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A Review on Wind and Seismic Analysis of RCC Building

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Abstract-This review paper provides a comprehensive analysis of the state-of-the-art methodologies and advancements in the field of wind and seismic analysis applied to Reinforced Concrete (RCC) buildings. With a growing emphasis on resilient and sustainable infrastructure, understanding the dynamic behavior of structures under wind and seismic loads is imperative. The review synthesizes key research findings and methodological developments, offering a valuable resource for engineers, researchers, and practitioners involved in the design and analysis, of RCC buildings.

Keywords-Wind analysis, seismic analysis, RCC building.

I. INTRODUCTION

The structural integrity and performance of Reinforced Concrete (RCC) buildings are paramount considerations in the face of natural disasters such as earthquakes and severe wind events. As the global population continues to concentrate in urban areas, the vulnerability of infrastructure to these dynamic forces becomes a pressing concern. Wind and seismic analyses are integral components of the design and evaluation process for structures, especially in regions prone to these hazards. In the realm of civil engineering, the design and analysis of structures play a pivotal role in ensuring the safety and resilience of the built environment.

Reinforced Concrete (RCC) buildings, being fundamental components of our urban landscape, face constant exposure to dynamic forces, particularly those induced by wind and seismic activities. The natural environment is dynamic, subjecting structures to a myriad of forces that can challenge their stability and integrity. Wind, with its unpredictable nature, exerts lateral loads on structures, while seismic events introduce complex ground motions. The challenges lie in understanding and predicting how these forces interact with the unique properties of reinforced concrete, a material celebrated for its versatility and strength. As urbanization intensifies, the need for structures that can withstand these forces becomes increasingly urgent. Over the years, the engineering community has responded to the challenges posed by wind and seismic forces by developing and refining design codes and standards. These guidelines serve as the foundation for structural engineers, providing a framework for the safe and efficient design of RCC buildings.

The evolution of these codes reflects a deeper understanding of structural behavior under dynamic loads, emphasizing the importance of adaptability and resilience in the face of changing environmental conditions. The performance of RCC buildings under wind and seismic forces is intricately linked to the material properties of concrete and the detailing practices employed in construction. From the selection of appropriate reinforcement to the meticulous detailing of connections, each decision influences the overall structural response. The wind and seismic analysis of Reinforced Concrete buildings stands at the

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forefront of contemporary structural engineering challenges. This study provides a comprehensive overview of the complexities involved, from the fundamental principles governing structural responses to the evolution of design standards, material properties, numerical modeling, and practical mitigation strategies. As we strive for resilient and sustainable urban infrastructure, understanding the dynamic interplay between RCC buildings and their environment becomes not only a scientific pursuit but a crucial endeavor for ensuring the safety and longevity of the structures that shape our communities.

II. WIND ANALYSIS

Wind is essentially a motion of the air from high-pressure areas to low-pressure areas to equalize the pressure. The wind effects on structures are complex. However, and in order to improve design methods for buildings and structures, these wind effects also need to be simplified. For example, wind velocity and direction are rarely constant in a wind occurrence. In certain situations, wind can change speed and direction very quickly. Building codes and guidelines usually allow for various construction approaches depending on the form of building or structure in consideration.

In some cases, it is appropriate to implement some simpler design procedures. Wind direction and velocity can be considered to be constant in these procedures. Wind direction is also seen as horizontal, leading to lateral forces on buildings. In some other situations, buildings and structures must be constructed using the wind tunnel procedure by making reduced-scale models of the structure and testing these prototypes in the wind tunnel facility. The general procedure for designing buildings for wind forces is to consider the effect of wind in the form of pressure applied to various building surfaces. These wind pressures are then translated into wind forces applied to structural members that must be engineered to withstand these forces. For engineering structures wind load is one of the necessary design loads for high rise structures. For tall high-rise buildings and structural design depends on the wind load as its dynamic in nature. because the impact of wind load on tall structures is distributed over the broader surface and also the intensity of the load is additionally high. In general, for the proposition of tall structures, both wind as well as seismic loads should be considered. As per IS 875(Part 3):1987, wind associates with a structure, every positive and negative pressures happen at the same time, the structure ought to have adequate strength to resist the applied loads from these weights to prevent wind attracted building failure.

