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Seismic and Airstream Examination of Many-Storey Construction by T, L Figure

[1]Name of 1st Kartik Patel

[1]Designation of 1st Asst Prof.
[1]Name of Department of 1st Civil Dept.
[1]Name of organization of 1st Gokul Global University, Sidhpur, India.

Abstract : In structural engineering, evaluating the seismic and wind performance of multistory buildings with T- and L-shaped geometries is a challenging but crucial problem. The stability and safety of such structures can be significantly impacted by both seismic and wind loads. It takes a thorough engineering strategy to perform seismic and wind assessments for multi-story structures with T- and L-shaped geometries. Determining the structure's geometrical features and material attributes is an essential first step in both situations. It takes a thorough engineering strategy to perform seismic and wind assessments for multi-story structures with T- and L-shaped geometries. Determining the structure's geometrical features and material attributes is an essential first step in both situations. In this research, wind and seismic.

***IndexTerms* - Seismic, Airstream Examination, Many-Storey Construction, T, L Figure.**

INTRODUCTION

In structural engineering, evaluating the seismic and wind performance of multistory buildings with T- and L-shaped geometries is a challenging but crucial problem. The stability and safety of such structures can be significantly impacted by both seismic and wind loads. It takes a thorough engineering strategy to perform seismic and wind assessments for multi-story structures with T- and L-shaped geometries. Determining the structure's geometrical features and material attributes is an essential first step in both situations.

It takes a thorough engineering strategy to perform seismic and wind assessments for multi-story structures with T- and L-shaped geometries. Determining the structure's geometrical features and material attributes is an essential first step in both situations. The use of pertinent design codes, such ASCE 7 or Eurocode 8, is then necessary to guarantee adherence to wind and earthquake requirements. The behavior of the building under seismic and wind loads is then accurately represented by structural modeling utilizing finite element analysis software. In seismic analysis, the structure's reaction to ground motion is evaluated using dynamic analytic.

To confirm that the building satisfies safety and performance requirements, the findings from both assessments must be carefully reviewed, taking into account elements such as member forces, interstory drift, and foundation design. A strong and durable multistory building with T-shape or L-shape geometry is a result of iterative design refinement, adherence to building codes, and thorough documentation of the analysis and design choices. The need to account for the structure's dynamic response to ground motion makes seismic analysis of multistory buildings with T- and L-shaped geometries more difficult. The distribution of mass and stiffness throughout the structure must be captured by the structural model in order to accurately represent the behavior of both vertical and lateral load-resisting components.
The selection of historical or synthetic ground motion recordings is based on the seismic threat to the area. The goal of the dynamic analysis is to forecast the internal forces, accelerations, and displacements of the structure over time. The results are then carefully examined to make sure the building meets performance goals, like preventing excessive displacements and minimizing interstory drifts. Because the study guides the selection of suitable foundation types and dimensions to effectively limit seismic stresses, foundation design issues become crucial. However, careful consideration of wind loads and their distribution is necessary for wind analysis of T-shape and L-shape structures. The geometry of the structure greatly affects the wind pressures on its surfaces, necessitating careful modeling.
Important inputs for calculating these loads include wind directionality, wind speed, and other meteorological variables. Static or dynamic analysis techniques are used by structural engineers to assess how wind forces affect the structure. This entails evaluating how loads are distributed across different structural components and examining how this affects the building's overall performance and stability. To make sure the structure can sustain wind-induced forces without suffering from severe deflections or structural damage, the results are closely scrutinized.

Given both earthquake and wind forces can work concurrently and interact, a comprehensive strategy is essential when taking both into account. For the building's structural integrity to be guaranteed under all applicable loading circumstances, the cumulative impacts must be carefully assessed. Iterative design procedures could be required to guarantee adherence to building codes and improve the structural components. The safety and resilience of multistory buildings with T-shape or L-shape geometries are primarily ensured by the thorough documentation of the whole analysis and design process, which serves as a foundation for reviews and future revisions.

LITERATURE SURVEY

According to Bharatbhai, N. K., Dubey, P., & Hardiya (2022), these tall buildings are positioned under a fundamental wind speed of 39 m/s and have an L-shaped, 20-story construction layout. Four examples have been examined in total using Staad pro software. The plan's dimensions differ from those of both projections, which apply wind in all four directions. All of the models' outcome parameters, including displacements, drift, axial forces in columns, and shear in beams in both longitudinal and transverse directions, are compared, and recommendations are given for the optimal site.

