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Seismic Assessment of RC Frame Under Amalgamation of Different Bracings

[1]Rishiv Virdhi, [2]Jagdish chand

[1] Student, Department of Civil Engineering, Chandigarh University, Mohali, India
[2] Associate Professor, Department of Civil Engineering, Chandigarh University, Mohali, India

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ABSTRACT

A number of studies was performed on the structures with various structural configuration and a variety of studies are still being carried out in finding the response spectrum of different amalgamation of bracings and shear walls. The response spectrum method was used to find the effect of the combination of various bracings on the different seismic factors like overturning moment, maximum storey drift, story displacement and storey shear. As the use of the shear walls is most common but the cost of installing the shear wall is very high so in this analytical study the effect of the steel bracings with different combinations on the multi-storey building was examined and the best suitable combination was found out of it.

1. Introduction

Most of the multistory buildings are made of RCC frame building so it's great importance given to make the structure safe against lateral load produce due to earthquake. There are various lateral resisting system and steel bracing is one of them. Due to their high strength, stiffness and lateral load capacity, steel bracing is an ideal choice for lateral load resisting system in a reinforced concrete structures. Bracing is a highly efficient and economical method of resisting lateral forces in a frame structure because the diagonals work in axial stress and therefore call for minimum member sizes in providing the stiffness and strength against horizontal shear. Bracing is a highly efficient and economical method to laterally stiffen the frame structures against wind loads. Bracing is efficient because the diagonals work in axial stress and therefore call for minimum member sizes in providing the stiffness and strength against horizontal shear.

A bracing system improves the seismic performance of the frame by increasing its lateral stiffness and capacity. Through the addition of the bracing system, load would be transferred out of the frame and into the braces, bypassing the weak columns while increasing strength. Steel braced frames are efficient structural systems for buildings

The seismic forces make the high rise buildings vulnerable and are most prone to failure in case of the earthquake. So the braces are used in the high rise buildings so that they can withstand the lateral forces and be safe for the residents. The braces are lightweight and perform well under the seismic forces

Bracings are used as the members to withstand lateral load in the buildings. The bracings have lesser weights as compared to the shear walls and at the same or even lesser cost they provide us the great safety against the earthquake forces and thus makes the building safe and secure.

There are various types of bracings used in a multistorey building In this study we are going to analyse the different combination of bracings in a multistorey RC building and the performance of the multistorey RC building in the effect of earthquake.

Study the effects of these combination of these bracings on the seismic parameters which are

Fundamental Time Period

Overturning moment

Maximum Storey Drift

Storey Displacement

Storey Shear

Shear walls are always the first preference when providing the seismic resistance to the multi storey building but in case of buildings with 10 storey and 20 storey buildings the shear walls are less preferred and thus the need of bracing arises and hence the bracings are chosen over the shear wall as shear wall becomes more costly and also increase the dead weight of the building but the bracings are more economic and that too with less increase in the dead weight of the building.

2. Methodology

Seventeen seismic models having bare frame was adopted for study.. The plan dimension of the bare model is 36 m * 36 m and having 6 bays in direction-X and 6 bays in direction-Y and having ground story height of 3.6 m and 3.3m upper story heights. The size of the column and beams conforming to IS 456:2000 and IS 13920:2016 is 200mm*300mm and 400mm*400 mm respectively. The grade of the concrete used was M25.