Load applied on the structure is moved to the structural system then passing through the footing and finally moved to the ground. Lateral loads due to wind which that performing on multi story building will cause shake in the higher stories. This might be impact caused due to wind at higher stories because the wind intensity is increasing with graduating heights. Thus, the multi-story building conjointly act as a portal frame the instant concentrating at base due to lateral wind forces are bigger. Thus, it’s necessary to nullify displacement in lateral direction by appropriate design.

III. EFFECT OF WIND LOAD ON STRUCTURE

Wind load refers to the force exerted by wind on a structure. It is a critical consideration in the design and construction of buildings and other structures, especially in areas prone to strong winds. Here are some key effects of wind load on structures:

1. Structural Integrity-Wind load can cause structural elements like beams, columns, and walls to experience bending, shear, and torsional forces. If these forces exceed the structural capacity of the material, it can lead to deformation or failure.

2. Stress Distribution- Wind load affects different parts of a structure in varying degrees. For example, the windward side typically experiences higher pressures, while the leeward side may experience suction forces. This non-uniform load distribution must be considered in the design.

3. Vibrations and Oscillations- Strong winds can induce oscillations or vibrations in a structure. If these vibrations reach a critical level, they can lead to discomfort for occupants and, in extreme cases, structural damage.

4. Dynamic Effects: Wind loads are dynamic, meaning they can change with time and direction. Gusts, turbulence, and changing wind patterns can lead to fluctuating forces on the structure.

5. In some cases, the natural frequency of a structure can align with the frequency of the wind, causing resonance. This can amplify the effects of wind load and potentially lead to structural failure.

6. Fatigue and Material Degradation-Repeated exposure to wind load can lead to fatigue in materials over time. This is especially important for structures in areas prone to frequent high winds.

7. Foundation and Anchoring-Wind load affects the foundation and anchoring system of a structure. It must be designed to withstand the uplift and lateral forces exerted by the wind.

8. Cladding and Envelope Systems-The outer shell (cladding) of a building is directly exposed to the wind. Proper design and attachment are crucial to prevent wind-driven rain or debris from entering the building.

9. Overturning and Sliding-Wind can exert overturning moments and lateral forces on a structure. These must be counteracted by proper design of the foundation and structural connections. Local Effects: Certain features of a building, such as parapets, can create localized areas of higher wind pressure. These need to be carefully designed to prevent damage.

10. Aerodynamic Design Considerations-The shape and orientation of a building can influence how wind interacts with it. Aerodynamic features and windbreaks can be used to mitigate wind effects.

IV. SEISMIC ANALYSIS

The latest version of seismic zoning map of India given in the earthquake resistant design code of India [IS 1893 (Part 1) 2002] assigns four levels of seismicity for India in terms of zone factors. In other words, the earthquake zoning map of India divides India into 4 seismic zones (Zone 2, 3, 4 and 5) unlike its previous version which consisted of five zones for the country. According to the present zoning map, Zone 5 expects the highest level of seismicity whereas Zone 2 is associated with the lowest level of seismicity. Table I shows the Zone factors.

Table 1: Zone Factor

Zone Factor	
Zone Type	Zone Factor
V	0.36
IV	0.24
III	0.16
II	0.1

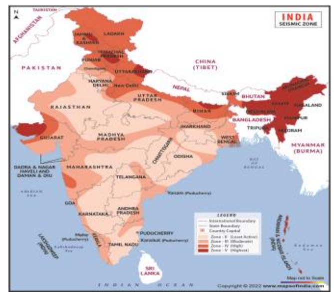

Fig 1: Seismic Zone of India

V. LITERATURE REVIEW

1.Kurlapkar et, al. (2023): High rise structures needs to be designed and constructed with lateral load resisting system in order to keep the structure stable when lateral loads are applied to them. For tall building bracing and fluid viscous damper has been used to stabilize the building. The bracing and fluid viscous damper is efficient technique used to reduce the displacement and drift.

In this work a g+15 story steel building has been modeled using x bracing and fluid viscous dampers, analyzed for seismic zone IV as per IS 1893: 2016 in ETAB software. The results obtained from lateral load resisting system were compared with conventional building. In this study it has been found that structure with bracing system at core of the structure perform well in terms of drift and displacement.

