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Response of Multi Storied RCC Building with Bracing in Soft Storey.

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Abstract - *A common cause for collapse of multistoried RCC building due to earthquake is occurrence of soft storey in ground floor due to presence of infill wall in upper story leading to stiffness irregularity between floors and increased shear force in ground floor columns. This paper focuses on studying the effect of Inverted V bracing and its various configurations in ground soft storey of a G+18 storied RCC building located in Zone III, India. Response spectrum analysis is carried out for the structure using ETABS 2015 software and results are computed based on time period, storey displacement, drift, stiffness, and base shear and overturning moments.*

Key Words*: *Soft ground storey, Inverted V Bracing, Response Spectrum Analysis.

1. INTRODUCTION

Earthquakes are the most disastrous and unexpected natural calamities in the world. Due to urbanization and increase in population most of the reinforced building has a special feature i.e. ground storey is left open for vehicle parking, shops, reception lobbies, a large space for meeting room or a banking hall etc. Such buildings are often called open ground storey buildings or soft story buildings.

A soft story known as weak story is defined as a story in a building that has substantially less resistance or stiffness or inadequate ductility (energy absorption capacity) to resist the earthquake induced building stresses. Soft story buildings are characterized by having a storey which has a lot of open space or floors with a lot of windows. To resist lateral forces they are provide with a special lateral resisting systems like the shear walls or the bracing systems.

The different types of bracings such as inverted V bracings, X bracings etc are commonly used. Effects of design earthquake loads applied on structures can be considered in 2ways: 1)Equivalent Static method 2)Dynamic Analysis method So further dynamic analysis can be performed Response Spectrum Method.

Response spectrum method – Response spectrum analysis is a method to estimate the structural response to short, nondeterministic, transient dynamic events. Examples of such events are earthquakes and shocks.

2. Objectives

1) Modelling and analysis of RCC model with open ground storey.
2) Evaluate the performance of RCC model with Bracings using response spectrum method.
3) To evaluate dynamic performance of RCC high rise buildings in terms of storey displacement, storey drift, storey stiffness, overturning moments, base shear and time period.

3. METHODOLOGY

In this study, the seismic analysis of reinforced concrete (RC) buildings with V Inverted type of Bracing studied. The bracing is provided for peripheral columns and any two parallel sides of building model. A G+18 storey building is analyzed for seismic zone III as per IS 875:1987 using ETAB software. The percentage reduction in storey displacement will be calculated as per response spectrum method and the type of bracing system which will be better and gives good stiffness and good strength capacity in displacement and base shear will be applied. The evaluation of the results will be in terms of storey drift and graphical comparison will be done and the maximum interstorey drift of the frame as perthe different types of bracings which contributes to the structural stiffness of the frame.

