Seismic Assessment of RC Building with Different Lateral Load Conditions

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Abstract **- Increasing population and urbanization makes parking space facilities very important in the construction. Therefore soft storey gets importance in construction to provide parking facility to vehicles. A soft storey constructs with infill or without infill affects the stiffness of structure, therefore before construction of soft storey, study about seismic condition and lateral load condition is necessary. In this study we analyze the models using ETABS-2013 software and compare each model results of mode shape and base shear using Response spectrum and Time history method, models used in this analysis are bare frame, alternative infill, alternative bracing and bracing outside in seismic zone 4. Seismic performance is mainly focused by this study. From the analysis, it is found that Base shear is more in soft storey is reduced by using bracing and infill in soft storey. This shows the poor performance of soft storey without using bracing or infill. Mode shape changes storey to storey and time to time, mode shape shows results x direction, y direction and rotational direction. All these results prove the soft storey without infill or bracing is giving poor performance compare to with infill and bracing.**

Index Terms **- Bare Frame, Masonry Infill, Soft Storey, Bracing.**

I. INTRODUCTION

Now a days in the RC building construction soft storey is unavoidable, all the buildings or structures needs essential parking place to the vehicles. But using soft storey is effects to the strength and stiffness of the building, it required stiff or large column to resist the lateral loads. This analysis studies the different lateral load resisting system in different seismic zone. Response spectrum and Time history method use to analyze the building in different lateral load conditions. It shows the suitable method of lateral load resisting system to reduce the damages. In this study, seismic performances of various infill panels behavior in the RC structure are compared with bare frame using dynamic analysis.

Provisions to soft storey are:

a. Provide a stiff column in soft storey
b. Provide a bracing alternatively or outer periphery
c. Provide a infill wall in alternatively or outer periphery
d. Provide a infill wall in inner core or edges

II. STRUCTURAL DATA

The study is carried out on RC building with different lateral load resisting system with soft storey.

Plan dimensions	22.5m X 16m
Total height of building	23.2m
Height of each storey	3.10m
Depth of foundation	1.50m
Size of longitudinal beams	300mmX500mm
Size of transverse beams	300mmX450mm
Size of columns	500mmX500mm
Thickness of slab	120mm
Thickness of external walls	230mm
Thickness of internal walls	115mm
Seismic zone	IV
Soil condition	Hard soil
Response reduction factor	5
Importance factor	1
Floor finishes	1.875 kN/m²
Live load at roof level	2.0 kN/m²
Live load at all floors	5.0 kN/m²
Grade of Concrete	M20

Grade of Steel	Fe415
Density of Concrete	25 kN/m³
Density of brick masonry	20 kN/m³

III. MODELS OF BUILDING

The building is modeled using the ETABS-2013 software, it is mainly structural analysis program with a special purpose features for structural design and analysis of building systems.
Model 1= Bare frame
Model 2= Alternative bracing
Model 3= Alternative infill
Model 4= Bracing in outer periphery

