M.Tech (Structural Engineering) Shubham Sharma 2024

A STUDY ON STRUCTURAL BEHAVIOUR OF HIGH-RISE STRUCTURES AGAINST WIND LOADING FOR DIFFERENT STRUCTURAL SYSTEM

A Dissertation Submitted
in Partial Fulfillment of the Requirement for the Award of the Degree of

MASTER OF TECHNOLOGY

in
Structural Engineering
by

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May, 2024

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that the project report entitled "**A Study on structural behaviour of high-rise structures against wind loading for different structural system",** is the bonafide work of **SHUBHAM SHARMA , 2K22/STE/16** the award of Masters of Technology in Structural Engineering from Department of Civil Engineering, The Delhi Technological University, Delhi. The work has been carried out fully under my supervision. The content and results of this report, in full or in parts has not been submitted to any other institute or university for the award of a degree.

Place: Delhi **(Prof. Pradeep K Goyal)**

Date: **(SUPERVISOR)**

ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the report of the M. Tech Project undertaken during M. Tech. Final Year. We owe special debt of gratitude to "**Dr. Pradeep K Goyal**", Department of Civil Engineering, for his constant support and guidance throughout the course of our work. His sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only his cognizant efforts that our endeavors have seen light of the day.

We also do not like to miss the opportunity to acknowledge the contribution of all faculty members of the department for their kind assistance and cooperation during the development of our project. Last but not the least, we acknowledge our friends for their contribution in the completion of the project.

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ABSTRACT

With an impressive rate of urbanization and migration of population from rural areas to urban areas; the rate of construction of high – rise structures has also increases. The construction of high – rise structures mainly categorized into residential complexes and corporate office buildings. In previous studies, many researchers had analyzed the behavior of high – rise structures with normal configurations, catering the need for the design of tall residential buildings. This study will be focusing on assessing the structural behavior of the high – rise buildings with different structural systems. The vulnerability behavior of six different structural configurations of high – rise structures is determined, by employing the design guidelines mentioned in IS 16700: 2017 and IS 875 (Part III): 2015. Different structural behavior such as deformation, inter story drift and overturning moments has been analysed which are considered as critical parameters in the designing of high – rise structures. A comparative study is presented and suitable recommendation is given for opting the optimum structural system for high – rise structures based on the analyzed data. The outcomes of the study may be contributed towards supporting SDG 09: Industry, Innovation, and Infrastructure; attempt to provide an innovative approach for making the smart infrastructure resilient against wind forces.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

In the ever-evolving landscape of urban development, the proliferation of high-rise structures stands as a testament to human ingenuity and ambition. As these towering edifices reach unprecedented heights, the challenges posed by external forces, particularly wind loading, become increasingly significant. Understanding the structural behavior of high-rise buildings under wind loading is paramount not only for ensuring their safety and stability but also for advancing the frontier of structural engineering. This paper presents a comprehensive study aimed at unraveling the intricate relationship between high-rise structures and wind loading, with a particular focus on evaluating the performance of various structural systems. By delving into this crucial aspect of structural engineering, we seek to provide invaluable insights that can inform the design, construction, and maintenance of high-rise buildings, thereby fostering safer and more resilient urban environments. The structural system employed in a high-rise building plays a pivotal role in determining its behavior under wind loading. Different structural systems, such as moment-resisting frames, shear walls, outrigger systems, and various combinations thereof, exhibit distinct characteristics in terms of stiffness, strength, and energy dissipation capabilities, which influence their wind response . When analyzing wind loads on tall buildings, it's crucial to differentiate between static and dynamic loading, which is determined by the duration over which the load affects the structure. Static loading applies to longer time periods, while dynamic loading pertains to shorter durations In dynamic wind response, the pressure exerted by the wind on the building induces vibrations, which can manifest as sinusoidal or narrow-band random motions. These vibrations occur both in the along-wind direction, which aligns with the wind flow, and the across-wind direction, which is perpendicular to the wind flow. Moreover, the building may undergo rotational motion around its vertical axis as a result of these dynamic forces. This study aims to investigate the structural behavior of high-rise structures under wind loading, with a particular focus on evaluating the performance of different structural systems. Through comprehensive numerical simulations and experimental analyses, the research seeks to provide a deeper understanding of the wind-structure interaction, identify the critical factors influencing the structural response, and develop guidelines for optimizing the design of high-rise structures to enhance their wind resilience. This study correlates the trajectory of the application of various STAADPro and SAP 2000 versions used for analysis and design purposes using ETABS 2020 Ultimate Edition as an analytical tool. Based on an advanced examination of the buildings, the building performance level of the structures is established. Determining the structure's deformation due to lateral loads and gravity loads is part of the advanced analysis stage of the structure.

The relentless advancement in urbanization has led to an unprecedented proliferation of high-rise structures, reshaping city skylines across the globe. These towering edifices, which symbolize the zenith of modern engineering and architectural prowess, are perpetually subjected to formidable natural forces, with wind loading being one of the most critical. As buildings soar to new heights, their interaction with wind becomes increasingly complex, presenting unique challenges that necessitate a profound understanding of structural behavior under these conditions.

This thesis delves into the nuanced response of high-rise buildings to wind loading, focusing on a comparative analysis of various structural systems. These systems, including moment-resisting frames, shear wall systems, braced tube systems, outrigger systems, and diagrid systems, each offer distinct advantages and limitations in mitigating the effects of wind. By scrutinizing these diverse structural configurations, this study aims to elucidate the underlying mechanics and effectiveness of each approach in enhancing the wind resilience of tall buildings.

Moment-resisting frames, known for their flexibility and ability to absorb energy through joint rotation, provide a foundational understanding of structural response but may lack the stiffness required for very tall structures. Shear wall systems, which utilize vertical walls to counteract lateral forces, offer increased rigidity but can impose architectural constraints. Braced tube systems, which incorporate diagonal braces in a tubular framework, deliver enhanced stiffness and load distribution but may be challenging to implement in buildings with irregular geometries. Outrigger systems, which connect the core to the perimeter columns via horizontal outriggers, optimize structural performance by reducing drift and distributing forces more evenly. Diagrid systems, characterized by a network of diagonal elements, present a modern solution that combines aesthetic appeal with superior structural efficiency.

By employing a combination of theoretical analysis, computational simulations, and empirical data, this research seeks to provide a comprehensive understanding of how these systems perform under wind loading. Theoretical analysis will involve the application of fundamental principles of structural dynamics and wind engineering to predict the behavior of each system. Computational simulations, using advanced software tools, will model real-world scenarios to validate theoretical predictions and explore the influence of various parameters on structural response. Empirical data, gathered from case studies and experimental tests, will offer practical insights and validate the findings from theoretical and computational analyses.

Ultimately, this thesis aims to contribute to the body of knowledge in structural engineering by offering a robust framework for optimizing high-rise building design to withstand wind-induced challenges. The insights gained from this research will not only enhance the safety and stability of tall buildings but also inform future architectural and engineering practices, fostering the development of more resilient and innovative urban structures.

1.2 WHAT ARE STRUCTURAL SYSTEM?

High-rise buildings employ a variety of structural systems to ensure stability, strength, and efficiency, each suited to different architectural designs, load requirements, and environmental conditions.

