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EFFECT OF BRACING SYSTEM ON DIFFERENT STORY STEEL STRUCTURE

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Abstract - *Now a days due to climate changes and human made activity, our environment affected adversely, which ultimately leads to cause of natural calamities. Natural calamities include landslides, earthquake, temperature variation and many other. Earthquake is one of the major destructive natural calamities which leads of destruction of human lives and property. To deals with earthquake problems, earthquake resisting structure design become very crucial task in structural design field. Specially when structure is high rise structure and steel structure. Due to earthquake horizontal forces are acting hence structure will not be able to serve to its designed life span. To reduce effect of forces acting due to earthquake various technique is to be used now days. In this project we are using of the technique, which is, providing bracing in the steel structure. In this project, selected G+10, G+20 and G+ 30 building and three different bracing is provided which are X bracing , K bracing and V bracing to the steel structure. Initially G+10, G+20 and G+ 30 steel structure is analyzed without any bracing and then after same structure with same loading, same section and keeping all other factor same will be provided with X bracing, K bracing and V bracing on plain ground and structure will be analyzed. Total 12 structure will be analyzed and result will be compared. In this we will study result for base share, story displacement, inter story ratio and maximum base share. After result analysis we will get idea which bracing system is most efficient that will be feasible to actual use on site.*

Key Words: STAAD.Pro, Bracing system, X bracing, K Bracing, V Bracing

1.INTRODUCTION

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2. BRACING SYSTEM

The bracing systems are necessary for structures that are subjected to lateral loads due to earthquake, wind, etc. They help in minimizing the lateral deflection of the structure

Majorly Bracing systems are classified as:

1. Horizontal Bracing System
2. Vertical Bracing System

VERTICAL BRACING SYSTEM

In vertical planes, there are bracing between column lines which provide load paths that are used to transfer horizontal forces to ground level. This system aims to transfer horizontal loads to the foundations and withstanding the overall sway of the structure. These are the bracings placed between two lines of columns

X-BRACED FRAME:

X braced frame is a structural system used in steel buildings to provide lateral stability and resist forces such as wind or seismic loads. It consists of diagonal braces arranged in an "X" shape within a rectangular frame, connecting opposite corners of a bay. X-bracing enhances the rigidity of a steel frame, limiting deformations under lateral loads.

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V BRACING

V bracing is a construction technology that today stabilizes many buildings and structures. It is an important feature of any building for reasons of stability and human safety, especially in earthquake-prone areas. It is designed to give resistance to lateral forces like winds and earthquakes. When using V bracing, two diagonal components meet in the center of the lower horizontal component after running from the top two corners of a horizontal beam or frame. Thus, this creates a “V” shape, which is why “V bracing” got its name. Its design is so basic, but it works so well to dissipate and absorb these buckling or swaying forces that pose a hazard to structures.

K-BRACING

K Bracing is another type of lateral bracing system used in steel structures to enhance stability and resist lateral loads like wind, seismic forces, and other horizontal forces. The

configuration of K-bracing is distinct, where diagonal bracing members are connected between columns and a beam to form a "K" shape.

3. OBJECTIVE

The following are main purpose of the research work,

1. The main purpose of the research work is to compare the different story steel building performance with various bracings used in those steel framed buildings
2. To analyze the commonly used bracing systems for high rise steel structure and study behavior of bracing system for tall structures.
3. To analyze different bracing systems used in high rise steel structures by creating t model using STAAD Pro software.
4. In this research work following are different type of bracing systems are used; X- Bracing systems/Cross-Bracing system. V-Bracing system. K-Bracing system.
5. After analysis all structure without bracing and with different bracing system, results is compared for story displacement, story drift, base share and story share.

4. BUILDING GEOMETRY

Earthquake Parameter Consider For Seismic Load

Sr. No	Seismic Parameter	Seismic Value
1	Seismic Zone (Z).	0.25 (IV)
2	Response Reduction Factor (R).	5
3	Importance factor (I).	1.5
4	Type of Soil.	3
5	Damping ratio (DM)	0.05

Geometry Property Of Building

Sr.No	Parameter of Building	Values
1	Length of Building	25 m
2	Width of Building	24 m
3	Height of floor	3.5 m floor to floor
4	Depth of foundation	4 m
5	No of Story	G+10,G+20,G+30

