Analysis of RC Building for Different Seismic zone with Braced and Unbraced system

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Abstract—Analyses of high-rise RC building frames with bracing systems have been conducted. Bracing systems are lateral load resisting systems that are very efficient and unyielding. Bracing systems are one of the components in RC buildings that increase stiffness and strength to protect buildings from natural forces such as earthquake force. The proposed problem analyses an RC story building frame for various bracing systems under seismic loading. STADD Pro analysis software is used.
To assess the efficacy of a specific type of bracing system to control the lateral displacement and member forces in the frame, the results of various bracing systems (X bracing, V bracing, K bracing, Inverted V bracing, and Inverted K bracing) are compared with bare frame model analysis. It is discovered that all bracing techniques efficiently control the lateral displacement of the frame.

Keywords—storey displacement, storey drift, X bracing, K bracing etc.

I. INTRODUCTION

Earthquake resistance & modification have gained significant importance in light ongoing waves architectural trends. Buildings these were high resistance to landslides were made possible by it's rising risk seismic activity. Rigid frame and iron braced frames were extensively utilised in these purposes. It really has worked out well demonstrated that bracings capable of enduring lateral stresses. For increased ductility and deformation, bracings have shown should become a very successful upgrading technique. There was a need for formwork in enable to lessen those weights involved earthquakes create. Massive ground movements could be safe withstand pressures or alterations brought along by energy lost to their construction and cost-effectiveness. Utilizing eccentrically braced structural steel the rigid, durable constructions that allowed them resilient to elastomeric waves pressures. Particularly tailored bracings structures have now been developed for stronger seismic resistance. Eccentric Reinforcements are applied help improve system's lateral rigidity and enhance their capacity for energy dissipation. The system's Compressive strength determined their lateral stiffness. Concentrated loads brought following an earthquake are created at the point, in the beams where unique bracings connect as in upward components. The buckling restrained braces' great Ability for horizontal displacement offers high resilience to it's necessary geological planning criteria. But after when it comes to buckling restrained braces, reasonable tension & buckling stiffness should be considered account. An Cross-braced frames was should be thought about in both stiffening techniques loading directions. When versus the compress brace's buckling capability, the V-braced setups also have had a higher strain productivity capacity. In knee bracings, The connection between the beam and column may be substantially or completely released. The horizontal movement's direction stresses will determine whether the when the knee brace is in compaction tension.

II. RELATED WORK

Saurav P. Patil,(Aug 2021)Bracings are utilised in these structures because concrete constructions can withstand lateral loads from an earthquake, wind, etc. It is one of the best methods for systems that withstand lateral stress. High-rise buildings with concrete frames are more common in large cities. Engineers are increasingly using braced concrete framed buildings as a low-cost means of seismic load resistance. Response spectrum analysis is used in this study to perform dynamic analysis on low-, mid-, and high-rise concrete structures using a variety of bracing methods. The goal of the study was to examine and compare the results of various seismic analyses for different kinds of braced and unbraced structures. With the same configuration and many bracing techniques, such as the X Brace, V Brace, and Single Diagonal Edge Brace, concrete building models of the G+4 Storey, G+12 Storey, and G+16 Storey heights are used for this. ETABS2018, a for-profit programme, is used for analysis. Results are obtained by accounting for base shear, displacement, and storey drift in concrete structure parameters.

Dr.S.L.Hake (July 2021) For this test, we are assembling a relative report on a G+25 tall structure. The sorts of corner bracing on the corners of this design will be compared to exposed casing. There is a 25 story, three dimensional structure that is 3.5 m tall. The bars and segments should only support dead and live loads. Bracings support seismic earthquake loads. Bracings are only applied to periphery areas. Utilizing the research tool Staad.pro, a programming tool with a limited number of components, extra displaying and analysis are carried out in this case. It will be looked at how seismic stress on tall structures relates to various seismic zones. Research on the effectiveness of bracings in terms of minimising lateral displacements and how well they function during an earthquake is crucial.

