International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 10 | Oct 2024 www.irjet.net p-ISSN: 2395-0072

Seismic and Wind load effect on high rise buildings

Sachin Kumar[1], Diwakar Yadav[2], Swadesh Prabha Jetli[3], Arti Maurya[4], Vikas Bharti[5], Shubhendu Mishra[6],

[1,2,3,4,5]*Student, Department of Civil Engineering, AKTU University, Goel Institute of Technology and Management, Lucknow, India*
[6]*Assistant Professor, Department of Civil Engineering, AKTU University, Goel Institute of Technology and Management, Lucknow, India*

Abstract – *This research paper investigates the impact of seismic and wind load effects on high-rise buildings, emphasizing their structural performance and safety. As urbanization increases, the necessity for taller structures has become paramount, necessitating a thorough understanding of the forces acting upon them. This study employs a combination of numerical simulations and experimental data to analyze how various design parameters influence a building's response to seismic and wind loads.*

The findings reveal that the interaction between these forces significantly affects the structural integrity and overall stability of high-rise buildings. Advanced modelling techniques, including response spectrum analysis and time-history analysis, are utilized to assess *the dynamic behavior of structures under different loading scenarios. The paper also highlights the importance of incorporating efficient design strategies and materials to mitigate potential damage during extreme events.*

Ultimately, the research underscores the need for updated codes and standards that account for the combined effects of seismic and wind loads in high-rise building design. Recommendations for future research directions and practical implications for engineers are also discussed, aiming to enhance the resilience of urban infrastructure in the face of natural hazards

Keywords—

1. Seismic loads ,2. Wind loads ,3. High-rise buildings ,4. Structural performance ,5. Dynamic analysis

1. INTRODUCTION

1.1 Seismic load

An earthquake is defined as the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves. This release of energy usually occurs because of the movement of tectonic plates beneath the Earth's surface.

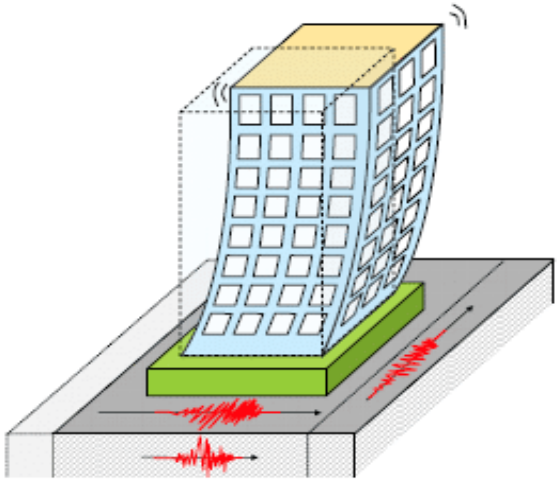

Figure1.1 Seismic effect on high rise building

Seismic load refers to the forces imposed on structures by an earthquake. These loads arise from ground motion, causing dynamic shaking that can lead to structural deformation or collapse if not properly accounted for. Engineers design buildings to resist seismic loads by using materials and systems that absorb and dissipate energy, ensuring safety and stability during earthquakes. This includes incorporating flexible structures, base isolators, and dampers to reduce seismic effects on the building.

1.2 Wind load

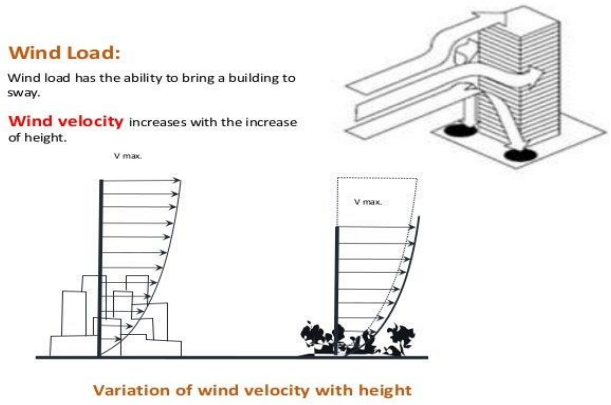

Figure 1.2 Variation of wind velocity with height

Any stresses or tensions that the wind transmits to a component or structure are referred to as wind loads in this context. Essentially, there are three different kinds of wind loads that could be applied to a building. Uplift, shear and lateral wind load. Even standard building designs must take wind loads into account. Especially, if located in some areas with significant wind forces such as coastal areas. When designing structures to effectively avoid these effects, wind analysis is utilized to evaluate the dynamic effects of wind on a structure.

Wind load is the effect of wind on buildings, structures and other objects. It is caused by wind pressure, air speed and wind velocity.

2. OBJECTIVE

The primary objective of controlling seismic and wind load effects on high-rise buildings in Srinagar is to ensure the structural safety and resilience of buildings against natural hazards. This includes analyzing the unique seismic and wind conditions of the region, developing design strategies that minimize structural vulnerability, and optimizing material use for enhanced strength and flexibility. The study also aims to integrate advanced modeling techniques, such as response spectrum and time-history analysis, to predict building behavior under combined loading conditions. Ultimately, the goal is to improve building codes and standards, promoting safer, more sustainable urban development in Srinagar.

