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Enhancing Structural Resilience: A Comparative Study of G+35 Storey Irregular Buildings with Shear Walls and Outrigger Braced Systems

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Abstract: The study at hand focuses on the structural performance of irregular buildings subjected to lateral loads, with a specific emphasis on node displacement and peak storey shear forces. Irregularities in building structures, stemming from variations in mass distribution, stiffness, or geometry, pose unique challenges that demand specialized engineering solutions. The primary objective of this study is to analyze and compare the response of three different structural systems across multiple storeys: an Irregular Building alone, an Irregular Building with Shear Wall, and an Irregular Building with Outrigger Braced System.

Understanding how these structural systems behave under lateral forces such as wind or seismic events is crucial for ensuring the safety, stability, and resilience of buildings. Node displacement, representing the movement of critical points within the structure, and peak storey shear forces, indicating the intensity of lateral forces at specific levels, are essential performance metrics. By evaluating these metrics across various storeys, we aim to discern patterns, trends, and the relative effectiveness of each structural system.

The incorporation of shear walls and outrigger braced systems represents common strategies employed by engineers to enhance the seismic and wind resistance of buildings. However, the specific impact of these systems on node displacement and peak storey shear forces in irregular buildings requires detailed investigation.

This study contributes to the broader body of knowledge in structural engineering, offering insights that can inform best practices, design guidelines, and decision-making processes. The findings may aid engineers and designers in making informed choices regarding the selection of structural systems for irregular buildings, particularly in regions prone to seismic activity or strong lateral forces. Additionally, the study may identify areas for further research, providing a foundation for the continuous improvement of structural design strategies.

Keywords: Vertical irregularities, Seismic performance, Lateral load resisting systems Shear walls Outrigger braced 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

1) Compare the effectiveness of an Irregular Building, Irregular Building with Shear Wall, and Irregular Building with Outrigger Braced System.
2) Identifying the system that demonstrates superior performance aids in making informed decisions during the design and construction phases.
3) Trend Analysis:
4) Analyze the trends in performance metrics across storeys for each structural system.
5) Optimization of Design:
6) 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