Rajeev Kishan Pandey (June 2021)In this review essay, we examined works on reinforced cement concrete frames or buildings with various bracing strategies. Following the conclusion of these research, we will publish some of our findings. In the earlier study work, the RC structure is fastened to the X, V, K, etc. steel bracing system. Installing a steel bracing system's main objective is to minimise the building's vulnerability to seismic and wind activity so that it can be used beams and columns as well as by frame action. Under significant earthquake loads, ductile fracture typically occurs at the connections between beams and columns.

G.D. Dhawale (September 2020)RC structures are often used to analyse the structures. To design a lateral resistance-adequate, seismically safe building, various RCC bracing system types—diagonal type, V type, X type, and inverted V type—and bracing system arrangements are used. Between the column members is a bracing system built to resist the lateral stress. The bracing system requires less space, is less expensive, and is easy to install. The structure is evaluated using Staad Pro software for seismic zone IV with various bracing techniques and compared to the bare frame. applying the load condition as per IS 1893:2002 The bracing system increases the displacement capacity of the structure.

III. PROJECT DETAILS

Utility of Building :- Residential Building

No. of Stories :- G+10

Specifications of geometry

SI.no	Specification		Direction
1	Node to node Distance	4m	X and Z
2	Node to node Distance	3m	Y
3	Length and width of building	16m	X AND Z
4	Height of building	33m	Y
5	Number of story	10	Y

Table 1: Building properties considered for Specifications of geometry.

Member properties

SI. No	Description	Parameter
1	Floor to Floor height	3 m
2	Grade of Concrete	M-25
3	Type of steel	Fe-415
4	Beam size	0.3 m x 0.5 m
5	Column size	0.5 m x 0.5 m
6	Unit wt. of masonry wall	20 KN/m3
7	Slab thickness	150mm
8	ISA	100X100X12

Table 2: Building properties considered for Member properties.

LOADING CONDITIONS

The loadings shown below are used for analysis:-

1) Dead Loads:

a. Self weight of Slab = 3.75 kN/m2

b. Wall Load = 11.6 kN/m

c. Floor Finish load = 1 kN/m2

2) Live Loads:

a. Live Load on typical floors = 4 kN/m2

3) Earth Quake Loads: The earth quake loads are derived for following seismic parameters as per IS: 1893(2002)

