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"COMPARATIVE ANALYSIS BETWEEN VARIOUS TYPES OF BRACINGS FOR STEEL BUILDING IN DIFFERENT SEISMIC ZONES"

Mr. Prafull J Barge[1] Dr.Nagesh Shelke[2]

[1]PG Scholar Dr.D.Y Patil school of Engineering & Technology,Lohegaon Pune Maharashtra 412105
[2]Guide, Dr.D.Y Patil school of Engineering & Technology,Lohegaon Pune Maharashtra 412105

Abstract: In this research paper we are preparing a relative report on a G+13 tall structure. In this structure we will contrast exposed casing and edges having various types of bracings at the corners. A three dimensional structure is taken, 13 stories is taken with story tallness of 3m. The bars and segments are intended to withstand dead and live load only. Seismic tremor loads are taken by bracings. The bracings are given just on the fringe sections. Here auxiliary displaying and examination is finished utilizing investigation programming Etabs which is a limited component based programming apparatus. A tall structure will be analyzed for seismic loading corresponding to various seismic zones. Effectiveness of bracings in reducing lateral displacements and their efficiencies during the earthquake is to be investigated. So the objective is to do comparative analysis between symmetrical G+13 storey RCC building with bracings and similar building without the bracings using commercially available software.In this paper static linear analysis is carried out for high rise steel frame building with different pattern of bracing system. The shear capacity of the structure can be increased by introducing Steel bracings in the structural system. There are 'n' numbers of possibilities to arrange steel bracings such as Diagonal,X,K,Inverted Vbracings such as Diagonal, X, K, Inverted V bracings. A typical 14th- story regular steel frame building is analyzed for various types of concentric bracings like Diagonal, X, inverted V and K-type and Performance of each frame is carried out through static linear analysis ie. equivalent static force method. Three types of sections i.e. ISMB, ISMC and ISA sections are used to compare for same patterns of bracing with different position.

Key Word: Static Analysis, Steel Frames with Different Types of Bracings

I INTRODUCTION

1.1 INTRODUCTION:

Today's tall buildings are becoming more and more slender, leading to the possibility of more sway in comparison with earlier high-rise buildings. This has brought more challenges for the engineers to cater both gravity loads as well as lateral loads, earlier buildings were designed for the gravity loads but now because of height and seismic zone the engineers has taken care of lateral loads due to earthquake and wind forces. Seismic zone plays an important role in the earthquake resistant design of building structures because the zone factor changes as the seismic intensity changes from low to very severe. Another important aspect in the design of earthquake resistant structures is soil type, as the soil type changes the whole behavior and design of the structure changes. So to cater all the lateral forces, we have to design the structure very uniquely so that the structure can withstand for the maximum time period so that there is no harm to the society.

Steel braced frame is one of the structural systems used to resist lateral loads in multistoried buildings. Steel bracing is economical, easy to erect, occupies less space and has flexibility to design for meeting the required strength and stiffness. Braced frames are often used to resist lateral loads but braces can interfere with architectural features. The steel braces are usually placed in vertically aligned spans. This system allows obtaining a great increase of stiffness with a minimal added weight, and so it is very effective for existing structure for which the poor lateral stiffness is the main problem. Bracings are usually provided to increase stiffness and stability of the structure under lateral loading and also to reduce lateral displacement significantly. Bracing is the highly efficient and economical method of resisting horizontal forces in a frame structure. A braced bent consist of the usual columns and girders, whose primary purpose is to support the gravity loading, and diagonal bracing members that are connected so that the total set of members forms vertical cantilever truss to resist the horizontal loading. The braces and girders act as the web members of truss, while the column act as the chords. Bracing is efficient because the diagonals work in axial stress and therefore call for minimum member sizes in providing stiffness and strength against horizontal shear. The bracing methods adopted in the past fall into two main categories, namely external bracing and internal bracing. In the external bracing system, existing buildings are retrofitted by attaching a local or global steel bracing system to the exterior frames. In the internal bracing method, the buildings are braced by incorporating a bracing system inside the individual bays of the RC frames. Bracing are member of the structural they are either eccentric or concentric.

