International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 08 | Aug -2017 www.irjet.net p-ISSN: 2395-0072

COMPARATIVE STUDY OF DIFFERENT TYPES OF BRACING SYSTEMS BY PLACING AT DIFFERENT LOCATIONS

Sachin Metre [1], Shivanand C ghule [2], Ravi kiran [3]

[1] *M.Tech Structures, Civil Engg., SSE Mangalore (India)*
[2] *Asst. Professor, Civil Engg., TOCE Bangalore (India)*
[3] *Asst. Professor, Civil Engg., SSE Mangalore (India)*

---***---

Abstract - *Now a days, Bracings in steel structure are commonly used because it can withstand lateral loads due to earthquake, wind, etc. It is one of the best method for lateral load resisting systems. This system provided to minimize the lateral deflection of structure. In this thesis 25 storey steel frame is analyzed for the rectangular plan of 25x15 m by considering Z-II and Z-V for soil type-II. The analyses were done by using the ETABS 2016 software. In this paper models are compared for different types of bracing such as X, inverted V and Single diagonal bracing by placing in different locations like Outer Edge, Inner Edge and at centre in X and Y-directions for the bracing angle ISA 130x130x8. Results are obtained by considering the parameters like storey displacement, storey drift and storey shear.*

Index Terms— Bracing, Analysis using ETABS, storey displacement, storey drift, storey displacement.

1. INTRODUCTION:

As steel bracing is economical, easy to set up, occupies minimum space and also have flexibility in nature to design for meeting the required strength and stiffness. Braced framed structures are usually considered to resist the lateral forces and also earthquake loads. Braced systems provide due to their strength, stiffness to the structures. They provide more stiffness against the horizontal shear because the diagonal member elements work in axial stress.

2. DIFFERENT TYPES OF BRACED FRAME STRUCTURE:

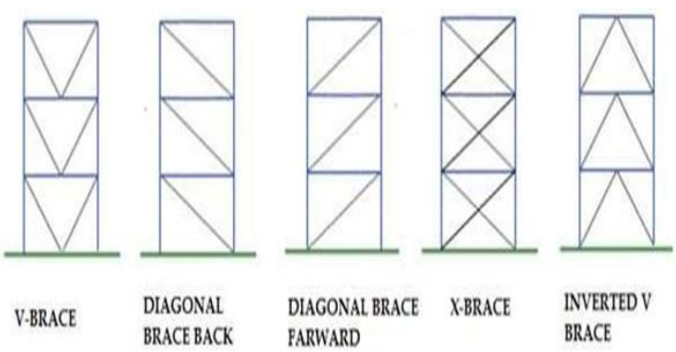

Fig.1: Types of Bracing System

3. PROBLEM MODELING:

Table 1: Building Details

PARAMETER	BRACED FRAME STRUTURE
Plan Dimension	25X15 m
Total height of building	75.5 m
No. of stories	25 floors
Height of typical storey	3.0 m
Height of ground storey	3.5 m
Grade of concrete	M-25 for Slab
Grade of steel	Fe 250
Depth of slab	150 mm
Size of beams	ISMB 300 0-15 stories ISMB 200 16-25 stories
Size of columns	ISMB 600 0-15 stories ISMB 400 16-25 stories
Angle of Bracing	130X130X8 mm

Table 2: Loading Details

Live load	3.0 kN/m^2 - typical floor 1.5 kN/m^2 - For Roof
Floor finish	2 kN/m^2 - typical floor 1 kN/m^2 - For Roof
Zone factor	Z-II and Z-V
Soil type	II
Importance factor	1
Response reduction, R	5
Codes	IS 456 : 2000. IS 875-1987 (Part II) – Live Loads/ Design Loads. IS 1893 (Part 1): 2002 – For Earthquake Designing.

4. LOCATIONS OF BRACING PLACED:

In this paper we considered three types of bracing such as X,A (inverted v) and Diagonal bracing systems at different locations like Outer edges, Inner edges and Centre for the seismic analysis for Zone II and V in X and Y directions as shown in the figure. Similarly for A and D type of bracing we placed as shown in the figure.

