Comparative Study of Analysis of Steel Frame With Different Types of Bracing Pattern Subjected To Lateral Load

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Abstract- *Steel is most useful material for building construction in the world and in last decades steel structure has played an important role in construction industry Now a day, shear wall in R.C. structure and steel bracings in steel structure are most popular system to resist lateral load due to earthquake, wind, blast etc. In this paper, G+4 steel frame building is analyzed for various types of concentric bracings as per the IS 800- 2000. comparative study of G+4 steel frame building without bracings & same building with different type of bracings like X, Diagonal, inverted V and K bracing using STAAD PRO (v8i). Performance of each frame has been carried out, various parameters of bracing and property of bracing by different researchers discussed. Effect of these different bracings on Steel is studied for different parameter like maximum axial force, column displacement, maximum bending moment. From the observed result best type of bracing will be recommended.*

Keywords- Bracing pattern, concentric and eccentric bracing, STAAD ProV8i

I. INTRODUCTION

In the present time, Steel structure plays an important role in the construction industry. Steel braced frame is one of the structural system used to resist lateral loads such as seismic and wind load in multistoried building. Members in a braced frame are designed to work in tension and compression, similar to a truss.. Previous earthquakes in India show that not only non-engineered structures but engineered structures need to be designed in such a way that they perform well under lateral loading. Braced frames are a very common form of construction, being economic to construct and simple to analyze. Bracing, which provides stability and resists lateral loads, may be from diagonal steel members.In braced construction, beams and columns are designed under vertical load only, assuming the bracing system carries all lateral loads.

Steel bracing is economical, easy to erect, occupies less space and has flexibility to design for required strength and stiffness. Among these buildings, different types of braced structures are probably the most favorite types, due to less skill needed for welding and joints, and possibility to use common and lighter section for beams and braces. There are 'n' number of possibilities to arrange steel bracings, such as cross bracing 'X', diagonal bracing, and inveted 'V' type bracing and K bracing. Braced frames categorize into two different types, concentric and eccentric, which have specific characteristics and design requirements. Bracing can be applied as concentric bracing or eccentric bracing.

To compare the efficiency of bracing, four types of steel bracing are selected in this study. These are:

1. X-bracing
2. Diagonal bracing
3. Inverted V-bracing
4. K bracing

II. OBJECTIVES OF THE STUDY

1) The main objective of this thesis is to compare the effectiveness of bracing systems for steel frame under lateral loads.
2) To understand the Behavior of different types of bracing.
3) To compare different pattern of bracing for the different models considered
4) To study the maximum lateral displacement of steel frame building model with different types of bracing and without bracing.

STRUCTURAL MODELLING

Investigation is carried out to assess the performance of the idealized (G+4) storied of steel frame structure with and without bracing system containing four different model of similar plan are subjected to lateral load with four types of bracing pattern like X bracing, Diagonal bracing, Inverted V bracing and K bracing. The Steel Framed Building used in this

study is G+4. The length of the building is 20m. Height of frame is 25m and floor height is 5m.