Bracing are said to be concentric if they are joined at center of beam with column beam junction or direct column beam junction and eccentric if an above condition not gets satisfied. The main aim of the research work has been to identify the type of bracing which causes minimum storey displacement such contributes to greater lateral stiffness to the structure. This project explores the structural behavior of steel building for both braced and unbraced conditions under static and lateral loading. The methodology of analysis have been presented and discussed in this Report. Finally a comparative study has been presented to assess the best structural performance of RCC building under lateral loading..

AIM

To compare various types of steel bracing (concentric) systems in high rise building under seismic loading for different zones

OBJECTIVE OF THE WORK:-

1) To study the role of bracing system in high rise structure
2) To analyze different parameters in high rise structure
3) To investigate efficient bracing system in high rise structure by following point of view

a] Lateral Displacement

b] Base shear

c] Total weight

d] Axial force

e] Bending Moment

II. PROBLEM STATEMENT

To analyze the effect of earthquake forces on high rise RCC building with bracing. To compare the behavior of RCC buildings with different kinds of bracings. Effectiveness of bracings in reducing lateral displacements and their efficiencies during the earthquake is to be investigated. So the objective is to do comparative analysis between symmetrical G+13 storey RCC building with bracings and similar building without the bracings using commercially available software.

STRUCTURAL DETAILS

Sr.no	BUILDING DESCRIPTION	
1	zone	3,4,5
2	Zone factor(IS 1893-2002)	0.16
3	Responce reduction Factor (IS 1893-2002)	5.0
4	Importance Factors(IS 1893-2002)	1.0
5	Height of Building	46.8
6	Floor to Floor height	3.2
7	Types of building used	Residential
8	Length of bays @ X & Ydirection.	3.0
9	Column details	ISMB 550
10	Beam details	ISMB 450
11	Bracing Type	ISMB 175
12	Thickness of slab	150mm
13	Grade of concrete	M 20
14	Grade of steel	Fe 415
15	Floor finished load(IS 875)	1.0 KN/m2
16	Live load (IS 875-P-II)	3.0 KN/m2
17	Live load on roof	1.5 KN/m2
18	Density of Brick(IS 875 P-I)	20 KN/m2
19	Thickness of inner wall	150mm
20	Thickness of outer wall	230mm
21	Density of concrete	25 KN/m2
22	Types of bracings provided	X,Diagonal, Inverted V,K-types