a. Earth Quake Zone-II,III,IV

b. Importance Factor: 1

c. Response Reduction Factor: 5

d. Damping: 5%

e. Soil Type: Hard Soil

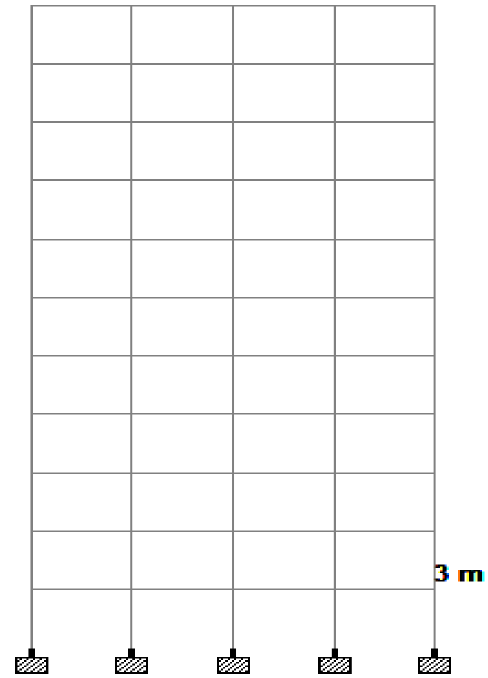


Fig: 2 Elevation

IV MODELLING

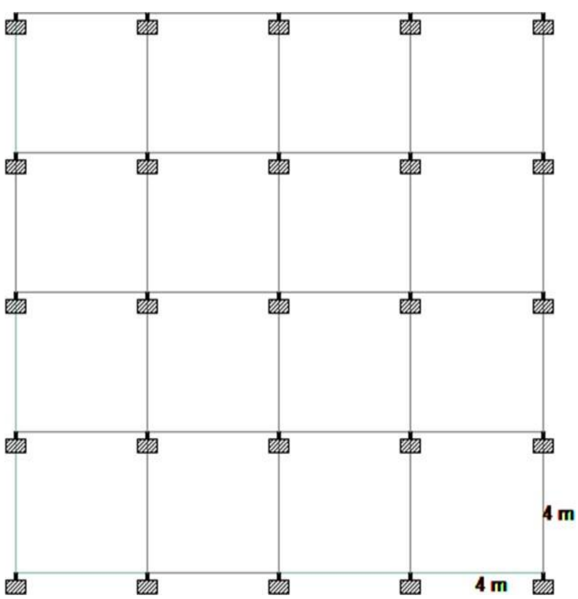


Fig:1 Plan of Building

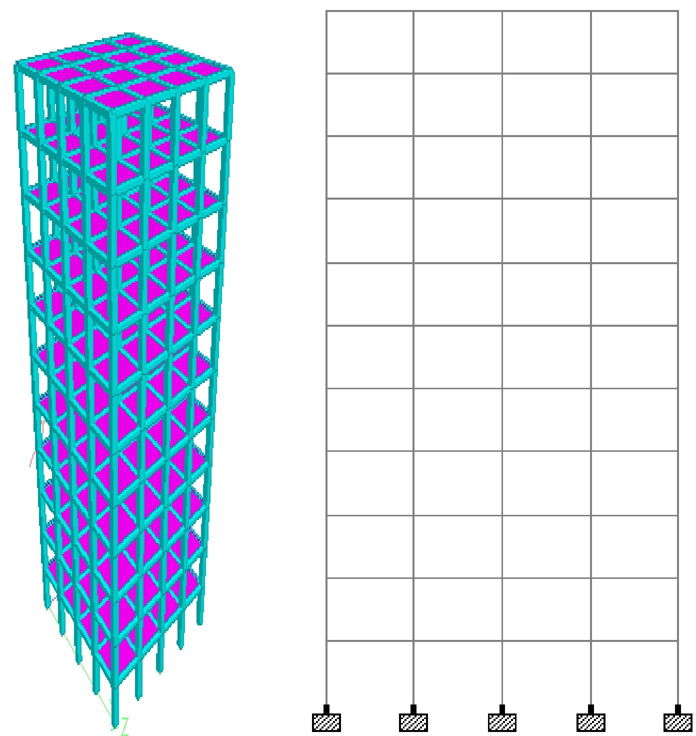
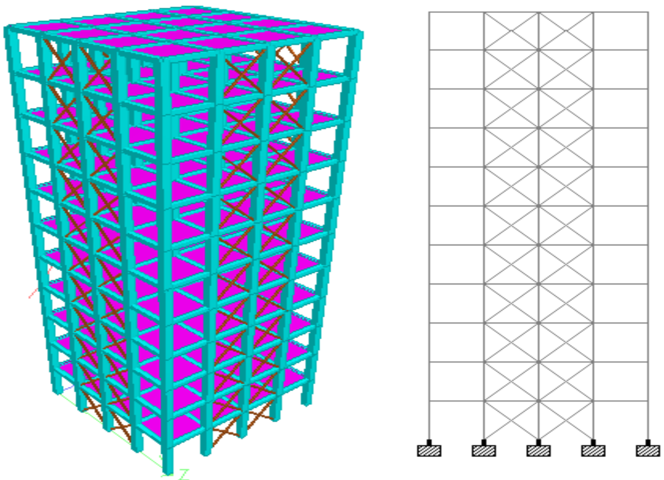


