



# STATE OF ART: USING THE FINITE ELEMENT METHOD TO ANALYSIS THE EFFECT OF WIND LOAD IN MULTI-STORY BUILDING

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## ABSTRACT

*In several places throughout the world, tall, narrow buildings have become more prevalent in recent years. Tall buildings may experience dynamic excitation from wind influences, which often determine the structural design for strength, stability, and serviceability. Wind is a very complex phenomena that can produce a wide range of flow scenarios depending on how it interacts with structures. Important correlations between wind speeds and moments, forces, and displacement are found through investigation. Based on each variation's percentage of opening, the displacement, moments, and forces obtained from each scenario are compared to wind speeds. The topography and terrain of the region, the kind of wind, the dimensions and form of the structure, and the dynamic properties.*

**Keywords:** Tall Buildings, Wind Excitation, Structural Design, Dynamic Properties, Wind-Structure Interaction

**Cite this Article:** Zahraa Rafea Naji and Prof. Dr. Hussam Ali Mohammed, State of Art: Using the Finite Element Method to Analysis the Effect of Wind Load In Multi-Story Building, Journal of Civil Engineering and Technology (JCIET). 10(1), 2024. pp. 30-33.

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## INTRODUCTION

And narrow have become more common in numerous places across the globe in recent years. Tall structures are vulnerable to wind-induced dynamic excitation, which usually dictates the structural design for strengthened robustness, stability, and suitability. Because wind interacts with things in so many different ways, it is a very complex phenomenon. Significant relationships between moments, forces, and displacement with wind speeds can be found through analysis.

In each example, the displacement, moments, and forces are compared with the wind speed based on the percentage of opening allowed for different variations. (2) the location's terrain and topography, the type of wind, the building's size and shape, and its dynamic qualities all affect the wind force (3) finite element methods, which are today widely employed in both academia and industry. The basic formulation is offered, a broad description of the approach is given, and various concerns related to efficient finite element processes are compiled. A few examples of contemporary applications are provided to show how the approach is being used (4).

## LITERATURE REVIEW

According to Fangwei Hou and Muhammad Jafari (5), resonant wind load occurs when a variable wind's frequency aligns with the inherent frequency of tall buildings. This phenomenon has the potential to greatly increase the amount of structural vibration. It is commonly acknowledged that resonant wind loads, torsional vibration, along-wind vibration, and across-wind vibration are the three components. Need to be taken into account when designing a building, and the significance of a specific component depends on the building type.

S.A. Raji\*[6] he found the study revealed that the first floor had lowest wind load of 112N/m<sup>2</sup> while the last floor (roof) had the highest value of 272 N/m<sup>2</sup> with displacement, shear force and bending moment value of (0.0086m) and 103.2445kN and 191 kNm respectively. Conclusively, must be considered while designing a structure, and the importance of a certain component varies depending on the type of building.

S.A. Raji \*[6] discovered According to the study, the wind load on the first floor was the lowest at 112 N/m<sup>2</sup>, while the wind load on the roof, the last floor, was the highest at 272 N/m<sup>2</sup>. The displacement, shear force, and bending moment values were (0.0086m), 103.2445kN, and 191 kNm, respectively. In summary,

A.O. Ibrahim [7] The soil produces a resistive force when wind blows across a building. force that is parallel to the direction and speed of motion. This incident leads to the air's velocity to zero. This implies that the ground floor of a building will be less impacted by wind than the upper floors.

A.Y. Shehata [8] provided a thorough numerical model that may be used to forecast how a transmission tower will behave structurally when subjected to downburst loading as part of a transmission line system. A computational fluid dynamic model that was previously created and approved serves as the foundation for the temporal history of the downburst wind data. The method for converting the velocity wind data to forces and scaling them is explained.

El Damatty, A.A. [9] Wind loads continuously dictates transmission line structure design. The wind loads that are incorporated into the majority of standards, guidelines, and design suggestions for transmission line design, When intense downdraft air strikes the ground, it creates a powerful wind that blows in all directions. This phenomenon is known as a downburst. Smaller and more concentrated downbursts, up to 4 km in size, are known as microbursts. In reference to the structural nonlinearity that transpired,

Alireza Mohammadi [10] suggested a remarkably strong lateral capacity, yet he corroborated the Poor serviceability performance at different wind loading levels.