K BRACING

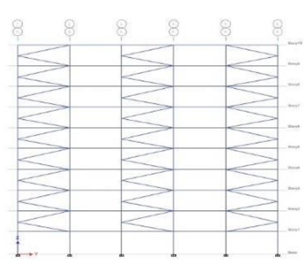


Figure 1 K Bracing

CHEVRON BRACING

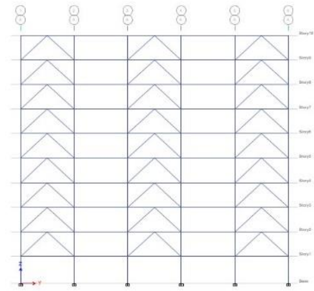


Figure 2 Chevron Bracing

V BRACING

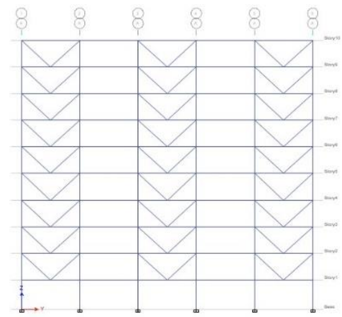


Figure 3 V Bracing

X BRACING

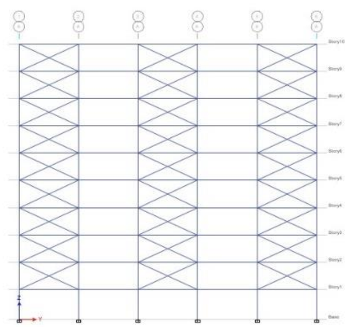


Figure 4 X Bracing

CHEVRON-K

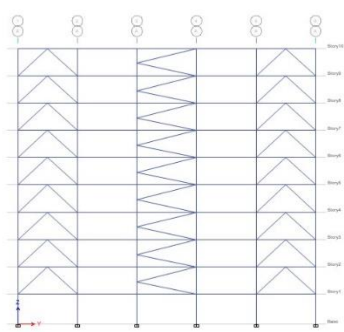


Figure 5 Chevron K1

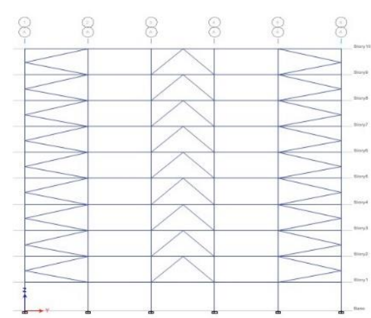
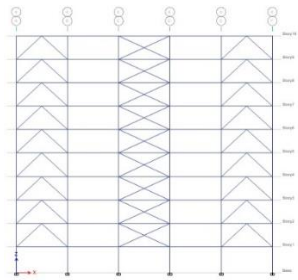


Figure 5 Chevron K2

CHEVRON-X



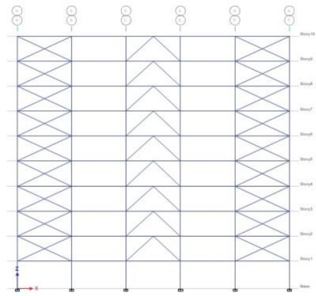
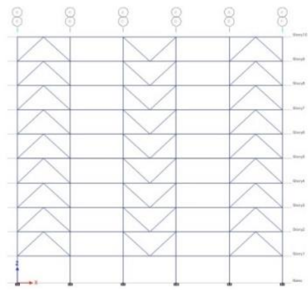


Figure 6 Chevron X1 *Figure 7 Chevron X1*

CHEVRON-V



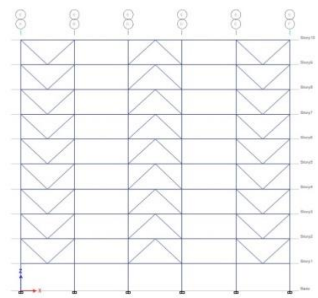
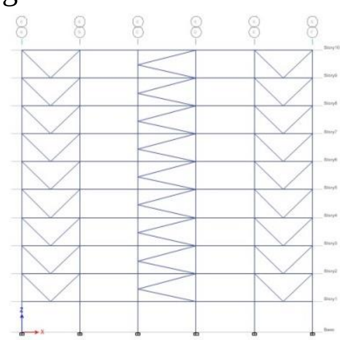