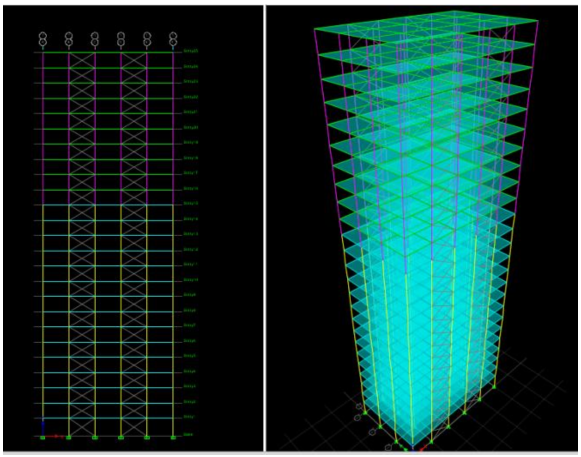

Fig.2: XBS in X direction at I.E

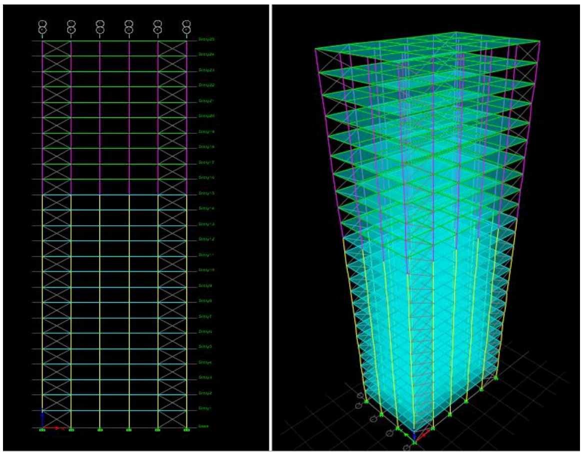

Fig.3: XBS in X direction at O.E

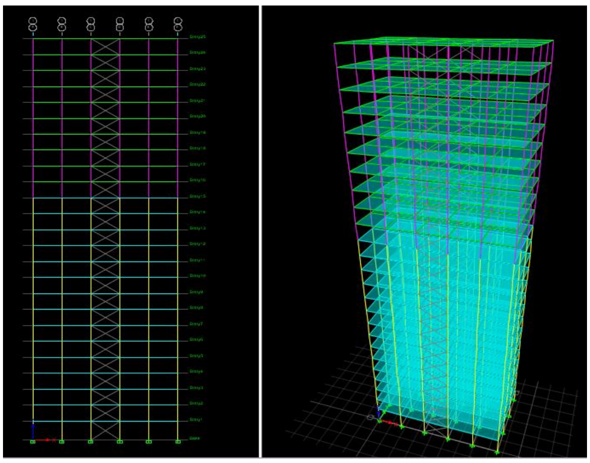

Fig.4: XBS in X direction at Centre

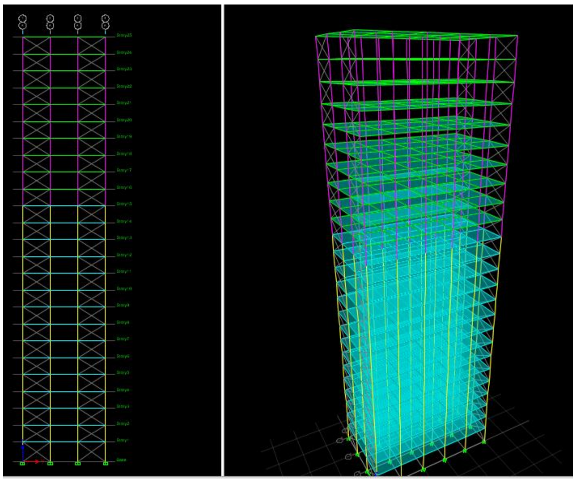

Fig.5: XBS in Y direction at O.E

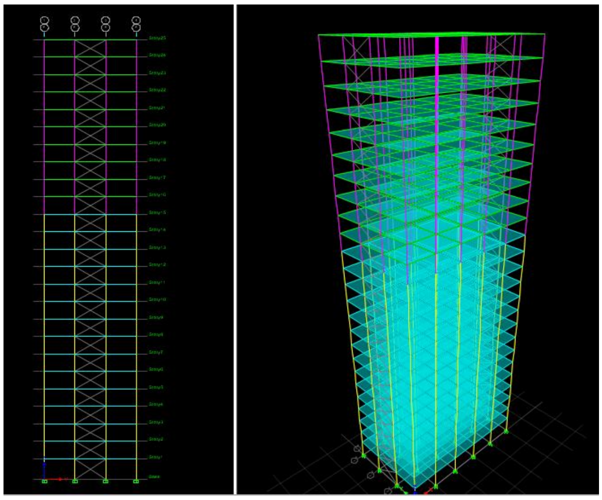

Fig.6: XBS in Y direction at Centre

5. RESULT AND DISCUSSIONS:

5.1 RESULTS FOR DISPLACEMENTS:

Table 3: Displacements values for Z-II in X and Y directions

STOREY DISPLACEMENT FOR Z-II					
MODEL	X DIRECTION			Y DIRECTION	
	OUTER EDGES	INNER EDGES	CENTRE	OUTER EDGES	CENTRE
X BRACE	154.10	122.353	210.515	113.949	135.17
A BRACE	148.313	119.294	206.402	111.084	133.606
D BRACE	173.843	140.779	232.254	122.491	144.461