According to research by Abdoulhakim Souhaibou [11], symmetrical buildings outperform asymmetrical ones. Symmetrical structures, such as frame structures, are strongly recommended when the position of the structure is subject to wind loads. The equivalent static wind loads on conventional structures were covered by Wang et al.

According to Ling-zhi Li [12], lateral load actions of RC frame structures are a probabilistic process; therefore, while designing a building, one should give special consideration to wind and earthquake loads in addition to dead and live loads. This is due to the fact that wind and seismic load actions are influenced by a wide range of elements, including geographical and environmental ones.

It is impossible to forecast with precision which forces will prevail during the structure's existence.

According to Vikrant Trivedi [13], research has been done on the relationship between wind speed and the structural reaction of a building frame on a sloping site. Examining different frame configurations. Wind and static load combinations are taken into account. Ten instances in various wind zones are examined for combination. For analysis purposes, STAAD-Pro v8i software has been utilized. Findings are gathered to measure the impacts of different structural heights, axial force, shear force, moment, storey-wise drift, and displacement are all rigorously examined.

According to Yi Li [14], wind loads operating on structures can be classified into torsional moment, along-wind, and across-wind loads. In the frequency domain, the time-varying wind loads in each direction can be broken down into mean, background, and resonant components by accounting for the dynamic amplification of fluctuating winds [46]. The wind loads' static effect is the mean component. The background component that is almost static has no bearing on the dynamic.

## REFERENCES

- [1] Yousef Abu-Zidan, Priyan Mendis, Tharaka Gunawardena, Damith Mohotti, 2022, Wind Design of Tall Buildings: The State of the Art, DOI:10.56748/ejse.2233101
- [2] Swati Ambadkar, Vipul S. Bawner, 2012, Behaviour of multistoried building under the effect of wind load, DOI:10.6088/ijaser.0020101066
- [3] Ashish Padiyar<sup>1</sup>, Vipin Verma, 2020, Effect of Wind Load on High Building with Different Aspect Ratio Using Staad Pro, International Research Journal of Engineering and Technology (IRJET)
- [4] Klaus-Jürgen Bathe, 2008, Finite Element Method, <https://doi.org/10.1002/9780470050118.ecse159>
- [5] Fangwei Hou, Mohammad Jafari, 2020, (Investigation approaches to quantify wind-induced load and response of tall buildings: A review), <https://doi.org/10.1016/j.scs.2020.102376>
- [6] S.A. Raji\*2016, Investigating the Effect of Wind Load On MultiStorey Building, Journal of Multidisciplinary Engineering Science and Technology (JMEST) ISSN: 2458-9403
- [7] A.O. Ibrahim, 2016, Investigating the Effect of Wind Load On MultiStorey Building, Journal of Multidisciplinary Engineering Science and Technology (JMEST) ISSN: 2458-9403

- [8] A.Y. Shehata, 2005, Finite element modeling of transmission line under downburst wind loading, <https://doi.org/10.1016/j.fincl.2005.05.005>
- [9] A.A. El Damatty, 2005, Finite element modeling of transmission line under downburst wind loading, <https://doi.org/10.1016/j.fincl.2005.05.005>
- [10] Alireza Mohammadi, 2018, Performance Assessment of an Existing 47-Story High-Rise Building under Extreme Wind Loads, [https://doi.org/10.1061/\(ASCE\)ST.1943-541X.0002239](https://doi.org/10.1061/(ASCE)ST.1943-541X.0002239)
- [11] Abdoulhakim Souhaibou, 2023, A comparative study on the lateral displacement of a multi-story RC building under wind and earthquake load actions using base shear method and ETABS software, <https://doi.org/10.1016/j.matpr.2023.04.287>
- [12] Ling-zhi Li, 2023, A comparative study on the lateral displacement of a multi-story RC building under wind and earthquake load actions using base shear method and ETABS software, <https://doi.org/10.1016/j.matpr.2023.04.287>
- [13] Vikrant Trivedi, 2018, Wind Analysis of Multistory Building: A Review, International Research Journal of Engineering and Technology (IRJET)
- [14] Yi Li, 2020, Wind-resistant optimal design of tall buildings based on improved genetic algorithm, <https://doi.org/10.1016/j.istruc.2020.08.036>

**Citation:** Zahraa Rafea Naji and Prof. Dr. Hussam Ali Mohammed, State of Art: Using the Finite Element Method to Analysis the Effect of Wind Load In Multi-Story Building, Journal of Civil Engineering and Technology (JCIET). 10(1), 2024. pp. 30-33

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