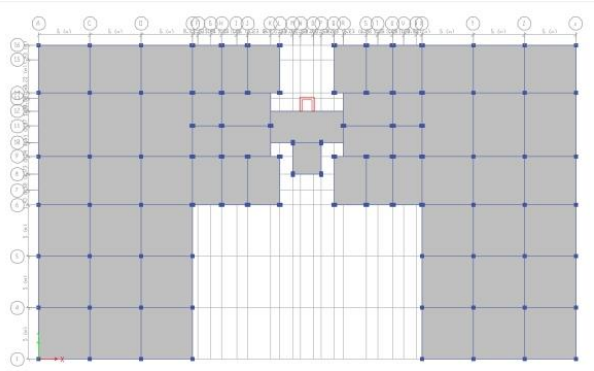

Figure 1. Line plan

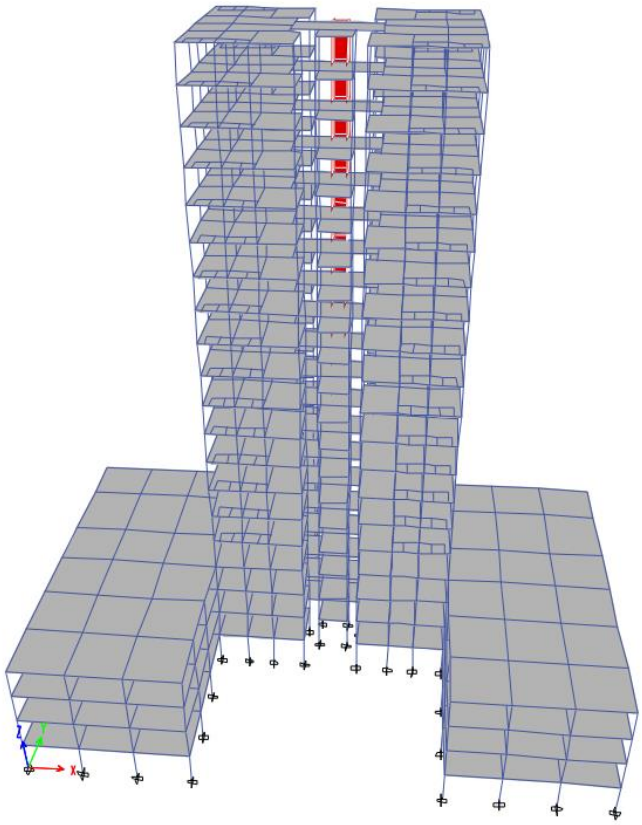

Figure 2. View Of Building

3.1 INPUT PARAMETERS

1) No of story:- G+18

2) Zone: 3 (IS 1893-2016, Part 1, Table-3)

3) Location :- Mumbai

4) Reinforcement Grade:- Fe500

5) Concrete Grade:- M40, M30

6) Floor Height :-3m

7) Plinth Height:- 0.6m

8) Beam Size: 230 450 mm

9) Column Size; For High Rise - (300 * 450 mm)

10) For Soft Story (300 * 300 mm)

11) Slab Thickness: 180 mm

12) Floor Dimension in X direction :- 52 m

13) Floor Dimension in Y direction:- 31 m

14) Density of Concrete:- 25 KN/m^2

15) Density of wall: 9 KN/m^2 (AAC Block)

4. RESULTS AND DISCUSSION

4.1. Story Displacement

1. RS X direction

Table -1 : Storey displacements in x direction (in mm)

Story Displacement (mm)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	0	0	0
Ground Floor	0.635	0.242	0.515
% Reduction	**-**	**61.89%**	**18.89%**

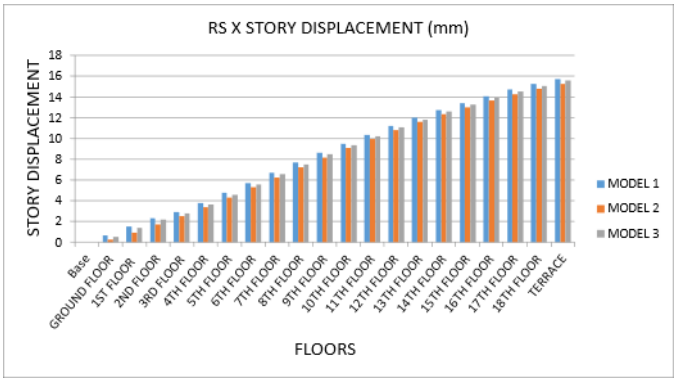

Figure 3. Storey displacements in x direction (in mm)

2. RS Y direction

Table -2 : Storey displacements in y direction (in mm)

Story Displacement (mm)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	0	0	0
Ground Floor	0.552	0.17	0.414
% Reduction	**-**	**69.20%**	**25%**

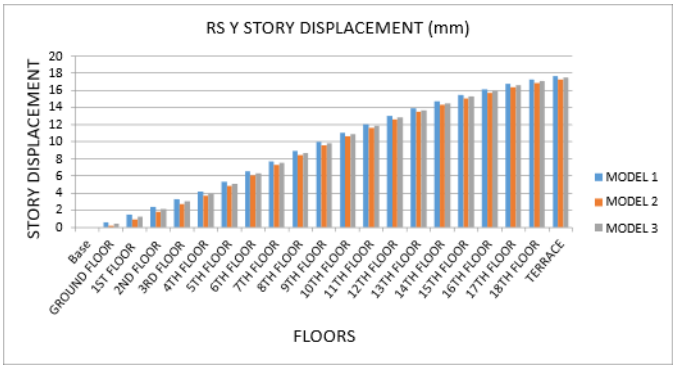

Figure 4. Storey displacements in y direction (in mm)

4.2. Story Drift

1. RS X direction

Table -3 : Storey displacements in x direction (in mm)

Story Drift (mm)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	0	0	0
Ground Floor	0.000212	0.000081	0.000172
% Reduction	**-**	**61.79%**	**18.87%**

