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COMPARATIVE ANALYSIS BETWEEN VARIOUS TYPES OF BRACING PATTERNS IN G+4 RCC BUILDING IN ZONE II

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Abstract

Whether it is a high-rise structure, a low-rise public building, or a residential building, bracing systems are a fairly uncommon characteristic in RCC projects in India. In constructions constructed in seismically active places, this trait is highly desirable. This study provides a strategy to retain the structure under the bracing system utilizing various strengthening systems and to minimize or reduce the impacts of an earthquake caused by a discontinuity in the load path and non-uniformity of stiffness. This feature helps create open floors on the first or ground floors and for getting rid of internal columns that limit open space. Different types of steel or RCC bracing systems are offered to resist the lateral load operating on buildings. RCC bracing has potential advantages over other types of bracing, including greater rigidity and stability. This study compared the seismic behavior of high-rise buildings with that of typical buildings and buildings with various RCC bracing systems. The bracing systems are installed around the building's perimeter. Using STADD.ProV8i, the frame models are examined following IS 1893: 2000 using the Equivalent static method for G+4 RCC building in zone II. Base shear, Storey lateral force, Storey drift, and storey displacement are the variables that will be compared in this study to compare the seismic impact of structures. When compared to moment-resistant frames, V-braced frames, and X-braced frame of frames, the likely results showed that X- braced frames are more effective and safer during earthquakes.

Keywords: *Comparative analysis; RCC building, Bracing; seismic zone II; G+4 building.*

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1. INTRODUCTION

In comparison to earlier highrise structures, today's tall buildings are becoming steadily more slender, which opens up the possibility of greater sway. Earlier structures were intended for gravity loads, but now because of their height and seismic zone, engineers have taken care of lateral loads caused by earthquake and wind forces. This has presented greater hurdles for the engineers to cater to both gravity loads as well as lateral loads. Because the zone factor changes as the seismic intensity changes from low to very severe, seismic zone plays a significant role in the design of earthquake-resistant building structures. Soil type is a crucial consideration in the construction of earthquake-resistant structures since it alters the structure's overall behavior and design. So, to accommodate all lateral pressures, we must construct the structure in a special way that will allow it to resist for the longest possible time without harming society.

One of the structural solutions utilized in multistory structures to counteract lateral loads is the steel-braced frame. Steel bracing is affordable, simple to set up, takes up less room, and may be designed in a variety of ways to get the desired strength and stiffness. Although braces can interfere with architectural aspects, braced frames are frequently utilized to resist lateral loads. Typically, the steel bracing is installed in spans with vertical alignment. This technique makes it possible to significantly increase stiffness while only adding a small amount of weight, making it ideal for existing structures where a lack of lateral stiffness is the main issue. Bracings are typically offered to strengthen the structure's rigidity and stability under lateral loads as well as to drastically lessen lateral displacement. The most effective and cost-effective way to counteract horizontal forces in frame construction is through bracing. The typical columns and girders, whose main function is to support gravity loading, are combined with diagonal bracing members to make a vertical cantilever truss that resists horizontal loading in a braced bend. The column serves as the chords, and the braces and girders serve as the web elements of the truss. Because the diagonals operate under axial stress, bracing is effective because it only requires the smallest possible member sizes to provide stiffness and strength against horizontal shear. The bracing techniques used in the past can be divided into two groups: exterior bracing and interior bracing.

A local or global steel bracing system is attached to the exterior frames of existing buildings as part of the external bracing system to retrofit them. By installing a bracing mechanism inside each bay of the RC frames, the buildings are braced using the internal bracing technique. Bracing is a structural component that can be eccentric or concentric. If the aforementioned criteria are not met, the bracing is considered to be eccentric if it is not attached at the center of the beam with the column beam junction or directly with the column beam. The primary goal of the research was to determine the kind of bracing that results in the least amount of story displacement and increases the lateral rigidity of the structure. g. This report presents and discusses the analysis's methodology. To determine the optimal structural performance of RCC buildings under lateral loads, comparison research has finally been presented.

The objective of The Work

1) To study the role of the bracing system in high-rise RCC structure
2) To analyze different parameters in high-rise RCC structure
3) To investigate the efficient bracing system in high-rise RCC structures by following the point of view
   a) Base shear
   b) Lateral force
   c) Storey displacement
   d) Storey drift

2. METHODOLOGY

Structural Details

The structure will be G+4 storey structure is symmetrical. 3 bays will be constructed along the X direction. Storey height will be 3 meters. The Bay width will be 3 m along both X and Z directions. The total height of the structure is 15 m. size of the columns is '0.4x 0.4' and the size of the beams is '0.3x0.3'. Bracings are provided using 'ISA 150x150 x10'angle sections. The structure is situated in medium soil conditions.

