Dynamic analysis of RC frame braced tube structure

Ajay Shinde[1]

Department of civil engineering

[1]P.G student, Saraswati College of Engineering,Kharghar,Maharashtra,India.

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Abstract - : *The RC frame braced structure are the combination of steel bracing and RCC shear wall are provided to be most power full lateral load resisting system. The use of different bracing system for strengthening the reinforced concrete frame in seismic loading is viable solution for enhancing earthquake resistance structure. In this paper, the seismic analysis of RCC structure with different system of bracing is studied. G+30 residential building is analyzed for seismic zone III as per IS 1893 – 2002 in E-tabs 2015 software. The parameter considered for analysis of structure is time period, story drift, displacement, base shear. The RCC structure is analyzed for dynamic loading and same structure is analyzed with different type of bracing system such as X-bracing, Concentric bracing, eccentric bracing. The base on study it can be concluded that along with type of bracing the location of bracing is also important in lateral force resisting system. The response spectrum method is applied and analytical results are compared.*

Key Words: Shell, Bracing, Concentric, Eccentric, base shear, time period, displacement

1.INTRODUCTION

Baracing is structural system, with RC core wall in inner side & braced shell tubing system on outer side. It is seen that the Shear wall system is very much effective in resisting lateral loads for the structures up to 25 stories. For structures beyond 25 stories the Framed tube system is very much effective than Shear wall system in resisting lateral loads.

Tall building must have to capable of carry all gravity loads to its foundation in life span of building. Conventionally designed columns of structure cannot carry weight of building and tolerate the large horizontal loads caused by the wind and seismic load.

This study examines the braced tube structure in the modeling of earthquake and wind flow around tall buildings of cross sectional shape, but same cross sectional area, consequently predicting the response of the structures under generated wind loads. It focuses on analysis of tall structures under earthquake and wind loading. ETABS 9.7.1 software has been used to analysis of the models for this study. This braced tube can also use for retrofitting of old R.C.C. frame structure.

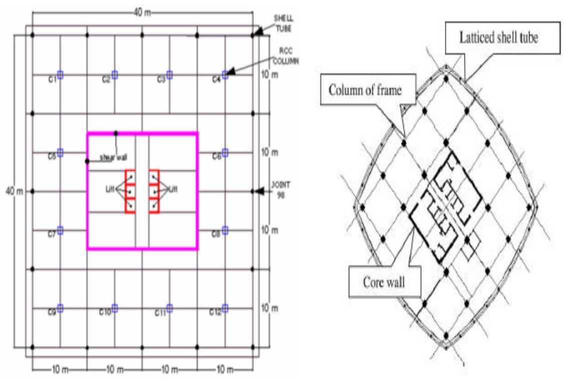


Figure 1:- Braced tube structure

1.1. Types of bracing systems :-

There are three types of bracing system

1) Concentric Bracing System
2) Eccentric Bracing System

The steel braces are usually placed in vertically aligned spans. This system allows to obtaining a great increase of stiffness with a minimal added weight.

1) Concentric Bracing System:-

Concentric bracings increase the lateral stiffness of the frame thus increases the natural frequency and also usually decreases the lateral storey drift. However, increase in the stiffness may attract a larger inertia force due to earthquake. Further, while the bracings decrease the bending moments and shear forces in columns and they increase the axial compression in the columns to which they are connected.

Figure 2 :- Concentrically braced frame

2) Eccentric Bracing System.

Eccentric Bracings reduce the lateral stiffness of the system and improve the energy dissipation capacity. The lateral stiffness of the system depends upon the flexural stiffness property of the beams and columns, thus reducing the lateral stiffness of the frame. The vertical component of the bracing forces due to earthquake causes lateral concentrated load on the beams at the point of connection of the eccentric bracings.

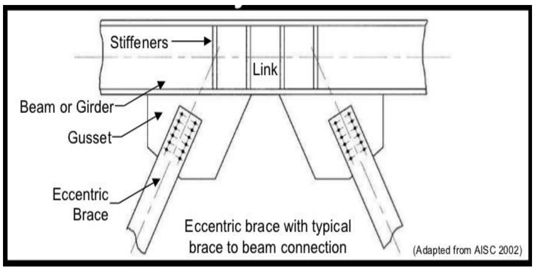


Figure 3 :- Eccentrically braced frame

2. LITERATURE SURVEY

Braced tube structure system is the RC core wall in center & Bracing shell tubing on outsides. The Shear rigidity of RC core wall is big and resisting overthrow capacity of external bracing shell tube is powerful. This combination can reduce structural damage that caused by seismic & it remarkably enhances the Seismic capability of structure.

Dalal et al. (2013) analyzed much system which has been the basic of many modern construction practice of high rise building. He concluded that X-bracing system is effectively resisting lateral loads.

