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

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Abstract: In this examination we are preparing a relative report on a G+25 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, 25 stories is taken with story tallness of 3.5 m. 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 Staad.pro 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+25 storey RCC building with bracings and similar building without the bracings using commercially available software. Bracing play important role in keeping structure stable. Earthquake produces inertial forces in structure. X-bracing system has shown good results when it comes to reducing lateral displacements. 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. 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 Lateral displacements (45.58%), Support reactions (26.77%), and maximum bending moment (14.16%). 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.

Keywords: Comparative Analysis, Bracings, RC Building, Seismic Zones

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 RCC building under seismic loading for different zones

OBJECTIVE OF THE WORK:-

- 1) To study the role of bracing system in high rise RCC structure
- 2) To analyze different parameters in high rise RCC structure
- 3) To investigate efficient bracing system in high rise RCC 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+25 storey RCC building with bracings and similar building without the bracings using commercially available software.

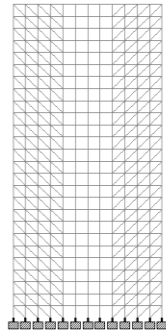
STRUCTURAL DETAILS

Structure will be G+25 storey structure is symmetrical. 8 bays will be constructed along X direction and 12 bays will be along Z direction. Storey height will be 3.5 meter. Bay width will be 4 m along both X and Z direction. Total height of structure is 91 m. size of columns are ‘0.35 x 0.35’ and size of beams are ‘0.25 x 0.35’. Bracings are provided using ‘ISA 110 x 110 x10’ angle sections. For braced structures, bracing is provided on the periphery about the corners. Bracing is provided in 8 bays along the length and provided in 4 bays along the width. Bracing is provided for all 25 storey. Structure is situated in medium soil condition.

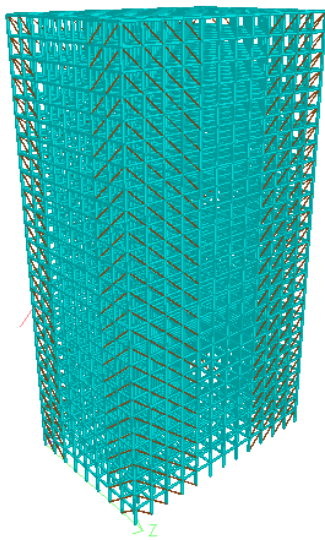
Details of structure

| Description | Values |
|-------------------------------|------------------------------------|
| Number of storey | 25 |
| Number of bays in X direction | 8 |
| Number of bays in Z direction | 12 |
| Height of each storey | 3.5 |
| Bay width in X direction | 4 |
| Bay width in Z direction | 4 |
| Size of beam | 0.25 x 0.35 |
| Size of column | 0.35 x 0.35 |
| Thickness of RCC slab | 0.130 |
| Steel bracing | Angle sections(ISA 110 x 110 x 12) |
| Wall Load | 13.892 KN/m |
| Live Load | 4 KN/m |
| Slab thickness | 130 mm |