This report presents and discusses the analysis's methodology. To determine the optimal structural performance of RCC buildings under lateral loads, comparison research has finally been presented.

Description	Values
Number of stories	G+4
number of bays in the X-direction	3
number of days in Y -the direction	3
height of each story	3m
Bay width in the X direction	3m
Bay width in the Y direction	3m
size of beam	0.3x0.3 m
size of column	0.4x0.4m
the thickness of the RCC slab	0.150m
steel bracing size	ISA 150X150X20
(floor load + floor finishing)	4.75 KN/m^2
wall load	12.5 KN/m
live load	4 KN/m
grade of concrete	M20
grade of steel	Fe415
seismic zone	II
Type of soil	Medium soil
importance factor	1.0

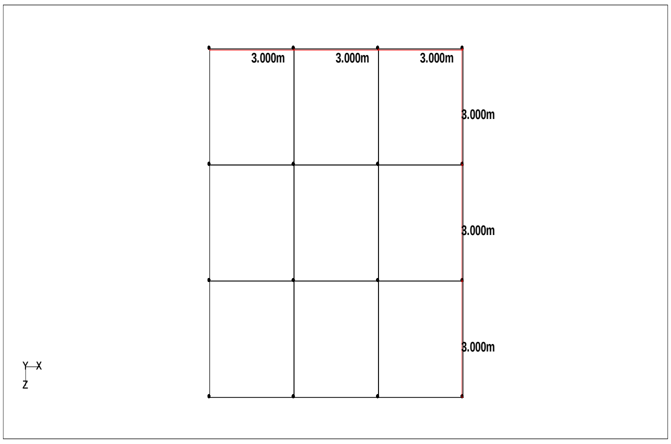

Fig. 4.1. Plan of the Building

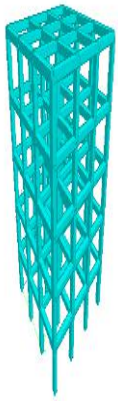

Fig:2 3D view of G+4 RCC MRF building

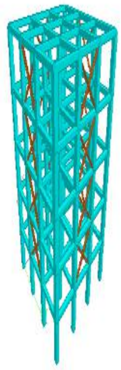

Fig:3 3D view of G+4 RCC X bracing building

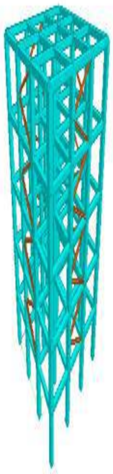

Fig:4 3D View of K Bracing Frame

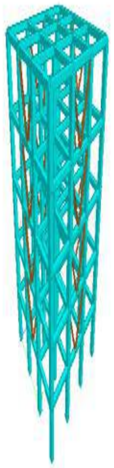

Fig:5 3D view of V Bracing frame

Table:2 Weight comparison of the frame structure

Bracing frame	**Total Weight (KN)**
MRF Frame	7654.34
X bracing frame	9292.78
K bracing frame	8949.64
V bracing frame	8949.64

Table3 Base shear comparison of the building frame

Types of frame	Base shear(KN)
MRF frame	182.10
X-bracing frame	221.08
K-bracing	212.92
V-bracing	212.92