DETAILS OF THE STEEL FRAME

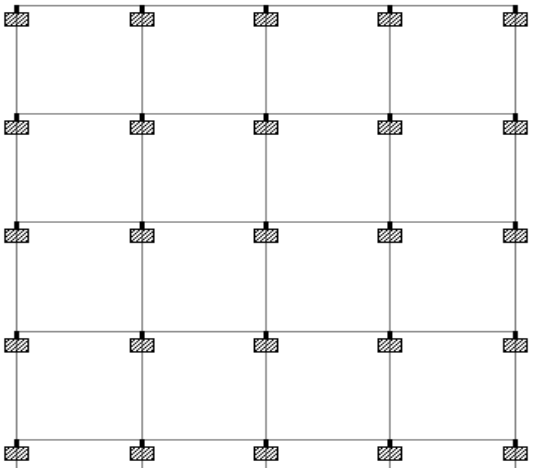

Figure 1. Plan of the building

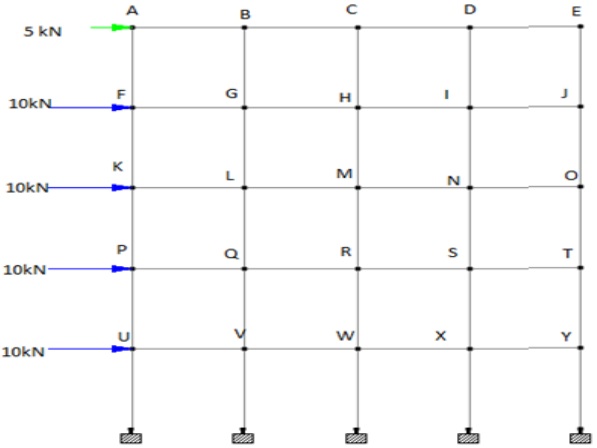

Figure 2. Elevation of the building

DIFFERENT TYPES OF BRACING MODEL USED IN THE STUDY

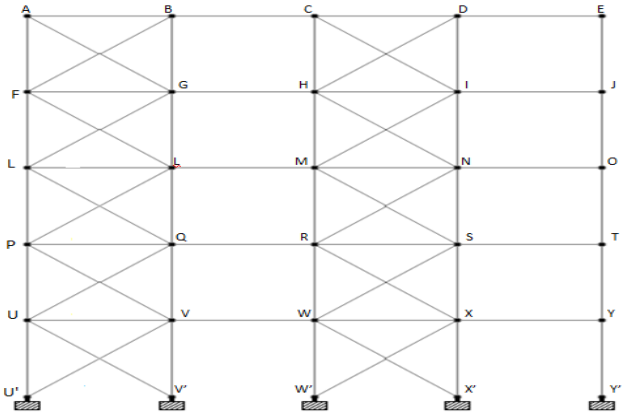

Figure 3. X Bracing

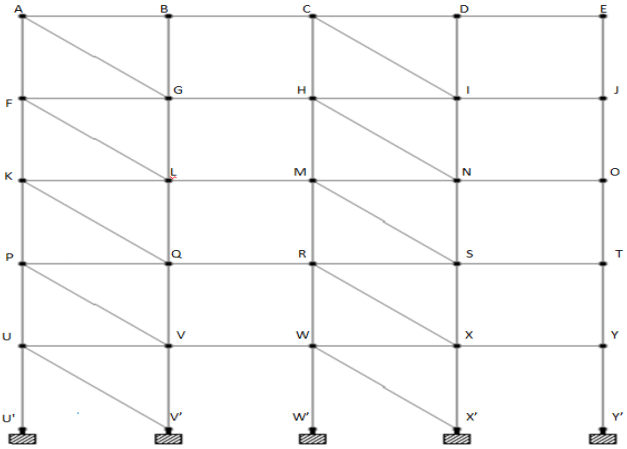

Figure 4. Diagonal Bracing

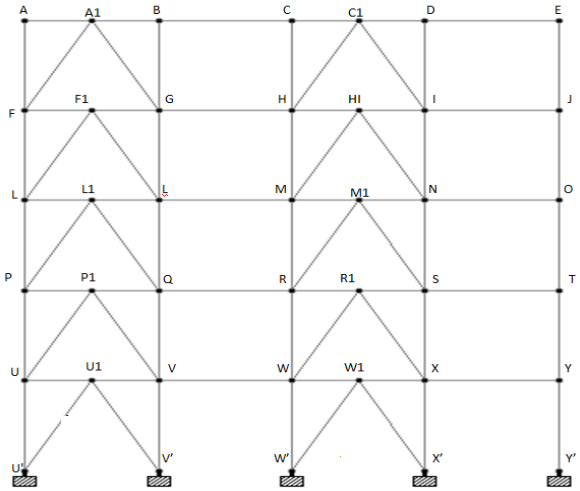

Figure 5. Inverted V Bracing

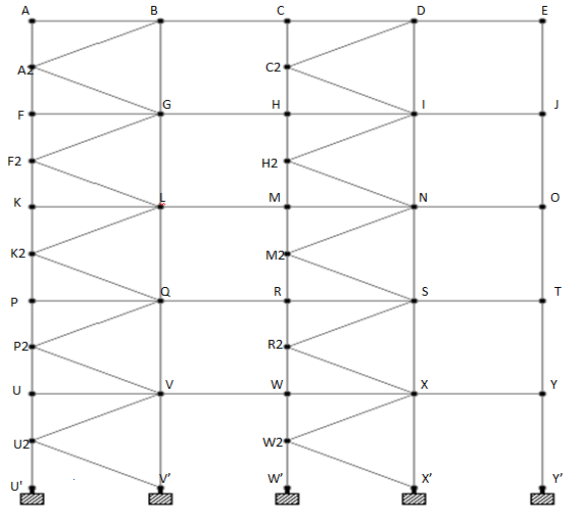

Figure 6. K Bracing

INPUT REQUIRED FOR THE BUILDING IN STAAD PRO.V8I

Table 1.

No. of stories	G+4
Length of frame	20 m
Height of frame	25m
Bay to bay distance	5 m
Storey height	5 m
Section of column	ISMB500
Section of Beam	ISMB300
Bracing angle	120*120*10
Lateral load on 4th storey	5kN
Lateral load on ground ,1st ,2nd, 3rd,	10kN

The STAAD Pro V8i software was utilized to create model and carry out the analysis. Lateral load is applied on the building frame. The frames are assumed to be fixed at the bottom. Model are created for different types four different braced frames with X , Diagonal , inverted 'V' and K braces are analyses for four storey building frame. . A bracing system is typically attached on the exterior of the perimeter frame.

1. Four storied building analyzed for lateral forces.
2. Four storied building analyzed with different types of bracing.

III. RESULTS AND DISCUSSIONS

1) Maximum Axial force in kN-

Table 2.