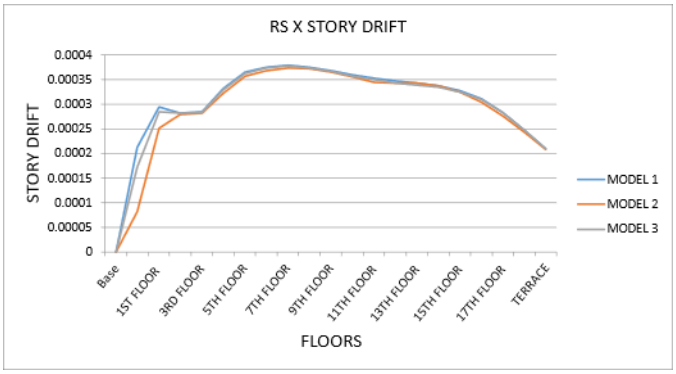

Figure 5. Storey drift in x direction (in mm)

2. RS Y direction

Table - 4 : Story Drift in y direction (in mm)

(Story Drift mm)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	0	0	0
Ground Floor	0.000184	0.000057	0.000138
% Reduction	**-**	**69.02%**	**25%**

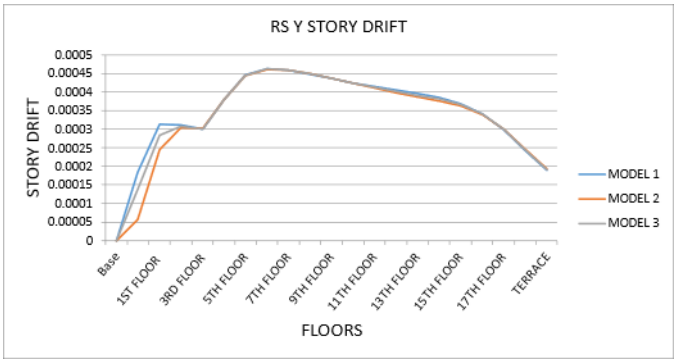

Figure 6. Storey drift in y direction (in mm)

4.3. Overturning moment

1. RS X direction

Table -5 : Overturning Moment in x direction (in KN-m)

(Overturning Moment KN-m)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	11641.7172	11693.7529	11672.0007
Ground Floor	10628.2709	10630.7969	10629.967
% Increment	**-**	**0.44%**	**0.26%**

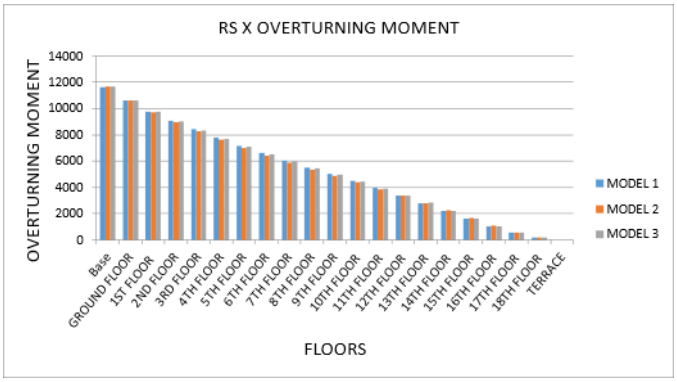

Figure 7. Overturning Moment x direction (in KN-m)

2. RS Y direction

Table -6 : Overturning Moment in y direction (in KN-m)

(Overturning Moment KN-m)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	12715.5009	12715.1692	12720.1445
Ground Floor	11607.2316	11578.6327	11596.4764
% Increment	**-**	**0.0026%**	**0.036%**

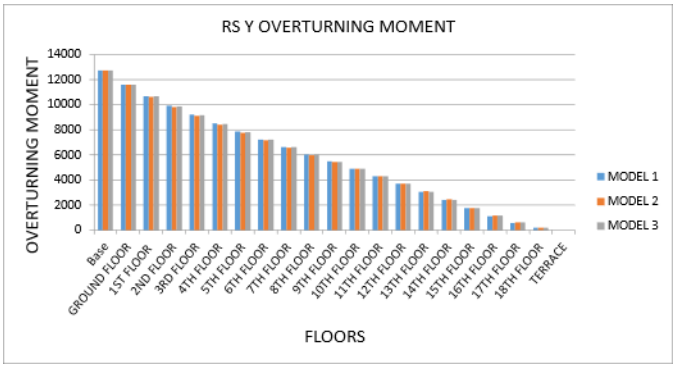

Figure 8. Overturning Moment in y direction (in KN-m)