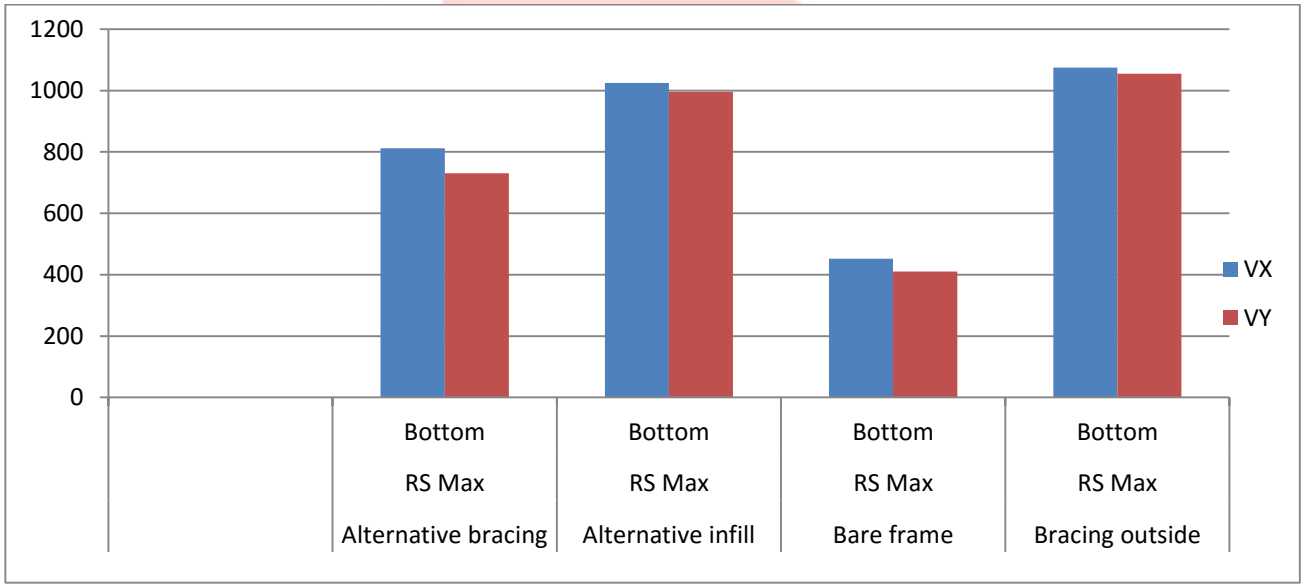
IV. RESULTS AND DISCUSSION

A) BASE SHEAR

Generally Base shear more in soft storey. Base shear varies based on different lateral load condition, using lateral loading system with soft storey it reduce the base shear. Following table and chart shows the base shear of alternative bracing, alternative infill, bare frame and bracing outside.

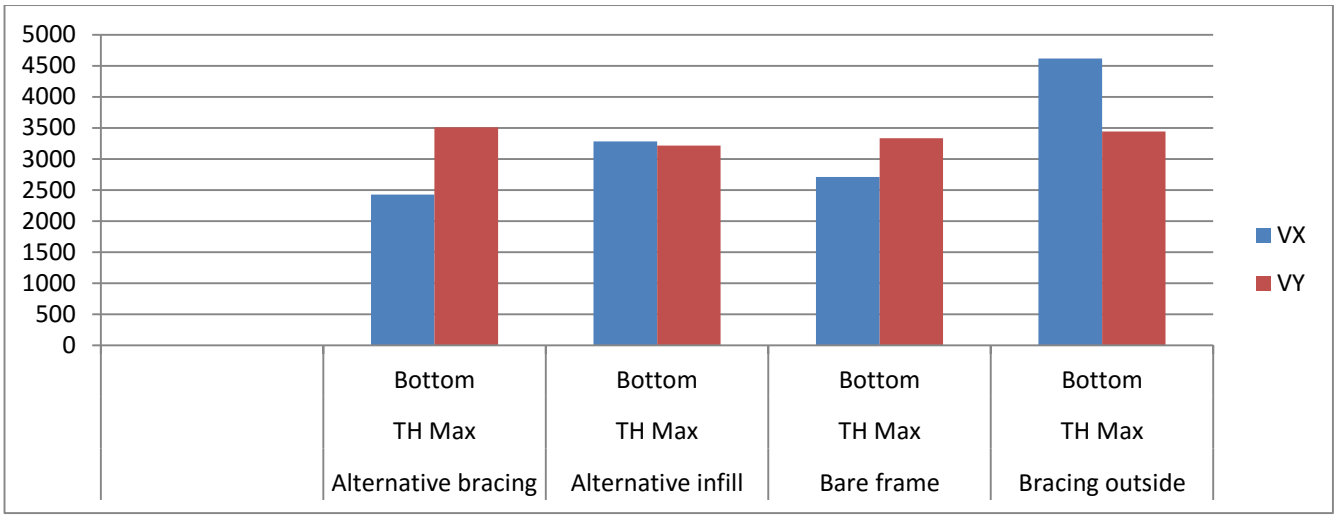
Response Spectrum Method

Structure	Load Case	Location	VX (kN)	VY (kN)
Alternative bracing	RS Max	Bottom	812.1377	730.9863
Alternative infill	RS Max	Bottom	1025.1957	995.8639
Bare frame	RS Max	Bottom	451.7103	409.8606
Bracing outside	RS Max	Bottom	1075.1722	1054.9015



Time History Method

STRUCTURE	Load Case/Combo	Location	VX (kN)	VY (kN)
Alternative bracing	TH Max	Bottom	2426.4116	3510.5928
Alternative infill	TH Max	Bottom	3281.5393	3217.252
Bare frame	TH Max	Bottom	2711.0111	3332.5613
Bracing outside	TH Max	Bottom	4615.2841	3439.9927



From the above graphs we conclude that the base shear of bare frame is less than other three models and hence there will be a considerably difference in the lateral force along the height of the building.

