

COMPARATIVE STUDY OF THE STEEL BRACING ON REINFORCED CONCRETE FRAME STRUCTURE USING SAP-2000

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Abstract - It is known that reinforced frames are well-organized structural systems for high rise buildings with high lateral loads, such as seismic loads and wind loads. The potential advantage of the bracing system is that it is a relatively small increase in the mass. In this study, building modeling is performed with and without a bracing system. Static Analysis is performed for each Different types of reinforcements are commonly used, such as inverted V braces, X reinforcement's etc. model with different types of reinforcement. The results are compared in terms of displacement, drift of the floors, Base Shear and Moment of the RC building. Resistance to wind and earthquake loading is the reason for the evolution of reinforcement. Several changes have been observed since the design of the earthquake resistance structure has been improved. Reinforcements also increase strength by avoiding weak columns. These braces are resistant to wind load and seismic forces. Reinforcements must be provided to improve the strength of the structures. Due to the earthquake significant losses can occur which can damage the structure and, in the worst case, collapse. To avoid this damage steel bracings in structure is to be applied to provide resistance and also to withstand the lateral load imposed by the earthquake and wind. There are "n" no. of possibilities to organize steel bracings reinforcements like X, V, inverted V. A building is located in the seismic zone V. The construction models are analyzed according to the IS 1893: 2002 standard with the SAP-2000 software. The main parameters considered are is to compare the seismic analysis of buildings for lateral displacement, floor drift, base Shear, etc. The steel reinforcement system is one of the effective measures to withstand horizontal forces such as seismic and wind forces in multi-storey reinforced concrete buildings. The reinforcing elements are subject to tension and compression; They are then supplied to take these forces. The steel reinforcement bracing system expands the rigidity and strength of the RC multi storey buildings and reduces its deformation

Key Words: Steel bracing, Linear analysis, RCC Frame, Sap2000, Storey displacement, Moment & Shear force.

1. INTRODUCTION

During seismic movements, deformations occur through the origins of the loading system following the response of the buildings to the measure of the ground. As a import of these deformations, the internal forces are developed through the loading system and the displacement behavior appears

throughout the building. The resulting displacement request varies based on the building mass and stiffness. Overall, buildings with larger rigidity and lesser mass have lower horizontal displacement needs. On the other hand, each building has a specific moving capacity. On the other hand, the magnitude of horizontal displacement, a building can withstand without collapsing. The main purpose of these methods is to confirm that the request for moving a building is retained below its displacement limit. This can be achieved mainly by reducing the displacement requirement of the structure system during a strong movement or by refining the displacement capacity of the RC structure.

1.2 OBJECTIVES

The following are the main objectives of this study:

- To compare the response of the building with and without bracing system Subjected to earthquake loads.
- Identify adequate bracing systems to withstand Efficiency of seismic loads.

1.3 BRACED FRAME STRUCTURE

A braced frame is an important system which is frequently used in structures subject to lateral loads as wind and seismic force. The members in a braced frame are frequently made of structural steel, which can work capably both in tension and compression. The beams and columns form the frame transmit vertical loads, and the bracing system transmit the lateral loads. The placing of braces, though, can be difficult as they can interfere with the design of the front and the location of openings. Buildings accepting high-tech or post-modern classes have answered to this by stating bracing as an internal or external design feature.



Figure: 1.1 Cross Bracing.

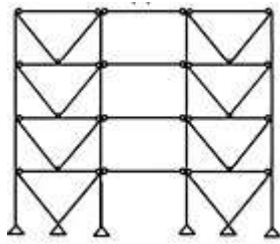


Figure: 1.2 V Bracing.

2. STRUCTURAL MODELLING

Following are the different types of models:

- a) Model without bracings.

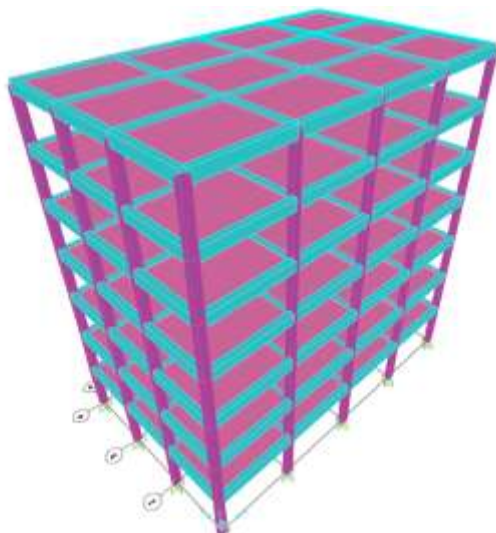


Figure: 2.1 Final Model without Bracing

- b) Model with different bracing systems (V type and X type bracings)

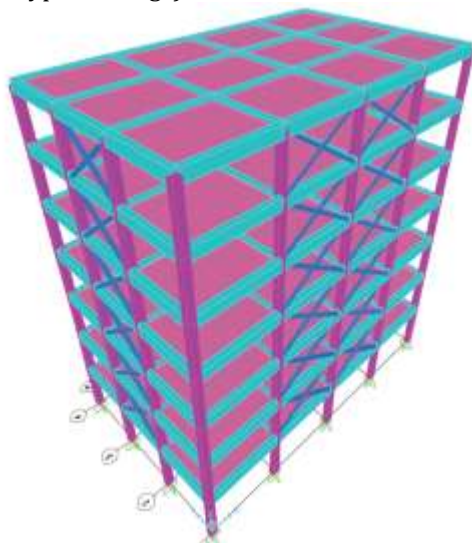


Figure: 2.2 Model with X bracings.