The **rigid frame system** uses beams and columns connected by rigid joints to resist both vertical and lateral loads, suitable for buildings up to about 20 stories due to its simplicity and architectural flexibility. Rigid frame structures consist of beams and columns connected by rigid joints, which transfer moments and shear forces between them. The rigidity of the connections ensures that the structure behaves as a single, unified entity, capable of resisting various loads, including gravity, wind, and seismic forces. The primary advantage of rigid frame systems is their ability to efficiently distribute loads and minimize deflections.

The **shear wall system** consists of reinforced concrete or steel walls that provide significant lateral stiffness, making it ideal for residential and office buildings up to about 35 stories, although it can limit interior space planning. Shear wall systems are critical structural components widely used in high-rise buildings and other structures to resist lateral forces caused by wind, seismic activity, and other environmental loads. These systems significantly enhance the stiffness and strength of buildings, making them essential for maintaining stability and safety in tall structures.

Shear walls are typically constructed from reinforced concrete or steel. They extend vertically throughout the building, from the foundation to the roof, and are strategically placed to optimize performance. Common locations include the building's perimeter, around staircases and elevators, or distributed symmetrically to balance the lateral load distribution.

The **braced frame system** incorporates diagonal braces to create a truss-like structure, effective in reducing lateral displacement for buildings up to 40 stories but potentially interfering with interior spaces. Braced frame structural systems are widely used in construction to enhance the lateral stability of buildings and structures. This system employs diagonal braces to form a triangulated framework, which significantly improves the structure’s ability to resist lateral forces such as wind and seismic loads.

Braced frames consist of vertical columns, horizontal beams, and diagonal braces. The braces can be made from steel or reinforced concrete and are typically arranged in various patterns such as X-bracing, K-bracing, or V-bracing. These braces effectively create a rigid triangular configuration that distributes lateral loads more efficiently throughout the structure

For taller buildings, the **outrigger and belt truss system** enhances lateral stiffness by using horizontal trusses extending from the core to perimeter columns, suitable for buildings up to 70 stories or more but involving complex construction.

The **diagrid system** features a diagonal grid that reduces the need for internal columns and offers unique aesthetics, applicable for buildings often exceeding 50 stories, though it requires sophisticated design and construction.

The **tube system** uses the building's exterior as a hollow tube to resist lateral loads, including variations like framed tube, trussed tube, and bundled tube, efficient for very tall structures but potentially limiting window designs.

The **core and outrigger system** combines a central core with outriggers connecting to perimeter columns, providing strong lateral stiffness for buildings over 50 stories but involving complex core construction.

The **superframe system**, with mega-columns and mega-beams forming a superframe, supports extremely tall buildings like the Shard, offering exceptional strength but at high costs.

The **Hybrid systems** combine elements from various systems to optimize performance, tailored to specific requirements but necessitating complex engineering.

Finally, the **exoskeleton system** places structural elements outside the building envelope, allowing for uninterrupted interior spaces and unique aesthetics, though it may pose challenges in exterior maintenance. Each system offers distinct advantages and challenges, with the choice dependent on specific building requirements, height, and environmental factors.

1.3 OBJECTIVE OF PRESENT STUDY

Objective of present study are as follows:-

- To incorporate the Indian Standard Codal Guidelines of IS 875 (Part III) and IS 16700:2017.
- To consider different geometries (shapes) in structural analysis of high rise stuctures.
- To study the structural behaviour of high rise structures with plan and vertical irregularities.
- To assess the behaviour of high rise structures with different structural systems against wind loading.

CHAPTER 2

REVIEW OF LITERATURE

2.1 GENERAL

This chapter provides a comprehensive review of various aspects related to high rise structures against wind loading, identifying different types of methods and their potential impacts on buildings and structures. This review offers valuable insights into the risks and challenges involved in designing for wind loads. The chapter also explores along-wind and across-wind loading, examining the mechanisms and effects of wind forces acting in different directions. Understanding the distinction between these types of loading is crucial for design considerations and load calculations for tall buildings.

Definitions and parameters for high-rise buildings across different codes are reviewed, clarifying how various codes classify and categorize these structures. This helps determine the appropriate wind load design criteria for specific building heights. Additionally, various wind-related elements are assessed, including building shape, vertical and horizontal irregularity, Understanding these characteristics is essential for accurate wind load predictions and designing structures to withstand expected wind forces.

2.2 LITERATURE REVIEW

Sitaram Vemuri et al. (2023) compares codal provisions, stochastic approaches, and CFD in analyzing wind loads on tall buildings. Codal provisions offer standardized guidelines, stochastic methods account for wind variability, and CFD provides detailed simulations. Each has unique strengths, and combining them can enhance the accuracy and resilience of structural designs

A tall building is considered and wind loads are obtained using codal provisions, using RV approach and using CFD. Along wind forces and across wind forces obtained using CFD are found to be very less compared to those obtained using codal provisions and RV approach. Wind forces obtained using Harris velocity PSD function, in RV approach are on higher end compared to the forces obtained using other velocity PSD functions.

Devesh Kasana et al. (2022) investigates the aerodynamic effects on tall buildings with equal areas but varying cross-sectional shapes. Studies show that form has a major impact on the distribution of wind loads and the reaction of the structure. The performance of elliptical, circular, and rectangular cross-sections varies with wind pressure. Elliptical forms frequently improve stability by reducing drag and vortex shedding, highlighting the significance of cross-sectional shape in maximizing structural robustness and aerodynamic efficiency. Comparison of two frames, i.e., regular and irregular in mass, has been carried out, taking into account various factors such as displacement, shear force, bending moment, and storey drift.They came to the conclusion that each building's windward face had the most positive pressure because of direct wind interaction.

Rahul Kumar et al. (2022) aims to ascertain the impact of wind on seven distinct regular-shaped high-rise structures that have the same height and base area. The wind pressure on each face of building models is calculated using the ANSYS CFX for Computation Fluid Dynamics investigations. Every building is represented by a model, scaled at 1:350. The mean pressure coefficient (CP) is found for every face. Furthermore, ANSYS CFX is also utilized to establish the wind flow pattern. Pressure contours showed positive pressure on the front or windward face as a result of the direct head-on hit. Suction or negative pressure was evident in faces that were turned sideways and backward. Vortices were observed on the reverse face. concluded that the pressure distribution in an octagonal tall structure is almost symmetrical.

Kamran Shahab et al. (2021) This comparative study of aerodynamic coefficients using CFD reveals that both the shape and twist of a building significantly affect its aerodynamic performance. Twisted buildings generally offer better aerodynamic efficiency, reducing wind loads and improving structural resilience. Among the various cross-sectional shapes, elliptical and circular forms outperform rectangular ones, highlighting the importance of thoughtful aerodynamic design in high-rise architecture.

A total of eighteen building models with sections that were square, pentagon, and hexagon were examined in this study. Following the completion of the simulations in FLUENT, the data were imported into CFD-POST (a post-processing tool included in the ANSYS package), and polylines representing the variation in mean pressure coefficients (CP) were made on the building's surface.The 180 twisted (S-180) model is found to be the best of all the models in resisting the aerodynamic loads after the force and moment coefficients (CD and CMZ) for various square section models are analyzed.