Material Used For Steel Building

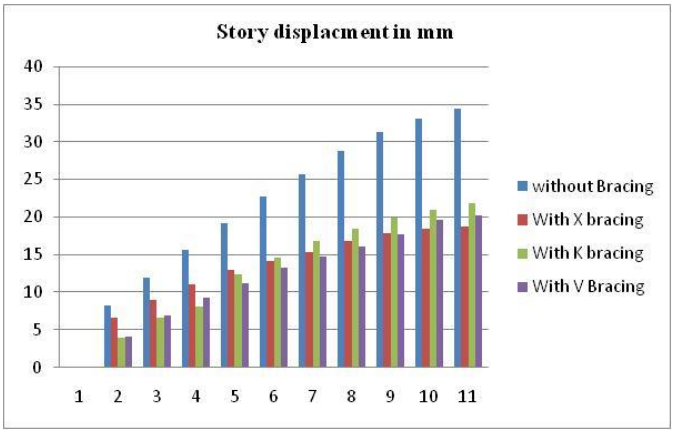
Sr.No	Parameter of Building	Section
1	Steel Column	I125016B55016
2	Steel Beam	I80012A40012
3	Secondary Beam	ISMC 150H
4	Bracing	ISMC 175H
5	Concrete slab	110 mm thick

5. RESULT

For G+10 Structure
1. Story displacement in mm

Table : Story displacement in mm

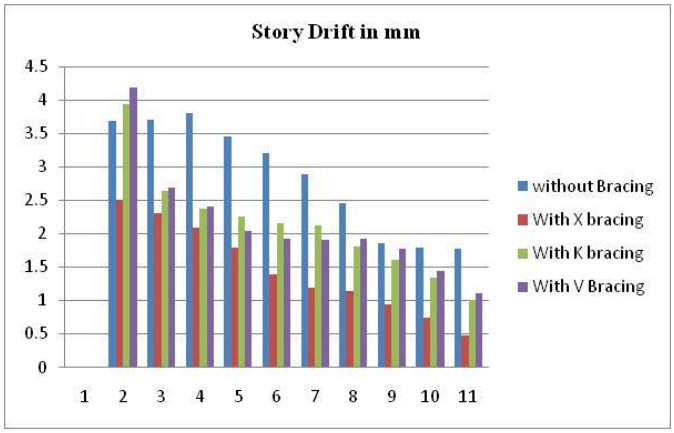
Floor	without Bracing	With X bracing	With K bracing	With V Bracing
GL	0	0	0	0
1	8.33	6.7	3.94	4.18
2	12	9	6.65	6.87
3	15.7	11	8.08	9.28
4	19.2	13	12.4	11.29
5	22.7	14.2	14.6	13.22
6	25.7	15.4	16.8	14.7
7	28.8	16.9	18.5	16.1
8	31.3	17.8	19.9	17.7
9	33.1	18.4	21	19.6
10	34.4	18.7	21.9	20.2



2. Story drift in mm

Table: Story drift in mm

Floor	without Bracing	With X bracing	With K bracing	With V Bracing
GL	0	0	0	0
1	3.68	2.5	3.94	4.18
2	3.7	2.3	2.64	2.69
3	3.8	2.1	2.38	2.4
4	3.448	1.8	2.26	2.05
5	3.212	1.4	2.16	1.92
6	2.89	1.2	2.13	1.91
7	2.456	1.14	1.81	1.93
8	1.86	0.954	1.61	1.78
9	1.8	0.74	1.35	1.45
10	1.78	0.48	1.02	1.12