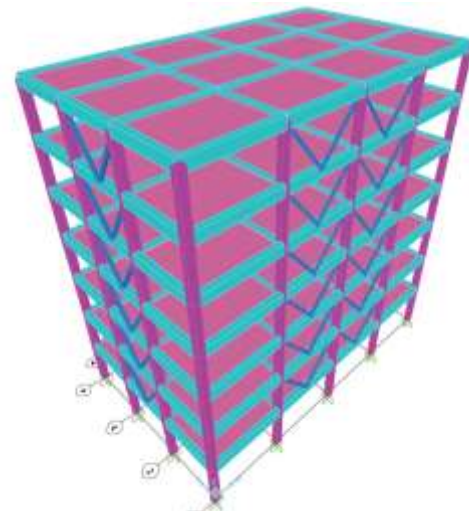


Figure: 2.3 Model with V bracings.

2.1 DESCRIPTION OF THE BUILDING

In this study, A G+6 storey RC building of 4 bays in X direction and 3 bays in Y direction have been considered for studying the effect of V type and X type bracings and there organization in various positions in the building. Following two types of structural arrangement is studied.

- a) Reinforced concrete multistory building without bracing system.
- b) Reinforced concrete multistory building with X type and V type bracing systems

Other building details are given below:
 All RC Column sizes = 450mm x 400mm
 All RC Beam sizes = 600mm x 300mm
 Slab thickness = 150mm
 Bracing = ISA 150x150x12
 Grade of concrete = M-30
 Grade of steel = Fe-415

Table:-1 Section Property

Section Name	Section Size(mm)	Longitudinal Bars	Confinement Bars	Design Type	Clear Cover(mm)
Beam	600x300	HYSD415	MILD250	M ₃ Design	25
Column	450x400	HYSD415	MILD250	P-M ₂ -M ₃ Design	50
Bracing(Angle section)	150x150x12	HYSD415	-	-	-

3. RESULTS AND DISCUSSION.

Displacement is the parameter of maximum significance as it oversees the failure pattern of the structure. From this

present study, the displacement of the model with and without bracings is detected. By providing the bracings to the structure we see that the displacement of the structure is reduced for X-bracing used in pairs shown in model.

3.1 STOREY DISPLACEMENTS

The following graph shows the variation of Story Displacement for different braced building in various seismic zones.



Figure: 3.1 Storey displacement of the model in X direction

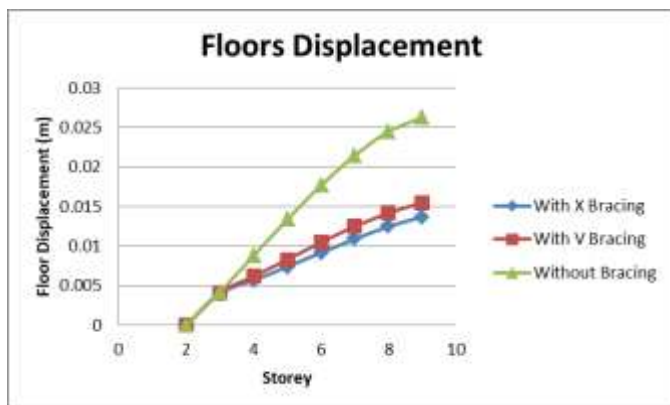


Figure: 3.2 Storey displacement of the model in Y direction

3.2 AXIAL FORCE IN COLUMN

Table:-2 Axial force

Floors Level	Unbraced	X-Braced	V-Brace
Ground Floor	4726.25	4418.59	4172.30
1	4231.78	4043.10	3901.63
2	3736.78	3457.73	3901.06
3	3220.21	2972.82	3071.05
4	2701.62	2484.10	2584.21
5	2178.42	1995.26	2097.06
6	1651.05	1505.21	1606.21
7	1120.53	905.71	1005.26

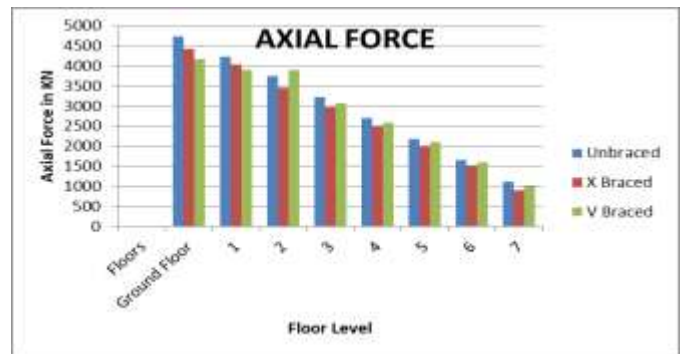


Figure: 3.3: Axial force

3.3 BASE SHEAR

Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure.