Mohammad Jafari et al. (2021) explores the use of smart facade technologies to enhance the aerodynamics of tall buildings. It identifies active control systems, passive design strategies, and wind tunnel testing as key approaches for improving aerodynamic performance. Opportunities for integration with energy efficiency, structural health monitoring, and human-centric design are highlighted, emphasizing the potential for synergistic benefits. However, challenges such as material innovation, multi-objective optimization, and considerations of urban context and microclimate effects are acknowledged.

The importance of ongoing research and innovation is emphasized in the review's conclusion in order to fully realize the promise of smart facades in creating resilient and sustainable urban settings. All things considered, incorporating smart facades into tall structures presents viable ways to alleviate issues relating to wind while also encouraging energy economy, occupant comfort, and structural integrity.This section provides a brief discussion of the geometry and wind direction parameters that affect the aerodynamics of tall buildings by reviewing related historical works.The most prevalent pattern is that lesser force coefficients are obtained the closer to circularity one gets.

Syed Mudassir et al. (2021) Wind analysis of tall buildings with vertical irregularities is a complex and multidisciplinary endeavor that requires integration of aerodynamics, structural engineering, and computational modeling. Advances in wind tunnel testing, CFD simulations, and analytical modeling have enhanced our knowledge of the aerodynamic response of high rise structures with vertical irregularities.

After reviewing a large number of publications for this subject, it is now known that there are two forms of structural irregularities: plan irregularity and vertical irregularity.concluded that, in comparison to seismic analysis, wind analysis is more important in the case of multi-story buildings. This study shows that the value of drift increases with abrupt fluctuations at irregular floors and increases from the top level to the lowest storey. Obtaining larger values for drift, axial force, bending moment, and base shear when lateral loads are applied to an uneven vertical structure

Nikhil Gauret al. (2021) Aerodynamic mitigation through corner modification on square models represents a promising strategy for reducing wind-induced pressures and enhancing structural stability. By employing a combination of CFD simulations and wind tunnel testing, researchers have gained valuable insights into the aerodynamic effects of corner modifications and optimized design parameters to achieve desired performance objectives.

In this study, the virtual wind tunnel's wind flow is visualized and created using Ansys 19.1. The wind tunnel geometries and the structural model were initially constructed with suitable domain and boundary conditions. Next To compare the accuracy of the CFD simulations, a comparison of the wind field quality between the virtual wind tunnel and the wind tunnel test was offered. concluded that little changes, such as reducing corners, might result in 25% and 20%, respectively, decreases in drag force and moment.

Qinhua Wang et al. (2020) examines, with an emphasis on a particular case study, wind-induced responses and loads on a very high-rise building with different cross-sections and high side ratios. The study examines how tall buildings that are subjected to wind loads behave aerodynamically while taking various geometric characteristics and structural configurations into account. Researchers assess how cross-sectional form and aspect ratio affect wind-induced reactions, such as wind pressures, forces, and structural vibrations, by examining data from wind tunnel tests and running computational fluid dynamics (CFD) simulations.

STAAD.Pro V8i software is used to assess a twelve-story high rise irregular RCC structure that is susceptible to wind stress both with and without different braced frame systems in accordance with the equivalent static analysis approach.The findings show that the wind-induced base overturning moments and acceleration responses peak at 60 or 330 wind directions rather than the orthogonal wind direction, and that the wind pressure distribution on the building's facade is impacted by the surrounding buildings' aerodynamic interference.

Ashish Padiyar et al. (2020) investigates the effect of wind load on high buildings with different aspect ratios using STAAD Pro software. By varying the aspect ratio of building models and subjecting them to wind loads, researchers analyze structural behaviors such as deflections, stresses, and dynamic responses. The study aims to understand how changes in aspect ratio influence the distribution of wind-induced forces and the overall stability of high-rise buildings After analysis it shows that as the height increase, The average displacement rises, but compared to square-shaped structures, the RCC rectangle shape exhibits greater displacement.In comparison to RCC rectangular structures, RCC square structures exhibit less storey drift when the wind load is applied along their length.

Andrew William Lacey et al. (2020) investigates the impact of stiffness in the connections between modules on the way modular steel constructions behave structurally when subjected to loads from wind and earthquakes. When it comes to modular structures' overall stiffness, stability, and seismic performance, inter-module connections are essential.

By varying the stiffness properties of connections, researchers investigate their impact on structural behaviors such as dynamic response, lateral displacement, and inter-story drift.

Using beam and column elements, non-linear interconnections were incorporated to model the inter-module connections in the structure, which was modeled using SAP2000 [13].The outcomes demonstrated that the inter-module connection stiffness, particularly the translational stiffness in the load direction, had an impact on the total response. Specifically, it was shown that the translational stiffness of the vertical inter-module connections had the biggest impact along the load direction, whereas the rotational stiffness had a negligible impact.

CHAPTER 3

METHODOLOGY

3.1 GEOMETRIC PARAMETERS

The examination of high-rise structures' structural behavior against wind loading for various structural systems is part of the study. The analysis to carry out the model - study behind the problem taken - uses a 36 x 36 meter construction plan. The concrete grade for the columns (600 mm x 600 mm) and beams (600 mm x 400 mm) in the G18 story structure is M40; the slab, which has a thickness of 150 mm, is graded M 30. The ETABS 20 Ultimate analytical tool was selected to conduct the study. The table below lists the 12 models that are taken into consideration, each in a different state:

Table 3.1: Models considered for the study

Plan	**Structural systems**					
	Normal	Rigid frame	X bracing(frame tube)	Extended x bracing	Belt truss	Opposite belt truss
Square(s)	S1	S2	S3	S4	S5	S6
Octagon(o)	O1	O2	O3	O4	O5	O6

3.2 SOFTWARE USED

A three-dimensional analysis of a building system that is extended A state-of-the-art multifunctional research and design program created especially for building systems is called ETABS. Even the largest and most complex building models may be easily sketched thanks to its highly integrated systems and abilities. The maximum storey displacement and inter-story drift on a typical building were determined using the Etabs-2018 software.