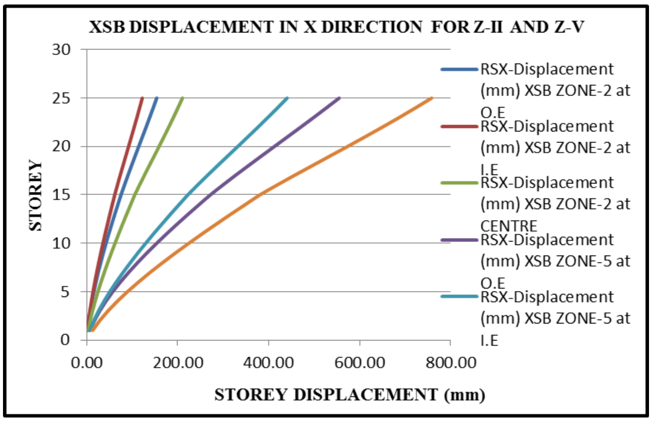

Fig.7: Displacement of XSB in X direction for Z-II and Z-V

Table 4: Displacements values for Z-V in X and Y directions

STOREY DISPLACEMENT FOR Z-V					
MODEL	X DIRECTION			Y DIRECTION	
	OUTER EDGES	INNER EDGES	CENTRE	OUTER EDGES	CENTRE
X BRACE	554.775	440.472	757.856	410.218	486.613
A BRACE	533.926	429.458	743.047	399.901	480.981
D BRACE	625.834	506.803	836.114	440.966	520.061

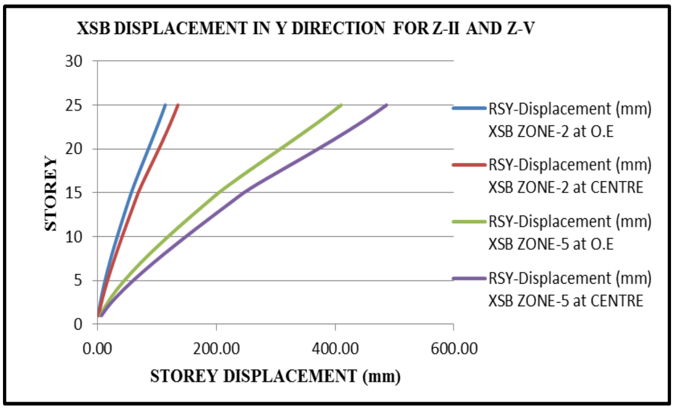

Fig.8: Displacement of XSB in Y direction for Z-II and Z-V

DISCUSSION ON DISPLACEMENT FOR STEEL BRACING:

Displacement is the main parameter which helps to know the structural behavior due to the lateral loads acting on the structure.

The displacement in both the direction (X and Y) for response spectrum analysis is presented in the above table for seismic both Z-II and Z-V for all locations of bracings i.e Outer Edges (O.E), Inner Edges (I.E) and at Centre. The graphs for XSB are plotted and shown in the fig 7 and 8.

From the obtained results it is found that for both the seismic Zones, in both (X and Y) directions the displacement reduced when the location of bracing changes.

The max displacement values in X direction for both Z-II and Z-V is lesser for inverted V type of bracing when the bracing is placed at inner edges it reduced by 20 % compared to outer edges and 42 % for centre and for Y direction the displacement is minimum for inverted V type of bracing when it is placed at outer edges, reduced nearly 17 % compared to when it is placed at Centre location.

Therefore A bracing is better to provide at Inner Edges In X direction and at Centre in Y direction.