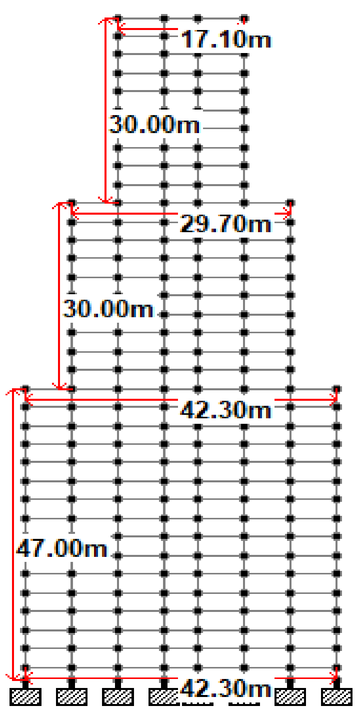

Fig. 1 Structural model G+35 storey

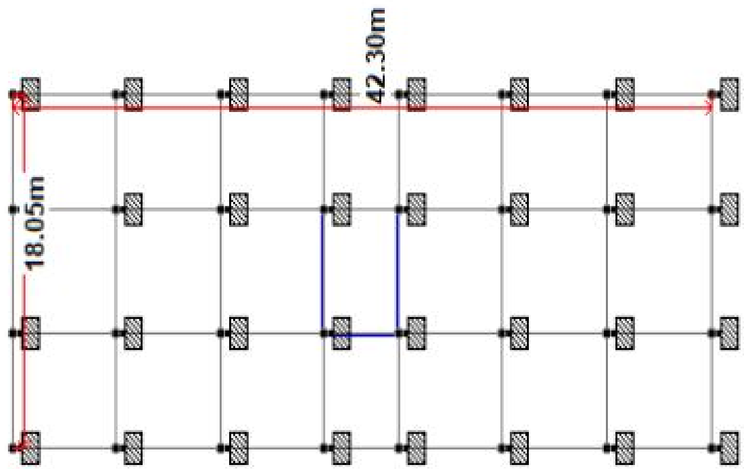

Fig. 2 Top View (Plan) G+35 storey

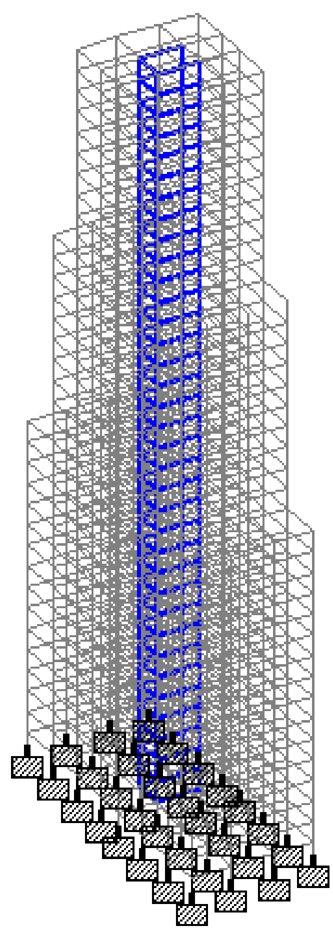

Fig. 3 Geometric vertical irregular G+35 Building with Shear wall system in Core elevation

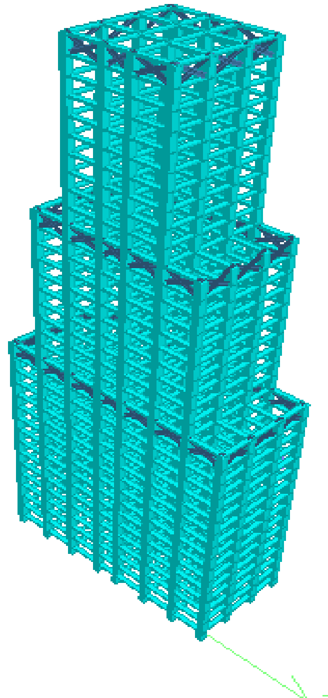

Fig.4 Geometric vertical irregular G+35 Building with outrigger Braced system elevation