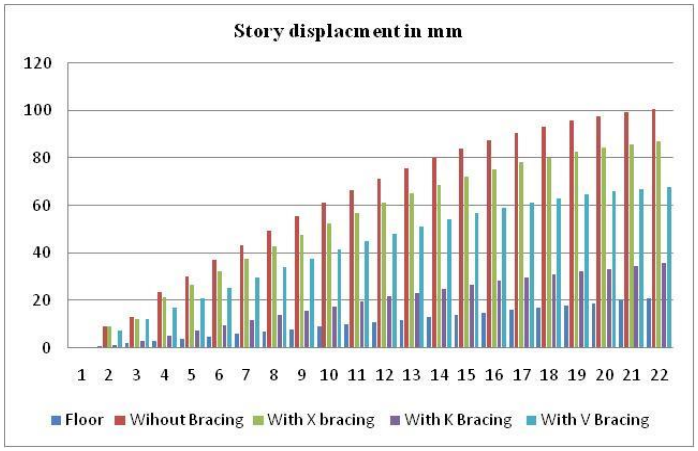
For G+20 Building

1. Story displacement in mm

Table : Story displacement in mm

Floor	Without Bracing	With X bracing	With K Bracing	With V Bracing
GL	0	0	0	0
1	9.3	9.3	1.41	7.3
2	13.23	12.4	3.282	12.3
3	23.6	21.4	5.32	17
4	30.4	26.8	7.43	21.2
5	37.1	32.3	9.53	25.6
6	43.5	37.7	11.7	29.9
7	49.7	42.8	13.8	34
8	55.5	47.8	15.6	37.8
9	61.1	52.6	17.6	41.6
10	66.4	57.1	19.7	45.1
11	71.3	61.4	21.7	48.3
12	75.9	65.2	23.4	51.4
13	80.1	68.7	25.1	54.2
14	84	72.2	26.8	56.8
15	87.5	75.3	28.3	59.1
16	90.6	78.2	29.7	61.2
17	93.4	80.3	31	63
18	95.8	82.7	32.3	64.7
19	97.8	84.5	33.5	66
20	99.4	85.9	34.6	67
21	100.6	87.1	35.7	67.9

Figure : Story displacement in mm



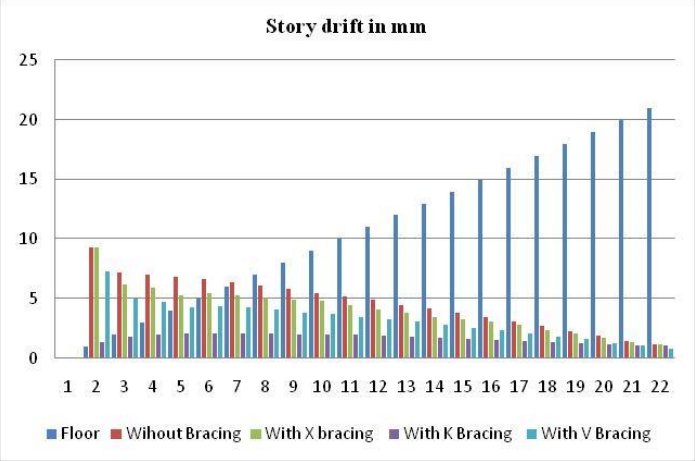
2. Story drift in mm

Table: Story drift in mm

Floor	Without Bracing	With X bracing	With K Bracing	With V Bracing
GL	0	0	0	0
1	9.3	9.3	1.41	7.3
2	7.2	6.2	1.87	5.01
3	7	5.9	2.04	4.7
4	6.88	5.3	2.1	4.26
5	6.65	5.5	2.1	4.37
6	6.4	5.3	2.14	4.29
7	6.1	5.1	2.14	4.07

8	5.8	4.9	2.02	3.85
9	5.5	4.8	1.99	3.73
10	5.2	4.5	1.97	3.47
11	4.9	4.1	1.91	3.24
12	4.5	3.8	1.85	3.08
13	4.2	3.5	1.76	2.8
14	3.8	3.3	1.62	2.55
15	3.5	3.1	1.59	2.37
16	3.1	2.8	1.49	2.08
17	2.7	2.4	1.36	1.82
18	2.3	2.1	1.27	1.61
19	1.9	1.7	1.2	1.32
20	1.5	1.4	1.1	1.06
21	1.2	1.2	1.06	0.84