Shruthi et al. (2014) Time history analysis is applied and analytical results are compared. From above study he found that X type of bracing is more effective than inverted K type bracing.

3. METHODOLOGY

3.1. To achieve the above objective following step by step procedure are followed

- Carried out literature study to find out the objective of the project work.
- Understand the earthquake and wind loading analysis of bracing tube structure.
- Analyze the entire selected model using Etabs software.
- Evaluate the analysis result and verify the geometrical requirement.

3.2. Structural details

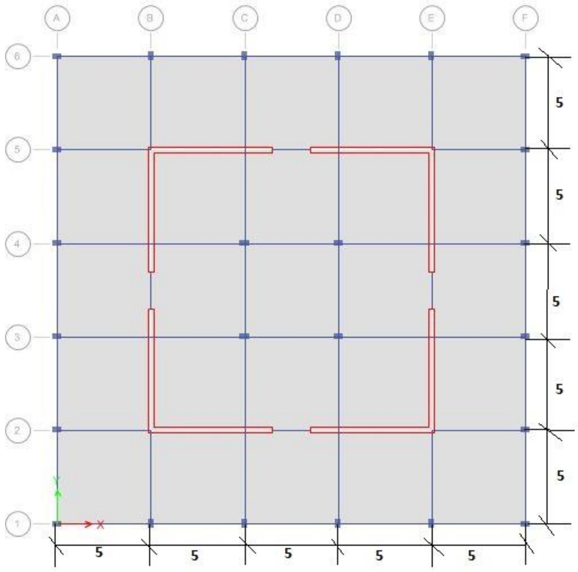


Figure 4:- Building plan

- G+30 story
- Story height = 3 m
- Plan dimension = 25 x 25 m
- Depth of foundation = 2 m below ground
- Shear wall = 6.5x0.3 m
- Column size

Up to 5th floor = 1.2 x 0.3 m
6th floor to 10th floor = 0.85 x 0.3 m
11th floor to 20th floor = 0.65 x 0.3 m
21st floor to 25th floor = 0.55 x 0.3 m
26th floor to 30th floor = 0.50 x 0.3 m

- Slab thickness = 0.15 m

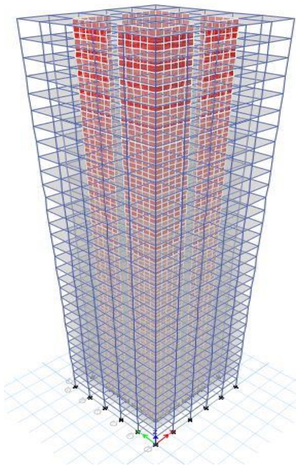


Figure 5:- Rcc frame with shear wall (M-1)

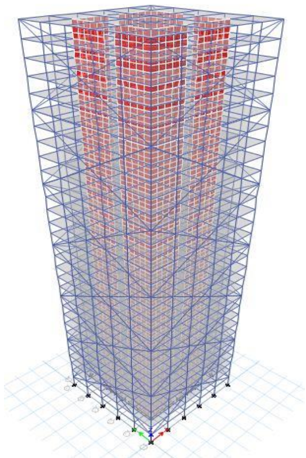


Figure 6:-RCC frame with X-bracing (M-2)

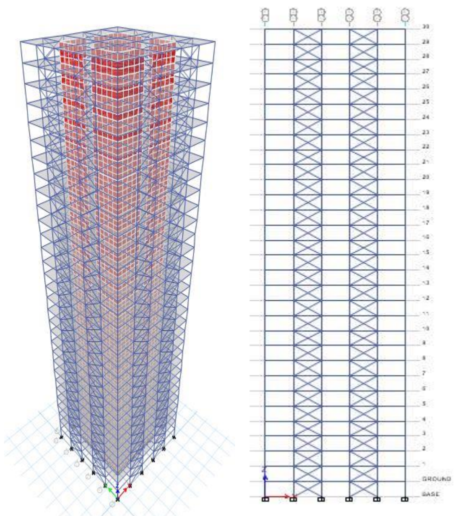


Figure 7:-Concentric bracing (Model-C1)

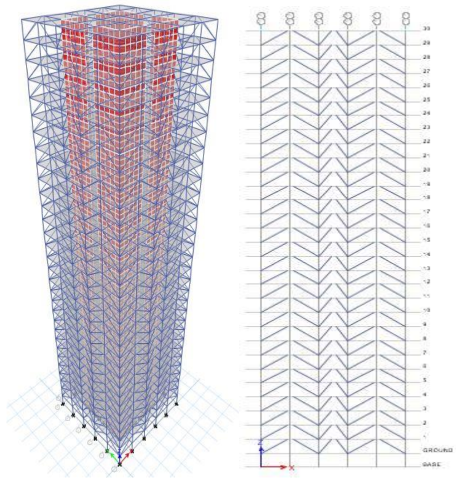


Figure 8:-Eccentric bracing (Model E-1)

