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Enhancing Structural Resilience: A Comparative Study of G+35 Storey Irregular Buildings with Bracing and Diagrid Systems

Nikhil Gupta[1], Kavita Golghate[2]
[1]PG Scholar, [2]Professor, Civil Engineering Department, SDBCE College, Indore, India

***Abstract:** The study presented herein delves into the structural performance and behavior of a building subjected to different configurations, namely, an Irregular Building, an Irregular Building with Steel Bracing, and an Irregular Building with Diagrid System. The focus of the investigation is on key structural parameters such as node displacements and storey shear values across various levels of the building. Understanding how these parameters vary in response to different design strategies is vital for assessing the overall stability, safety, and efficiency of the structure in the face of external forces. Structural engineers and designers are constantly striving to optimize building designs to meet safety standards and performance criteria. The incorporation of additional elements, such as steel bracing or a diagrid system, can significantly impact a structure's ability to withstand lateral forces, ensuring resilience in the face of dynamic loads such as wind or seismic events. By comparing the performance of the three configurations, this study aims to provide insights into the efficacy of these design strategies and their influence on key structural indicators. Through a comprehensive analysis of node displacements and storey shear values at various levels, this study seeks to contribute valuable information to the field of structural engineering. The findings may inform future design decisions, guide improvements in structural systems, and enhance the understanding of how different configurations influence the overall behavior of a building. Ultimately, the knowledge gained from this study can contribute to the advancement of resilient and efficient structural designs, with implications for the broader fields of architecture and civil engineering.*
***Keywords:** Vertical irregularities, Seismic performance, Lateral load resisting systems Bracing System, Diagrid system.*

I. INTRODUCTION

High-rise multistory buildings have become increasingly prevalent in urban landscapes worldwide due to the growing demand for space in densely populated areas. However, this proliferation of vertical structures brings with it the challenge of ensuring their structural integrity and safety, particularly in regions prone to seismic activity. Earthquakes can exert significant lateral forces on buildings, leading to structural damage, compromising occupant safety, and causing substantial economic losses.

This thesis seeks to bridge the knowledge gap in the field of structural engineering and earthquake resilience by systematically investigating the seismic response of high-rise multistory vertical irregular buildings with different lateral load resisting systems. Through numerical simulations and analytical methods, we aim to provide valuable data and recommendations for architects, engineers, and policymakers to better address the seismic challenges posed by modern urban development.

II. OBJECTIVE

Compare the effectiveness of an Irregular Building, Irregular Building with Bracing, and Irregular Building with diagrid System. Identifying the system that demonstrates superior performance aids in making informed decisions during the design and construction phases.

A. Trend Analysis

Analyze the trends in performance metrics across storeys for each structural system.

B. Optimization of Design

Identify the most efficient structural system for mitigating lateral displacements and ensuring stability in irregular buildings.

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III. METHODOLOGY

In this study, we focus on three reinforced concrete (RC) buildings. These buildings are characterized by their vertical geometric design and are classified as multi-story structures. Specifically, they belong to the category of G+35 buildings, indicating that they comprise a ground floor plus 35 additional stories. The inter-story height, which refers to the vertical distance between each level, is consistently set at 3 meters for each story.

The structural components of these buildings, such as columns and beams, are designed with specific dimensions and materials to ensure their stability and load-bearing capacity. The columns in these buildings have a cross-sectional size of 1100x1100 millimeters, indicating that they are square in shape and measure 1100 millimeters on each side. On the other hand, the beams within the structure have dimensions of 800x400 millimeters, denoting that they are rectangular with a width of 800 millimeters and a height of 400 millimeters.

Table no. 1 Structural Data

Property	Specification
Number of storey	G+35 storey
Plan area	18.05 m x 42.30m
Storey height	3 m
Grade of concrete	M25
Grade of steel	Fe500
Size of columns	1100 mm x 1100mm
Size of beams	400 mm x 800 mm
Slab thickness	150 mm
Steel	Fe500
Shear Wall Thickness	200 mm