2. Faruk et al. (2023) focused on a comparison of two energy dissipators- a) buckling restrained bracing (BRB) and b) fluid viscous damper (FVD) used in an RCC structure following pushover analysis to produce a pushover curve and evaluate structural performance. Four Ground floor + 14 (G + 14) storey RCC structures were created according to Indian Standard (IS) provisions in Extended Three-Dimensional Analysis of Building System (ETABS) software and applied BRB and FVD separately in diagonal and inverted V shapes. To compare structural responses with BRB and FVD independently, the results of the diagonal and inverted V systems have been explored.

All the data were acquired by utilizing response spectrum sources developed under IS 1893:2016 following ASCE 41–13 NSP graphical display for static pushover curve in ETABS. It has been determined that the sample BRB has performed more admirably than FVD in both circumstances while using a diagonal and inverted V bracing system. But in large displacement FVD tends to increase performance. BRB is stiffer than FVD, allowing it to be used to raise the structure's stiffness as needed. It is essential to consider the seismic weight of BRB and FVD while designing a new building or retrofitting and restoring a structure.

3. Tiwari and Singh (2021) checked that how many ways bracing can be applying on the structure that drift and displacement value give should be minimum and enhancing the lateral resisting capacity of the structure. In high rise building due to earthquake load and wind load failure of chances is the maximum. Structural engineer always try that the how to minimize failure of chances. Different type methods are developing whose structure failure not occurs during earthquake. This chapter deal with one method name retrofitting with X type bracing. For finding the minimum value of some parameter like drift and displacement do the analysis of structural system. Retrofitting structure with x type bracing placed on different-Different span, we'll analysis for all case.

4. Shirisha (2022) studied the reduction in responses of a structure under lateral loading due to the incorporation of different bracing systems. In this study a G+20 building structure of plan area 10.5m X 9m is analysed under earthquake load in zone IV by placing different bracing systems at different locations. The analysis is performed in ETABS by using the response spectrum method. The bracing systems considered are inverted V, and Vand X bracings. These bracings are placed at the centre and outer bays of the building. From the analysis of the buildings with different bracings storey displacements, storey drifts, storey shears and overturning moments are evaluated. These results are evaluated for the load combination (1.2DL+1.2LL+1.2EQ X). Because of seismic loading a building normally experiences lateral as well as torsional displacement under seismic loading Bracing system in any form increases the overall stiffness of the system and hence acts as a control mechanism for both lateral and torsional movement of the structure.

5. Arora (2019) analysed a 20 story reinforced concrete building has been modeled in standard package ETABS 2016 for the purpose of study. Total of 6 models have been made, bare frame, bracing with its type and fluid viscous damper. Also equivalent static and linear response spectrum analysis have been performed to capture accurate response of structure. For seismic efficiency base shear, time period and lateral deflection of each model have found and compared with each other.

6. Autade (2021) solved practical problems and to comprehend real characteristics of soils and construction having BRB also without BRB designs, 12 models were developed utilizing different forms of bracing and soil types. It includes X bracing, V bracing, Y bracing, and bracing without BRB, as well as three types of soil: sand, silt, and clay, each of which will produce four models, for a total of 12 models. Buildings with a height of 21 meters and seismic zone 4 have been considered. The earthquake load combination will be based on multi-story steel frames with and without BRBs. It is studied using ETABS17 and linear dynamic analysis. The results show how various characteristics of the structure, such as story displacement, story drift, story stiffness, and story shear, change in response to seismic excitation and seismic forces. According to the findings, story displacement, story drift, and story stiffness all vary dramatically when the soil type varies, and different forms of BRB help significantly to withstand distortion. As a result, soil structure interaction in combination with X BRB must be favored over seismic excitation.

IV. SUMMARY

By studying the various literature regarding wind loads on RC framed building.The following details present a brief summary of the literature.