Li, Y., Deng, Y., Li, A., & Xu, T. (2023) show that it is reasonable and feasible to estimate wind pressure using the Realizable k-ε turbulence model and to simulate the pagoda's CFD geometry using Revit. The more the LoD model, especially on the leeward side of the pagoda, the better the CFD results match the wind tunnel test results. The building's ridges, columns, railings, and other structural features all have a significant impact on the wind field. Rather, the hidden components of the architectural shape, such as Dougong, barely change the wind field. This study aims to enhance our comprehension of the CFD simulation while analyzing wind impacts and structural safety on a tall wooden pagoda utilizing multi-LoD geometric models.
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An summary of earlier studies on the seismic and wind analysis of multi-story buildings with a variety of intricate and irregular plan forms is given by Patidar, G., & Pandey, A. (2022). In addition, wind speed, seismic zone fluctuations, and the effect of shear walls are taken into account. Methods used by different researchers to evaluate seismic and wind data for structures of different shapes are reviewed. This study investigates the effects of plan shape on a number of variables, including axial force, moments, base shear, storey shear, soft storey, lateral displacement, and storey drift.

The ground floor stiffness and seismic response of non-uniform reinforced concrete buildings with and without shear walls were investigated by Kumawat, K., Gupta, T., Shekhawat, R. S., & Agrawal, Y. (2024). A ten-story regular frame is modified to create vertical irregularity in elevation by elevating the ground level. The complete structural analysis and modeling process is carried out using the ETABS 2020 application. Seismic zones V in India are the subject of the study, which use the Time History approach. Storey displacement, storey drift, storey shear, and overturning moment are among the measures used to compare the performance of different structures. According to the results, a building structure with uneven stiffness is more prone to become unstable, as seen by higher drift and displacement values.

Malge, A., and Belvekar, A. (2024) comprehend how the wind booster behaves at various frequencies. The full numerical analysis is done using ANSYS SAMCEF software. The maximum and minimum stress are estimated using the von Mises stress model. The highest defection in vertical deflectors is 9.75×10^{-3}, and the maximum stress created is 4.64 MPa. Von Mises stress has been analyzed analytically and numerically for wind booster deflectors, and the results show good agreement with other studies.

In their 2018 study, Sadh, A., and Pal, A. investigate how tall buildings respond to wind force in the second wind zone; the L shape is analyzed and assessed at various elevations. The behavior of the structure is also significantly influenced by the wind direction.

Bhole, S., and Ansari, S. J. (2016)These days, anomalies including torsional irregularity, soft story, asymmetrical in-fill wall layouts, vertical and plan abnormalities, etc., are commonly found in most constructions. According to earlier seismic study, most RC structures with these types of defects experienced considerable damage from earthquake-induced ground motion. This paper summarizes the structural integrity of buildings that are subjected to seismic investigation, whether they are symmetrical or asymmetrical, or torsionally balancing or unbalanced. In terms of stiffening distribution, three L-shaped and T-shaped architectural models—one symmetrical and three asymmetrical—are examined. According to IS: 1893-2002[9], these structures are situated in India's seismic zone II on medium soil. Static analysis (with regard to gravitational and seismic stresses).

METHODOLOGY

General

The purpose of this study is to compare a G+10, 15, and 25 story building in order to determine how seismic and wind loads affect RCC structures with L and T shapes. Staad Pro software is used for the modeling and analysis.

Structure

With the overall layout and elevation depicted in figure 1, the G+10, 15, and 25 RCC multistory framed buildings of the L and T shapes are taken into consideration for analysis in order to determine the realistic behavior during an earthquake. Staad Pro is used to model the RCC multi-story framed building. The plan's X and Y dimensions are 10 and 10 meters, respectively. The structures are made up of beams that are 400x300 mm in size and columns that are 500x300 mm for every story. The thickness of the floor slabs is 150 mm. Every storey is 3.5 meters high. SMRF and I=1 are assumed to have a modal damping of 5%. It is believed that the columns are fixed at the base. M30 is the grade of concrete material.