4.4. Story Stiffness

1. RS X direction

Table -7 : Storey Stiffness in x direction (in KN/m)

Story Stiffness (KN/m)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	0	0	0
Ground Floor	1097005.041	2850457.799	1330388.318
% Increment	**-**	**61.51%**	**17.54%**

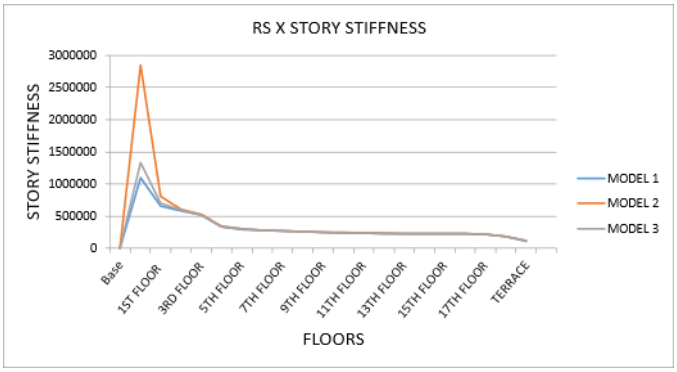

Figure 9. Storey Stiffness in x direction (in KN/m)

2. RS Y direction

Table -8 : Story Stiffness in y direction (in KN/m)

(Story Stiffness KN/m)			
Story	MODEL 1	MODEL 2	MODEL 3
Base	0	0	0
Ground Floor	1002299.496	3129000.049	1384920.103
% Increment	**-**	**67.97%**	**27.62%**

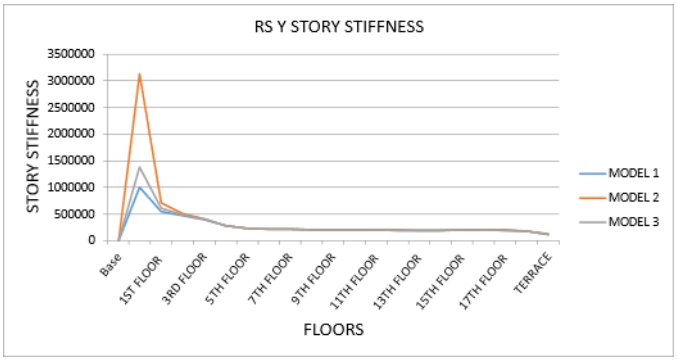

Figure 10. Storey Stiffness in y direction (in KN/m)

4.5. Base Shear

1. RS X direction

Table -9 : Base Shear in x direction (in KN)

Base Shear (KN)			
	MODEL 1	MODEL 2	MODEL 3
RS Y Max	779.89	860.03	835.46
% Increment	**-**	**9.31%**	**6.65%**

2. RS Y direction

Table - 10: Base Shear in y direction (in KN)

(Base Shear KN)			
	MODEL 1	MODEL 2	MODEL 3
RS Y Max	723.54	789.07	763.91
% Increment	**-**	**8.30%**	**5.28%**

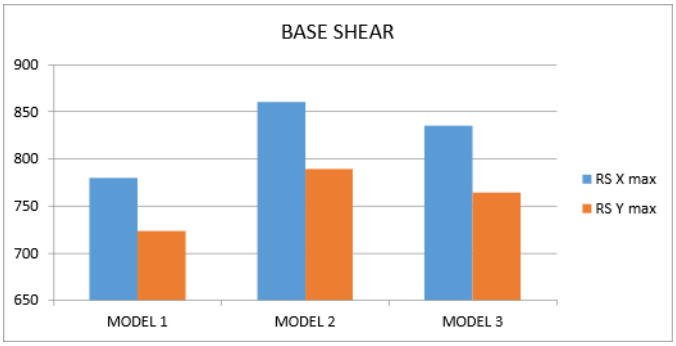

Figure 11. Base Shear in x & y direction (in KN)

4.6. Time Period

Table -11 : Time Period (in Sec)

