Analysis of A 3 Dimensional Building Frame Using Cross Bracing Through Etabs

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Abstract- *This Paper incorporates X-bracings to greatly increase the seismic resistance of the construction of both buildings. The structural design incorporates X-bracings to assess its impact on performance under seismic loads. This study focuses on how X-bracingcan increase lateral stiffness while reducing the building's overall deflection and wobbling. This study compares two G+ 15 reinforced concrete buildings to evaluate their seismic performance in different seismic zones. Both buildings are analyzed and designed using sophisticated structural analysis tools.*

The first building is located in seismic zone IV, which contributes an area with considerable seismic activity, while the second structure is located in seismic zone III, which accounts for moderate seismic pressure. Using IS codes, seismic analysis is performed for both structures based on bending moment, torsion, axial force, base shear, and shear force.

Two different kinds of comparisons are made in this study. First, the same models with different seismic zones are compared, and then the same models are compared using different software. The results of the analysis are compared in order to determine the difference in structural reaction between the two seismic zones. The comparison demonstrates how zone IV's high seismic force produces stronger building moments, shear forces, axial forces, and torsion than zone III. Additionally, the sturdy evaluates the performance of X-bracing in both seismic zones, highlighting its significance in reducing structural deformation and improving the overall safety of high-rise structures in seismic zones.

Keywords- X-bracing, seismic effect control, seismic analysis, bending moment, IS 1893-2016 (Part-1) shear force, and ETABS etc.

I. INTRODUCTION

The thesis investigates the effectiveness of X-bracing in improving a structure's seismic resistance. It does this by integrating X-bracing into the structural design of two buildings and evaluating its impact on performance under seismic loads. The primary focus is on how X-bracing can reduce the overall deflection and sway of the building by increasing lateral stiffness. The diagonal bracing system known as X-bracing provides additional support against lateral forces such as those generated during earthquakes. This greater lateral rigidity is crucial to preventing the structure from collapsing and deforming excessively. The thesis will model and stimulate the behavior of the building with and without X-bracing under different seismic scenarios. The study will include configurations with and without X-bracing. Finite element analysis (FEA) will be used to simulate how the structure will behave under different seismic loading situations. By comparing the reaction of construction with and without X-bracing, the benefit of structural elements may be quantified.

Fig 1: Building with X bracing

II. ADVANTAGES OF BRACING

- An existing structure can be strengthened and retrofitted with the aid of bracing.
- The bracing system has a major impact on the limiting of the relative floor-to-floor lateral movement.
- The embracing system considerably lessens interstory drift.
- It can be designed to obtain the desired strength and stiffness.
- The reduction of lateral displacement is a major benefit of bracing.

- Concentric X bracing outperforms eccentric V bracing in this instance.
- It uses less room, is affordable, and is simple to install.

III. OBJECTIVES

Herea are some amin objective of the study-

- To assess the high-rise building's performance in various seismic zones.
- To assess how well X-bracing protects high-rise buildings from earthquakes.
- ComparingETABS software utilizing the same model under various loading conditions based on parameters like as bending moment and shear force, among others.
- To assess how the seismic zone affects the structural response of the reinforced concrete building when steel bracings are used in its construction.

IV. LITERATURE REVIEW

Hassan and Wazni (2024),This paper has conducted a numerical analysis of retrofitting a multi-story steel building adjacent to the Imam Ali Holy Shrine in Najaf, Iraq. The retrofitting process involves analyzing four different bracing systems located along the x and y axes of the model: X, V, diagonal, and IV. The elastic response spectrum approach was used for seismic analysis of two earthquake types: weak and strong. Numerous criteria are compared, such as maximum lateral displacement, tale drift ratio, and base shear values.

The results show that retrofitting with four different bracing systems reduces the maximum lateral displacement in the x-axis by 55%, 44%, 41%, and 30% for X, IV, V, and diagonal bracing, respectively, improving the existing building model's capacity to dissipate energy under seismic stress. The X-bracing considerably raises the model's shear base value by 39% in the x-axis and 49% in the y-axis when compared to the other bracing techniques. This suggests that it is more economical. Consequently, the IV-bracing type is fairly priced and has a suitable impact on the building's ability to endure seismic loads.

V. METHODOLOGY

Steps involved in methodology and design

Step 1: The G+14 storey structure, which has 15 stories and a typical storey height of 3 meters and a bottom story height of 2 meters, was modeled as a regular construction.