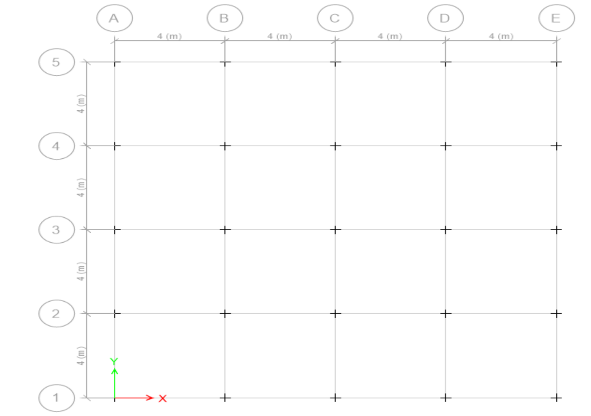


Fig. 4.1. Plan of the Building

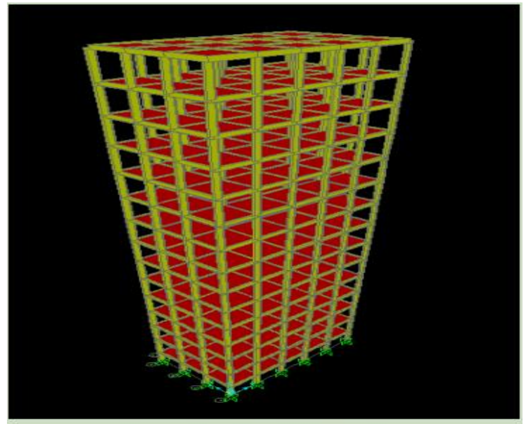


Fig. 2. 3D View Of Bare Frame

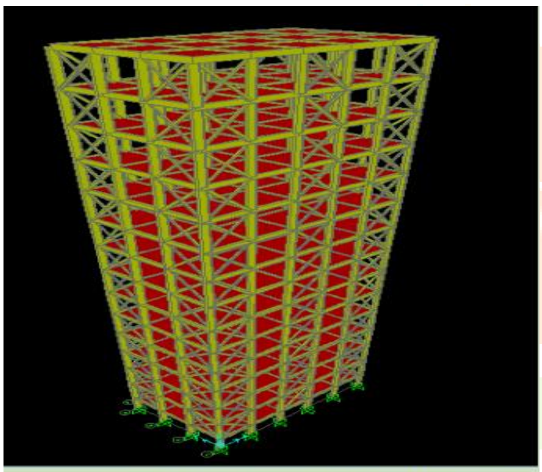


Fig. 3. 3D View Of X-Type Bracing

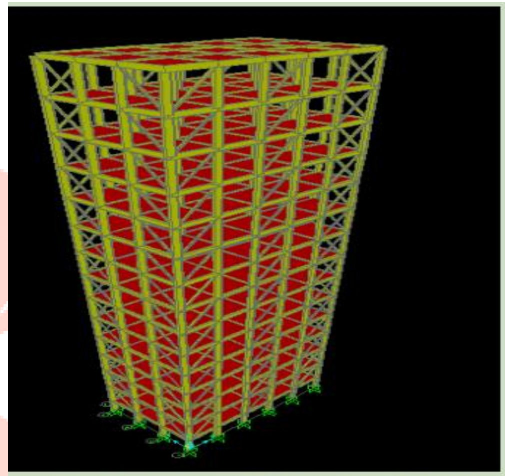


Fig. 4. 3D View Of Diagonal Type Bracing

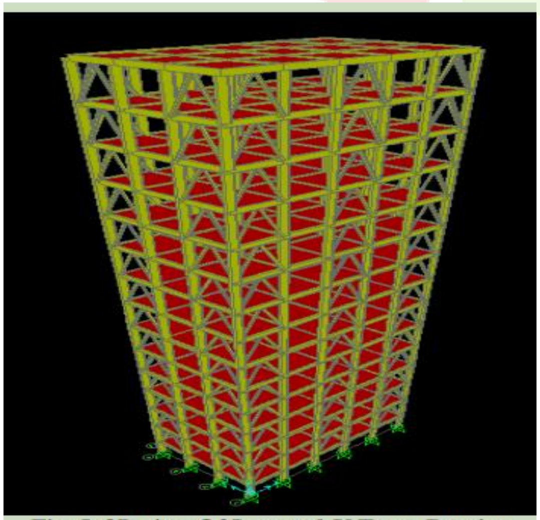


