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Analysis of Bracing in Symmetric and Asymmetric RC Building

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Abstract

In this study, seismic analysis of high rise symmetric and asymmetric RC building frames have been carried out considering eccentric X braced and eccentric inverted V braced systems. Bracing systems is resisting lateral load in RC building. Bracing is a structural element that provides resistance or stiffness to the building against lateral forces i.e., Earthquake and wind. In proposed problem G+15 story symmetric and asymmetric RC building frame is analyzed for eccentric X bracing system and eccentric inverted V bracing system under lateral loading i.e. earthquake and wind. ETABs software is used for analysis. The results of eccentric X Bracing system, eccentric Inverted V Bracing, eccentric X Bracing system with shear wall and eccentric Inverted V Bracing with shear wall are compared with bare frame model analysis to evaluate the effectiveness of a particular type of bracing system in order to reduces the lateral displacement and story drift in the frame. It is found that all the bracing systems reduces the lateral displacement and story drift of frame very effectively. In this study eccentric X braced system performed better than other braced system and bare frame system.

1. Introduction

Earthquake-resistant structures are structures designed to withstand earthquakes. Not a single structure which is entirely immune the members of the structure from the earthquakes, the goal of earthquake-resistant construction is to erect structures that fare better during seismic activity than their conventional counterparts. According to codes of a building, earthquake-resistant structures are intended to withstand the largest earthquake of a certain probability that is likely to occur at their location. This means to minimize the losses of life due to the collapse of building for rare earthquakes while the loss of the functionality should be limited for more frequent ones. Braced frame system offers multiple design objective. Strength and stiffness provided by the elastic property is to achieve operational performance objectives. Lateral loads in multi-storied buildings is resist by the steel braced frame is the one of structural system. The use of steel bracing systems for strengthening seismically inadequate reinforced concrete frames and for earth enhancing quake resistance it is a viable solution. Steel bracing is easy to erect and occupies less space and its gives the flexibility to design for meeting the required stiffness and strength. Bracing is a structural element that provides stiffness or resistance to the structure against lateral forces i.e., Earthquake and Wind. A braced frame is one of the structural systems used to resist horizontal forces like wind load and earthquake in multi-storeyed buildings. Braced frame members are not allowed to sway horizontally. There are two types of steel braced frames, (a) Eccentric braced frames and (b) Concentric braced frames depending upon their geometric characteristics.

2. Modelling and Analysis

In this study, A G+15 story symmetric RC building of 3 bays in both the direction and G+15 story asymmetric RC building of 5 bays in both the direction have been considered for investigating the effect of X type braced system and inverted V type braced system and these two braced system along with shear wall. Following three types of structural configuration is studied. 1. Reinforced concrete multi-story building without bracing system 2. Reinforced concrete multistory building with X type and inverted V type bracing systems 3. Reinforced concrete multistory building with X type and inverted V type bracing systems along with shear wall.
Building details are given below:
1. Number of story - G+15
2. Story height – 3 m
3. Type of soil – medium soil
4. Seismic zone – 4
5. Importance factor – 1
6. Grade of concrete – M30
7. Grade of steel - Fe-415
8. All RC Column sizes - 400mm x 500mm

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9. All RC Beam sizes -300mm x 450mm
10. Slab thickness - 150mm
11. Brick wall thickness - 230mm
12. Live load – 2.5 KN/m^2
13. Floor Finish – 1 KN/m^2

Total 10 models are analyzed in this study are given below:
In symmetric building total 5 models are analyzed.
1. Moment resisting frame.
2. Eccentric X braced frame.
3. Eccentric inverted V braced frame.
4. Eccentric X braced frame along with shear wall.
5. Eccentric inverted V braced frame along with shear wall.
In asymmetric building total 5 models are analyzed.
6. Moment resisting frame.
7. Eccentric X braced frame.
8. Eccentric inverted V braced frame.
9. Eccentric X braced frame along with shear wall.
10. Eccentric inverted V braced frame along with shear wall.