3.3 MODELS CONSIDER FOR STUDY

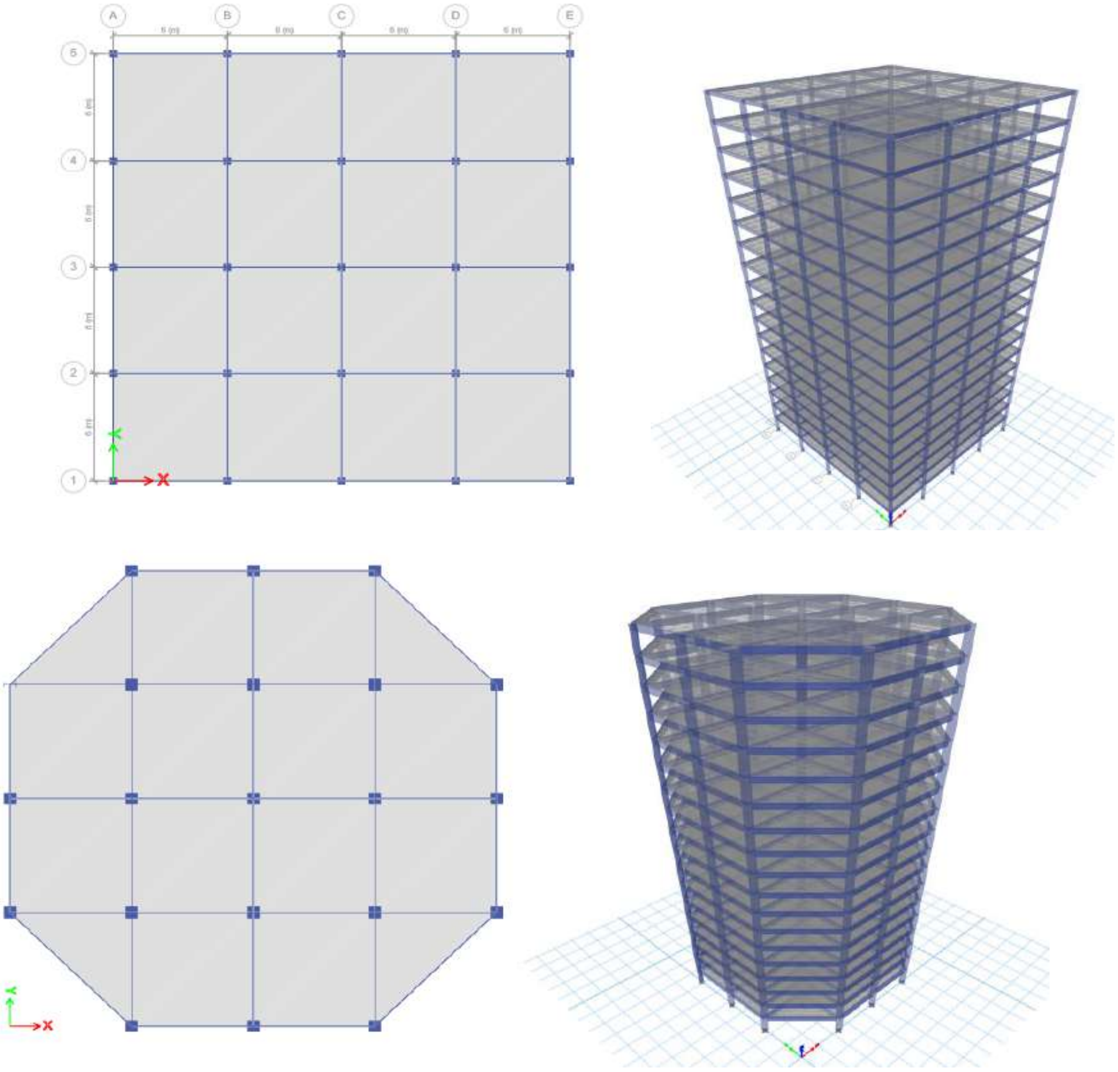


Fig. 3.1: Plan And Models In Etabs Workspace

On the windward side, the models have bracings. According to the Indian Standard Codal Provisions of IS 875 (Part I) for dead load and IS 875 (Part II) for live load calculations, the gravity loads applied to each structural member are as follows. The structural dimensions of the structural elements are maintained constant for the purposes of the comparison study. When ascribed the same features in Etabs, the slab is regarded as a "thin-shell" membrane. According to the codal rules included in IS 875 part (III), separate load cases are created for the consideration of wind loading on the structure.