IV. RESULT

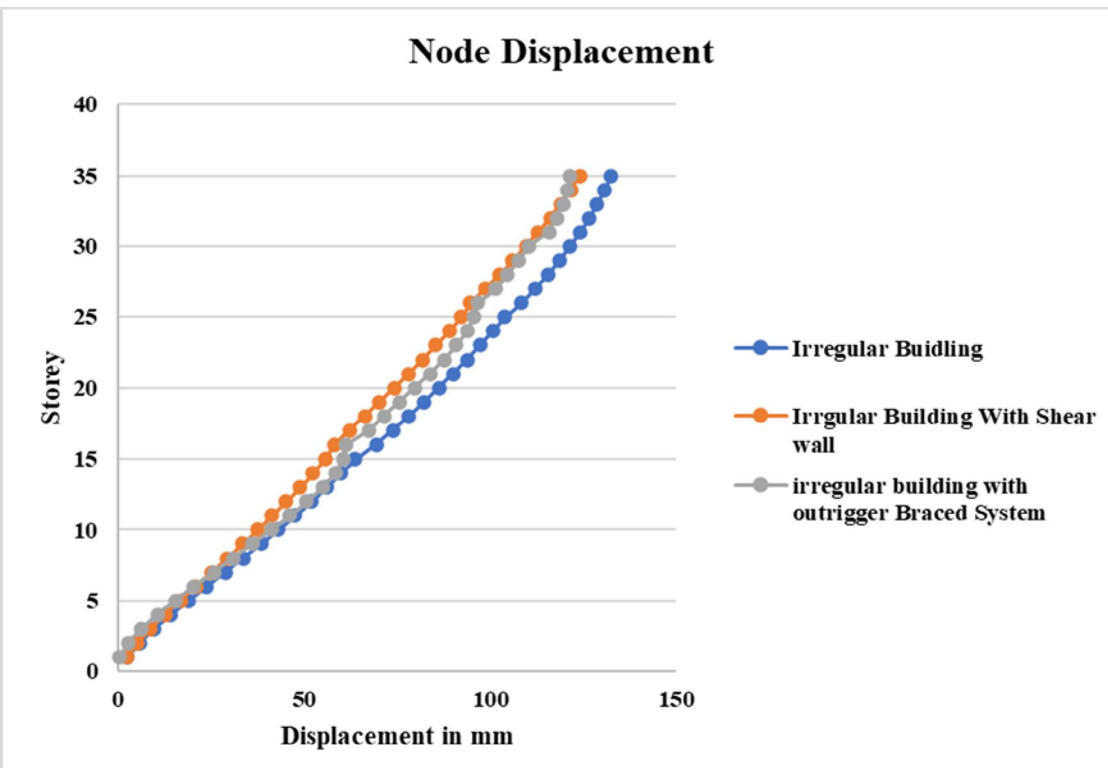

Fig.5 Node Displacement

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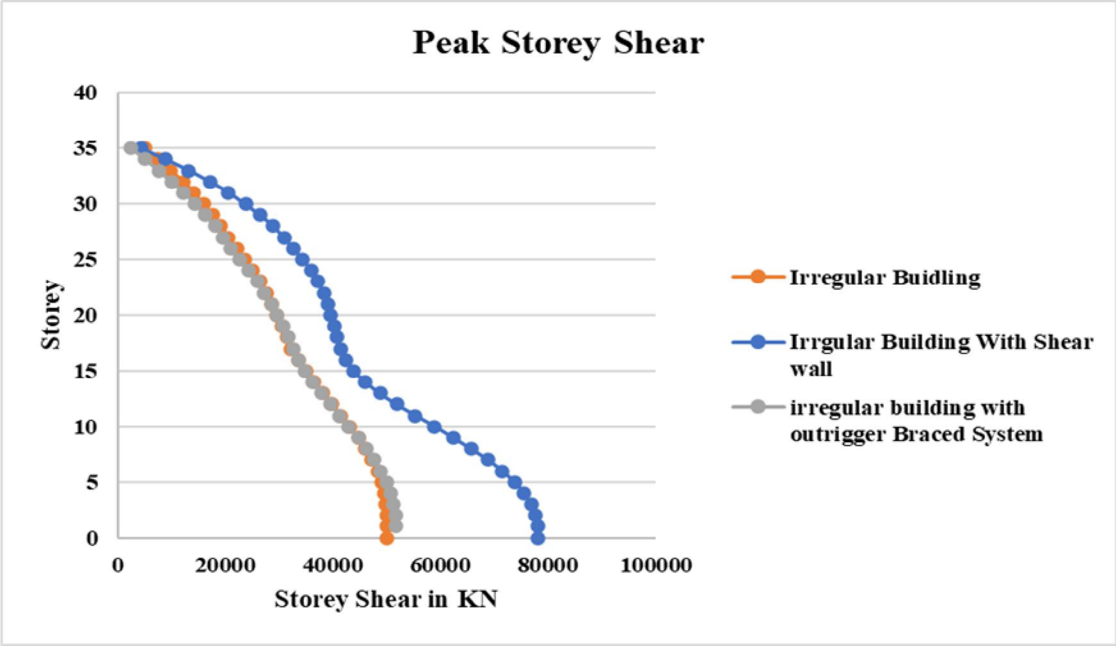


Fig.5 Peak Storey Shear

V. CONCLUSION

A. Node Displacement

1) Across all storeys, the data indicates that the Irregular Building with Outrigger Braced System consistently exhibits the lowest node displacements.
2) The Irregular Building with Shear Wall generally shows intermediate node displacement values, while the Irregular Building alone consistently demonstrates the highest displacements.

B. Peak Storey Shear

1) In terms of peak storey shear forces, the Irregular Building with Outrigger Braced System consistently displays the lowest values across all storeys.
2) The Irregular Building with Shear Wall tends to have intermediate shear forces, while the Irregular Building alone exhibits the highest peak storey shear forces.

C. Trends Across Storeys

1) Both node displacement and peak storey shear values tend to decrease as we move from higher to lower storeys for all three structural systems.
2) The reduction in values suggests an overall improvement in the structural response and stability with the introduction of outrigger braced systems or shear walls.