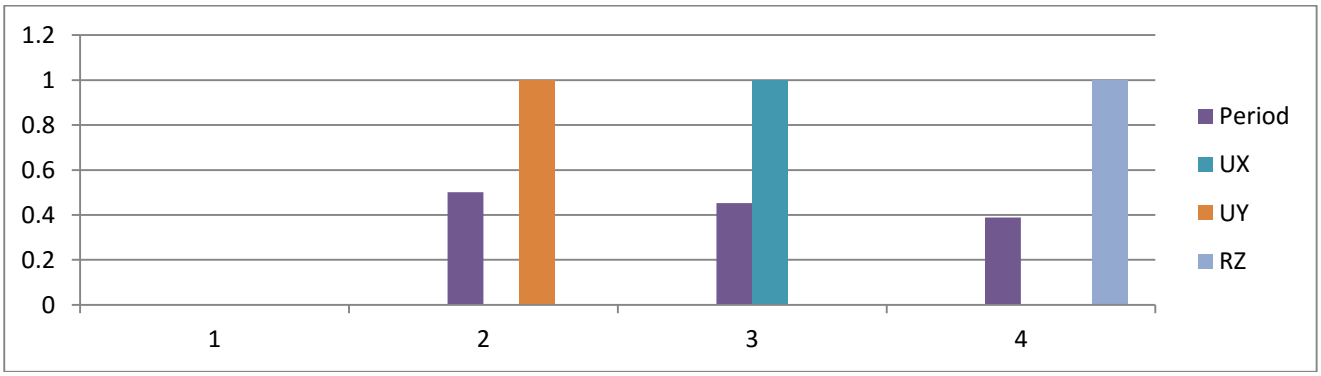
MODE SHAPE

Model shape in x direction, y direction and rotation changes with time. Following table and charts shows the different time period and different direction of mode shapes in different lateral load conditions.

Sl. No.	Structure	Mode shape	Period (sec)	UX	UY	RZ
1	Alternative bracing	1	0.501	0	1	0
		2	0.453	1	0	0
		3	0.388	0	0	1
2	Alternative Infill	1	0.411	0	1	0
		2	0.383	1	0	0
		3	0.333	0	0	1
3	Bare frame	1	0.789	0	1	0
		2	0.727	1	0	0
		3	0.689	0	0	1
4	Bracing in outside	1	0.387	0	1	0
		2	0.35	1	0	0
		3	0.3	0	0	1

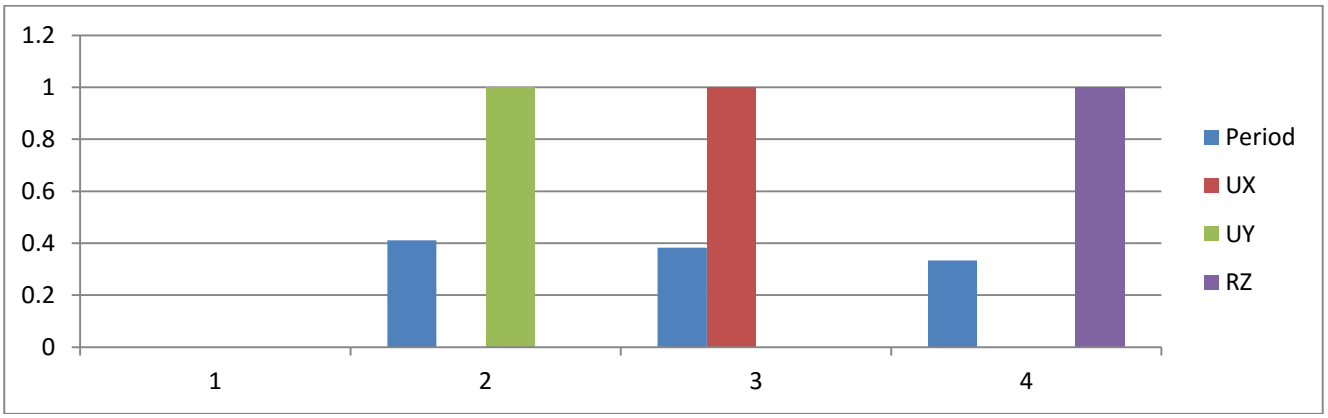
Alternative Bracing

From the graph shown below for modal 1, First mode shape is y-direction having 0.501sec, second mode is x-direction having 0.453 sec and third mode is torsson having 0.388 sec.