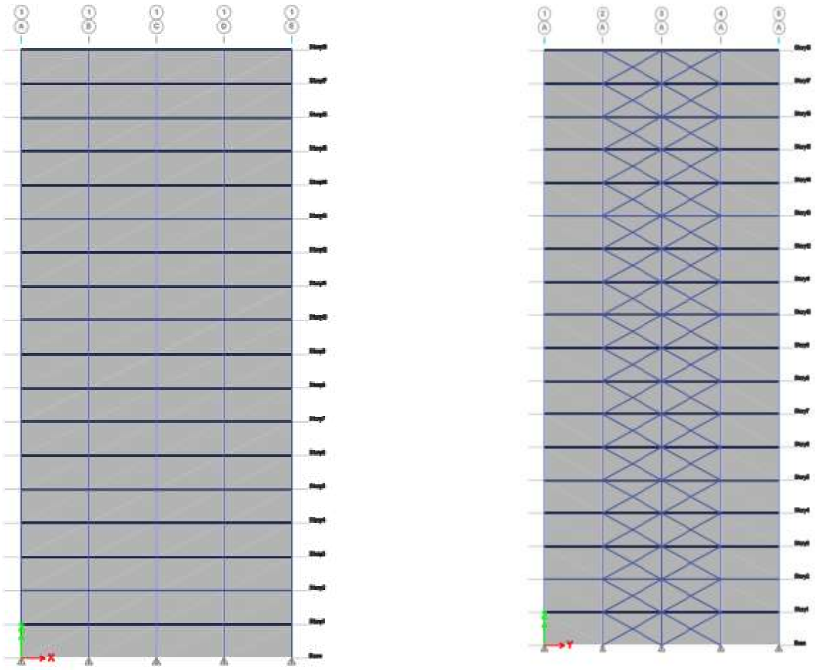


Fig 3.2 plane structure and rigid frame structure

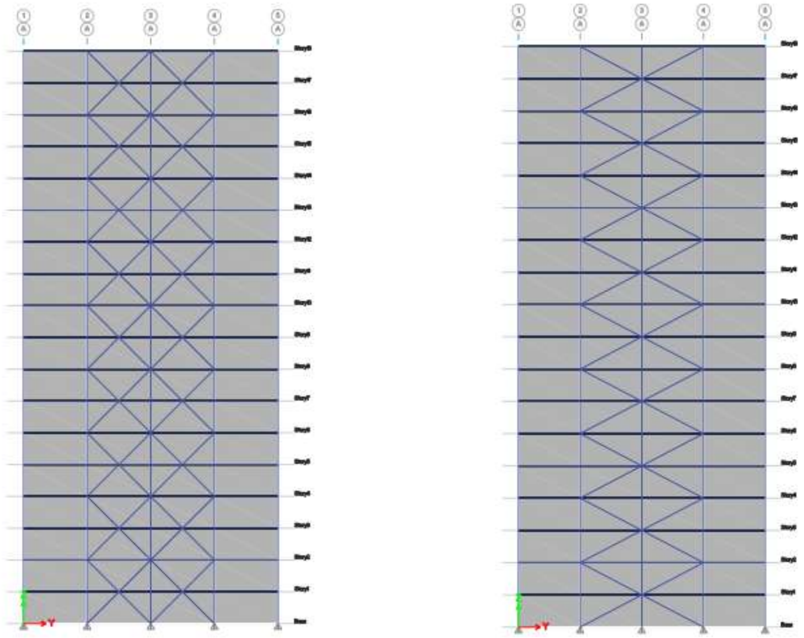


Fig 3.3: X - bracing and Extended X bracing

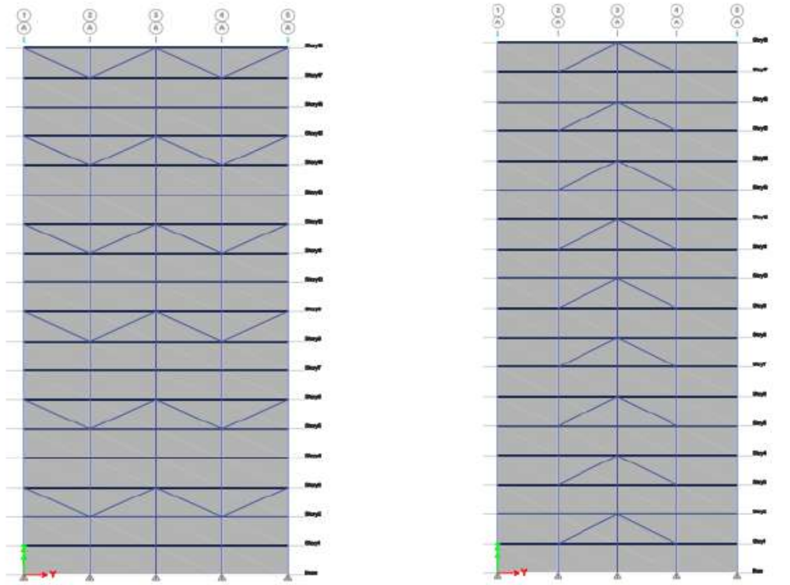


Fig 3.4 Belt Truss And Opposite Belt Truss

According to IS 875 (Part III), the wind coefficients taken into account for the wind analysis are 0.8 for the windward side and 0.25 for the leeward side. Category 3 terrain is used, and the wind speed is calculated to be 50 m/s. Since the structure falls under the category of "Normal Structure," the importance factor is assigned a value of 1. The modeling and application of the loads on the structural parts are included in the study. Prior to applying a load on the structure, load cases are constructed and then combined in order to account for the influence of wind on the same. After that, an analysis is performed to verify the overturning moment, inter-story displacement, and deformations.

Table 3.2: Structural Dimensions

Structural Elements	**Specifications**
Number of storeys	G+18
Storey height	3m
Column Size	600*600 mm
Beam Size	600* 400 mm
Slab Width	150 mm

Table 3.3: Material Properties

Structural Properties	**Specifications**
Grade of Concrete	M40 and M30
Grade of steel	Fe415 and Fe250

Table 3.4: Wind load parameters

Wind speed	50m/s
Terrain category	3
Windward Coefficient	+0.8
Leeward coefficient	-0.25
Structure class	C
Risk coefficient(k1)	1
Topography(k3)	1
Importance factor	1

Table 3.5: Loads Applied

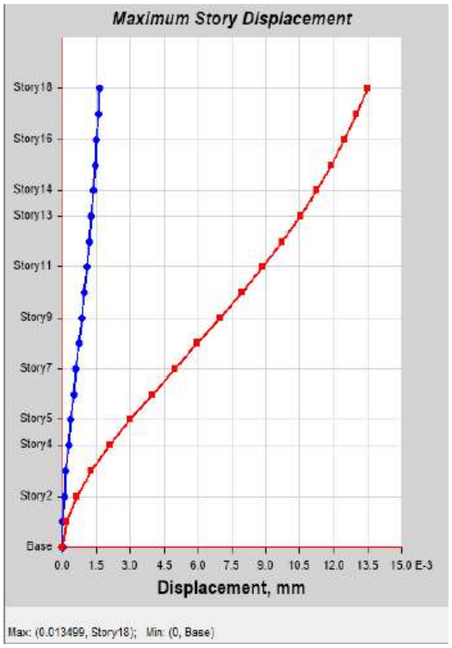
Dead load	2(kn/m)
Live load	5(kn/m)
Auto cladding	0.2(kn/m)

CHAPTER 4

RESULTS

The software's analysis, which included all computations and considerations from the IS codes, yielded results for the two most crucial parameters—storey displacements and storey drift—that allow for the determination of the structure's behavior in various modes. In a planar structure, the windward direction is denoted by "X," while the transverse direction is denoted by "Y." The top story of each model has the most displacement, but the second to fourth storeys show the greatest storey drift.

4.1 STOREY DISPLACEMENT



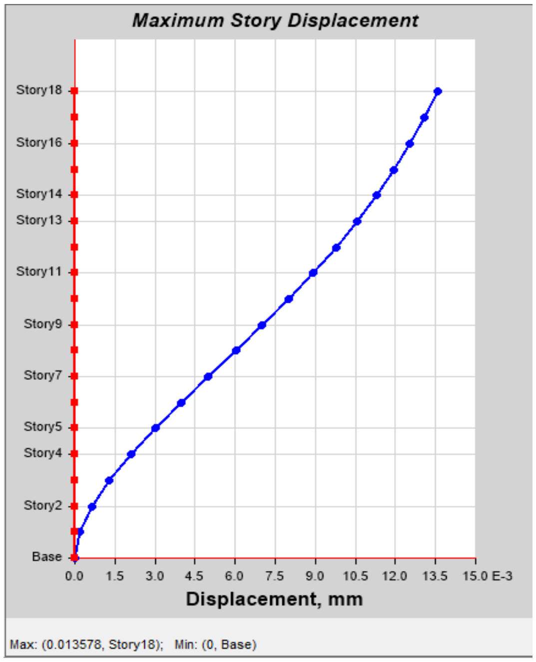
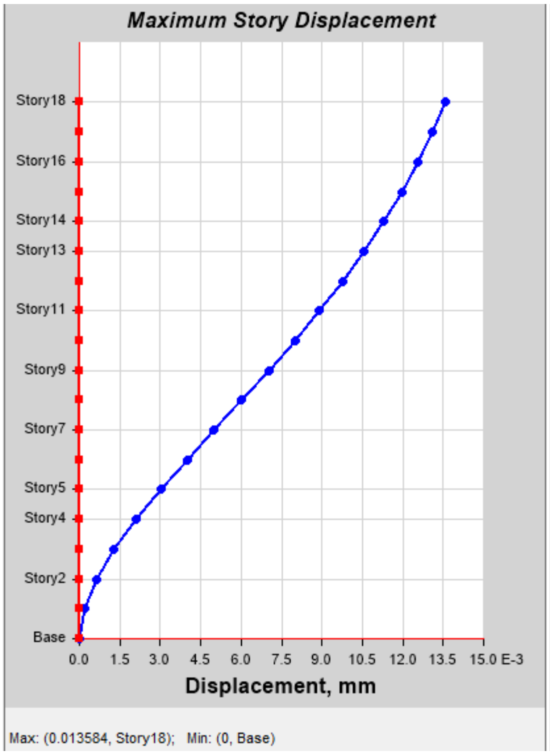


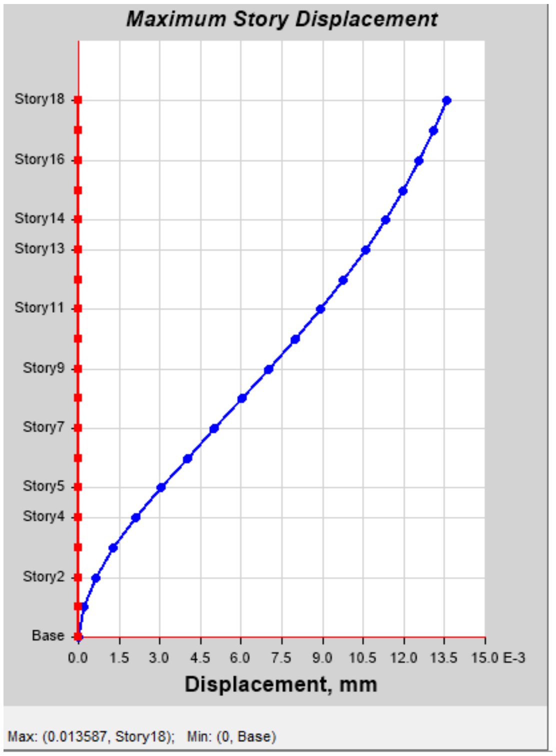
Fig 4.1 S1 Storey Displacement

Fig 4.2 S2 Storey Dispalcement



Max: (0.013584, Story18); Min: (0, Base)

