 02

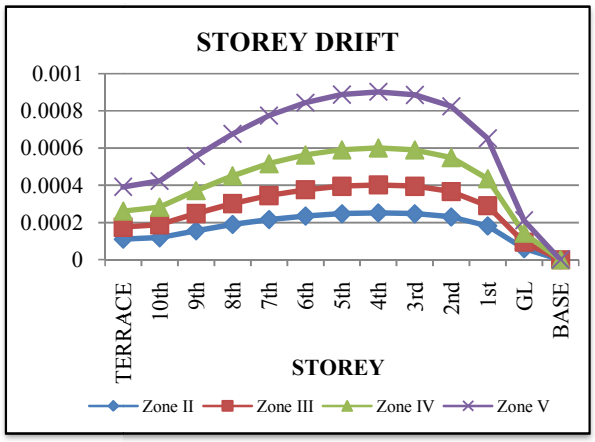

Fig.09: Storey Drift ratio of model 03

From the result it is observed that the storey drift of Model 01 and Model 02 is having somewhat similar value of storey drift in all the four seismic zones. While the Model 03 having low value of storey drift in ZONE V & ZONE IV with respect to the other two models.

Base Shear

Base shear of all three models in all four seismic zones of India, are as shown below:

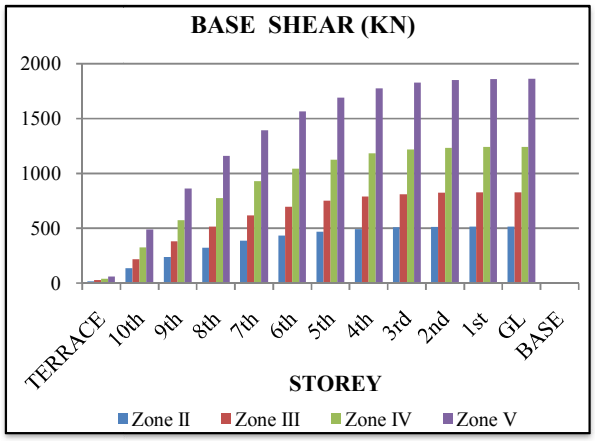

Fig.10: Base Shear of model 01

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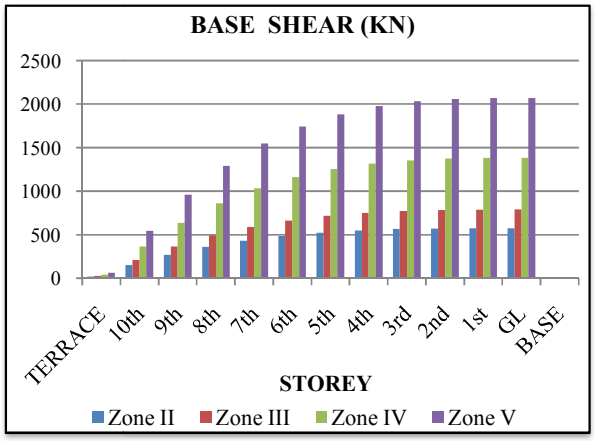

Fig.11: Base Shear of model 02

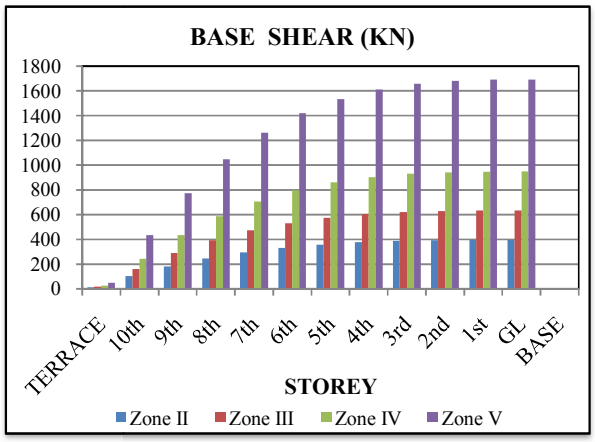

Fig.12: Base Shear of model 03

From the above results it is observed that the Model 01 is having low value of Base Shear as compared to the Model 02 in all the seismic zones. While the model 03 is having low value of base shear as compared to the other models in each seismic zone.