5.2 RESULTS FOR STOREY DRIFT:

Table 5: Storey Drift values for Z-II in X and Y directions

STOREY DRIFT FOR Z-II					
MODEL	X DIRECTION			Y DIRECTION	
	OUTER EDGES	INNER EDGES	CENTRE	OUTER EDGES	CENTRE
X BRACE	0.00263	0.002	0.00332	0.00186	0.00201
A BRACE	0.00248	0.00189	0.00316	0.00177	0.00193
D BRACE	0.00267	0.00201	0.00319	0.00178	0.00198

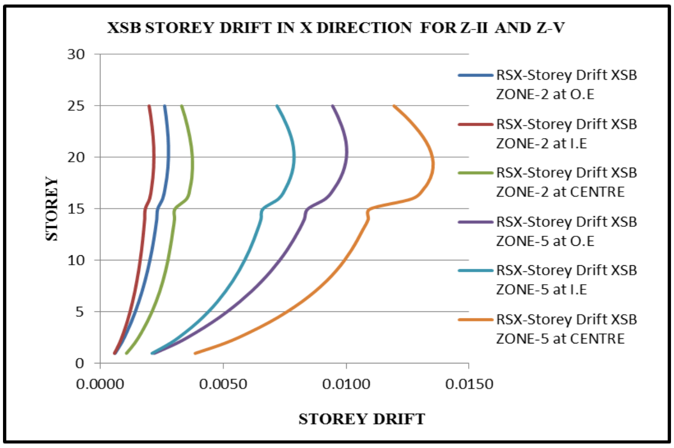

Fig.9: Drift of XSB in X direction for Z-II and Z-V

Table 6: Storey Drift values for Z-V in X and Y directions

STOREY DRIFT FOR Z-V					
MODE L	X DIRECTION			Y DIRECTION	
	OUTER EDGES	INNER EDGES	CENTR E	OUTER EDGES	CENTR E
X BRACE	0.0094 5	0.0071 9	0.0119 4	0.0066 9	0.0072 5
A BRACE	0.0089 3	0.0068	0.0113 7	0.0063 8	0.0069 5
D BRACE	0.0096	0.0072 2	0.0114 8	0.0064 2	0.0067 7

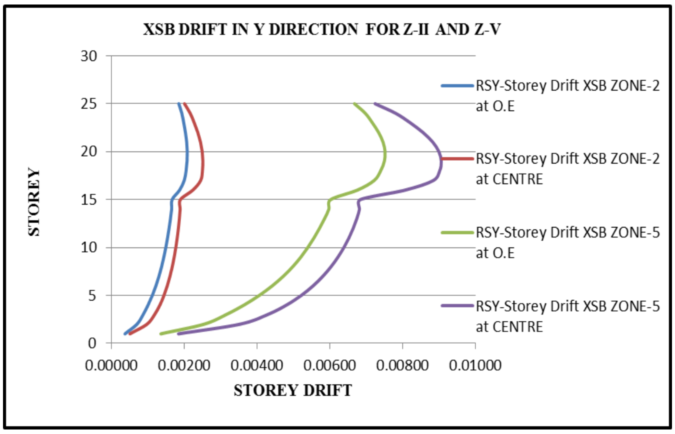

Fig.10: Drift of XSB in Y direction for Z-II and Z-V

DISCUSSIONS FOR DRIFT VALUES:

As the height of the building increases, drift stories also increases up to certain then decreases. From the results the drift values for A bracing is lesser compared to the other two types of bracing (X and D) when it is placed at the inner edges, it is reduced 24 % for outer edges and 40 % lesser at centre in X direction for both the Zones (II and V) and inn Y direction 8 % for Outer compared to Centre for both the Zones.

Thus, we can say A bracing system can be placed at Inner edges.

5.3 RESULTS FOR STOREY SHEAR

Table 7: Storey Shear values for Z-II in X and Y directions

STOREY SHEAR FOR Z-II					
MODE L	X DIRECTION			Y DIRECTION	
	OUTER EDGES	INNER EDGES	CENTR E	OUTER EDGES	CENTR E
X BRACE	659.61 6	659.61 6	659.05 7	659.05 7	659.61 6
A BRACE	659.25	659.24 9	658.87 2	659.25	658.87
D BRACE	659.05 8	659.05 8	658.77 7	659.05 9	658.77 9