Figure 8 Chevron-V1 *Figure 9 Chevron-V2*

K-V Bracing



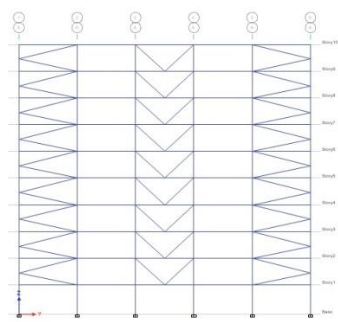
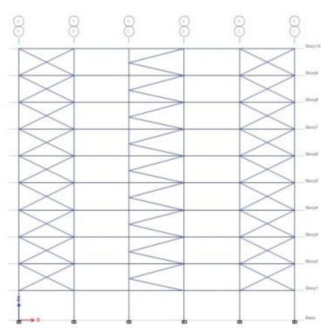


Figure 11 K-V1 *Figure 12 K-V2*

K-X



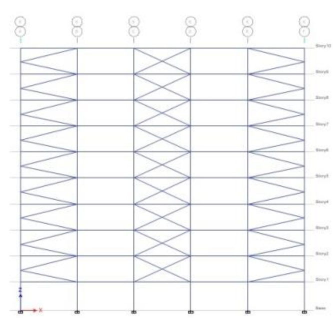


Figure 13 K-X1 *Figure 14 K-X 2*

V-X

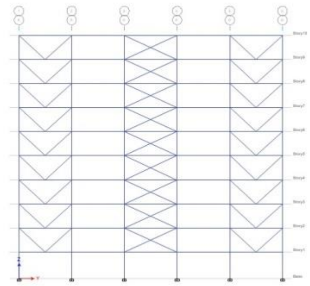


Figure 16 V-X 1

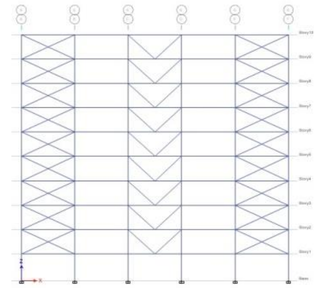


Figure 17 V-X 2

3. Results

A. FUNDAMENTAL TIME PERIOD

Buildings with different amalgamations of bracings the chevron bracing have the least fundamental time period of 1.94 seconds which is 65.72% less than the bare frame.

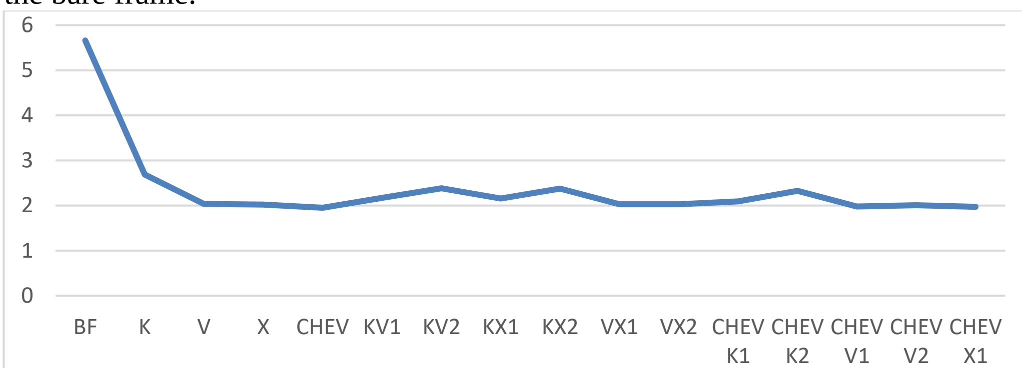


Fig-18

B. BASE SHEAR

The base shear of the building in the case of the chevron k1 is 2331.97 kN which is least among the other amalgamation of the bracing and is 0.043% less than the bare frame.