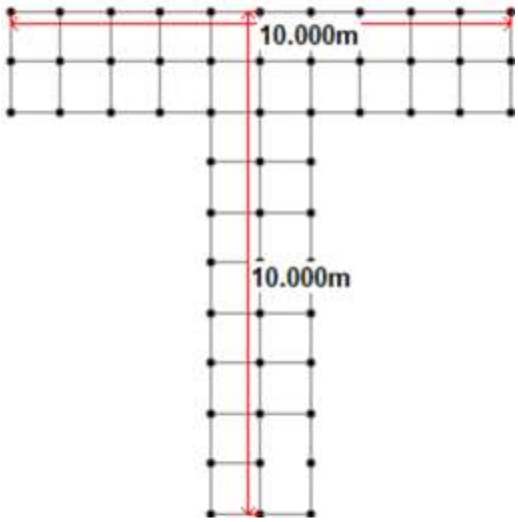

Fig. T-Shape

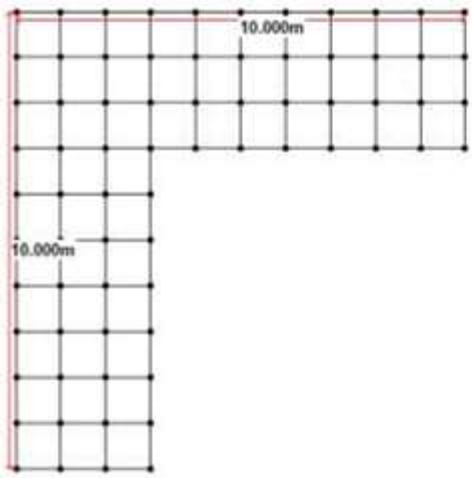

Fig. L-Shape

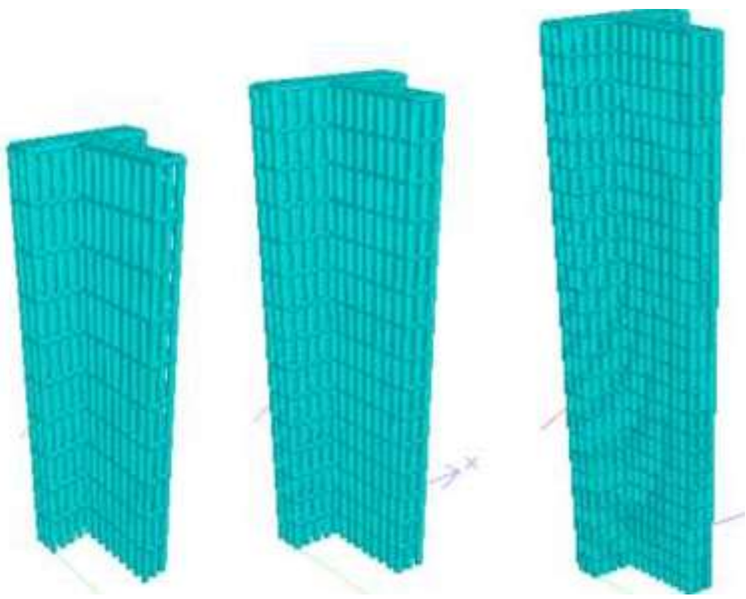

Fig. T-shape structure

Fig. L-shape structure

Geometrical Specifications

Particulars of Item	Properties for L-shape		
Number of Storey	G+10	G+15	G+25
Total height of Structure	35m	52.5m	87.5m
Typical Storey height	3.5m	3.5m	3.5m
Bottom Storey Height	3.5m	3.5m	3.5m
Floor Diaphragm	Rigid	Rigid	Rigid
Beam Size	400x300mm	400x300mm	400x300mm
Beam Shape	Rectangular	Rectangular	Rectangular
Column Size	500x300mm	500x300mm	500x300mm
Column Shape	Rectangular	Rectangular	Rectangular

Geometrical Specifications of the T-Shape Structure

Geometrical Specification			
Particulars of Item	Properties for T-shape		
Number of Storey	G+10	G+15	G+25
Total height of Structure	35m	52.5m	87.5m
Typical Storey height	3.5m	3.5m	3.5m
Bottom Storey Height	3.5m	3.5m	3.5m
Floor Diaphragm	Rigid	Rigid	Rigid