D. Performance Ranking

Based on the provided data, the ranking of structural systems in terms of minimizing node displacement and peak storey shear is as follows:

1) Irregular Building with Outrigger Braced System (lowest values)
2) Irregular Building with Shear Wall (intermediate values)
3) Irregular Building alone (highest values)

E. Recommendations for Further Study

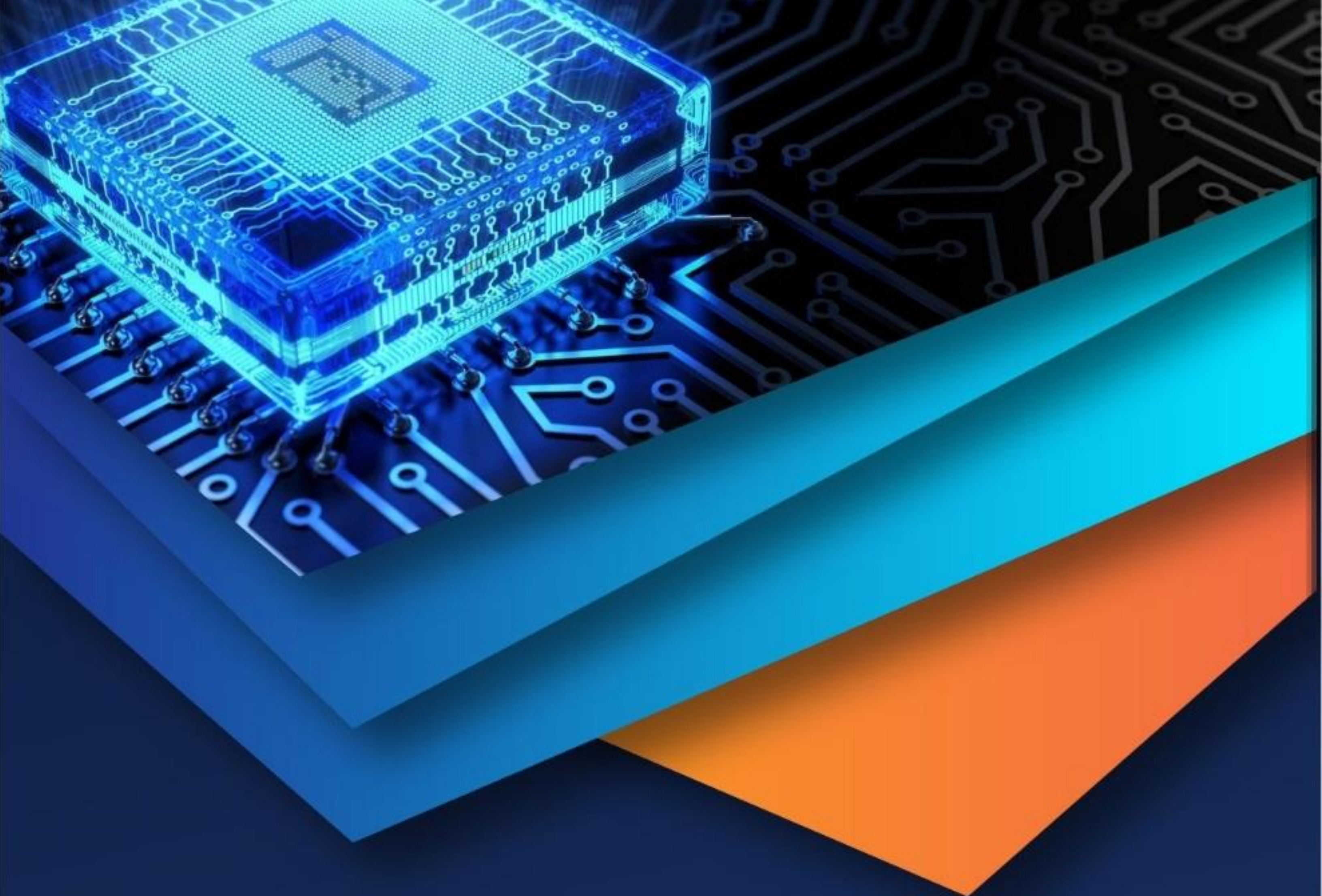
1) Further investigation into specific design parameters, material properties, and seismic/wind conditions would provide a more comprehensive understanding of the observed trends.

2) The inclusion of additional performance metrics and unit clarification would enhance the precision of conclusions drawn from the data.

In summary, the comparative analysis of node displacement and peak storey shear forces indicates that the inclusion of outrigger braced systems is particularly effective in improving the structural performance of irregular buildings. The findings are valuable for guiding engineering decisions in the design and construction of structures subjected to lateral forces.

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 Sarmento (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] Pragya 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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