Step 2 Assigning Fixed Support at the bottom of the structure in X, Y and Z direction.

Step 3: 3 Defining section properties of beam and column. Here, we have considered300x500mm beam size and 350x400 and 400x350mm column size.

Step 4 Assigning the properties of X-type steel bracing to the structure.

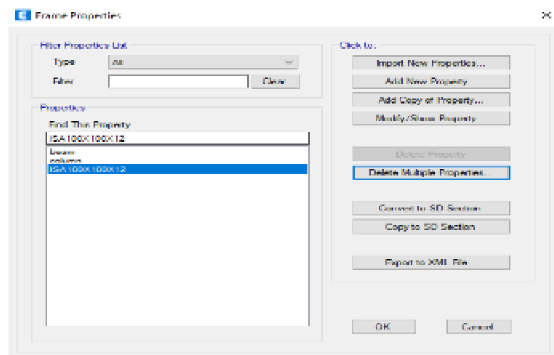


Fig 2:property of Steel bracings

Step 5 Defining Loading conditions for dead load, live load

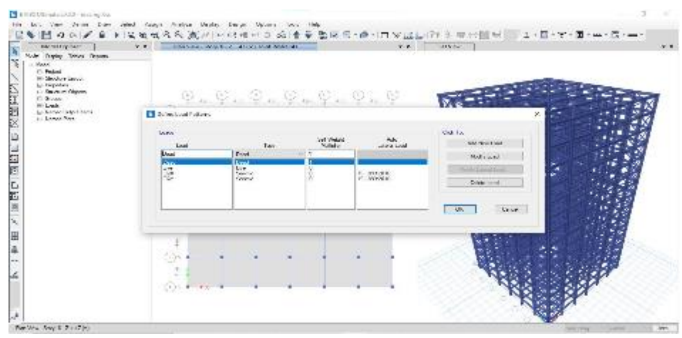


Fig 3:Defining load cases

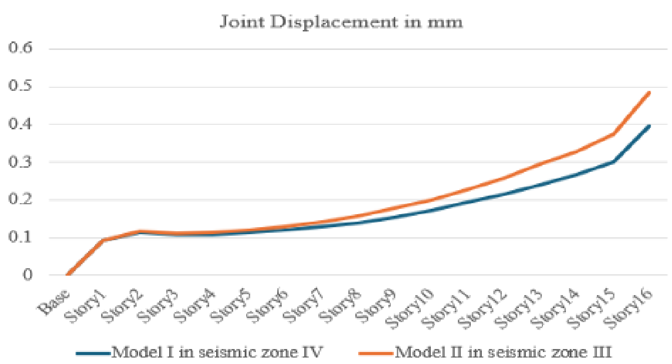
Step 6 Defining seismic load data for the considered structure, here Zone IV and soft soil condition is taken.

Step 7 analyzing the structure for dead load:

Table 1 Geometrical data

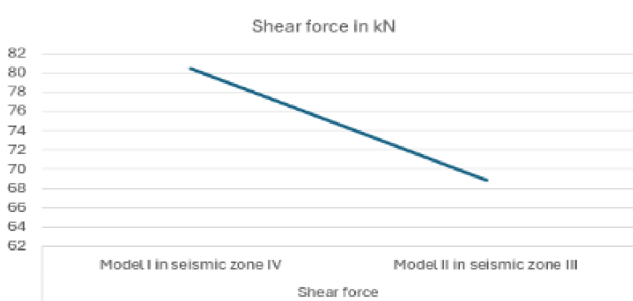
Particulars	Data
Type of structure	Rcc Structure (X-bracing)
Number of stories	16 Story
Floor to Floor height	3m
Depth of the foundation	2m
Total height of the building	45 m
Length of the building	24 m
width of the building	24 m
Shape of the columns	Rectangular
Size of column	400x400
Shape of the beams	Rectangular
Sze of beams	200x400
Steel used for bracing	ISA100x100x12