Fig:3 Structure frame without Bracing system

Structure frame with X Bracing system



Structure frame

Fig:4 Model of X Bracing Structure

Structure frame with Inverted V Bracing System

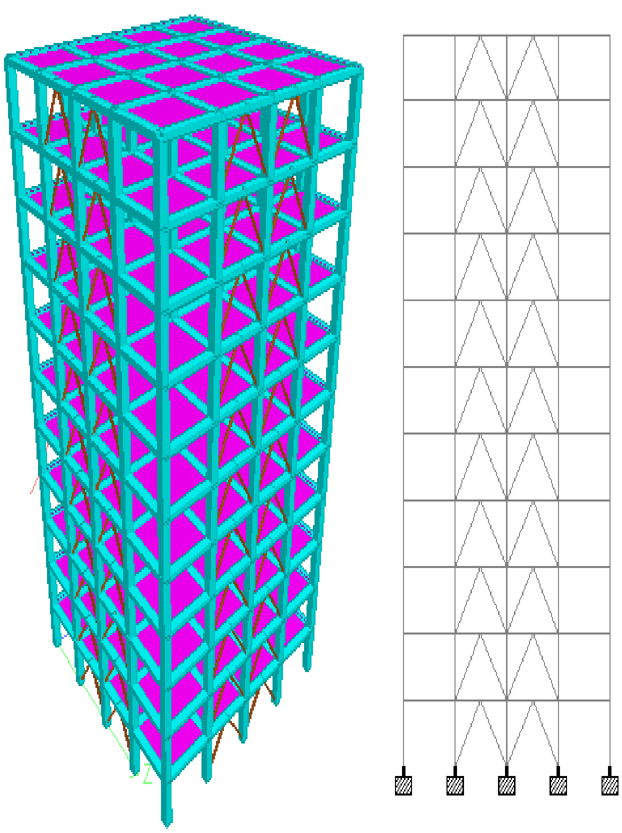


Fig:5 Model of Inverted V Bracing System

Advantages of Bracing systems:-

- When direct bending forces are applied, the compression flange buckles horizontally, but the bracing systems prevent the key beam from buckling.
- The arrangement of the main beams to distribute the lateral and vertical loads safely.
- Bracing allows columns to reduce their axial force, bending moment, and lateral storey movement significantly.
- Braced frames can withstand wind and seismic pressures better than unbraced buildings.
- It has a simple design that provides the necessary stiffness and strength, and it is inexpensive, simple to build.
- A significant benefit is the reduction in lateral displacement. In this situation, concentric (X) bracing is preferable to eccentric (V).
- It also helps if the major beams are evenly distributed with respect to the vertical and lateral stresses.
- A flexible, economical method can be used to provide the necessary stiffness and strength.
- The brace frames offer superior resistance to seismic stresses and high-speed winds compared to non-braced buildings.
- The decrease in lateral movement is one of the primary advantages of using a bracing system.

Disadvantages of Bracing Systems:-

- Building span lengths are restricted to 40 feet when reinforced.
- The construction of the bracing systems required skilled labour.

V RESULTS

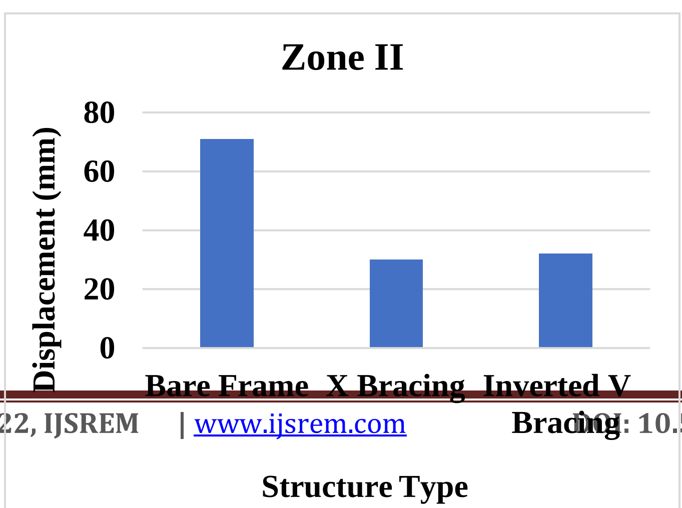
Find the findings for bending, displacement, story drift, etc., and then compare the results to identify the most effective bracing system among those offered in various seismic zones. In order to determine the best system to withstand seismic forces under the following heads, the tables and graphs below are presented. Bracing is crucial to the stability of a structure. Inertial forces are produced in a structure by an earthquake. Along the building's height, base shear is dispersed among the different floors. This force causes later structural displacements. Towing loading frequently causes lateral displacements in high rise buildings. However, a strong earthquake can have severe effects. In order to distribute this force among the columns and beams, bracings are crucial. In this project, we examined unbraced structures with various types of bracing.