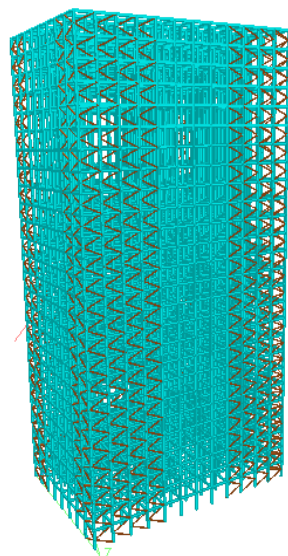
LOADING



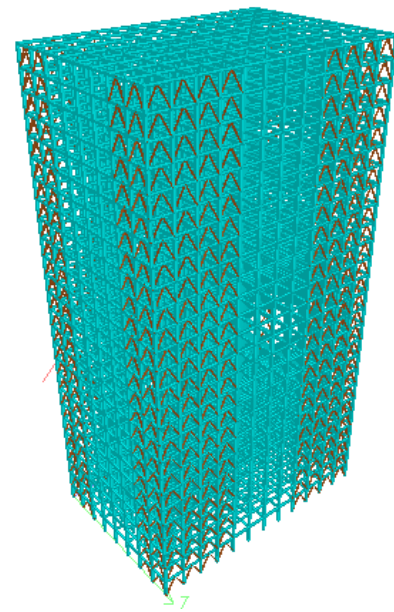
Diagonal bracing arrangement



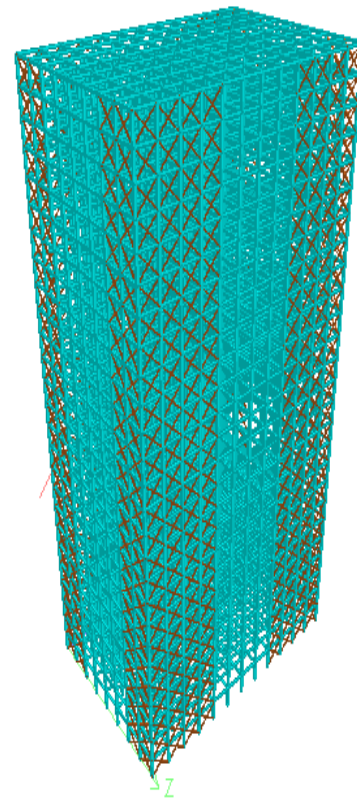
Diagonal bracing 3D rendered view



K-bracing 3D rendered view



Inverted V-bracing 3D rendered view



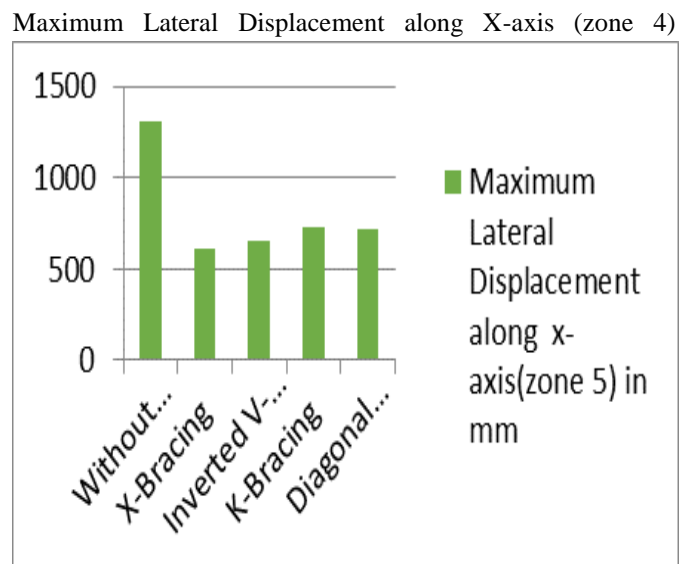
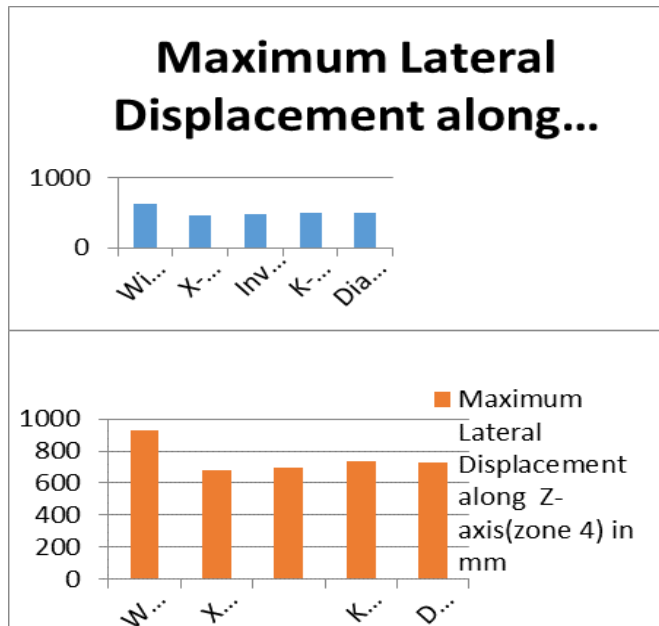
X-bracing 3D rendered view