RESULT AND DISCUSSION

Overall Comparison of Seismic load analysis

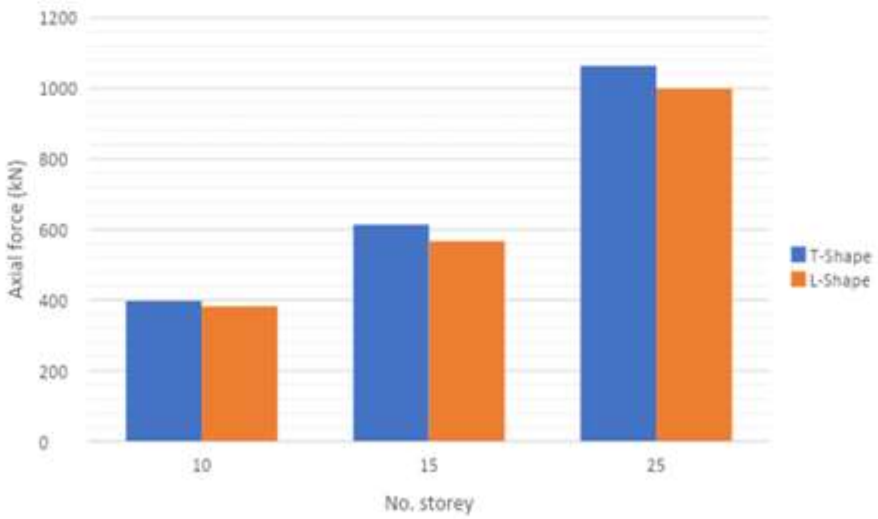

Fig. Comparison of axial force under seismic loading condition

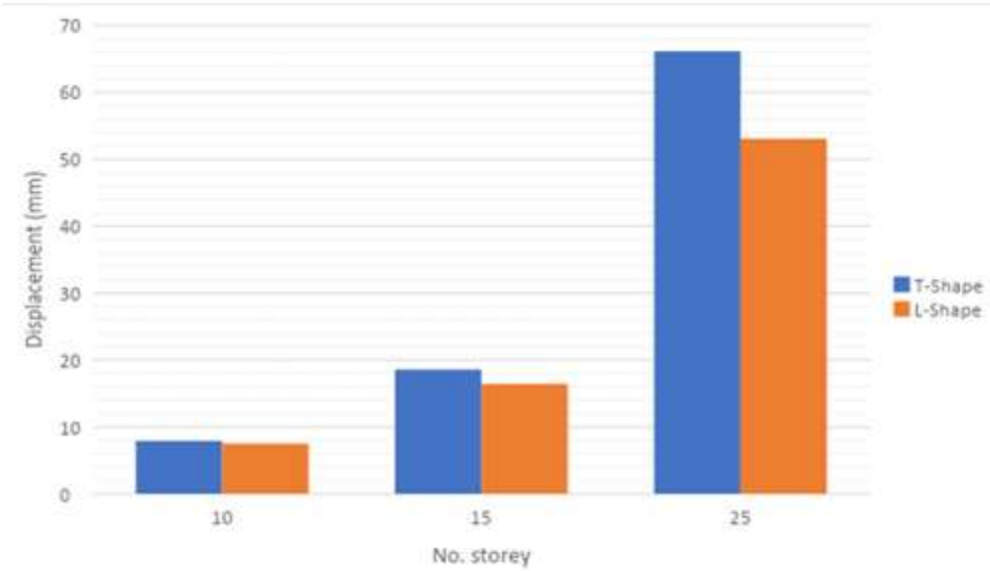

Fig.: Comparison of displacement under seismic loading condition

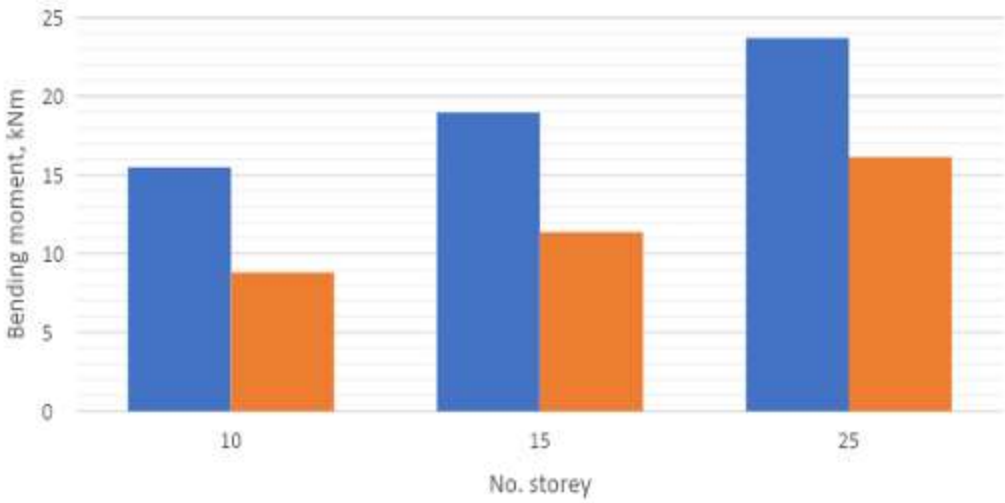

Fig.: Comparison of bending moment under seismic loading condition

In a T-shaped building, the maximum axial force is recorded at 25 and min. In an L-shaped building subjected to seismic loading, axial force is displayed. When a T-shaped building has 25 stories and less, the maximum shear force is seen. Under seismic loading conditions, shear force is seen in L-shaped buildings. When the number of stories in a T-shaped building is 25 and min, the maximum displacement is seen. Under seismic loading circumstances, displacement is seen in L-shaped buildings.

Max. Bending moment is observed in T-shape building when no. storey is 25 and min. The bending moment is shown in an L shape building under seismic loading conditions