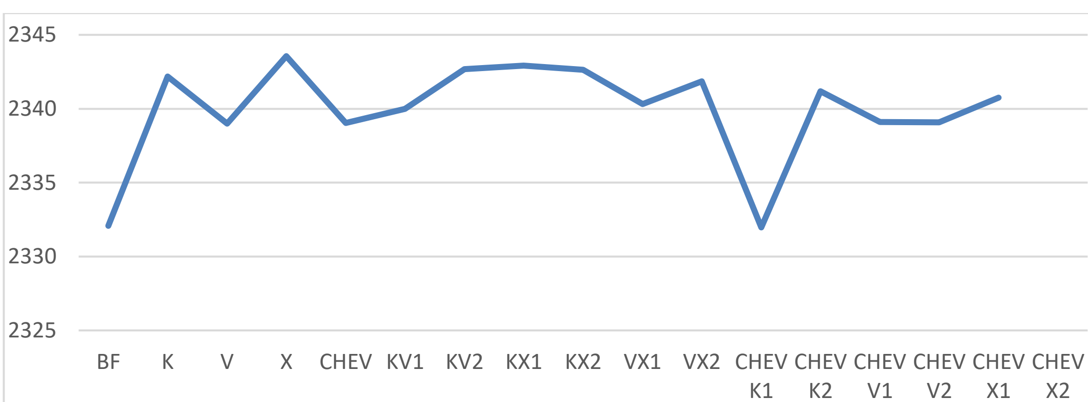
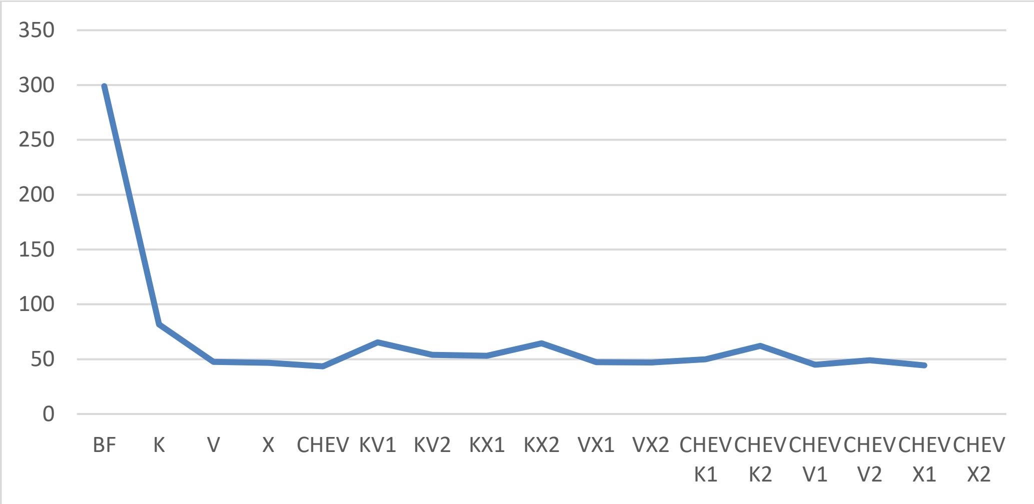


Fig-19

C. STOREY DISPLACEMENT

The chevron bracing is showing the lesser storey displacement of 43.46 mm and that is 85% lesser than the bare frame.



D. OVERTURNING MOMENT

V bracing shows minimum overturning moment of 49683 kNm and is 19.23% lesser than the bare frame.