Overturning Moments:

Overturning moments of all three models in all four seismic zones of India, are as shown below:

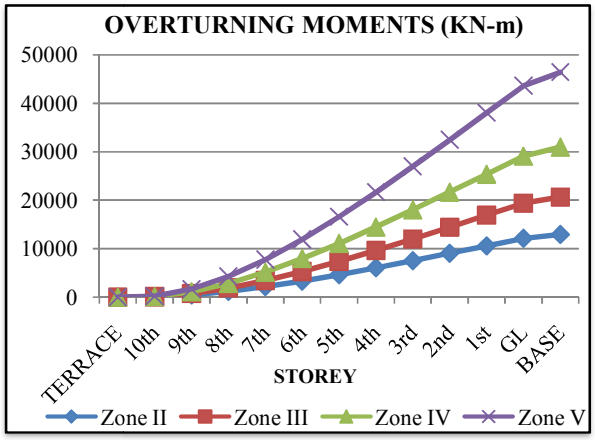

Fig.13: Overturning moment of model 01

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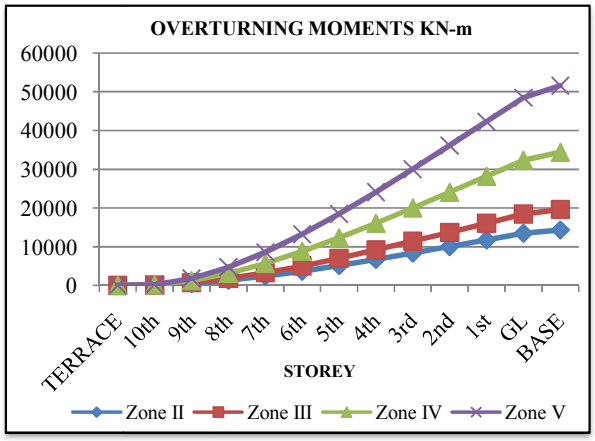

Fig.14: Overturning moment of model 02

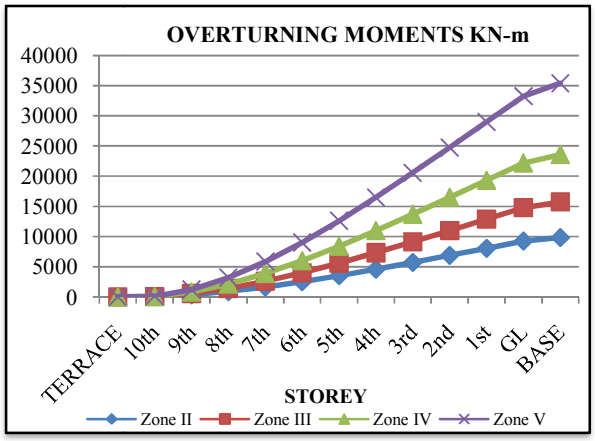

Fig.15: Overturning moment of model 03

From the above results it is observed that the Model 01 is having low value of overturning moments as compared to the Model 02 in all the seismic zones. While the model 03 is having low value of overturning moments r as compared to the other models in all seismic zone.

Concluding Remark:

From the above given observations of model 01, 02, 03 the effective performance in seismic zone of India are as follow:

Sr. No.	Particulars	ZONE II	ZONE III	ZONE IV	ZONE V
1.	Lateral Displacement	M-3	M-3	M-3	M-3
2	Storey Drift	M-3	M-3	M-3	M-3
3	Base Shear	M-3	M-3	M-3	M-3
4	Overturning Moments	M-3	M-3	M-3	M-3

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III. CONCLUSION

From the above seismic analysis of RCC building of G+ 10 storeyed it is observed that the building with the shear walls as a replacement of columns can be economical and effective in high rise buildings. It is also observed that

1. The accurate position of shear wall in frame structure plays a vital role as it attracts the seismic forces.
2. More the stiffness of shear wall will attract take the more seismic forces.
3. Providing shear wall can reduce the base shear of structure.

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