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

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**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.

### 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-storey structures. Specifically, they belong to the category of G+35 buildings, indicating that they comprise a ground floor plus 35 additional stories. The inter-storey height, which refers to the vertical distance between each level, is consistently set at 3 meters for each storey.

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

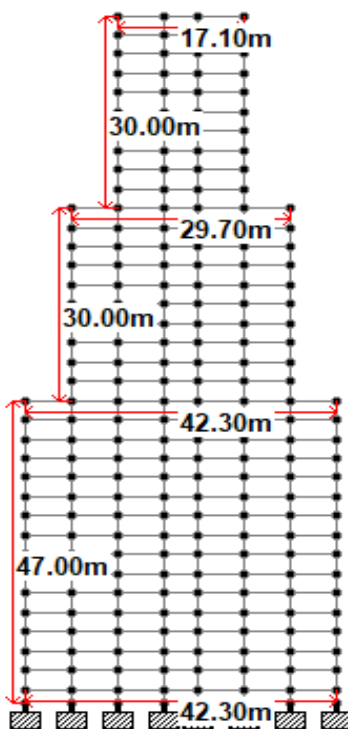


Fig. 1 Structural model G+35 storey

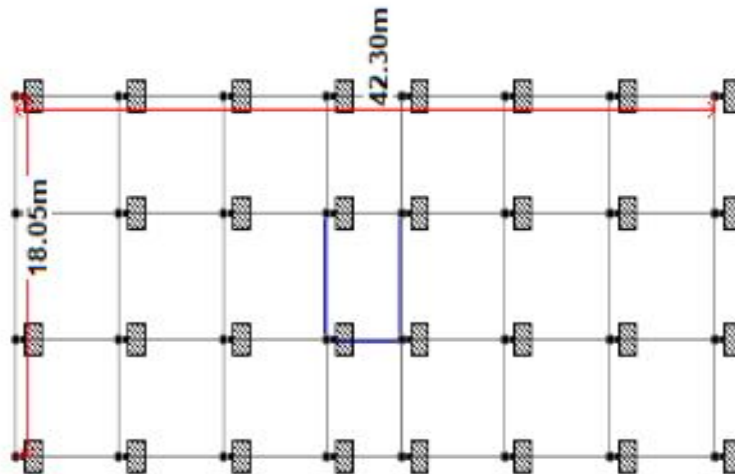


Fig. 2 Top View (Plan) G+35 storey

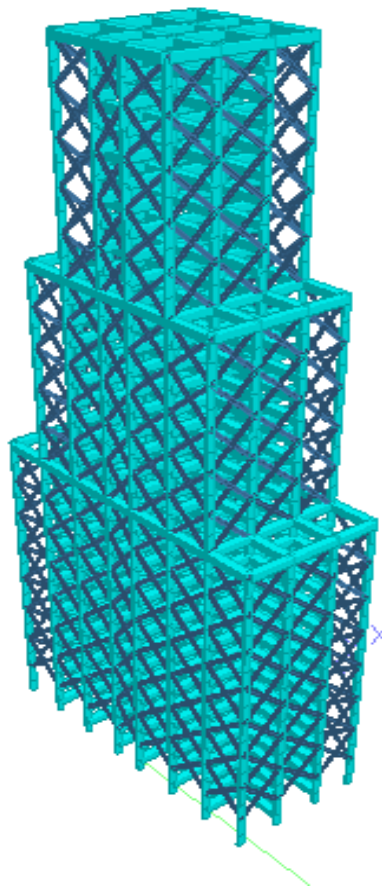


Fig. 3 Geometric vertical irregular G+35 Building with Bracing system elevation

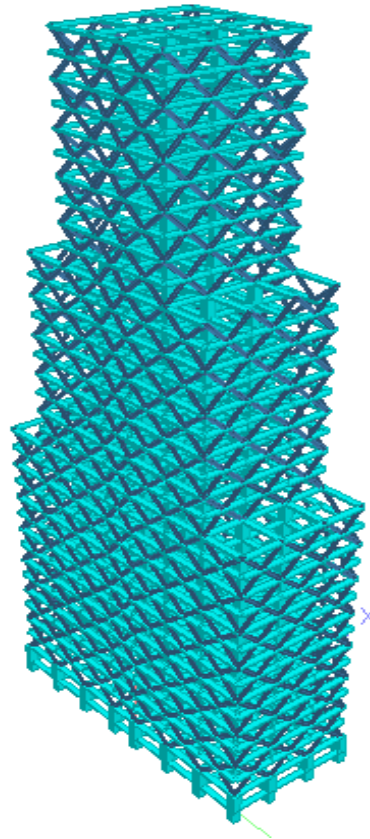


Fig.4 Geometric vertical irregular G+35 Building with Diagrid System elevation

#### IV. RESULT

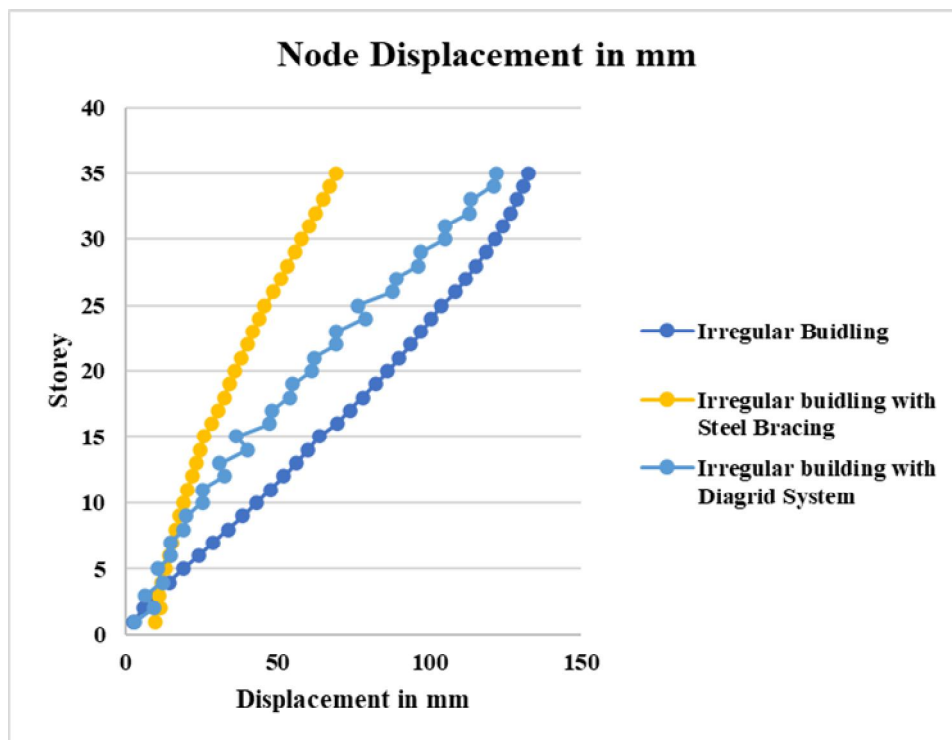


Fig.5 Node Displacement

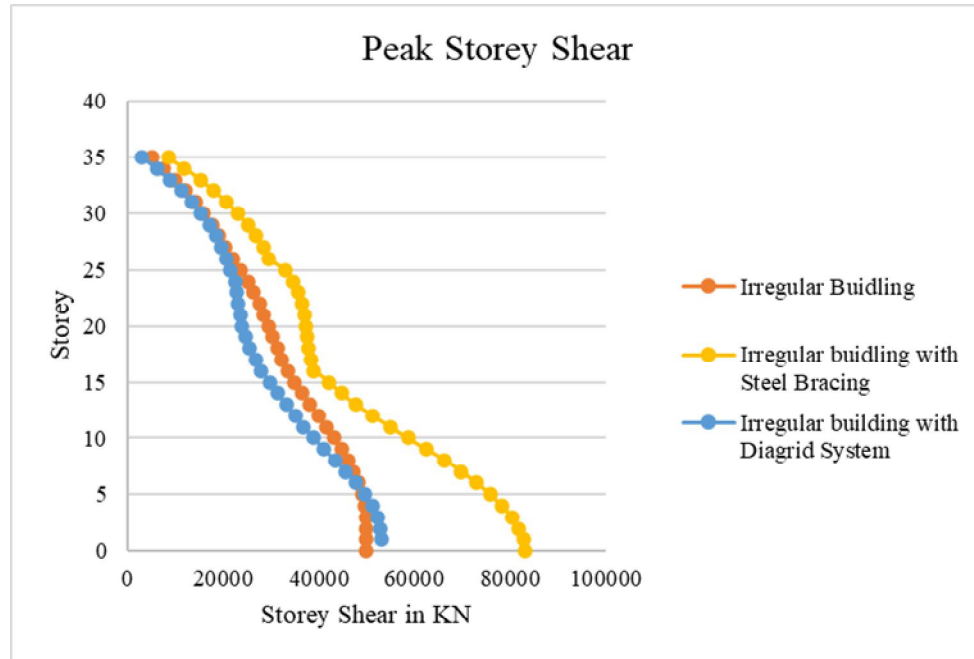


Fig.5 Peak Storey Shear

## 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.

### REFERENCES

- [1] Ujwal Bhongade et al. (2022). "Approximate analysis of multistory building structures stiffened by a combination of lateral load-resisting subsystems." *Journal of Structural Engineering*, vol. 148, no. 4.
- [2] Anjali Mistry et al. (2022). "Lateral load resisting systems and vibration control systems in tall structures." *International Journal of Civil Engineering and Technology*, vol. 13, no. 3.
- [3] Mir M. Ali and Kheir Al-Kodmany (2022). "A comprehensive narrative of different structural systems for tall buildings." *Journal of Building Engineering*, vol. 45.
- [4] Mohit Kumar Prajapati (2021). "Advancement of high-strength structural materials and development of tall buildings." *International Journal of Engineering and Advanced Technology*, vol. 10, no. 3.