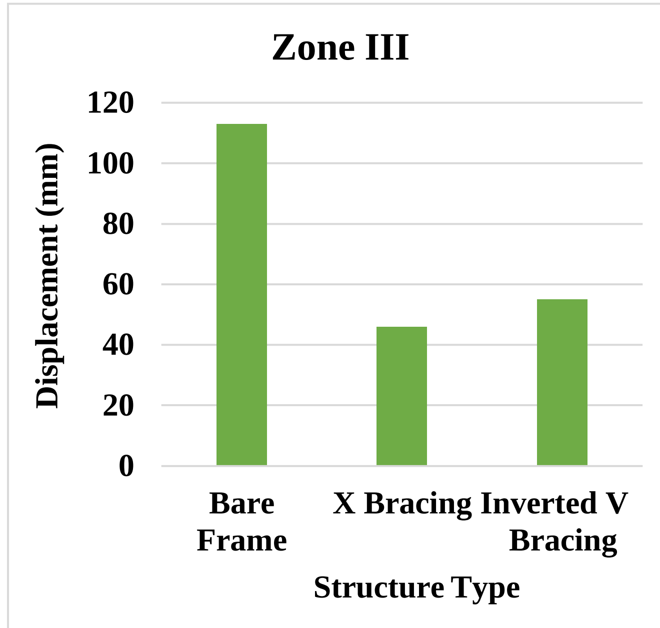
MAXIMUM LATERAL DISPLACEMENT

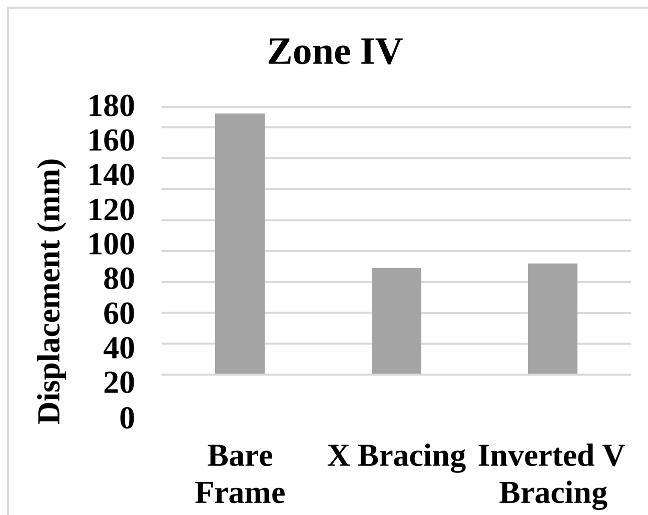
Tables 3 and 4 and Figures show a comparative study of lateral displacements in structures with different bracing systems. For all seismic zones, the minimum displacement in structures is seen in X bracing and Inverted V bracing.