- By studying various research paper, wind load values get increased with theheight of structure.
- Wind effect gets reduced with reduction in aspect ratio.
- For tall structures wind loads were found to be more critical than earthquakeloads.
- Wind load acting on structure not only depends on wind velocity and turbulencebut also, on shape of building.
- Displacement and inter story drift increases with increase in ground slope

REFERENCES

1. Kurlapkar, R., Chougale, R., Mujawar, A., Shinde, K., & Patil, A. (2023, May). Comparative study of seismic response for steel building using steel bracing system and fluid viscous damper system. In AIP Conference Proceedings (Vol. 2716, No. 1). AIP Publishing.
2. Faruk, M. O., Singh, S. K., & Mondal, S. (2023). Comparative study of buckling restrained braces and fluid viscous damper applied in an RCC structure following pushover analysis. Materials Today: Proceedings.
3. Tiwari, S. K., & Singh, R. (2021). Seismic Retrofitting of Existing Multistory Building with Bracing.
4. Shirisha, C., Harshitha, A., & Rekha, K.(2022) Analysis Of Industrial Steel Structure By Using Bracing And Damper Under The Wind Load And Earthquake Load.ISSN: 2057-5688, Volume XIII, Issue IV, http://ijte.uk/ 131.
5. Arora, S. (2019). Optimization of bracing and viscous damper and comparison of fluid viscous damper and bracing system for stabilization of high rise building. Int. J. Civ. Eng. Technol, 10, 1978-1986.
6. Autade, M. M. L. P. P. (2021). Dynamic Analysis Of High Rise Normal And Unsymmetrical Steel Building With Eccentric Bracing System. International Journal, 6(6).
7. Al-sabaeei, M. S., Dabhekar, K. R., &Khedikar, I. (2023). State of art on seismic comparison of different types (V, diagonal and X) of bracings on different shapes of buildings (L, H, T and rectangular) with response spectrum method. Materials Today: Proceedings.
8. Rajput, P. S., &Satbhaiya, R. (2022). Analysis of a Tall Structure Considering Two Different Type of Dampers Using Analysis Tool.
9. Choudhary, J., &Khare, D. G. (2018). Comparative Study and Analysis of Unbraced RCC Framed Structure with Steel Braced RCC Framed Structure using Response Spectrum Method. International Journal of Scientific and Engineering Research, 7(8), 120-132.
10. Trivedi, M., Doshi, A., Koshy, K. S., & Mohan, S. C. (2022, December). Comparative Study on Seismic Performance of Existing Building with and without Retrofitting Using Lateral Load Resisting Systems. In ASPS Conference Proceedings (Vol. 1, No. 3, pp. 807-814).
11. Takey, Manish S; Vidhale, S S. International Journal of Electronics, Communication and Soft Computing Science & Engineering (IJECSCSE); Amravati Vol. 2, Iss. 1, (Apr 2012): 17-25.
12. Divya C. Bhuta, Umang Pareekh "Comparative Study on Lateral Load Resisting System in Tall Building"IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue 11 | May 2016 ISSN (online): 2349-784X
13. Ankur Agrawal, K. Divya, Lokesh Singh "Analysis of Lateral Load Resisting Systems for High Rise Building Frame Considering Utilization of Analysis Tool A Review"Volume 4, Issue 6 Page Number: 39-45 Publication Issue : November-December2020.
14. Yogesh Dudhe, Dr. Swati Ambadkar, Comparative Analysis of Different Lateral Load Resisting System for High Rise Building "International Journal for Research in Applied Science & Engineering Technology (IJRASET)" ISSN: 2321-9653; IC Value: 45.98; SJ Impact

Factor: 7.429 Volume 8 Issue VI June 2020-Available at www.ijraset.com © IJRASET: All Rights are Reserved 1571.
15. Abdul Karim Mulla, Srinivas B. N, A Study on Outrigger System in a Tall R.C Structure with Steel Bracing. International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERTV4IS070459 www.ijert. Vol. 4 Issue 07, July-2015.
16. Shah, Z. A., &Satbhaiya, R. (2022). Analysis of Twisted Tall Structure Considering Lateral Load using ETABS.
17. Gurung, L., Dema, Y., Wangmo, U., Chhetri, M., &Choden, Y. Case Study on Structural Performance of various Bracings in Steel Frame of Buildings (2020).
18. Safai, A. J. (2001). Analytical studies of a 49-storey eccentric braced building (Doctoral dissertation, University of British Columbia).