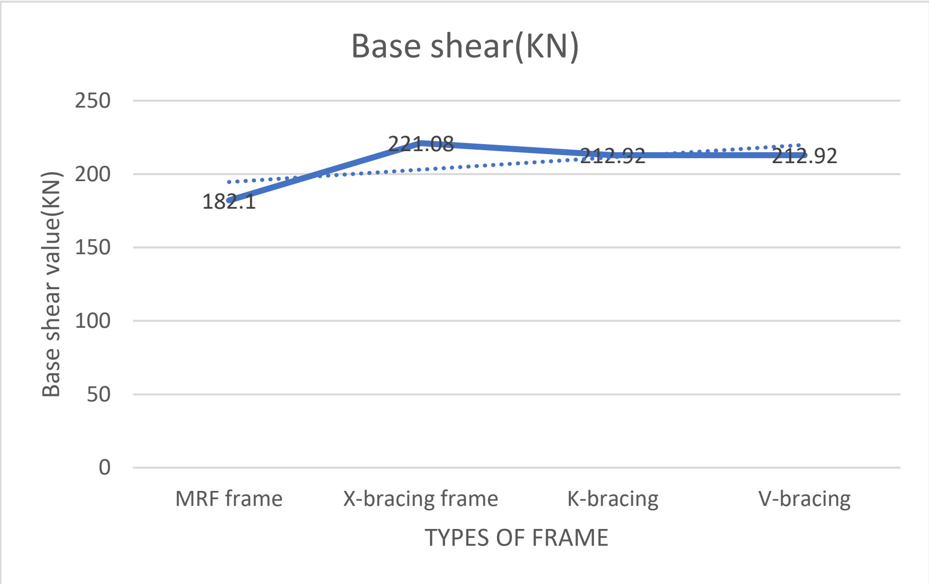

Fig:6 Base shear comparison for different bracing frame

Table:4 storey lateral force comparison

STOREY	FRAME TYPE			
	MRF Frame	X-bracing frame	K-bracing frame	V-bracing frame
Ground floor	3.531	3.990	3.656	3.894
1st floor	14.13	17.845	15.129	17.066
2nd floor	31.775	40.151	34.404	38.398
3rd floor	56.990	71.380	60.493	68.263
4th floor	76.185	87.7117	79.321	85.300

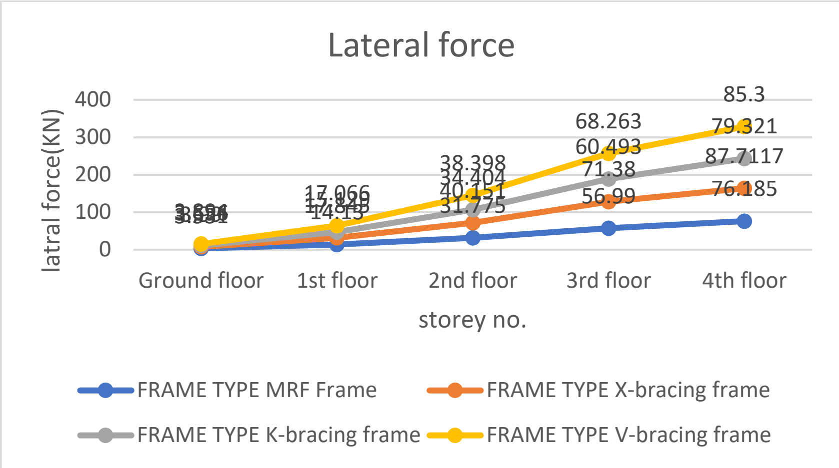

Fig:7 storey lateral force for different bracing

STOREY DISPLACEMENT AND STOREY DRIFT COMPARISON FOR EVERY TYPE OF FRAME:

Table:5 storey displacement and storey drift comparison for every type of frame

STOREY N0.	STOREY DISPLACEMENT(mm)				STOREY DRIFT(mm)			
	MRF Frame	X-bracing	K-bracing	V-bracing	MRF Frame	X-bracing	K-bracing	V-bracing
Base	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ground floor	0.2279	0.1942	0.1972	0.1327	0.2279	0.1942	0.1972	0.1327
1st floor	0.6170	0.3632	0.3899	0.2698	0.3892	0.1690	0.912	0.1371
2nf floor	1.0053	0.5283	0.5704	0.4009	0.3883	0.1651	0.0967	0.1311
3rd floor	0.8824	0.6820	0.7312	0.5180	0.3183	0.1537	0.0834	0.1172
4th floor	1.5306	0.8023	0.8607	0.6041	0.1656	0.1203	0.5530	0.861