4. RESULTS

Table 1:- Comparison of time period, base shear, displacement

Model	Time period (t)	Base shear (dynamic load) kN	Base shear (Static load) kN	Story drift (mm)	Displacement (mm)
M-1	1.791	29250.1	3908.63	0.828	80.3
M-2	1.598	3940.71	5911.07	0.677	64.1
C-1	1.726	3950.00	7406.97	0.973	75.6
E-1	1.600	3940.64	5910.96	0.671	63.3

Table 2:- Base shear % for dynamic loading

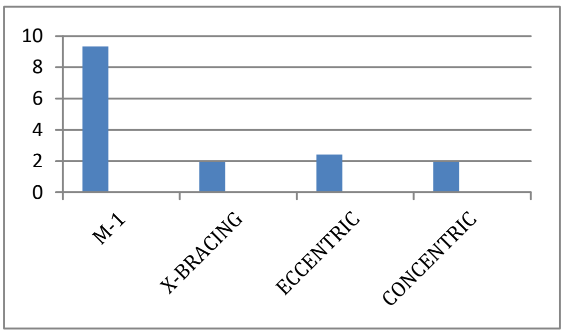


Table 3:- Fundamental time period.

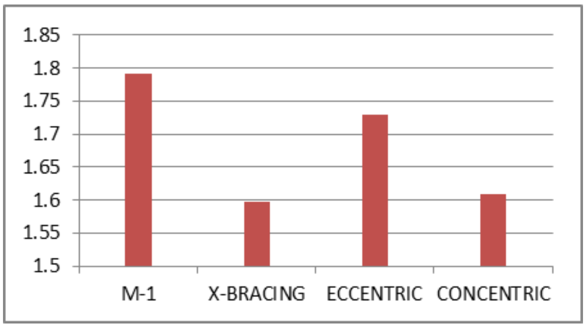
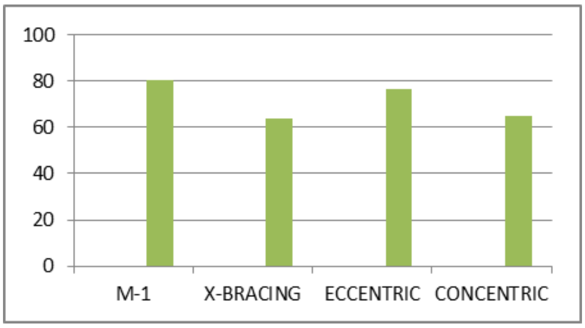
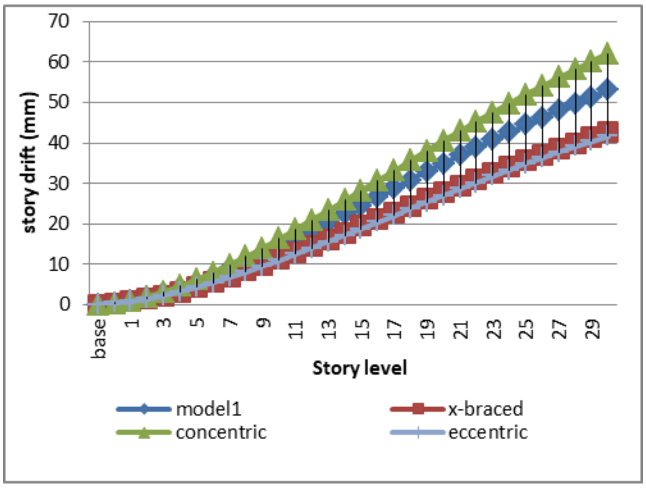


Table 4:- Displacement.



Graph 1:-Story drift graph



5. CONCLUSION

In this study performance of different type of bracing configuration is studied. Models are analyzed for different bracing configuration subjected to wind & earthquake load. To check the performance of these different building models time period, maximum roof displacement, base shear in the column are evaluated and analyzed

- X- Type of bracing are found to be more effective than concentric bracing, eccentric bracing. This type of bracing is more effective to reduce displacement, base shear, time period.
- Concentric bracing are more effective when the loading is higher in particular bay, to transfer that load in another member.
- Eccentrically braced structure gives better result than concentrically braced structure but not better than X-bracing.
- Eccentrically braced structures are effective for long span beam or slab and for distribution eccentric load.
- The fundamental time period of building is reduce to 10-15% for braced building.
- The lateral displacement of the building is reduced by 20% with X-bracing, 5 to 10 % for concentric bracing, 22% for eccentric bracing system.
- Bracing system is less costly and complex compare to damping system and other earthquake resistant techniques.

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