.Figure: Story drift in mm



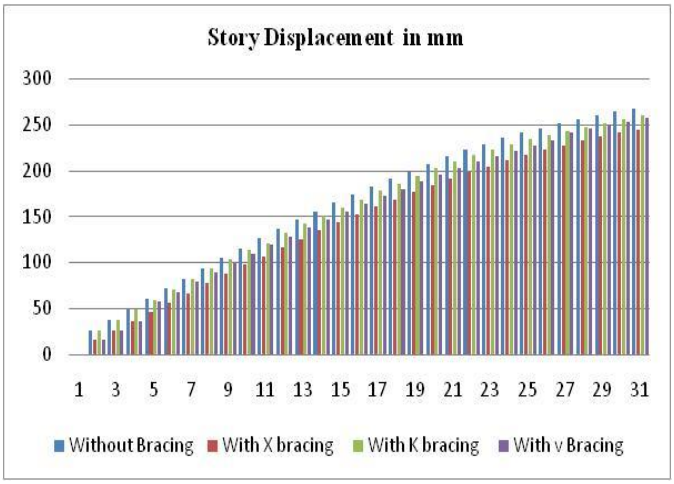
For G+20 Building

1. Story displacement in mm

Table : Story displacement in mm

Floor	Without Bracing	With X bracing	With K bracing	With V Bracing
FL	0	0	0	0
1	25.4	15.92	26.2	15.4
2	36.9	25.8	37.2	26.1
3	48.4	36.1	48.2	36.6
4	59.9	46.3	59.2	57.8
5	71.2	56.4	70.3	68.1
6	82.4	66.6	81.7	78.6
7	93.5	77.01	92.7	88.7
8	104.4	87.1	103.2	98.7
9	115.2	96.9	113.4	108.8
10	125.7	106.4	121	118.5
11	135.9	115.7	132.7	127.9
12	145.9	125	142	137.4
13	155.6	134.4	151.1	146.4
14	165.1	143.5	159.9	155.14
15	174.2	152	168.6	163.8
16	183	160.25	177.5	172
17	191.5	168.19	185.6	179.9
18	199.6	175.99	194	187.8
19	207.4	183.7	202.1	195.1
20	214.8	191	209.5	202
21	221.8	197.8	216.3	208.9
22	228.5	204.3	222.5	215.2
23	234.8	210.44	228.2	221.2
24	240.7	216.3	233.5	226.9
25	246.1	221.9	238.4	232.2
26	251.2	227.2	243	241.8
27	255.9	232	247.4	246
28	260.1	236.4	251.6	249.8
29	264	240.5	255.6	253.3
30	267.5	244.2	259.5	256.8

Figure : Story displacement in mm

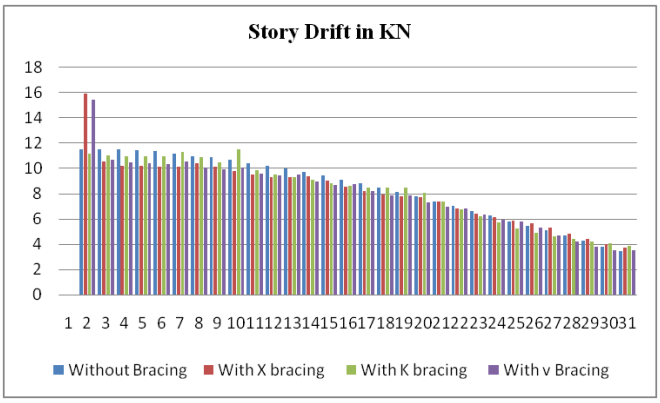


2. Story drift in mm

Table: Story drift in mm

Floor	Without Bracing	With X bracing	With K bracing	With v Bracing
FL	0	0	0	0
1	11.55	15.92	11.2	15.42
2	11.52	10.54	11.02	10.69
3	11.49	10.2	10.99	10.5
4	11.44	10.18	11	10.39
5	11.35	10.13	11	10.33
6	11.2	10.17	11.3	10.55
7	11	10.39	10.9	10.1
8	10.9	10.17	10.5	9.96
9	10.7	9.76	11.5	10.1
10	10.4	9.49	9.83	9.61
11	10.2	9.33	9.53	9.42
12	10	9.3	9.29	9.51
13	9.72	9.376	9.09	8.97
14	9.43	9.06	8.82	8.72
15	9.12	8.55	8.63	8.74
16	8.8	8.18	8.51	8.19
17	8.47	7.94	8.48	7.89
18	8.13	7.8	8.46	7.84
19	7.77	7.7	8.04	7.3
20	7.41	7.35	7.4	6.96
21	7.03	6.84	6.78	6.84
22	6.65	6.43	6.23	6.32
23	6.27	6.11	5.72	5.95
24	5.8	5.868	5.25	5.76
25	5.47	5.65	4.89	5.28
26	5.07	5.29	4.61	4.66
27	4.67	4.83	4.38	4.19
28	4.26	4.39	4.19	3.8
29	3.8	4.02	4.07	3.52
30	3.47	3.73	3.89	3.5

Figure: Story drift in mm



6. CONCLUSION

1. The G+10 structures, on comparison without and with various bracing system structure shows following story displacement behavior. If structure is without any bracing system shows maximum displacement which is 34.4 mm, if same structure along with same loading but by providing x bracing system shows 18.7 mm story displacement. On comparison with structure without any bracing system story displacement with X bracing reduced by 45.6 %. Similarly structure with K bracing system having maximum displacement of 21.9 mm, which is 36.33 % reduced on comparing with structure without bracing system and at last Structure with V bracing system shows maximum displacement of 20.2 mm, which is 41.26 % less comparing with structure without bracing system. If structure is compared with various bracing system and without bracing systems show result that for story displacement structure with X bracing is provides more stability against lateral loads and this bracing system gives lesser story displacement.