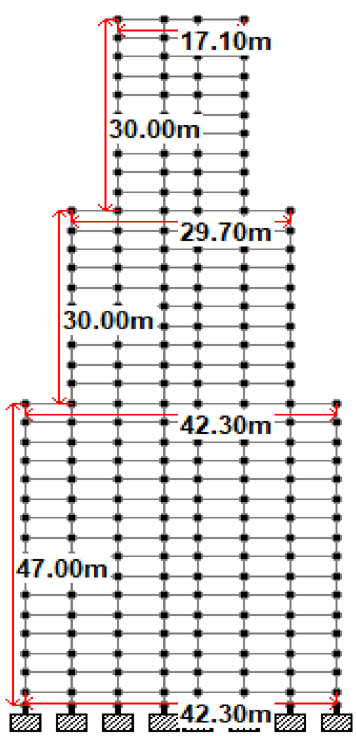

Fig. 1 Structural model G+35 storey

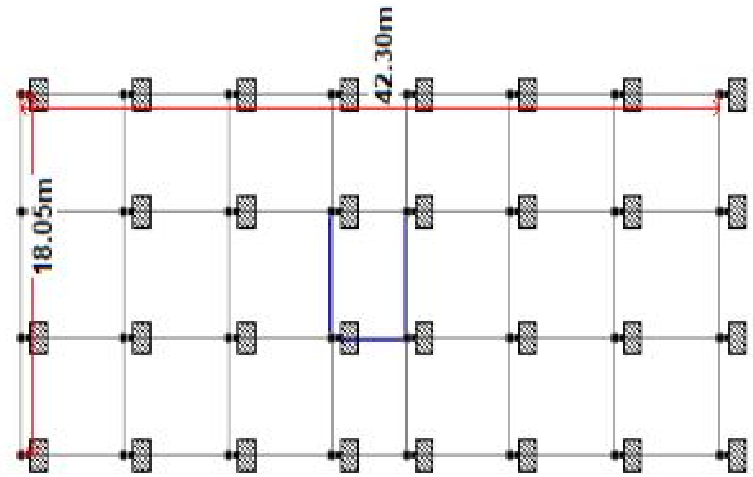

Fig. 2 Top View (Plan) G+35 storey

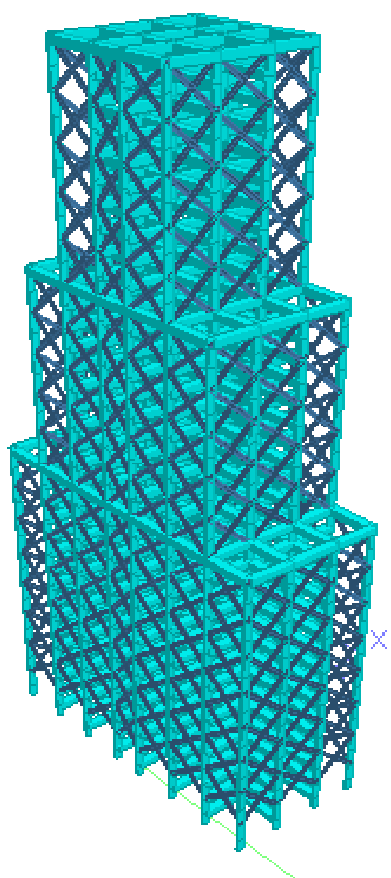

Fig. 3 Geometric vertical irregular G+35 Building with Bracing system elevation

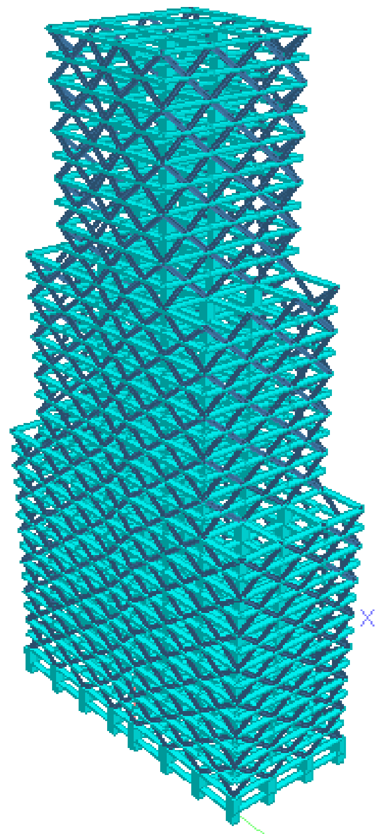

Fig.4 Geometric vertical irregular G+35 Building with Diagrid System elevation

IV. RESULT

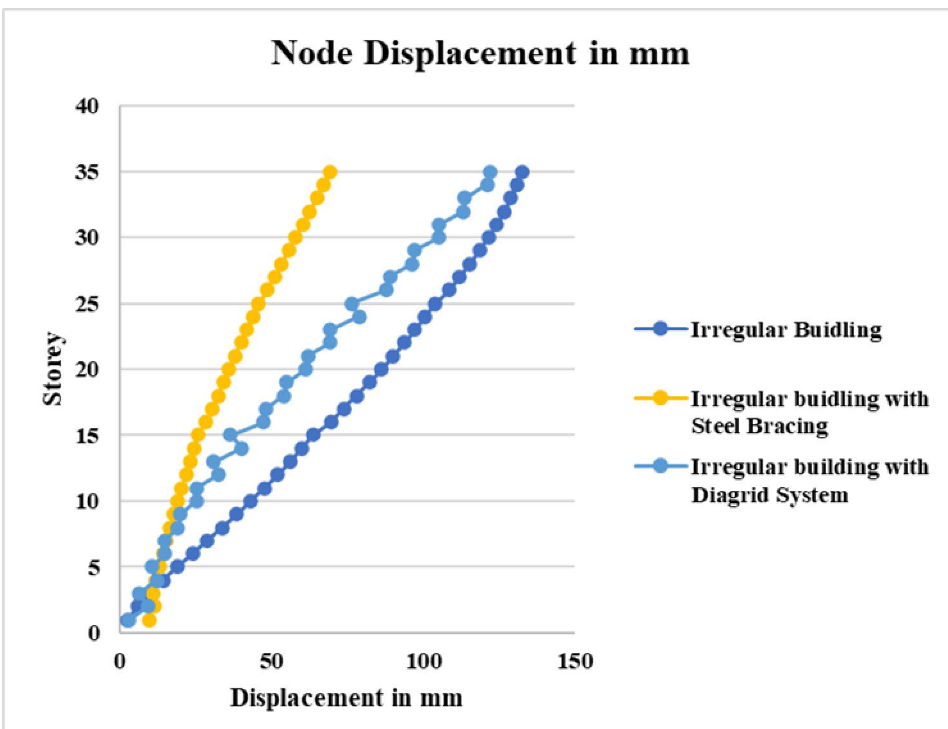

Fig.5 Node Displacement

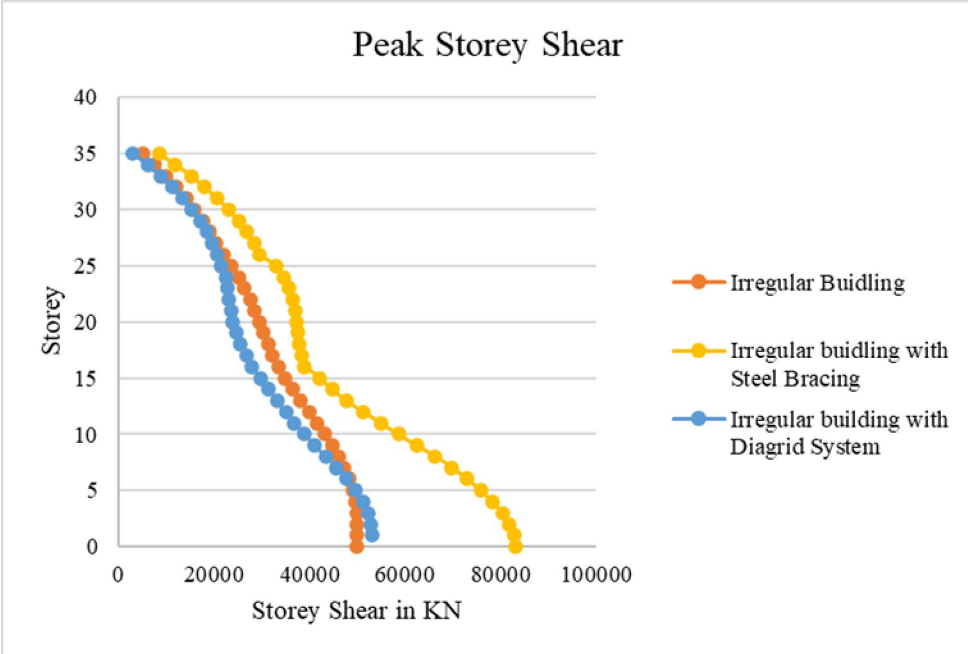

Fig.5 Peak Storey Shear

V. CONCLUSION

In conclusion, the study has provided valuable insights into the structural behavior of a building across different configurations, specifically focusing on node displacement and peak storey shear values. The analysis of these parameters offers crucial information for understanding the overall stability and response to lateral forces in each structural scenario.

A. *Node Displacement*

1) The node displacement values indicate the extent of deformation or movement at various points within the structure.
2) The Irregular Building with Diagrid System exhibited the lowest node displacement values, suggesting enhanced rigidity and potentially controlled deformations.
3) Irregular Building with Steel Bracing showed moderate node displacements, implying a balance between flexibility and structural restraint.
4) The Irregular Building without additional systems displayed varying node displacement values, indicating a diverse response to lateral loads across different storeys.