2.1 Models for Symmetric RC building

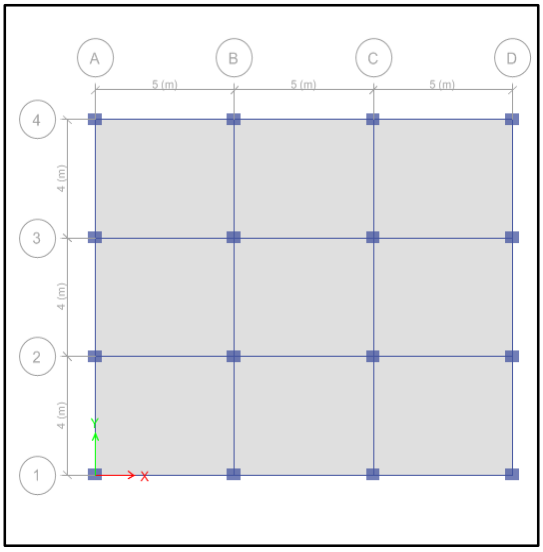

Figure 1. Plan of symmetric RC building

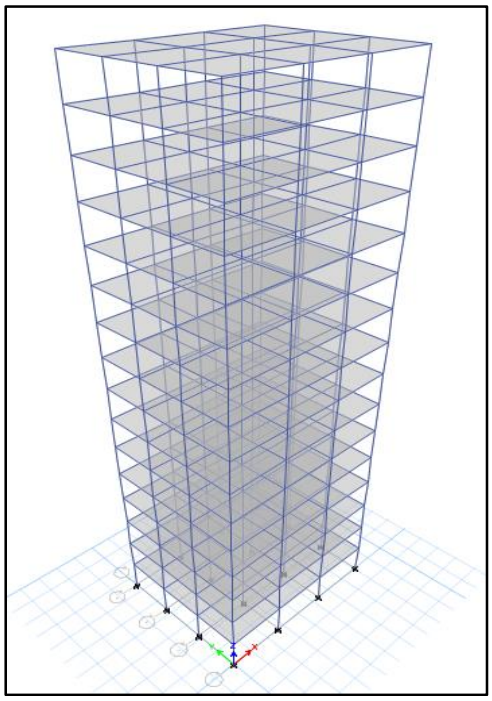

Figure 2. Moment resisting frame

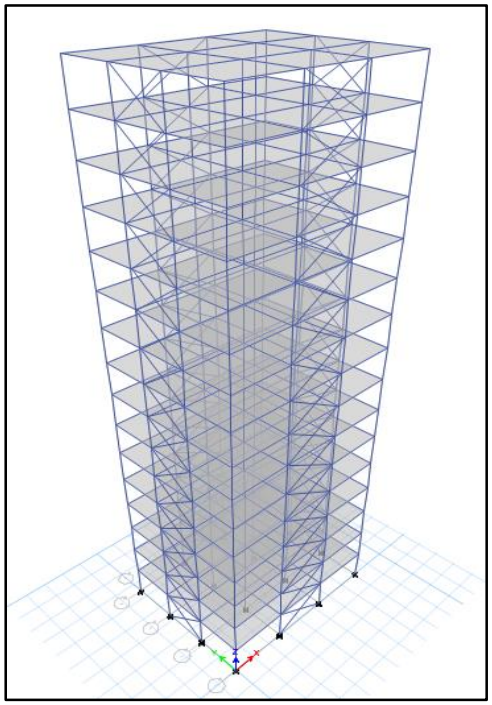

Figure 3. Eccentric X braced frame.

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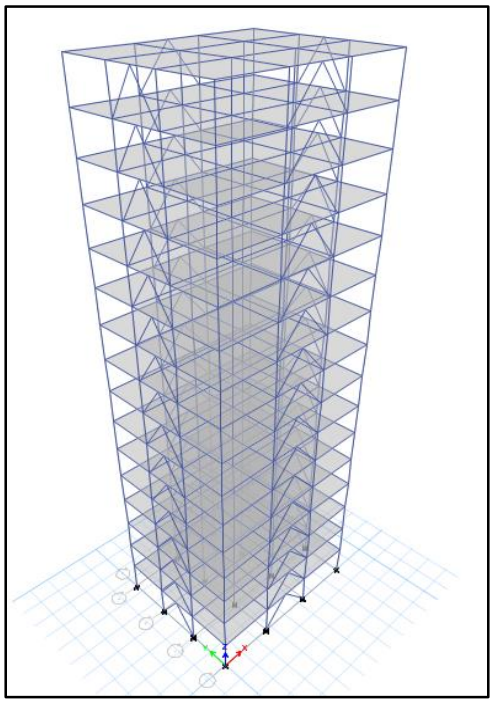

Figure 4. Eccentric inverted V braced frame.