VI. ANALYSIS RESULTS



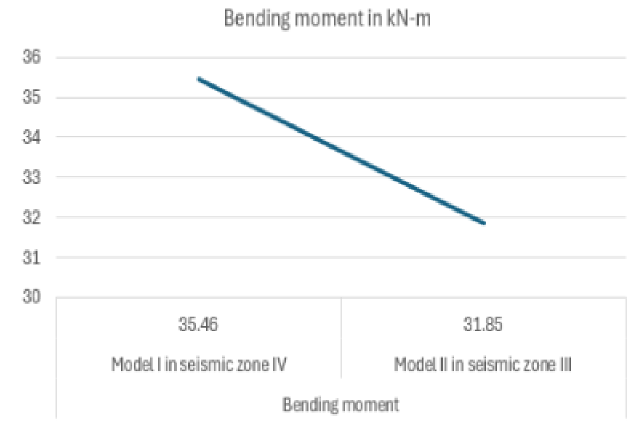
Graph 1: Shear force in kN

Inference- When comparing ETABS to ETABS' model, a 25% increase was seen, with values in ETABS model falling between 0 and 0.0356 mm and those in ETABS model II falling between 0 and 0.476 mm.



Graph 2: Shear force in kN

Inference- When comparing ETABS to ETABS' model, a decrease of about 17% was noted, with ETABS model I am exhibiting values of 80kN and ETABS model II exhibiting values of 68kN.



Graph 2: Shear force in kN

Inference- About 12% more was seen in this comparison between ETABS and ETABS' model, with values of about 35.46 kN-m in ETABS model I and 31.85 kN-m in ETABS model II.

VII. CONCLUSIONS

- The two models' general behavior may be affected by variations in material qualities, structural arrangements, or boundary conditions, which could account for Model II's greater displacement.
- Variations in the material qualities, structural design, or boundary conditions may be the cause of the decline. Compared to Model I, the decreased load in Model II may suggest a better load distribution or a more effective structural arrangement.
- Modifications to the boundary conditions, material characteristics, or structural design may be the cause of Model II's moment reduction. It suggests that compared to Model I, Model II may encounter less rotational resistance or more effective load distribution.
- The discrepancy in results may be due to differences in the two models' boundary conditions, material characteristics, or structural design, which affect how the loads are distributed and resisted. Model I has a marginally larger moment capacity.

VIII. FUTURE SCOPE

- The impacts of different X-bracing setups can be examined.
- It is possible to consider how bracing interacts with other structural elements.

- Look into integrating X-bracing with other retrofit techniques to enhance performance.
- Conduct experimental studies to verify the computational results and investigate how X-braced RC buildings behave under dynamic loading.

REFERENCES

[1] Saja Sahib Ali, Mazin A. Ahmed and Adel A. Zahra, [Mega bracing system with RC multistory based on plate-frame method by sap2000], BIO Web of Conferences, 2024

[2] Zainab Q Hassan and Saad Al-Wazni, [Seismic Evaluation of Retrofitting Technique Using Bracing Systems for Steel Multi-Story Building], BIO Web of Conferences, 2024

[3] Aparna Nishtala, Ajay Radke, [Review of Using Shear Walls & Bracings for Seismic Strengthening of HighRise RC Structures], International Research Journal on AdvancedEngineering Hub (IRJAEH), Vol. 02 Issue: 03 March 2024

[4] Shubham Bhalchandra Ajmire, Dr. B. H. Shinde, [Analysis of multi-storey buildings with hybrid shear wall- steel bracing structural system: a review], International journal of progressive research in engineering management and science (ijprems), Vol. 04, Issue 03, March 2024

[5] Arbaz Ahmad Lone, Gurpreet Singh and Jagdish Chand, [Comparative Study on Dynamic Analysis of Diagrid Bracings and Shear Wall in Different Location in terms of Sustainability using ETABS], IOP Conf. Series: Earth and Environmental Science 1110 (2023) 012054.

[6] Mohammed Asif and Nadeem Pasha, [Seismic Analysis of Multi- Storey Building by Providing Flat Slab with Different Types of Bracing System and Shear Wall], International Journal of Research Publication and Reviews, Vol 4, no 3, pp 491-510, March 2023.

[7] Mitali Shelke, Suraj Marchande, Jay Bari, Sumit Malkar and Ajmal shaikh, [Comparative Analysis for with & Without Elastomeric Base Isolated Structure Using E-Tabs], JournalPublication of International Research for Engineering and Management (JOIREM) Volume: 04 Issue: 10 | may-2022.

[8] S. M. R. Hosseini and Gh. R. Nouri, [Seismic performance of asymmetric isolated steel structures with different bracing systems], Amirkabir Journal of Civil Engineering, 53(12)(2022) 1187-1190.