III DATA FROM ANALYSIS

LATERAL DISPLACEMENTS

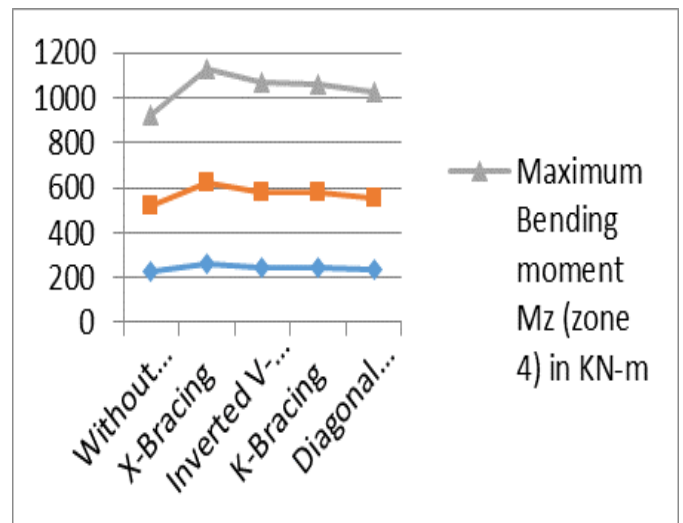
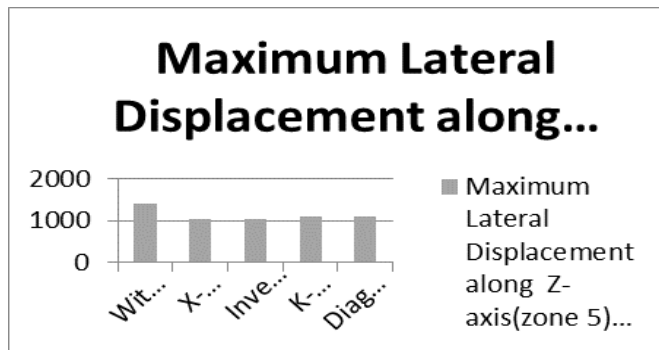
Maximum horizontal displacements for building without bracing and for each type of bracing is obtained.

Maximum horizontal displacements in Z direction (along the width)



Maximum Lateral Displacement along Z-axis (zone 4)

Maximum Lateral Displacements in X-direction (zone 5)

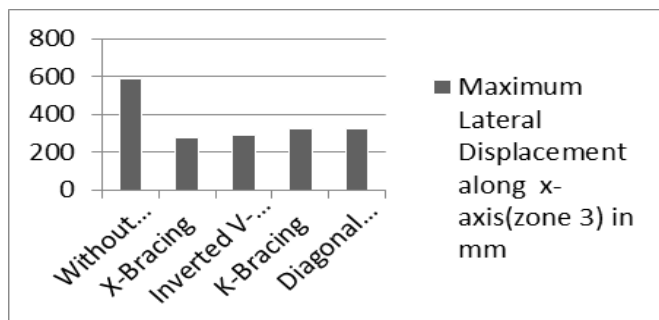


Maximum Lateral Displacement along z-axis (zone 5)

Maximum Observed Bending Moment

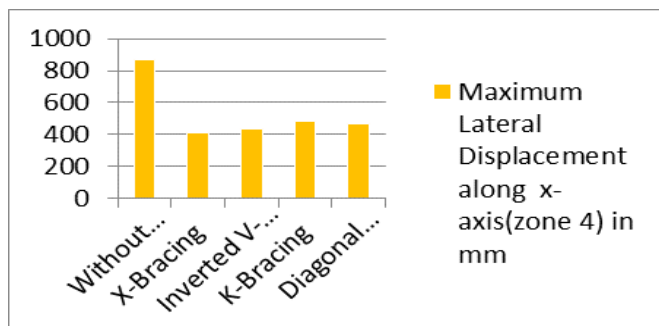
Weight of the Structure

Percentage increase in weight of structure



| 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 % |

Maximum Lateral displacement along X-axis (zone 3)



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) in 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. 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. 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 Lateral displacements (45.58%), Support reactions (26.77%), and maximum bending moment (14.16%).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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