Displacements (mm) Structure In X (Transverse) Direction			
Structure Types	ZONE-II	ZONE-III	ZONE-IV
Bare Frame	71.66	113.59	169.78
X Bracing	30.58	46.20	69.29
Inverted V Bracing	32.13	55.40	72.30

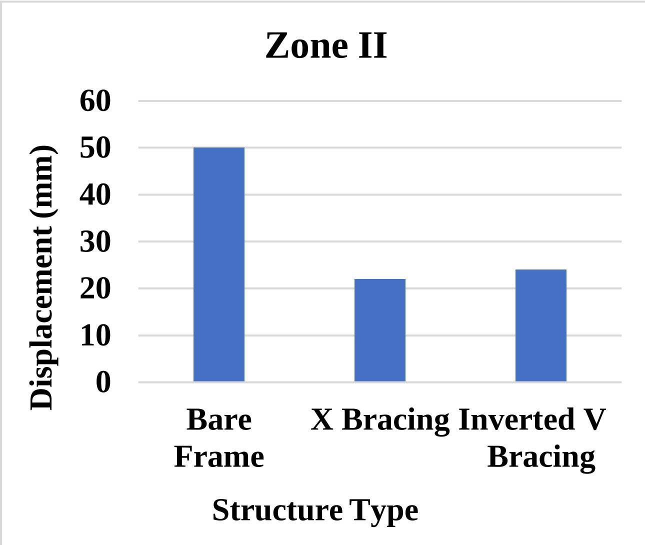
Table 3 Lateral Displacement (mm) in X Direction

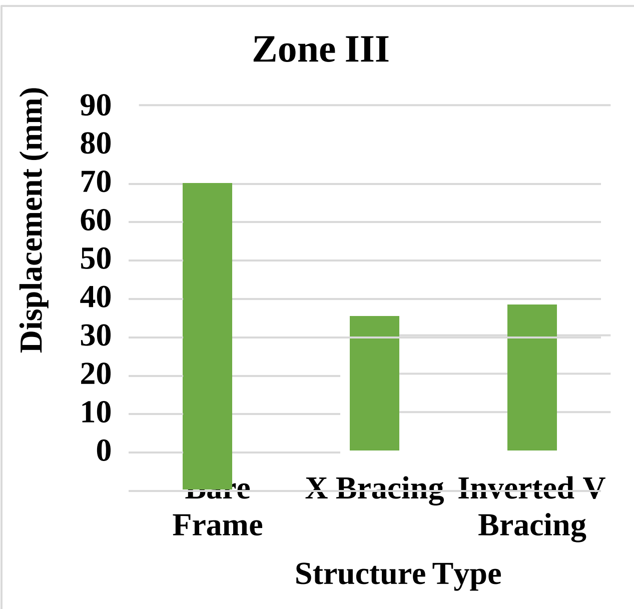


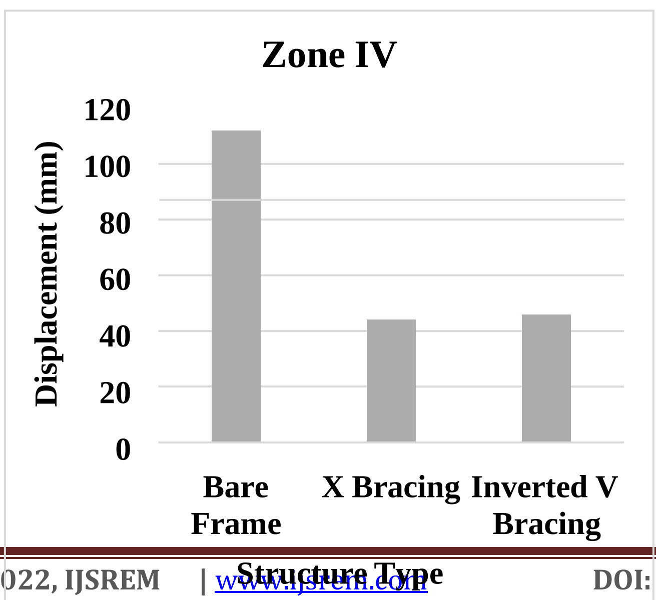




Displacements (mm) Structure In Z (Transverse) Direction			
Structure Types	ZONE-II	ZONE-III	ZONE-IV
Bare Frame	50.21	81.54	112.43
X Bracing	22.35	35.79	44.86
Inverted V Bracing	24.12	38.49	46.04