Fig. 5. 3D view Of Inverted-V Type Bracing

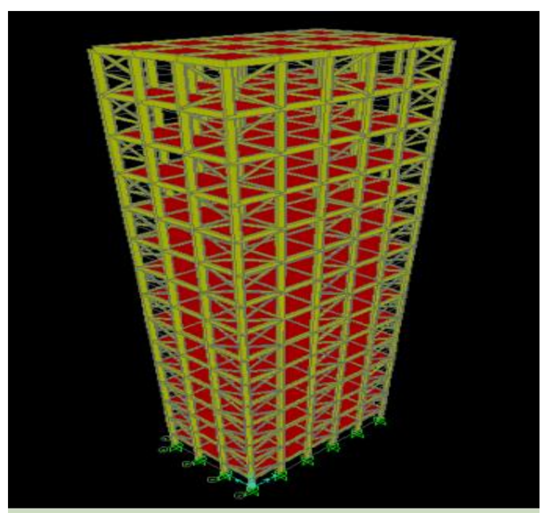
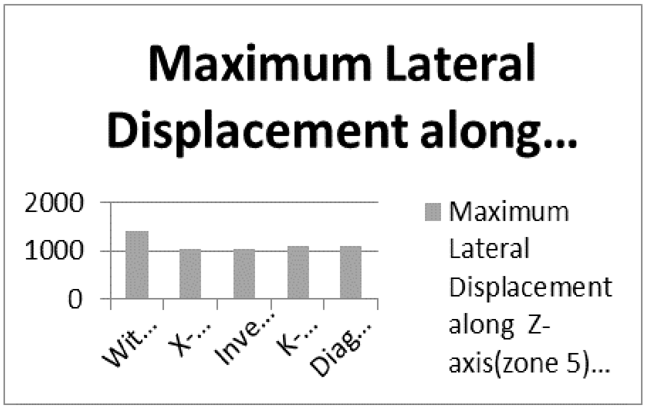
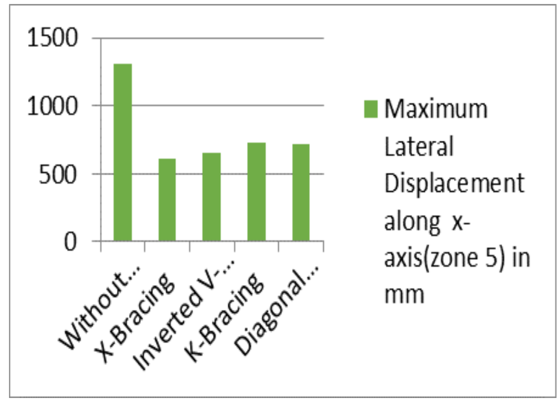


Fig. 3. 3D View Of K-Type Bracing

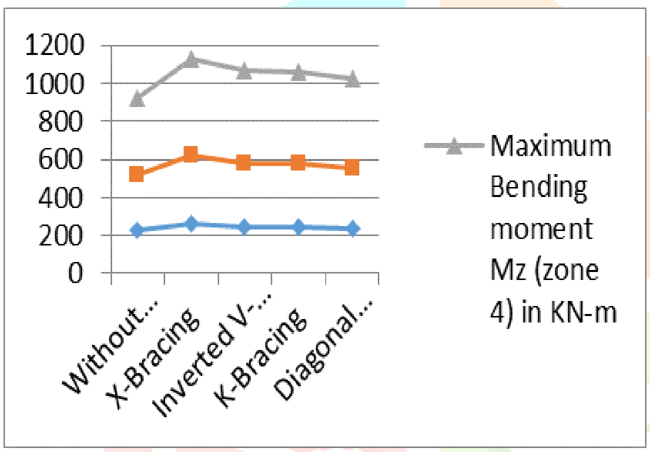
Max. Lateral Displacement along Z-axis (zone 5)



Max. Lateral Displacement along X-axis (Zone 5)