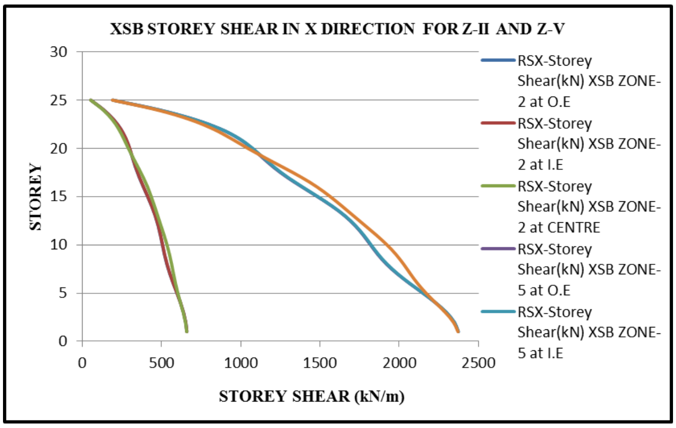

Fig.11: Storey Shear of XSB in X direction for Z-II and Z-V

Table 8: Storey Shear values for Z-V in X and Y directions

STOREY SHEAR FOR Z-V					
MODE L	X DIRECTION			Y DIRECTION	
	OUTER EDGES	INNER EDGES	CENTR E	OUTER EDGES	CENTRE
X BRACE	2374.6 2	2374.6 1	2372.6 0	2374.6 2	2372.60
A BRACE	2373.3	2373.2 9	2371.9 4	2373.2 9	2371.95
D BRACE	2372.6 1	2372.6 0	2371.6 0	2372.6 1	2371.60 6

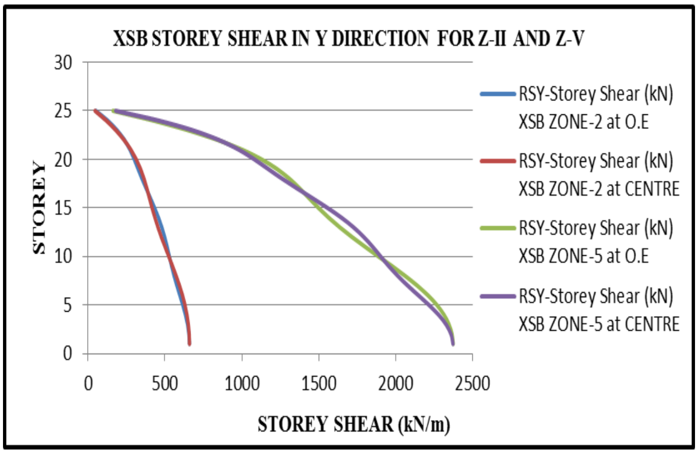

Fig.12: Storey Shear of XSB in Y direction for Z-II and Z-V

DISCUSSIONS FOR STOREY SHEAR VALUES

The maximum Storey shear values for both the directions response spectrum analysis is presented in the above table for seismic both Z-II and Z-V for all locations of bracings i.e Outer Edges (O.E), Inner Edges (I.E) and at Centre.

The graphs of Storey Shear for X Steel Bracing (XSB) are plotted in X and Y direction as shown in the above fig.12.

6. CONCULUSION:

- Bracing Structures gives more resistance to lateral deflection and also it suitable in earthquake prone areas.
- The bracing system effectively reduces the lateral displacement and drift for the A bracing of the structure compared to other bracings.
- By using A bracing it is possible to adopt openings for windows and doors which are critical in XBS because X-bracings run across the entire wall area.
- Storey Shear increases for the Bracing models especially for the X bracing compared to inverted V (A type bracing) and Single Diagonal bracing.

7. SCOPE OF FUTURE WORK:

- By using bracings in the structures, the displacement of the structure greatly reduced can be changed or altered. Hence the further study can be done by examining the behavior of the storey building due to wind load forces and Time history analysis.
- We can also study on the behavior of Bending Moment, shear Force etc.
- We can study other types of bracings in different Zones for the different soil type conditions.
- We can study for the different sections in steel structures and compare with and without bracings.

REFERENCES

[1] Adithya.M, Swathi rani K.S, Shruthi H K and Dr.Ramesh B R (February 2015): "Study On Effective Bracing Systems for High Rise Steel Structures" SSRG International Journal of Civil Engineering (SSRG-IJCE) – Volume 2 Issue 2.

[2] Amol V. Gowardhan, G.D.Dhawale and Shende (2015) “A Review On Comparative Seismic Analysis Of Steel Frame With And Without Bracing By Using Software” International Journal Of Research Vol.3.

[3] A. Jesumi, M.G. Rajendran, (March-April 2013)“Optimal Bracing System for Steel Towers” International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 3, Issue 2.

[4] A Kadid, D.Yahiaoui (2011) “Seismic Assessment of Braced RC Frames.”2011 Published by Elsevier Ltd, A. Kadid and D. Yahiaoui / Procedia Engineering 14 ,Pages2899–2905.

[5] A R Khaloo and M Mahdi Mohseni: (2008) “Nonlinear Seismic Behaviour of RC Frames with RC Braces” Asian Journal of Civil Engineering, Vol. 9, No6.

[6] Charles W Roeder and Jerome F Hajjar (July 2013) “Seismic Design of Steel Special Concentrically Braced Frame System” NEHRP technical note of NIST, US.