Fig 4.3. S3 Storey Displacement



Max: (0.013587, Story18); Min: (0, Base)

Fig 4.4 S4 Storey Displacement

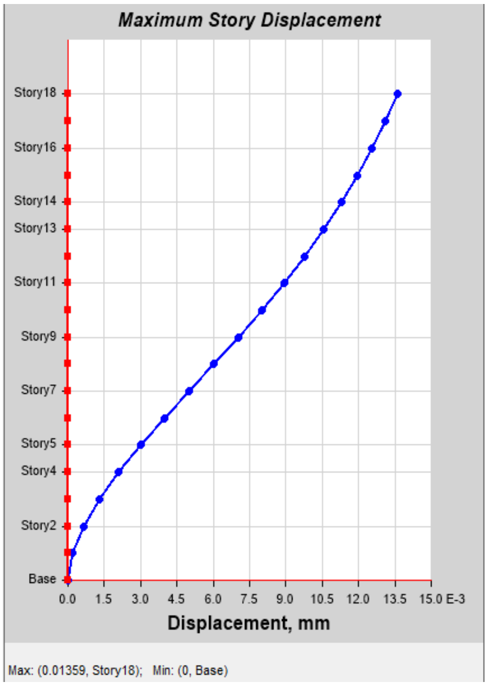


Fig 4.5 S5 Storey Displacement

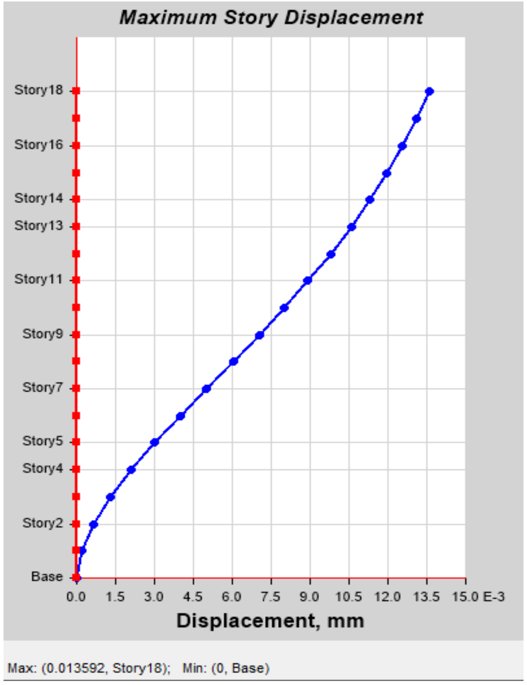


Fig 4.6 S6 Storey Displacement

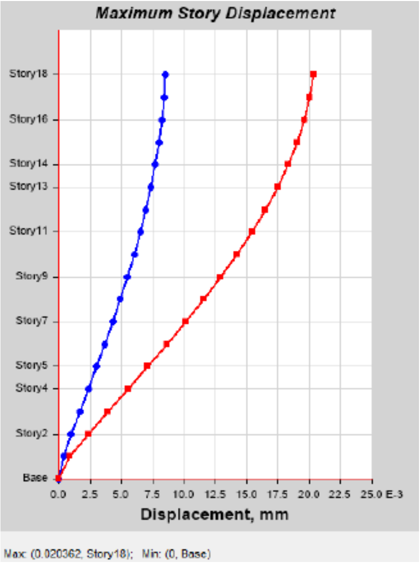


Fig 4.7 O1 Storey Displacement

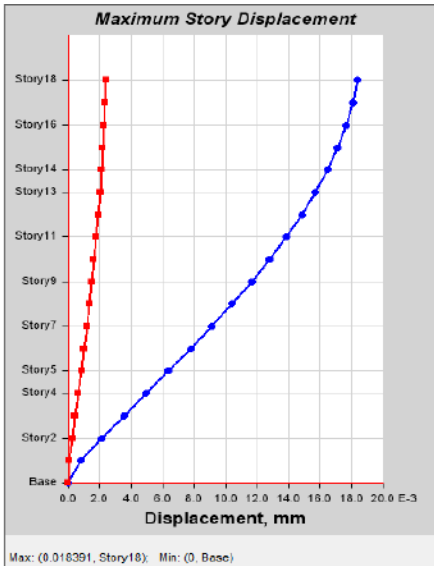


Fig 4.8 O2 Storey Displacement

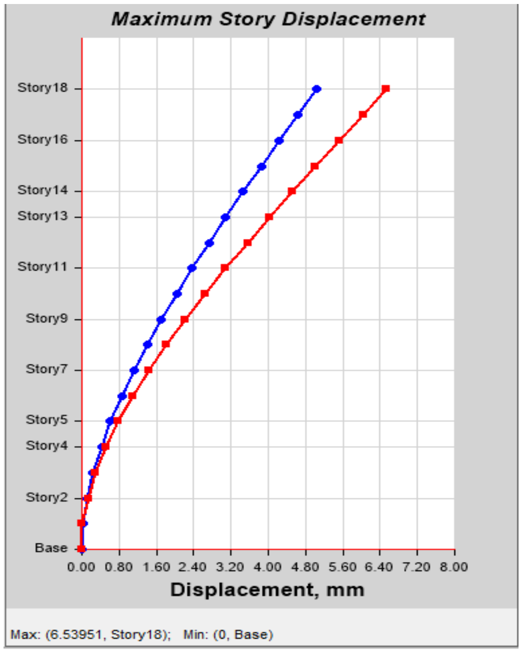


Fig 4.9 O3 Storey Displacement

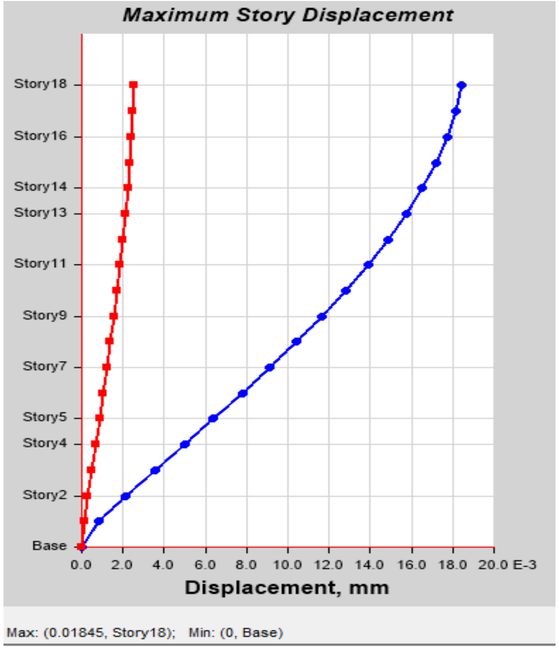


Fig 4.10 O4 Storey Displacement

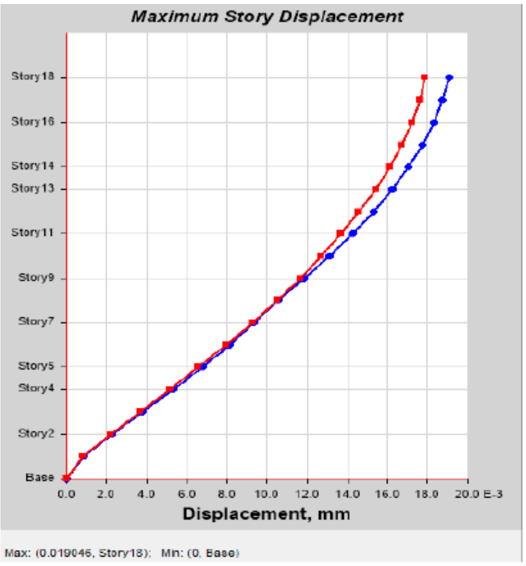