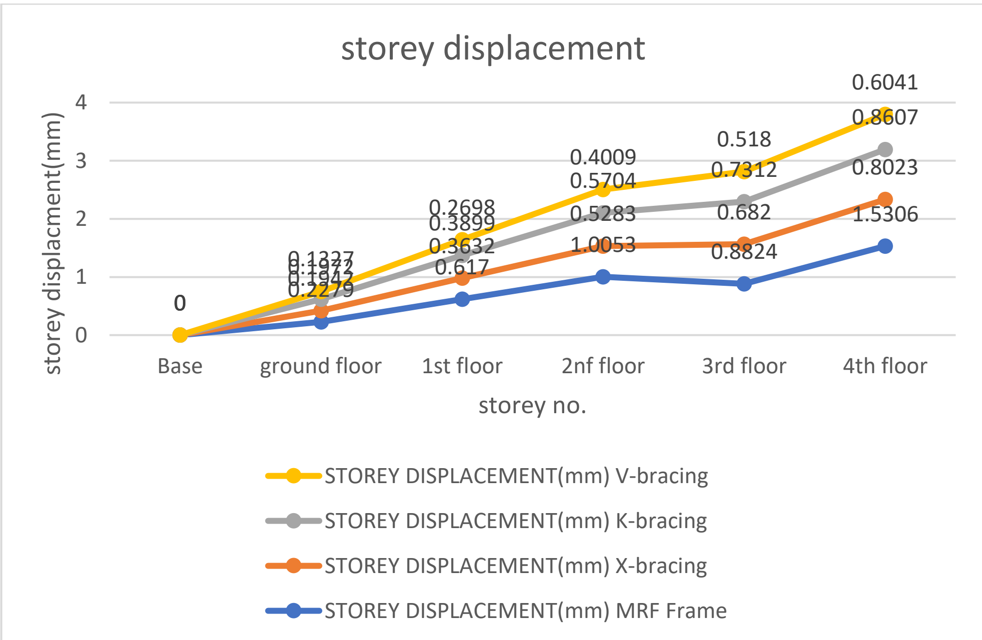

Fig:8 storey displacement comparison of every storey for every type of bracing frame

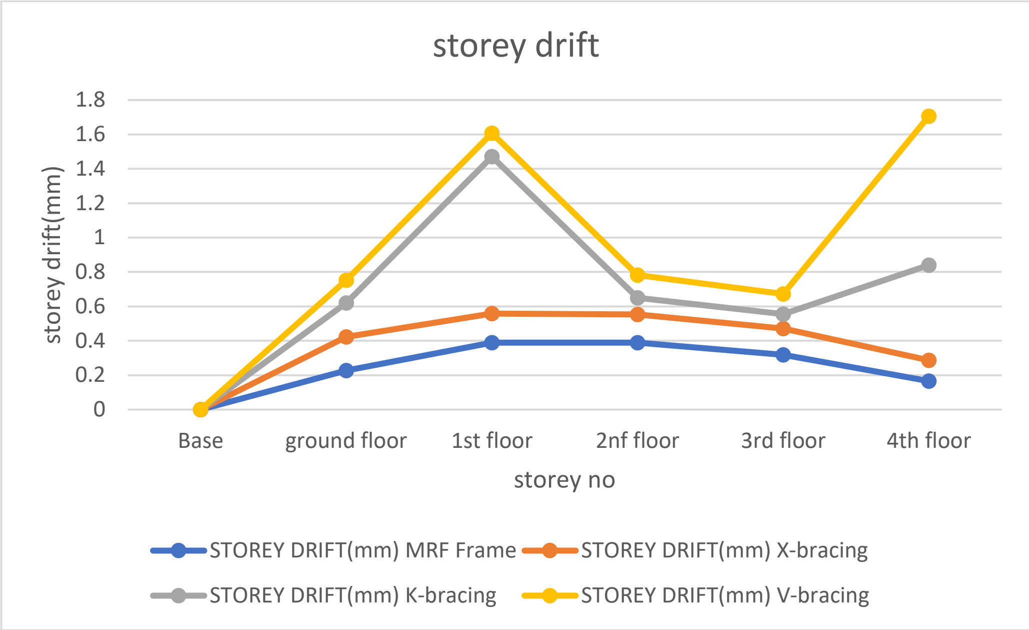

Fig:9 storey drifts comparison for every type of brace

3. RESULT & DISCUSSION

Bracing play important role in keeping structure stable. An earthquake produces inertial forces in the structure. These inertial forces act in the form of base shear on the structure. Base shear is distributed to the different floors along the height of the building. This force produces later displacement in the structure. For high-rise buildings, lateral displacements are common due to 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 structures with structures having different bracings.

X-bracing system has shown good results when it comes to reducing lateral displacements. Base shear values are the same in both directions. Since the number of bracings along X-directions was more, bracings showed good performance in lateral displacements along X-axes. The weight of the structure remains almost the same. Not more than a 2 percent change in weights of structure. Since base shear is dependent on weight, base shear also remains similar.

4. CONCLUSION

Lateral forces are distributed to beams and columns by bracings. In this project, a comparative analysis of unbraced structures with structures having different bracings has been done using the Equivalent static method for G+4 RCC building.

Based on the present study the following conclusions can be drawn:

1) The concept of using Steel bracing is one of the advantageous Concepts which can be used to strengthen or retrofit existing and new structures and also resist seismic force.
2) In the braced building, the story drifts decrease as compared to the unbiased building.

3) the story displacement is reduced in buildings after providing an embracing system.
4) The base shear of the building with the bracing system is increased as compared to the building without the bracing system.
5) Storey lateral force also reduces after providing a bracing system.
6) The X-braced system gives a good performance as compared to the V bracing & K bracing.

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 arrangement. 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 and wind loads. Work is done on the static coefficient method. It can be redone using the 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 the structure.

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