B. *Peak Storey Shear*

1) Storey shear values highlight the distribution of lateral forces throughout the building.
2) Irregular Building with Steel Bracing demonstrated the highest peak storey shear values, suggesting a structure well-equipped to handle substantial lateral loads.
3) The Irregular Building with Diagrid System displayed lower peak storey shear values, indicating a potentially more distributed and controlled response to lateral forces.
4) The Irregular Building exhibited a range of storey shear values, reflecting the complexity of its structural response across the height of the building.

C. *Overall Implications*

1) The choice of additional structural elements, such as steel bracing or a diagrid system, significantly influences both node displacement and peak storey shear values.
2) Engineers and designers should carefully consider the trade-offs between flexibility and stability when selecting structural configurations.

3) The findings contribute to the broader understanding of how different design strategies impact a building's behavior under lateral forces.
4) The study's outcomes can guide future structural design decisions, promoting the development of resilient and efficient building structures.

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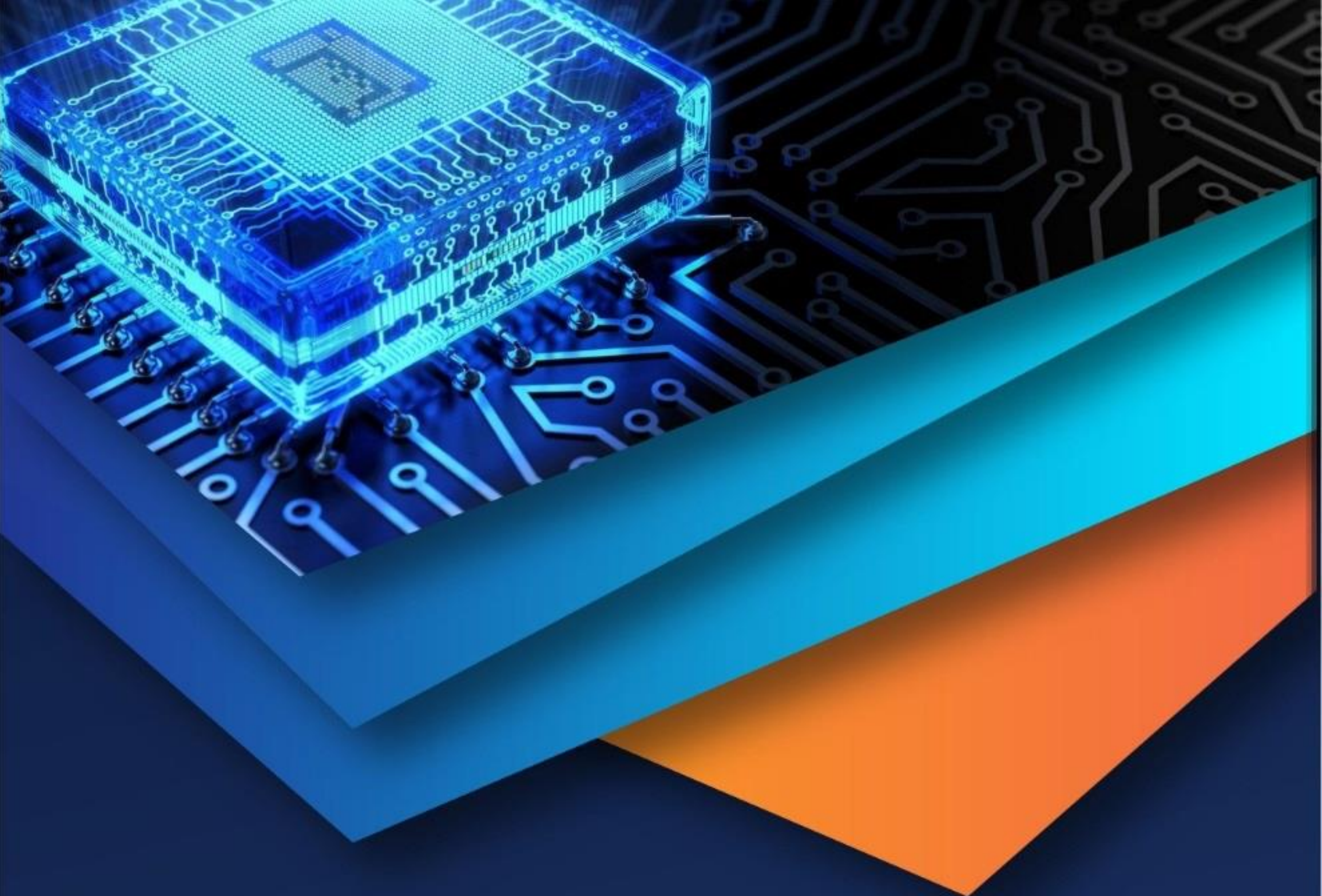

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