Fig 4.11 O5 Storey Displacement

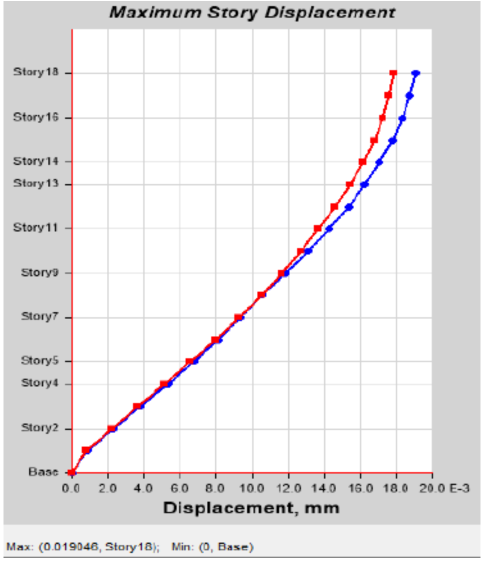
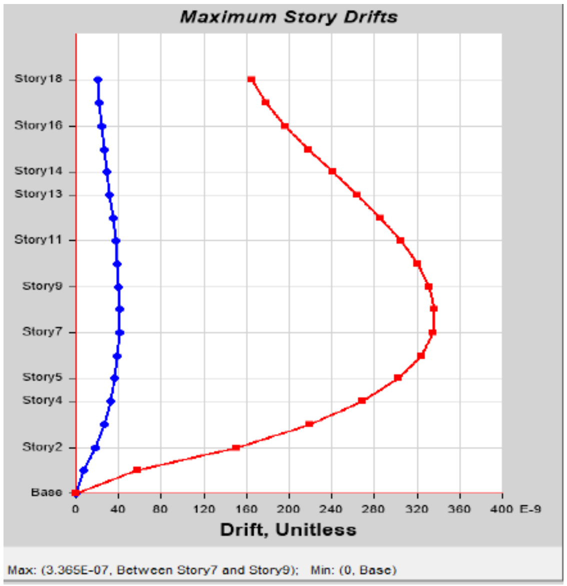
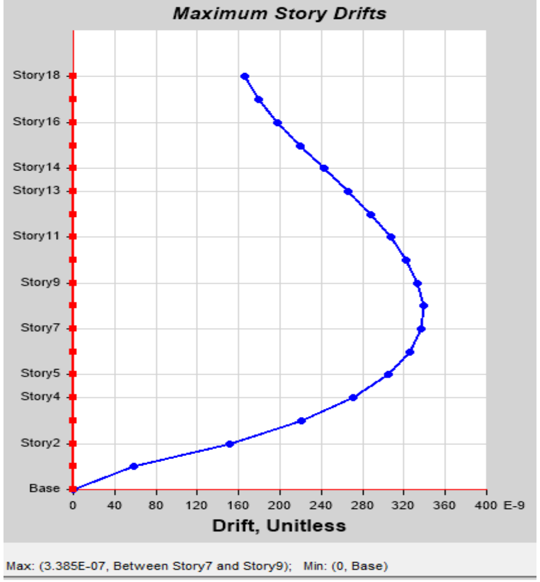


Fig 4.12 O6 Storey Displacement

4.2 STOREY DRIFT



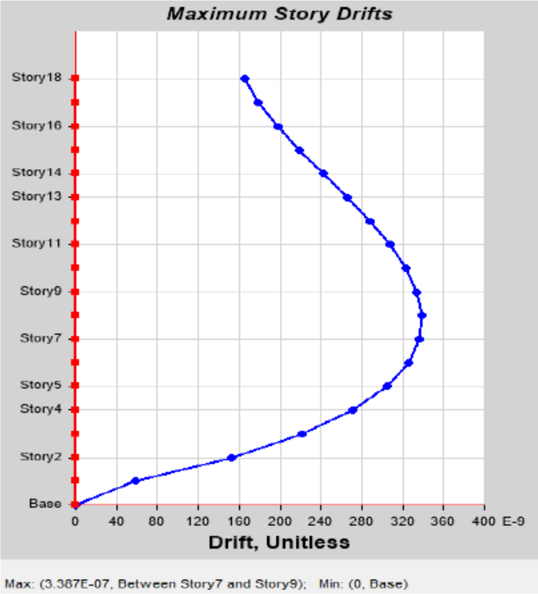
Max: (3.365E-07, Between Story7 and Story9); Min: (0, Base)



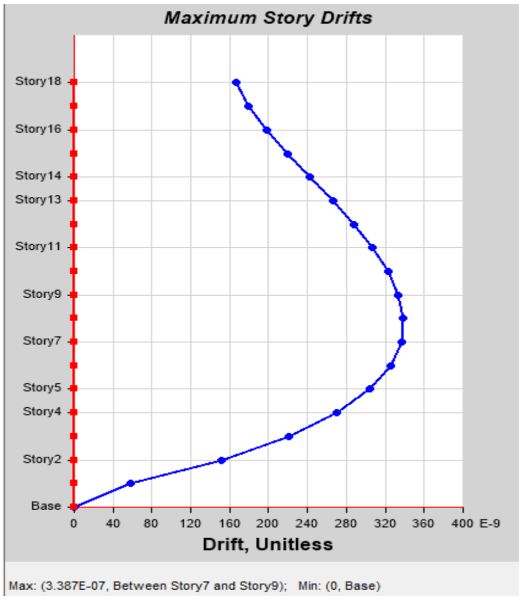
Max: (3.385E-07, Between Story7 and Story9); Min: (0, Base)

Fig 4.13 S1 Storey Drift

Fig 4.14 S2 Storey Drift



Max: (3.387E-07, Between Story7 and Story9); Min: (0, Base)



Max: (3.387E-07, Between Story7 and Story9); Min: (0, Base)