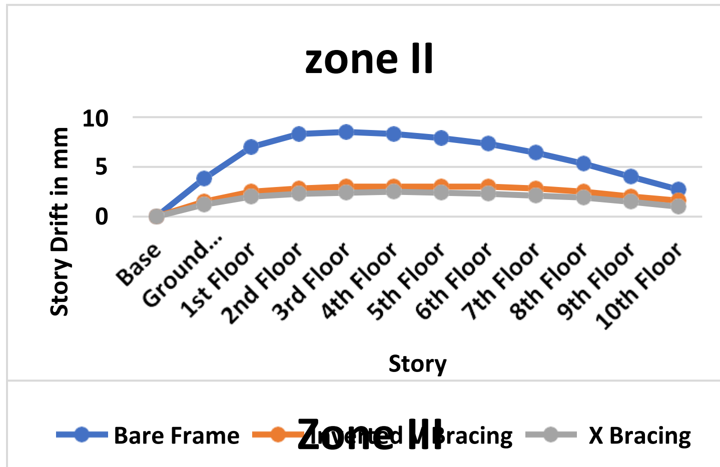


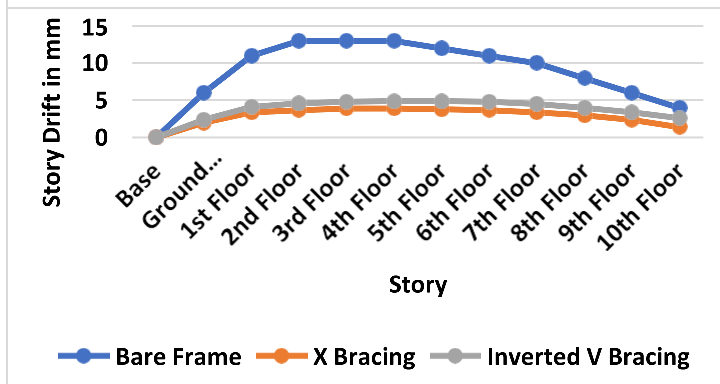


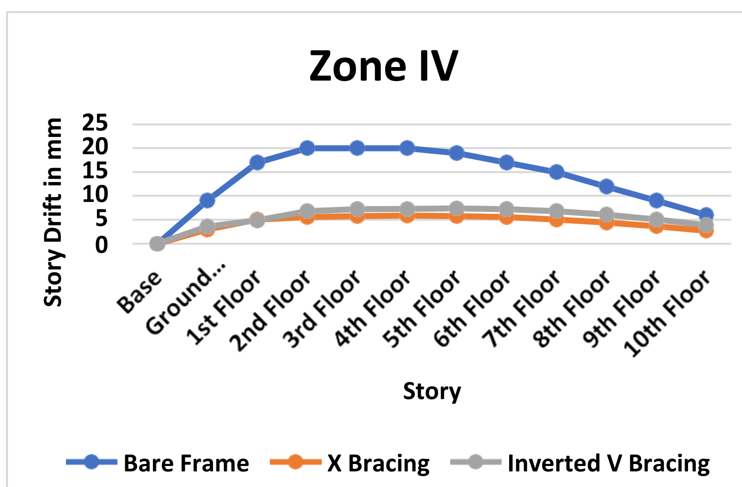


STORY DRIFT

After analyzing many buildings in various seismic zones, it was found that X bracing had the least amount of story drift, however Inverted V bracing also performed similarly to X bracing. Bracing limits the amount of drift, for example, X bracing limits drift to 55.83 percent and Inverted V bracing limits drift to 56.79 percent.