Table:-3 Base shear

SR. No.	Name	X-Direction(KN)	Y-Direction(KN)
1.	Without Bracing	3638.32	3435.58
2.	X-Bracing	3097.48	2653.25
3.	V-Bracing	3310.54	3134.25

3.4 BEMDING MOMENT IN COLUMN

The following graph shows the variation of bending moments in X and Y direction.

Table:-4 Bending moment in X direction.

Floor Level	Unbraced	X Braced	V Braced
Ground Level	18.47	18.10	20.32
1	-74.223	-66.93	-71.56
2	-68.34	-58.98	-62.42
3	-75.93	-62.52	-61.26
4	-80.34	-63.86	-59.26
5	-84.20	-65.07	-56.57
6	-87.41	-66.97	-53.62
7	-89.26	-67.20	-52.23

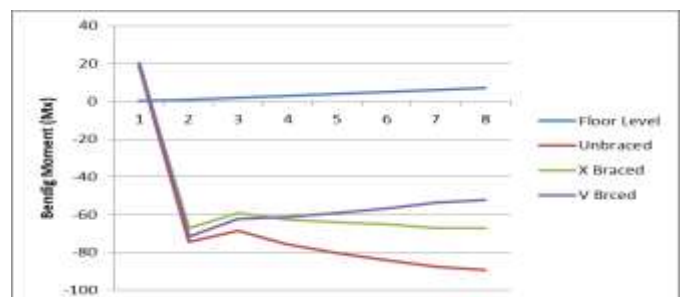


Figure:3.4 BendingMoment(Mx)

Table:-5 Bending moment in Y direction.

Floor Level	Unbraced	X-Bracing	Y-Bracing
Ground Level	17.25	17.10	19.35
1	-73.25	-65.95	-70.54
2	-67.34	-57.95	-61.54
3	-74.92	-61.51	-60.24
4	-79.34	-62.87	-59.28
5	-83.21	-64.08	-55.58
6	-86.26	-65.95	-52.67
7	-88.28	-67.20	-51.21

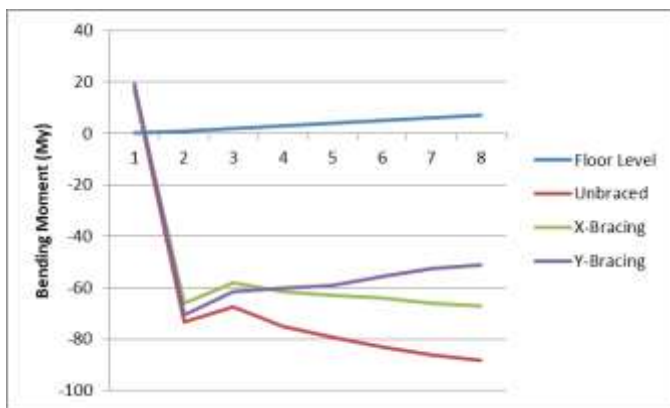


Figure: 3.5 Bending moment(my)

4. CONCLUSION

Steel braced RCC frame was examined with different arrangements of steel braces and with various types of braces such as X and V braces. After the analysis the results were denoted in tabular as well as graphical form. On the basis of the graphs following are the conclusion obtain:

4.1 Maximum storey displacement due to cross bracing system.

Comparative to unbraced RCC frame there is 51.25% reduction in maximum storey displacement in X direction and 47.25% reduction in Y-direction when X braced frame arrangement is used.

4.2 Maximum storey displacement due to V bracing system.

Comparative to unbraced RCC frame there is 43.375% reduction in maximum storey displacement in X direction and 41.06% reduction in Y-direction when V braced frame arrangement is used.

4.3 Maximum base shear due to X bracing system.

Comparative to unbraced RCC frame there is 14.86% reduction in Base Shear in X direction and 22.27% reduction in Y-direction when X braced frame arrangement is used.

4.4 Maximum base shear due to V bracing system.

Comparative to unbraced RCC frame there is 9.0% reduction in Base Shear in X direction and 8.7% reduction in Y-direction when V braced frame arrangement is used.

4.5 Bending moments and axial force.

After considering the structure with various types of RC structural systems, it has been determined that the maximum the reduction of the axial force and of the bending moment occurs after the application of the crossed Bracings and V Bracings. The bracing system reduces the bending moments in the columns. The Lateral load is transferred to the foundation through axial action. Steel bracings can be used to modernize the existing structure. Total weight of the existing structure. Will not change significantly after the bracings are applied.

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