2. The G+10 structures, on comparison without and with various bracing system structure shows following story drift behavior studied at maximum story displacement. If structure is without any bracing system shows story drift which is 1.78 mm, if same structure along with same loading but by providing x bracing system shows 0.48 mm story drift. On comparison with structure without any bracing system story drift with X bracing reduced by 73 %. Similarly structure with K bracing system having story drift of 1.02 mm, which is 42.69 % reduced on comparing with structure without bracing system and at last Structure with V bracing system shows story drift of 1.12 mm, which is 37.07 % less comparing with structure without bracing system. If structure is compared with various bracing system and without bracing systems show result that for story drift structure with X bracing is provides more stability against lateral loads and this bracing system gives lesser story drift hence X bracing system is best among all other with reference to story drift.

3. The G+20 structures, on comparison without and with various bracing system structure shows following story displacement behavior. If structure is without any bracing

system shows maximum displacement which is 100.6 mm, if same structure along with same loading but by providing X bracing system shows 87.1 mm story displacement. On comparison with structure without any bracing system story displacement with X bracing reduced by 13.41 %. Similarly structure with K bracing system having maximum displacement of 35.7 mm, which is 64.5 % reduced on comparing with structure without bracing system and at last Structure with V bracing system shows maximum displacement of 67.9 mm, which is 32.50 % less comparing with structure without bracing system. If structure is compared with various bracing system and without bracing systems show result that for story displacement structure with K bracing is provides more stability against lateral loads and this bracing system gives lesser story displacement

4. The G+20 structures, on comparison without and with various bracing system structure shows following story drift behavior studied at maximum story displacement. If structure is without any bracing system shows story drift which is 1.2 mm, if same structure along with same loading but by providing x bracing system shows 1.2 mm story drift. On comparison with structure without any bracing system story drift with X bracing both are nearly same and hence there is no change. Similarly structure with K bracing system having story drift of 1.06 mm, which is 11.66 % reduced on comparing with structure without bracing system and at last Structure with V bracing system shows story drift of 0.84 mm, which is 32 % less comparing with structure without bracing system. If structure is compared with various bracing system and without bracing systems show result that for story drift structure with V bracing is provides more stability against lateral loads and this bracing system gives lesser story drift hence V bracing system is best among all other with reference to story drift

5. The G+30 structures, on comparison without and with various bracing system structure shows following story displacement behavior. If structure is without any bracing system shows maximum displacement which is 267.5 mm, if same structure along with same loading but by providing x bracing system shows 244.2 mm story displacement. On comparison with structure without any bracing system story displacement with X bracing reduced by 8.7 %. Similarly structure with K bracing system having maximum displacement of 259.5 mm, which is 2.8 % reduced on comparing with structure without bracing system and at last Structure with V bracing system shows maximum displacement of 256.8 mm, which is 4 % less comparing with structure without bracing system. If structure is compared with various bracing system and without bracing systems show result that for story displacement structure with X bracing is provides more stability against lateral loads and this bracing system gives lesser story displacement.

6. The G+30 structures, on comparison without and with various bracing system structure shows following story drift behavior studied at maximum story displacement. If structure is without any bracing system shows story drift which is 3.47 mm, if same structure along with same loading but by providing x bracing system shows 3.73 mm story drift. On comparison with structure without any bracing system story drift with X bracing increase by 6.3 %. Similarly structure with K bracing system having story drift of 3.89 mm, which is 10.7 % increased on comparing with structure without bracing system and at last Structure with V bracing system shows story drift of 3.5 mm, which is 0.08 % less comparing with structure without bracing system. If structure is compared with various bracing system and without bracing systems show result that for story drift structure with X and K bracing is provides showing that there is increase in story drift . V bracing system and structure without bracing system shows that story drift is almost same. Hence from observation it is clear that none of any bracing is suitable for G+30 Story structure

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