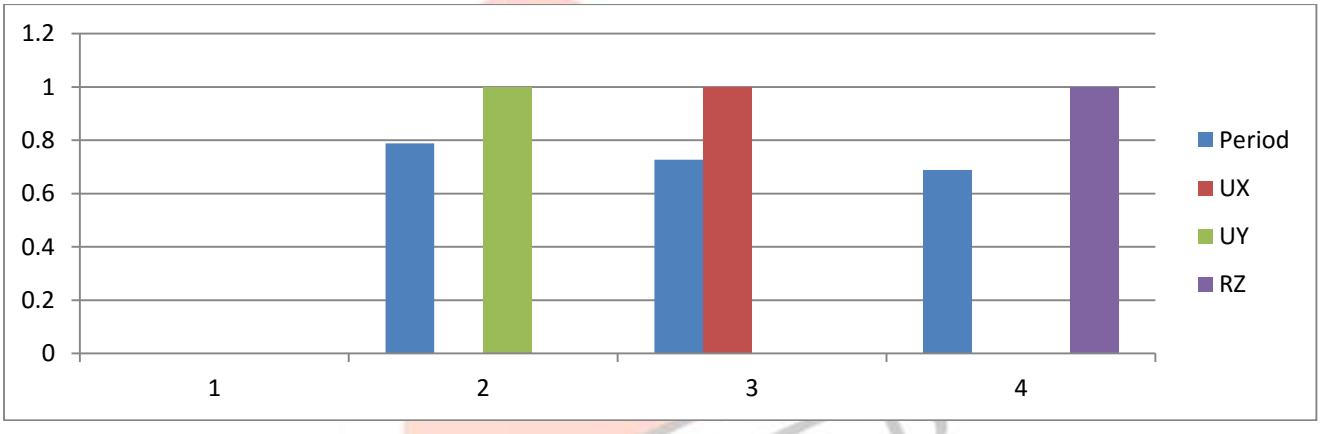
Alternative Infill

From the graph shown below for modal 2, First mode shape is y-direction having 0.411sec, second mode is x-direction having 0.383 sec and third mode is torsson having 0.333 sec.



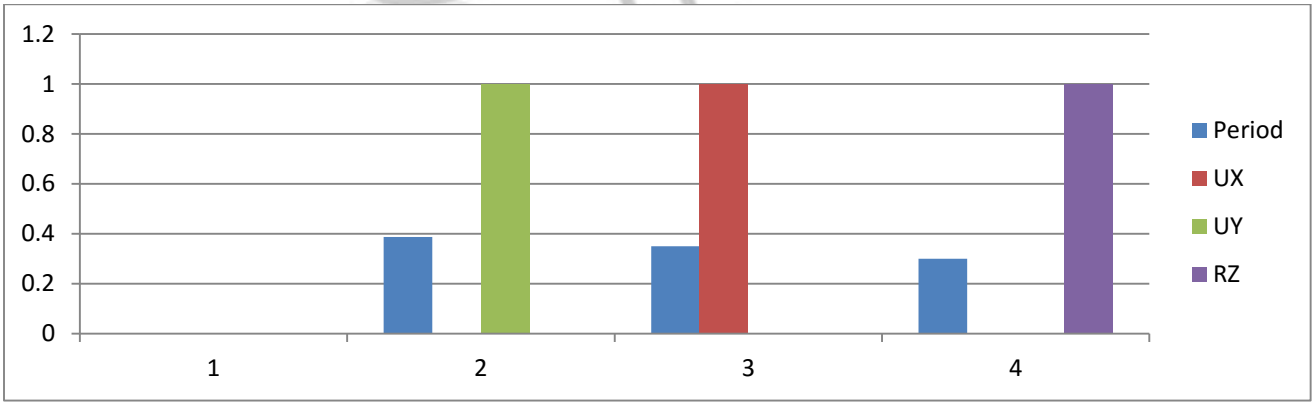
Bare Frame

From the graph shown below for modal 3, First mode shape is y-direction having 0.789sec, second mode is x-direction having 0.727 sec and third mode is torsson having 0.689 sec.



Bracing In Outside

From the graph shown below for modal 4, First mode shape is y-direction having 0.387sec, second mode is x-direction having 0.35 sec and third mode is torsson having 0.3 sec.



V. CONCLUSIONS

The object of this study is to find the effect of horizontal loading on RC building in different lateral load conditions. It shows the results vary in mode shape and base shear in different lateral load conditions. Compare to the Response spectrum method, Time history method shows 3 times more because the method is designed for maximum earthquakes data.

1. Compare to other systems, base shear in bracing outside structure is more because of increased mass of structure.

2. Compare to other systems, mode shape period in structure using bare frame is more, then it can be applicable to resist seismic forces.
3. The presence of infill wall can affect the seismic behavior of frame structure to large extent and the infill wall increases the strength and stiffness of the structure.
4. From the observation of the results it states that decrease in the time period will leads to increase in the base shear of the building.
5. Because of high stiffness of the infill walls, considering them as structural elements leads the initial stiffness of structures to increase. Such elements show high strength at the first step of seismic loading, but by reaching to the maximum strength, the infill walls fail and high loss of strength occurs in small drifts.

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