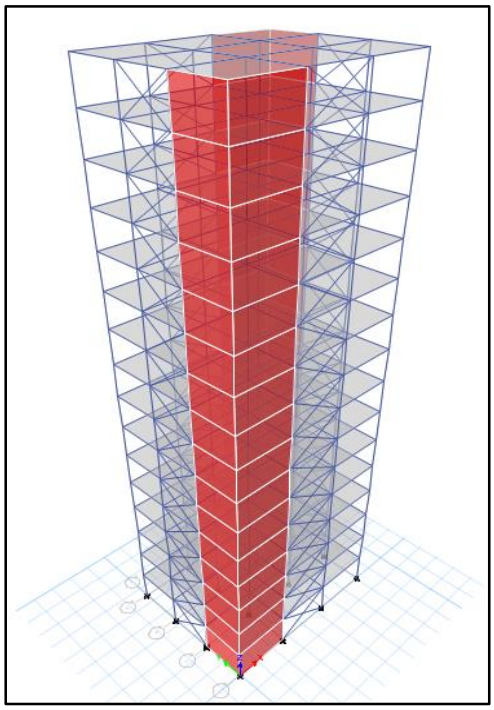

Figure 5. Eccentric X braced frame along with shear wall.

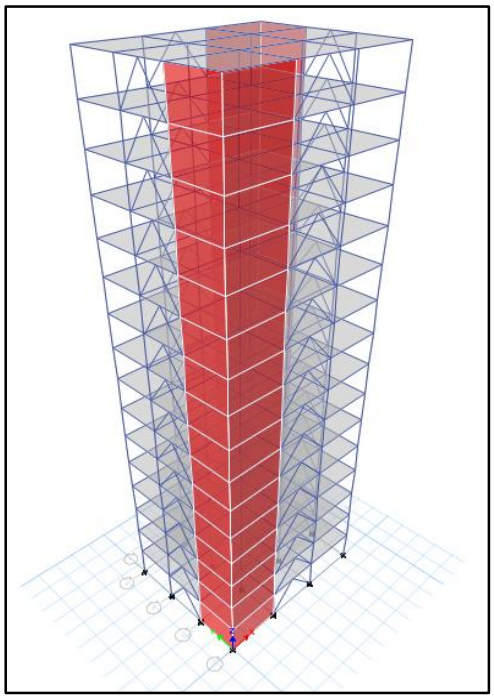

Figure 6. Eccentric inverted V braced frame along with shear wall.

2.2 Models for Asymmetric RC building

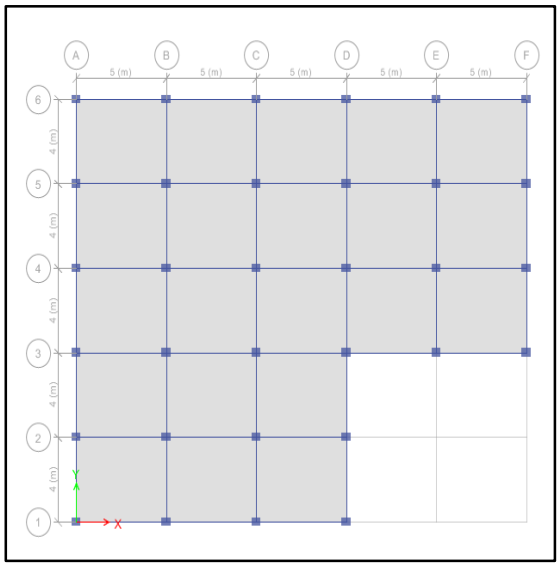

Figure 7. Plan of asymmetric RC building

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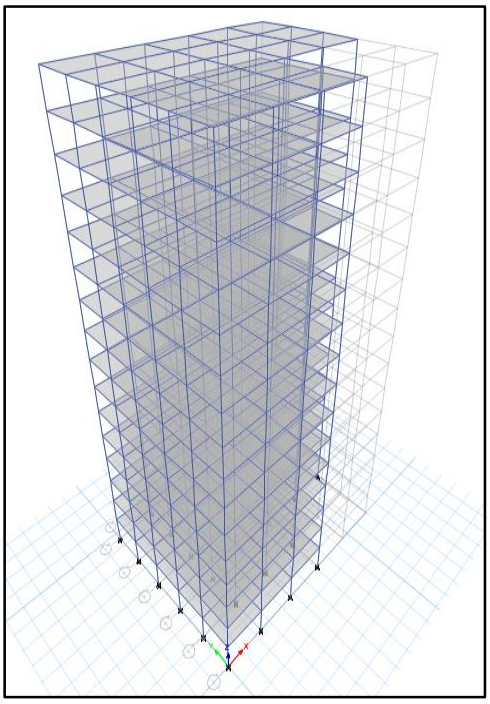