3.METHODOLOGY

A new method to control seismic and wind load effects on high-rise buildings involves the integration of adaptive structural systems, advanced materials, and cutting-edge technology. One promising approach is the use of **tuned mass dampers (TMDs)** in conjunction with **base isolation systems**, creating a dynamic dual defense against both seismic and wind forces. Tuned mass dampers reduce vibrations by counteracting motion through oscillating weights, while base isolation decouples the building from ground motion during an earthquake, mitigating seismic effects. Combining these two systems ensures protection against lateral forces caused by both wind and seismic activities.

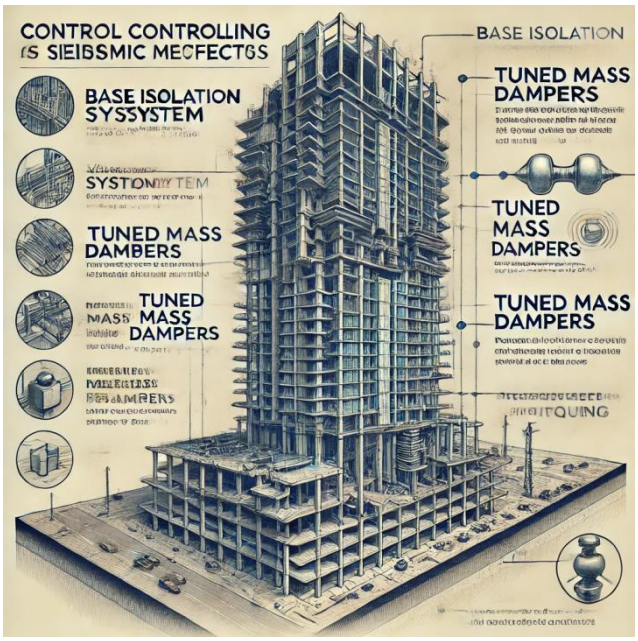

Figure 2.1 Seismic effect on high rise buildings

Smart materials such as shape memory alloys (SMAs) and fibre-reinforced polymers (FRPs) can further enhance structural resilience. SMAs can deform during seismic or wind events and return to their original shape, reducing permanent structural damage. FRPs, known for their strength-to-weight ratio, offer excellent stiffness and flexibility, making them suitable for reinforcing critical load-bearing components.

Another innovative solution is the use of **active control systems**, where sensors detect real-time environmental forces, and actuators respond by adjusting structural elements to counteract excessive loads. Such systems are particularly effective in regions like Srinagar, where buildings face both seismic and wind challenges.

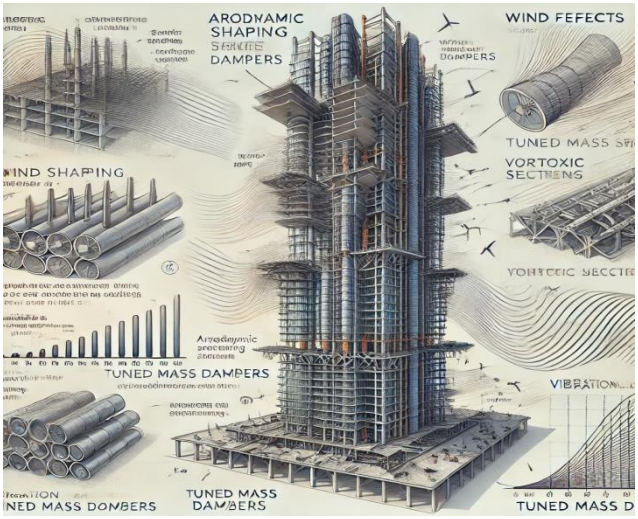

Figure 2.2 Wind load effect on high rise building

Lastly, incorporating **aerodynamic building designs** that reduce wind drag and lateral pressures can significantly lower wind-induced stresses on high-rise structures. By integrating these methods, high-rise buildings can achieve improved performance, increased durability, and enhanced safety in the face of seismic and wind loads, paving the way for more resilient urban infrastructure.

4.CONCLUSION

In conclusion, controlling seismic and wind effects on high-rise buildings requires a combination of advanced technologies, innovative materials, and efficient design strategies. Integrating systems like tuned mass dampers, base isolation, and smart materials can significantly enhance a building's resilience. By adopting these methods and updating structural codes, we can ensure safer, more durable high-rise buildings capable of withstanding extreme natural forces.

REFERENCES

1.https://onlinelibrary.wiley.com/doi/10.1155/2020/8850688

2.https://www.sciencedirect.com/science/article/abs/pii/S2210670717305 94

3. http://eprints.utar.edu.my/3759/1/1600469_FYP_Report_-_YEE_JIN_TAN.pdf

4. https://www.nature.com/articles/s41598-023-46207-8

5.https://www.iitk.ac.in/nicee/wcee/article/WCEE2012_1281.pdf

6.https://ascelibrary.org/doi/abs/10.1061/(ASCE)0733-9445(2008)134:7(1139)

7. WAYNE SEAMES

8. LIMIT STATE DESIGN OF STEEL STRUCTURE (S. K. DUGGAL)

9. SEISMIC ANALYSIS OF STRUCTURE (T.K. DATTA)

10. SEISMIC HAZARD AND RISK ANALYSIS (JACK W. BAKER)