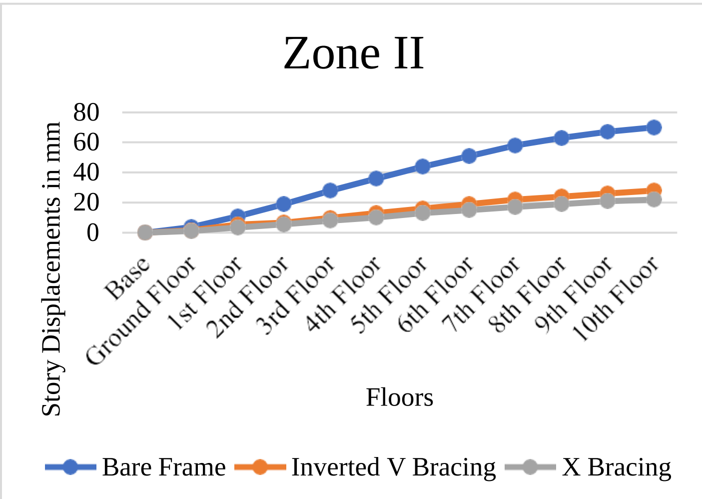


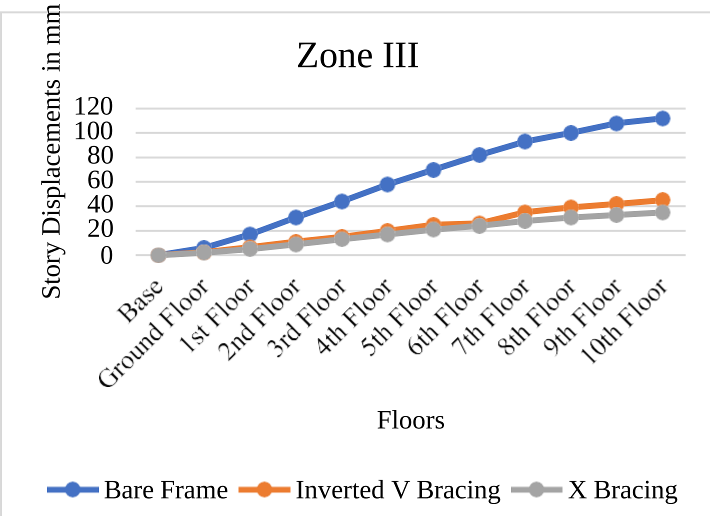


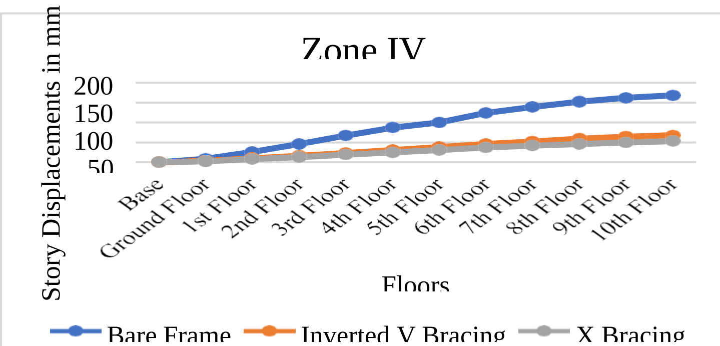


STORY DISPLACEMENT

Section displacement is also greatly decreased, with reductions of up to 62.05 percent for X bracing, 55.02 percent for V bracing, 39.72 percent for K bracing, 57.77 percent for Inverted V bracing, and 44.45 percent for Inverted K bracing. The narrative displacements are found to be better controlled by X bracing and V bracing.







CONCLUSIONS

- The idea of using steel bracing to withstand earthquake stresses is helpful.
- When compared to a bare frame, the bracing system successfully minimises the lateral movement of the structure by up to 80%.
- Steel bracings greatly lower the forces acting on members.
- The margin of safety against collapse improved after using the bracing component as a resistive member.
- Steel bracing system demonstrates effective and affordable methods for RC multistory buildings situated in seismically active areas.
- In higher earthquake zones, buildings with an X bracing system are more effective than those without one.
- After installing an X bracing system, the Maximum Displacement is decreased in buildings in higher risk zones.
- After installing an X bracing system, the combined stress in structures located in greater risk zones is decreased.

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