Figure 8. Moment resisting frame

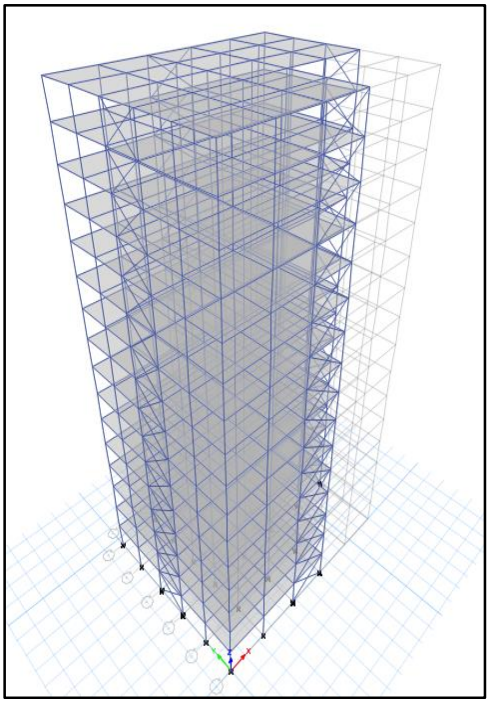

Figure 9. Eccentric X braced frame.

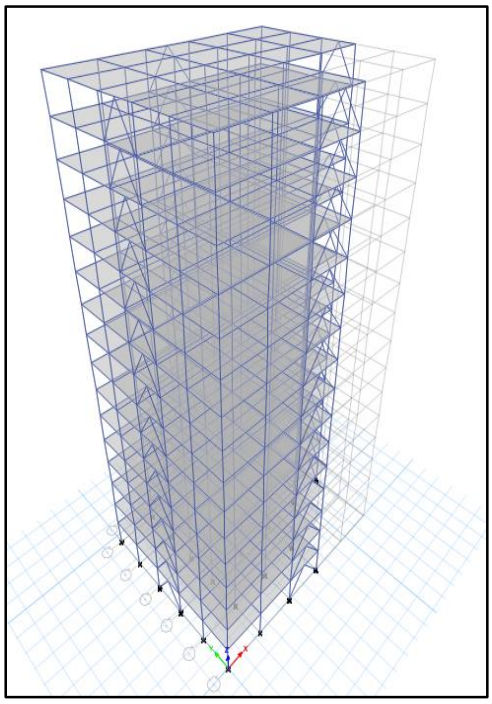

Figure 10. Eccentric inverted V braced frame.

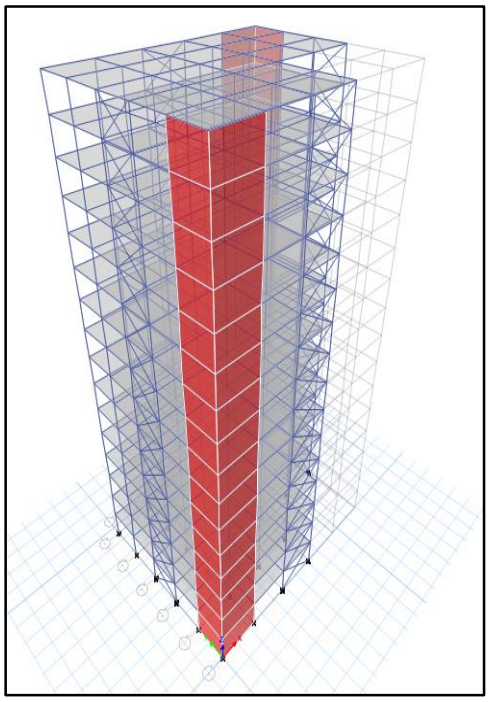

Figure 11. Eccentric X braced frame along with shear wall.

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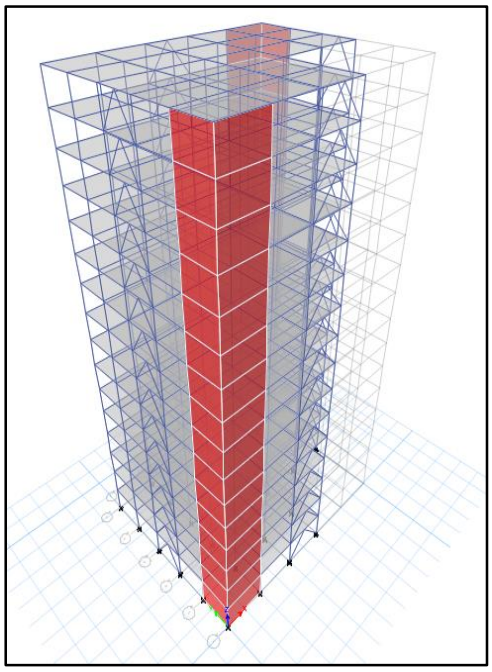

Figure 12. Eccentric inverted V braced frame along with shear wall.