- [5] Pankaj Patel and Rahul Sharma (2021). "Significance of lateral loads in multi-story buildings and the effect of shear wall apertures." *International Journal of Advanced Research in Engineering and Technology*, vol. 12, no. 3.
- [6] Afonso Morais Sarmiento (2021). "Importance of lateral load resisting systems in tall buildings: A comparative study of outrigger frame systems." *International Journal of High-Rise Buildings*, vol. 10, no. 1.
- [7] Amit K. Mali et al. (2021). "Various lateral load resisting systems for tall structures: A parametric study." *International Journal of Civil Engineering and Technology*, vol. 12, no. 7.
- [8] Pragma Patel et al. (2021). "Necessity of multi-storied buildings and lateral load analysis of a G+30 story building." *International Journal of Scientific Research in Science, Engineering and Technology*, vol. 7, no. 11.
- [9] Hussin Ahmad Hasrat (2021). "Significance of lateral load resisting systems in high-rise structures." *Journal of Applied Engineering Research*, vol. 16, no. 4.
- [10] Kutbuddin A Ranpurwala et al. (2021). "Comparative study of lateral load resisting systems in tall buildings." *International Journal of Innovative Research in Science, Engineering and Technology*, vol. 10, no. 12.
- [11] Karthik, Batra, and Gupta (2020). "Efficient and economical lateral force resisting system for 30-story buildings." *International Journal of Civil Engineering and Technology*, vol. 11, no. 3.
- [12] HB Akhilesh and BO Naveen (2020). "Wind load performance of vertical geometric irregular tall structures." *International Journal of Civil Engineering and Technology*, vol. 11, no. 3.
- [13] Bui Thanh Dat et al. (2018). "Classification of structural systems for tall buildings and the influence of shear lag effects." *Journal of Civil Engineering and Architecture*, vol. 12, no. 6.
- [14] Prof. S. Vijaya Bhaskar and M. Eadukondalu (2018). "Selection of lateral load resisting systems for different number of story buildings." *International Journal of Civil Engineering and Technology*, vol. 9, no. 9.