Sr.no	Members	Plain frame	X bracing	Diagonal bracing	Inverted V bracing	K bracing
1.	Horizontal	8.604(C)	6.145(C) (PQ)	12.157(T) (WX)	16.187(C) (UU1)	9.218(C) (UV)
2.	Vertical	22.227(C)	45.575(T) (UU')	52.581(T) (UU')	36.120(T) (UU')	54.312(T) (U2U')
3.	Diagonal	-	14.652(C) (UV')	24.349(C) (WX')	20.695(C) (U1V')	23.631(C) (U2U')

2) Maximum Bending Moment in kN.m-

Table 3.

Max. Bending Moment(kN.m)	Plain frame	X bracing	Diagonal bracing	Inverted V bracing	K bracing
Horizontal members	16.891(UV)	2.922(LM)	3.367(XY)	2.962(VW)	3.441(QR)
Vertical members	38.002(WW')	4.996(UU')	8.555(VV')	7.297(VV')	14.168(U2U')

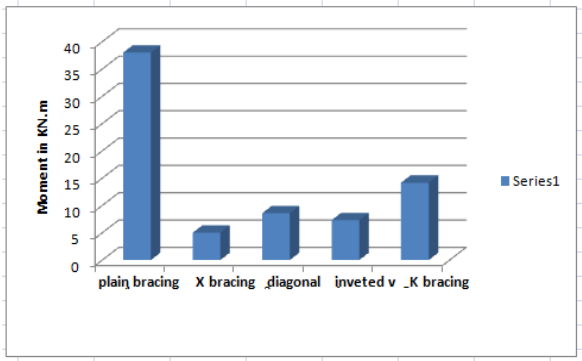

Figure 7. Graph1: Moment in Horizontal Members

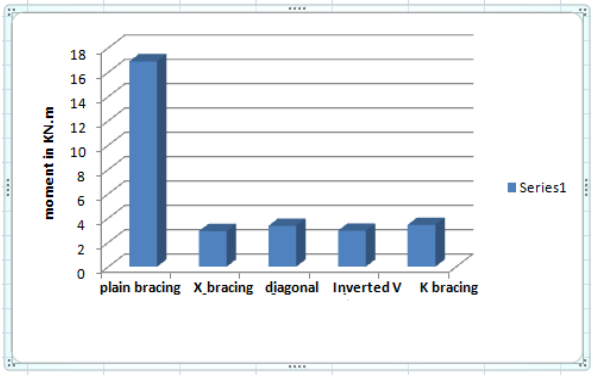

Figure 8. Graph2: Moment in Vertical Members

3) Maximum lateral Displacement in mm-

Table 4.

Sr.no	No.of stories	Plain frame	X bracing	Diagonal bracing	Inverted V Bracing	K bracing
1.	4th storey	16.146	2.113	2.940	2.445	2.885
2.	3rd storey	14.667	1.757	2.560	2.132	2.455
3.	2nd storey	11.937	1.315	2.045	1.691	1.947
4.	1st storey	7.852	0.836	1.407	1.140	1.321
5.	Ground storey	3.044	0.355	0.668	0.508	0.610
6.	Base	0	0	0	0	0

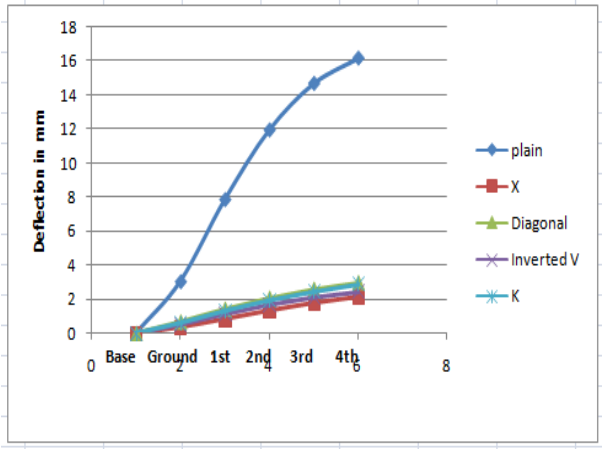

Figure 9. Graph3:Comparision of maximum displacement for different models

IV. CONCLUSION

1. The result of the present study shows that bracing element will have very important effect on structural behavior under Lateral effect. From the tables it shows that, Use of Bracings reduce the lateral displacement of floors.
2. X bracing undergo lesser lateral displacement than Diagonal, Inverted V and K bracing.
3. The X-bracing is very much effective, as it show minimum lateral displacement as compared to other bracing
4. The Inverted V-bracing show minimum lateral displacement next to X-bracing
5. Axial forces in columns increases from unbraced to braced system.
6. Bending moment in column decreases from unbraced to braced system.
7. X bracing is much effective ,as it show minimum bending moment than other braced frame.

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