3. RESULTS AND DISCUSSIONS

Results of analysis are given below in the form of various graphs and their discussion.

3.1 Results for Symmetric building –

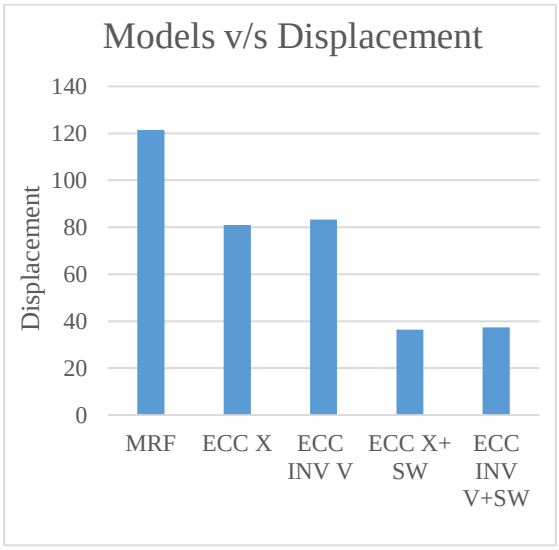

Figure 13. Displacement for symmetric building

On comparing displacement for symmetric RC building having 15 story, it was observed that there is reduction of displacement in RC buildings braced with eccentric X braced system is 33.37%, eccentric inverted V braced system is 31.47%, eccentric X braced system along with shear wall is 66.99% and eccentric inverted V braced system along with shear wall is 66.30% in comparison to bare frame system.

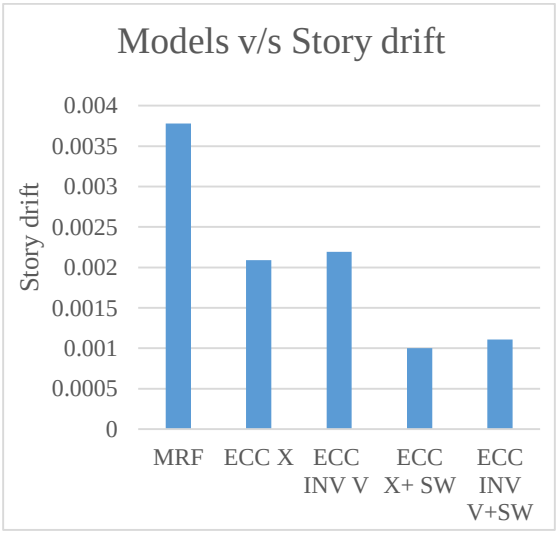

Figure 14. Drift for symmetric building

On comparing drift for symmetric RC building having 15 story, it was observed that there is reduction of drift in RC buildings braced with eccentric X braced system is 44.72%, eccentric inverted V braced system is 42.04%, eccentric X braced system along with shear wall is 73.47% and eccentric inverted V braced system along with shear wall is 70.64% in comparison to bare frame system.

3.2 Results for Asymmetric building -

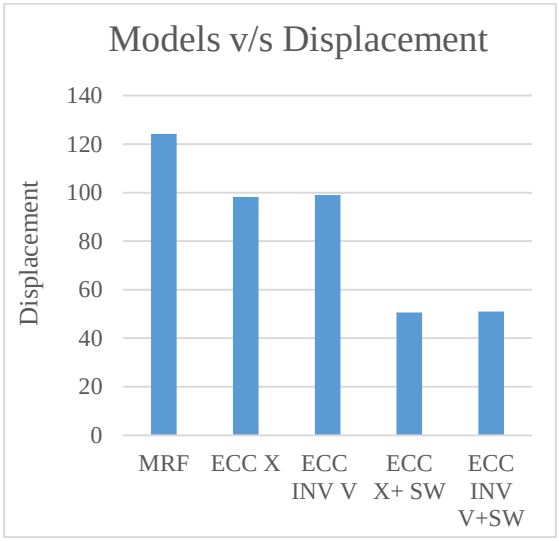

Figure 15. Displacement for asymmetric building

On comparing displacement for asymmetric RC building having 15 story, it was observed that there is reduction of displacement in RC buildings braced with eccentric X braced system is 20.95%, eccentric inverted V braced system is 20.27%, eccentric X braced system along with shear wall is 50.61% and eccentric inverted V braced system along with shear wall is 50.95% in comparison to bare frame system.