- [15] Jayant Shaligram and Dr. K.B Parikh (2018). "Role of lateral load resisting systems in high-rise buildings." *International Journal of Science, Engineering and Technology Research*, vol. 7, no. 8.
- [16] Ms. Jiji Thomas and Dr. Rakesh Patel (2017). "Analysis of shear wall system for building construction." *International Journal of Engineering Research and Technology*, vol. 6, no. 8.
- [17] Yogendra Bhojuji Meshram and S.B. Sohani (2017). "Behavior of different lateral load resisting systems in tall buildings." *International Journal of Engineering Sciences & Research Technology*, vol. 6, no. 12.
- [18] Piyush Gupta and Dr. Neeraja (2016). "Efficiency analysis of lateral force resisting systems in RCC structures." *International Journal of Research in Engineering and Technology*, vol. 5, no. 5.
- [19] Rasool and Tantray (2016). "Efficiency of lateral load resisting systems in tall buildings." *International Journal of Science, Technology and Management*, vol. 5, no. 3.
- [20] V. Kalpana et al. (2016). "Importance of shear walls in tall buildings." *International Journal of Innovative Research in Science, Engineering and Technology*, vol. 5, no. 10.
- [21] P. Kalpana et al. (2016). "Analysis of structural shear walls in different building models." *International Journal of Civil Engineering and Technology*, vol. 7, no. 1.
- [22] Divya C. Bhuta and Umang Pareekh (2016). "Behavior of lateral load resisting systems in tall buildings." *International Journal of Scientific & Engineering Research*, vol. 7, no. 4.
- [23] Vijaya Kumari Gowda M R and Manohar B C (2015). "Efficiency analysis of belt truss systems in tall buildings." *International Journal of Innovative Research in Science, Engineering and Technology*, vol. 4, no. 11.
- [24] P. Jayachandran (2013). "Design of tall buildings: Conceptual design, approximate analysis, preliminary design and optimization." *Indian Concrete Journal*, vol. 87, no. 7.



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