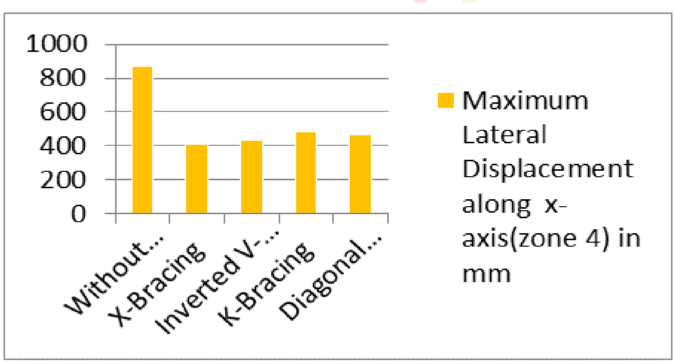


Maximum Bending moment Mz (zone 4) in KN-m

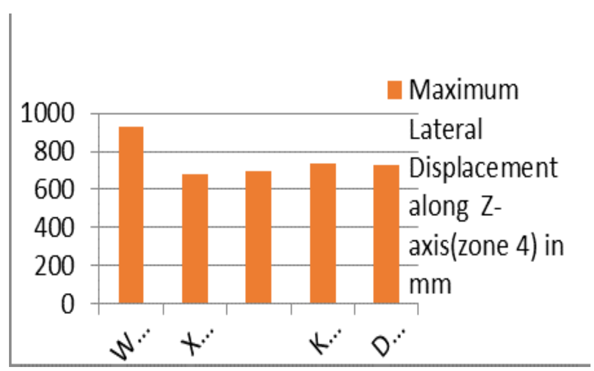


Type of Bracing	Weight of structure in KN	Percentage increase in weight of structure
Without bracing	76186.914	
X-Bracing	77259.414	1.40 %
Inverted V-Bracing	77152.64	1.26 %
K-Bracing	77074.944	1.16 %
Diagonal Bracing	76723.164	0.70 %

Max. Lateral Displacement along X-axis (Zone 4)in mm



Max. Lateral Displacement along X-axis (Zone 4) mm



Base Shear

Percentage increase in Base shear

Type of Bracing	Base Shear Vibe (zone 3) in KN	Base Shear Vibe (zone 4) in KN	Base Shear Vibe (zone 5) KN
Without bracing	5800.722	8701.083	1051.624
X-Bracing	5811.316	8716.362	13075.46
Inverted V-Bracing	5810.277	8715.416	13073.124
K-Bracing	5809.420	8714.130	13671.19
Diagonal Bracing	5806.018	8709.026	13063.539

IV. RESULT & DISCUSSION

Bracing play important role in keeping structure stable. Earthquake produces inertial forces in structure. These inertial forces act in the form of base shear on structure. Base shear is distributed to different floor along the height of the building. This force produces later displaces in structure. For high rise building, lateral displacements are common due towing loading. But if the earthquake is of high intensity, it can be disastrous. Bracings play important role in distributing this force in columns and beams. In this project we have analyzed unbraced structure with structures having different bracings.

X-bracing system has shown good results when it comes to reducing lateral displacements. Base shear values are same in both directions. Since number of bracings along X-directions were more, bracings shown good performance in lateral displacements along X-axes. Diagonal bracing shows overall good performance considering maximum bending moment.. K-bracing has shown good performance considering Maximum support Reactions. Weight of the structure remains almost same. Not more than 2 percent change in weights of structure. Since base shear is dependent on weight, base shear also remain similar.

V CONCLUSION

Lateral forces are distributed to beams and columns by bracings. In this project a comparative analysis of unbraced structure with structures having different bracings.

With parameters such as Bending Moments, Lateral displacements, support reactions. X-bracing system has shown good results when it comes to reducing lateral displacements.

1. As much as 26% decrease in lateral displacements in Z-Direction and up to 53% reduction in lateral displacements along X-direction is observed. But X-bracing arrangement shows most increase in value of Maximum bending moment (24.86%) and support reactions (30%).Base shear values are same in both directions.
2. Since number of bracings along X-directions were more bracings shown good performance in lateral displacements along X-axes.
3. Diagonal bracing shows overall good performance considering Lateral displacements (45.58%), Support reactions (26.77%), and maximum bending moment (14.16%).
4. Weight of the structure remains almost same. Not more than 2 percent change in weights of structure. Since base shear is dependent on weight, base shear also remain similar.

VI FUTURE SCOPE OF WORK

This project primarily focused on concentric bracings. There are so many different types of concentric bracings. In this project only four of them are utilized. There are various types of eccentric bracings too.

Eccentric bracings can useful when lateral loads are of know directions. In future works this analysis can be utilized as a source of data for further analysis. There could be multiple arrangements.

Here we have only focused on only one type of arrangements. This work can be further carried out with different arrangements. Bracing types can be compared by using many more parameter

This project can also be tested for dynamic loading, wind loads. Work is done on static coefficient method. It can be redone using Response spectra method, Time history analysis. This is a symmetrical structure. Further projects can be done on irregular structures. Irregularity can induce unexpected forces in structure.

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