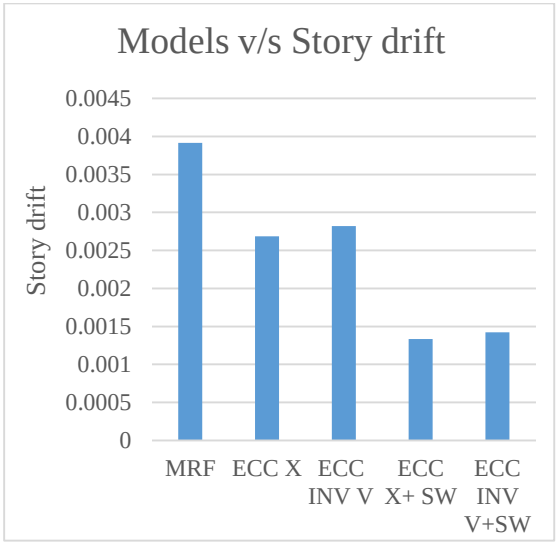

Figure 16. Drift for asymmetric building

On comparing drift for Symmetric RC building having 15 story, it was observed that there is reduction of drift in RC buildings braced with eccentric X braced system is 31.42%, eccentric inverted V braced system is 27.98%, eccentric X braced system along with shear wall is 65.97% and eccentric inverted V braced system along with shear wall is 63.69% in comparison to bare frame system.

4. CONCLUSIONS

Following are the conclusions of the study –
(1) Bracing provides better strength and stiffness to the RC building.
(2) Eccentric X bracing is performed better than eccentric inverted V bracing in reducing the displacement and drift values of the RC building.
(3) Eccentric X bracing with shear wall is performed better than eccentric inverted V bracing with shear wall in reducing the displacement and drift values of the RC building.
(4)The lateral displacement of the building is reduced by 40% to 45 % by the use of eccentric X Type steel bracing system, and eccentric X bracing type reduced maximum displacement.

5. REFERENCES

[i] H. Moghaddam, I. Hajirasouliha "An investigation on the accuracy of pushover analysis for estimating the seismic deformation of braced steel frames" *Journal of Constructional Steel Research, Science Direct*, 2006, 343–351.
[ii] M. R. Maheri, R. Kousari, M. Razazan "Pushover tests on steel X-braced and knee-braced RC frames" *Engineering Structures, Science Direct*, 2003, 1697–1705.
[iii] Ghobarah, H. Abou Elfath "Rehabilitation of a reinforced concrete frame using eccentric steel bracing" *Engineering Structures, Science Direct*, 2001, 745–755.
[iv] Kadid, D.Yahiaoui "Seismic Assessment of Braced RC Frames" *Procedia Engineering, Science Direct*, 2011, 2899–2905.
[v] M. A. Youssef, H. Ghaffarzadeh, M. Nehdia "Seismic performance of RC frames with concentric internal steel bracing"

Engineering Structures,Science Direct, 2007,1561–1568.

[vi] Hendramawat A Safarizki, S.A. Kristiawan, A. Basuki "Evaluation of the Use of Steel Bracing to Improve Seismic Performance of Reinforced Concrete Building" *Procedia Engineering, Science Direct*, 2013,447 – 456.

[vii] Hassan A. Moghaddam, Homayoon E. Estekanchi "Seismic behavior of off Centre bracing systems" *Journal of Constructional Steel Research, Science Direct* 1999, 177–196.

[viii] Jung-Han Yoo, Charles W. Roeder, Dawn E. Lehman "Simulated behavior of multi-story X-braced frames" *Engineering Structures, Science Direct*, 2009, 182-197.

[ix] Temel Turker, Alemdar Bayraktar "Finite element model calibration of steel frame buildings with and with-out brace" *Journal of Constructional Steel Research, Science Direct*, 2013, 164–173.

[x] Mahmoud R. Maheri, R. Akbari, "Seismic behavior factor, R, for steel X-braced and knee-braced RC building" *Engineering Structure, Science Direct*, 2003, 1505–1513.