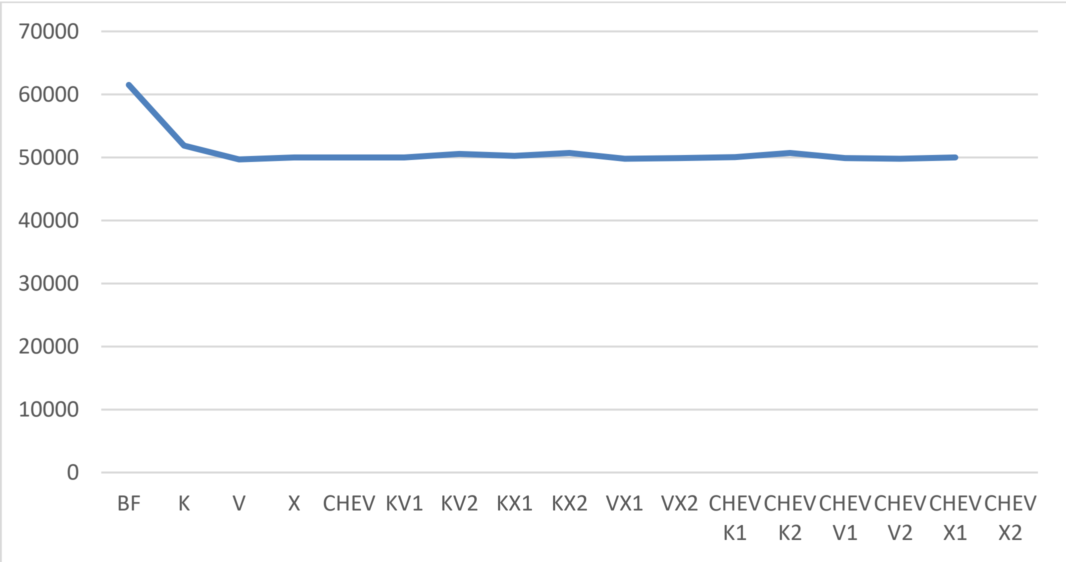


Fig-21

E. MAXIMUM STOREY DRIFT

Chevron bracing shows lesser storey drift compared to the other as 0.003447 that is 74% lesser than the bare frame.

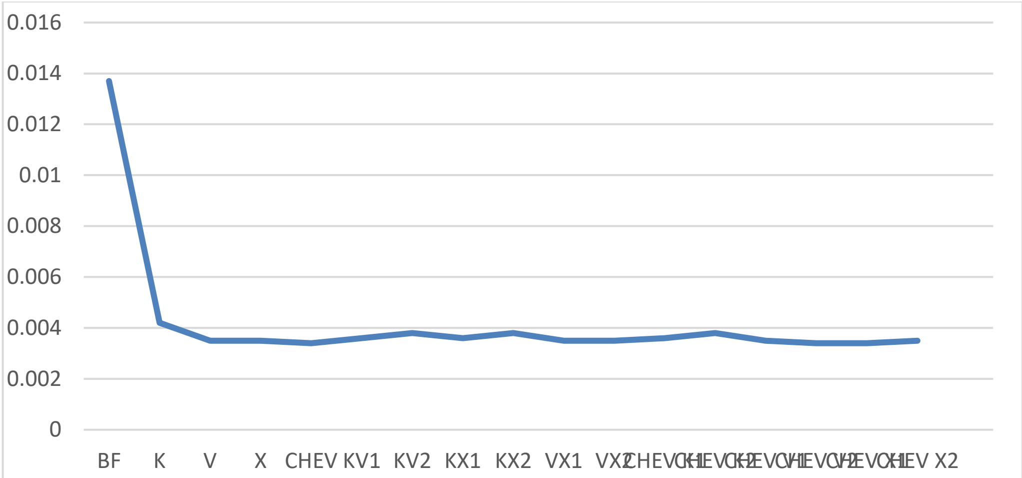


Fig-22

4. Conclusion

Fundamental time period of the building is best in case of chevron bracing that is 1.952s which was 65.72% lesser than that of bare frame and the other bracing combinations showed lesser reduction as compared to that of chevron bracing. The base shear is minimum in case of the chevron K1 bracing combination of 2331.97kN which is 0.043% reduction as compared to that of bare frame. The storey displacement of chevron bracing is the least that is just 43.46 mm and reduced 85% to that of bare frame. The overturning moment is minimum in case of V bracing that is 49683 kNm and os 19.23% lesser than that of bare frame. Chevron bracing shows lesser storey drift compared to the other as 0.003447 and is 74% lesser than the bare frame.

Among all the bracing combinations it was seen that the chevron bracing was giving better results although other bracing combinations were also performing almost as efficient as chevron bracing but the chevron bracing has reduced the overturning moment, fundamental time period, base shear, storey displacement and storey drift.

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