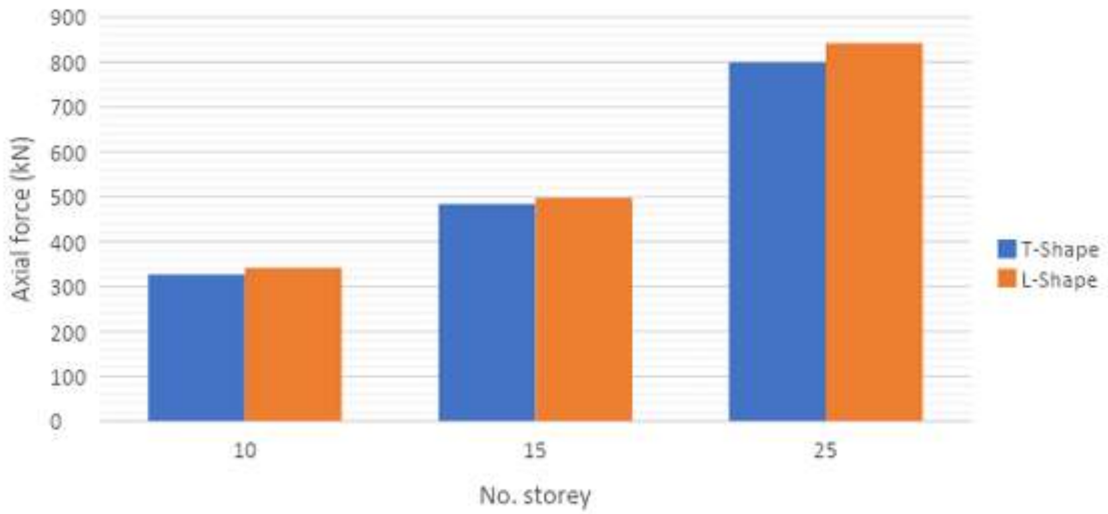

Fig. : Comparison of axial force under wind loading condition

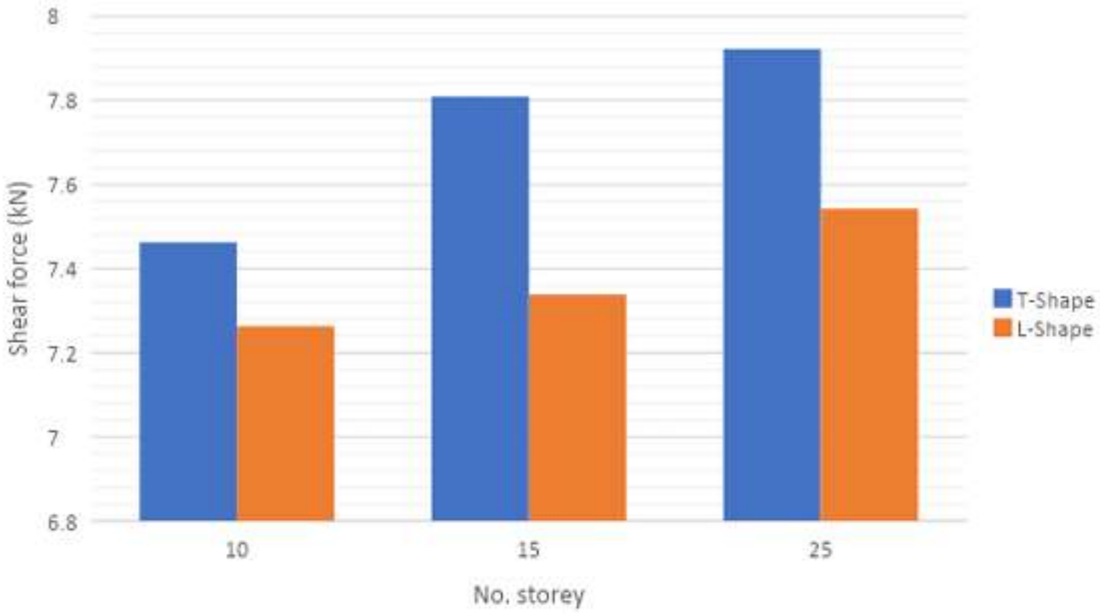

Fig. : Comparison of shear force under wind loading condition

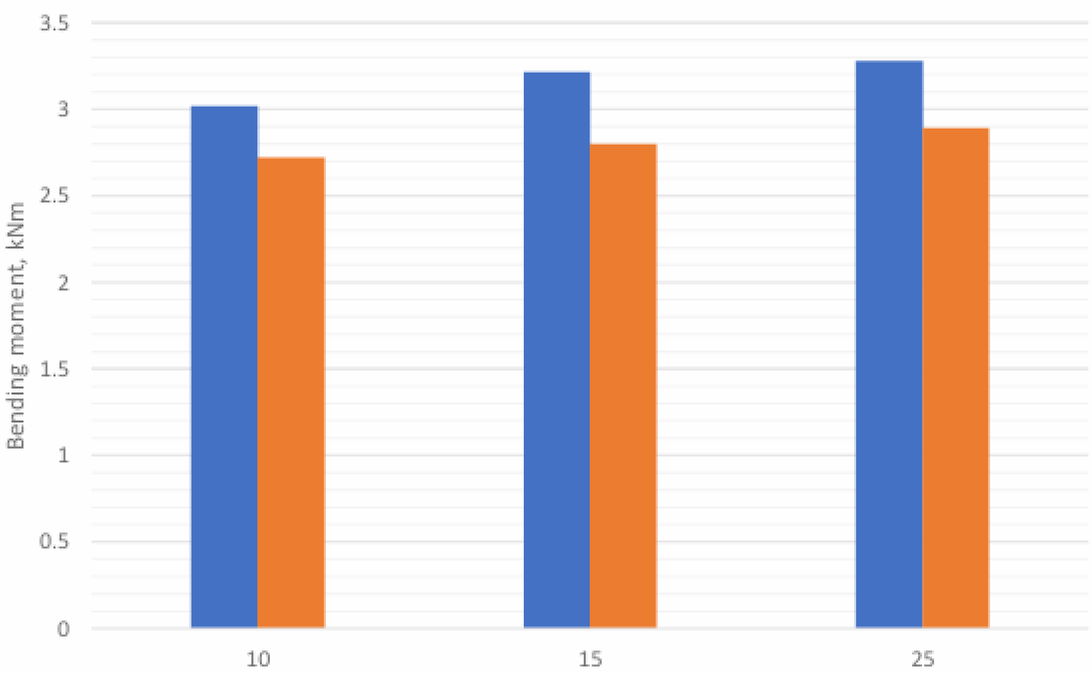

Fig. : Comparison of bending moment under wind loading condition

The effects are the reverse for displacement and axial under wind load conditions. Maximum axial and displacement values are seen in L-shaped buildings, but T-shaped buildings displayed greater values for shear force and bending moment.

CONCLUSION

1. The axial and displacement effects are the reverse under wind load conditions. Maximum axial and displacement values are seen in L-shaped buildings, but T-shaped buildings displayed greater values for V bending moments.
2. In a T-shaped building, the maximum axial force is recorded at 25 and min. In an L-shaped building subjected to seismic loading, axial force is displayed.
3. When the number of stories in a T-shaped building is 25 and min, the maximum shear force is seen. Under seismic loading conditions, shear force is seen in L-shaped buildings.

4. When the number of stories in a T-shaped structure is 25, the maximum displacement is seen, and when seismic loading is applied, the minimum displacement is seen in L-shaped buildings.

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