Time Period (Sec)			
Mode	MODEL 1	MODEL 2	MODEL 3
1	2.382	2.344	2.365
2	2.167	2.138	2.157
3	1.974	1.958	1.972
% Reduction	**-**	**1.62%**	**0.71%**

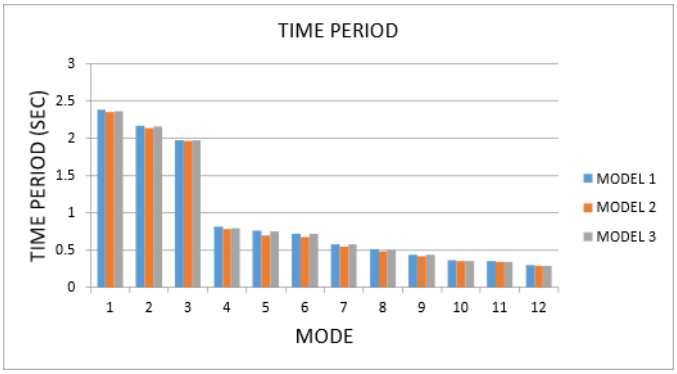

Figure 12. Time Period (in Sec)

5. CONCLUSIONS

The present study is an attempt to identify the behaviour of the G+18 RCC framed Structure with ground soft-storey. Various configurations of Inverted V Type of bracings are used in this study. This study reveals that the storey displacement, drift, base shear, time period and the overall seismic response of the structure is affected by the arrangements of bracings. From numerical results of the present study, the following conclusions may be drawn:

1) Storey drift is maximum at intermediate storey levels and minimum at the top storey.
2) When compared model 2 and 3 with model 1, it was found that model 2 (Fully braced) has maximum percentage reduction for Story Displacement and Story Drift.
3) Bracing system is not capable of enhancing overturning capacity of building due to its axial action of lateral load carrying system.
4) Storey stiffness is higher for building with inverted V brace than the bare frame building. It is found that the increment in the storey stiffness along X direction is about 61.51% for model 2 and 17.54% for model 3 at ground floor and similarly along Y direction the increment is about 67.97% for model 2 and 27.62% for model 3 at ground floor.
5) Time period after bracing the structure is reduce by 1.62% for model 2 and 0.71% for model 3 when compared with the bare model.
6) Base shear after bracing the structure is increased about 9.31% for model 2 in X direction and increased about 8.30% for model 2 in Y direction than that of the bare model.
It can be concluded that Seismic performance of Fully braced model is effective.

6. FUTURE SCOPE

This study can further be extended by considering the following:
1) Bare model can be compared with adjacent braced and adjacent centrally braced.
2) This bracing can also be applied to buildings having symmetric plan.
3) The structure can be analysed for different seismic zones.

4) Different types of bracings with different position.
5) The time history analysis of structure can also be carried out.

7. REFERENCES

1) B. Kameshwari et.at., International Journal of Science and Technology, "Dynamic response of high rise Structures under the influence of discrete staggered shear walls", (Oct, 2011).

2) F Hejazil et al., Institute Of Advanced Technology, "Effect of soft storey on structural response of high rise buildings" (2011).

3) Akbari R. et.al., Asian Journal of Civil Engineering,"Seismic fragility assessent of steel X-braced and chevron-braced RC frames", (Feb, 14).

4)Mohd atif et. al., International Research Journal of Engineering and Technology, "Comparative study of seismic analysis of multistorey building stiffenent with bracing & shear wall", (Aug, 2015).

5) K.S. K. Reddy et. al., International Journal of Science Technology and Engineering, "A Comparative study on behavior of multi storied building with different types and arrangements of Bracing systems", (2015).

6) Lakshmi Baliga et al.,International Research Journal of Engineering and Technology, "Study of concentric steel bracing at soft storey during Earthquake" (Dec 2017).

7) K L Rakshith et.al., International Journal of Advance Research, Ideas and Innovations in Technology, "Effect of bracings on multistored RCC frame structure under dynamic loading", ISSN: 2454-132X, Vol 3, (2017).

8) Dharanya et.al., International Journal of Science and Technology, "Comparative study of shear wall & bracing under seismic loading in multi-storied residential building", Vol 10, no 8, (2017).

9) IS Codes :
IS - 875 (Part 1) – 1987
IS - 1893 (Part 1) - 2016
IS - 875 (Part 2) – 1987
IS - 456 – 2000