Fig 4.15 S3 Storey Drift

Fig 4.16 S4 Storey Drift

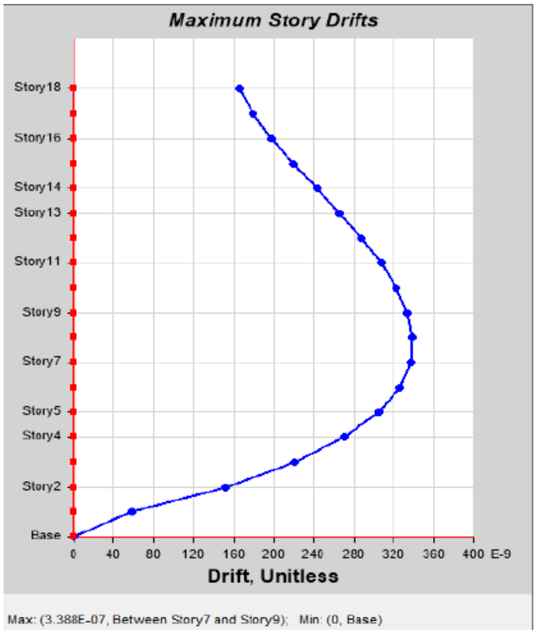


Fig 4.17 S5 Storey Drift

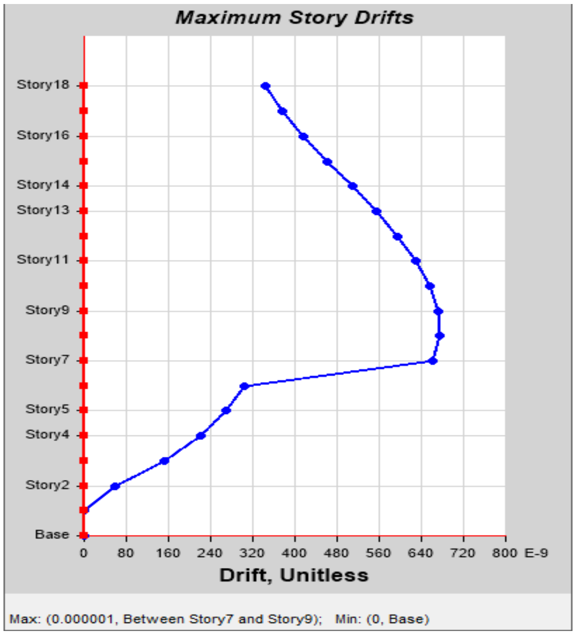


Fig 4.18 S6 Storey Drift

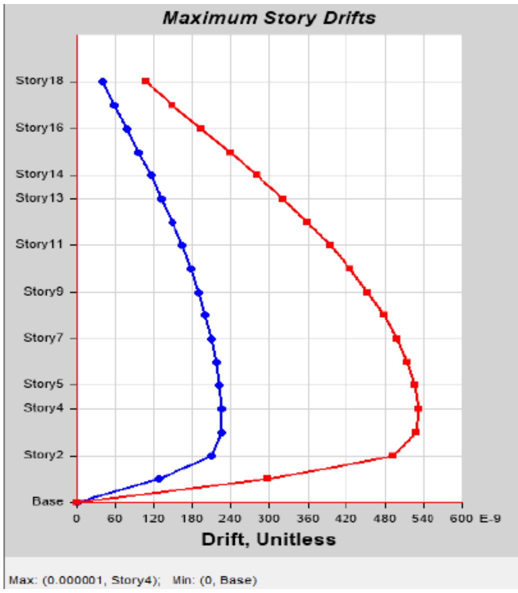
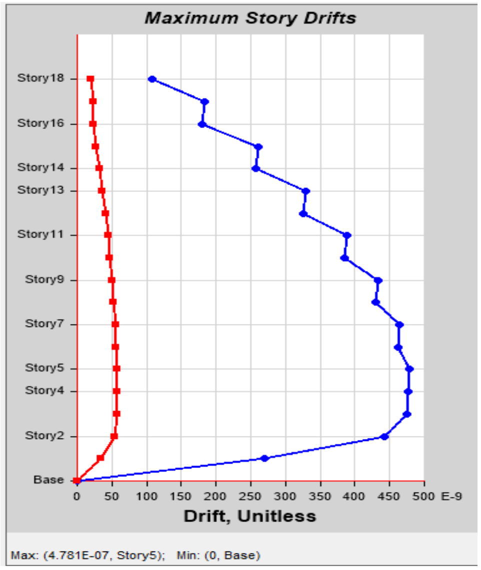


Fig 4.19 O1 Storey Drift

Fig 4.20 O1 Storey Drift



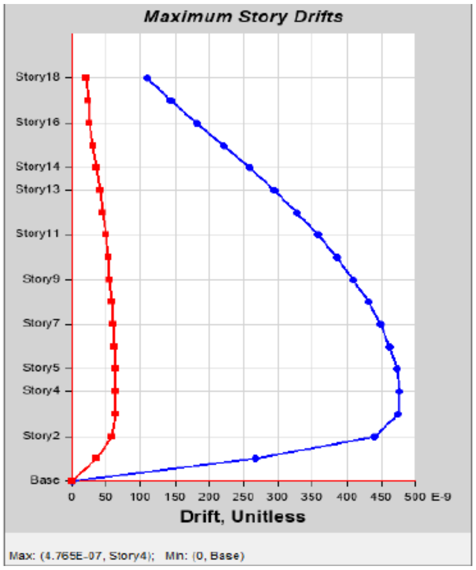
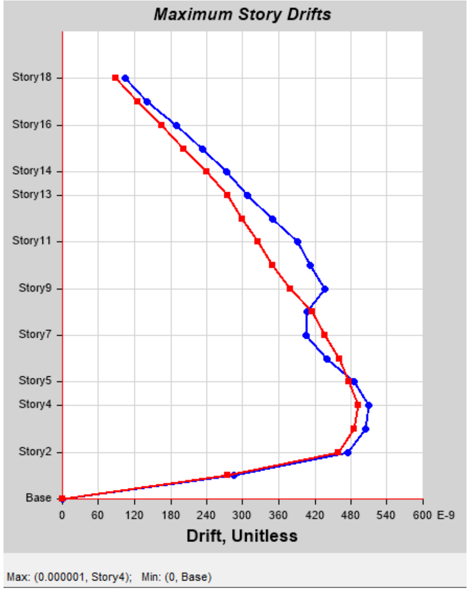


Fig 4.21 O3 Storey Drift

Fig 4.22 O4 Storey Drift



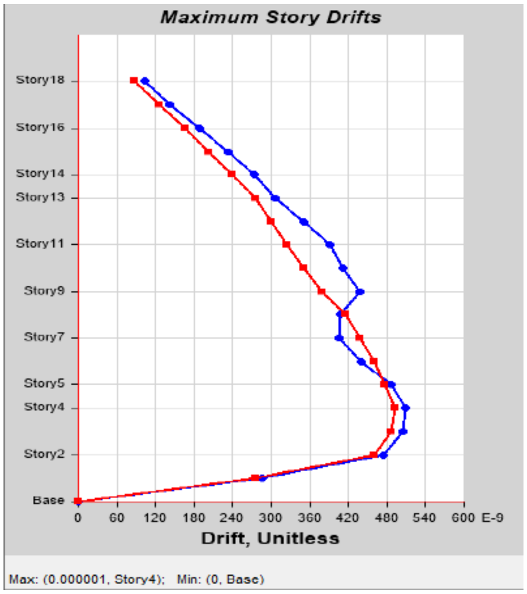


Fig 4.23 O5 Storey Drift

Fig 4.24 O6 Storey Drift

The software's analysis, which included all computations and considerations from the IS codes, yielded results for the two most crucial parameters—storey displacements and storey drift—that allow for the determination of the structure's behavior in various modes. In a planar structure, the windward direction is denoted by "X," while the transverse direction is denoted by "Y." The top story in every model shows the most displacement, but the second and fourth storeys show the greatest storey drift.

Fig 4.25 Maximum Displacement Observed For Square Shape Models

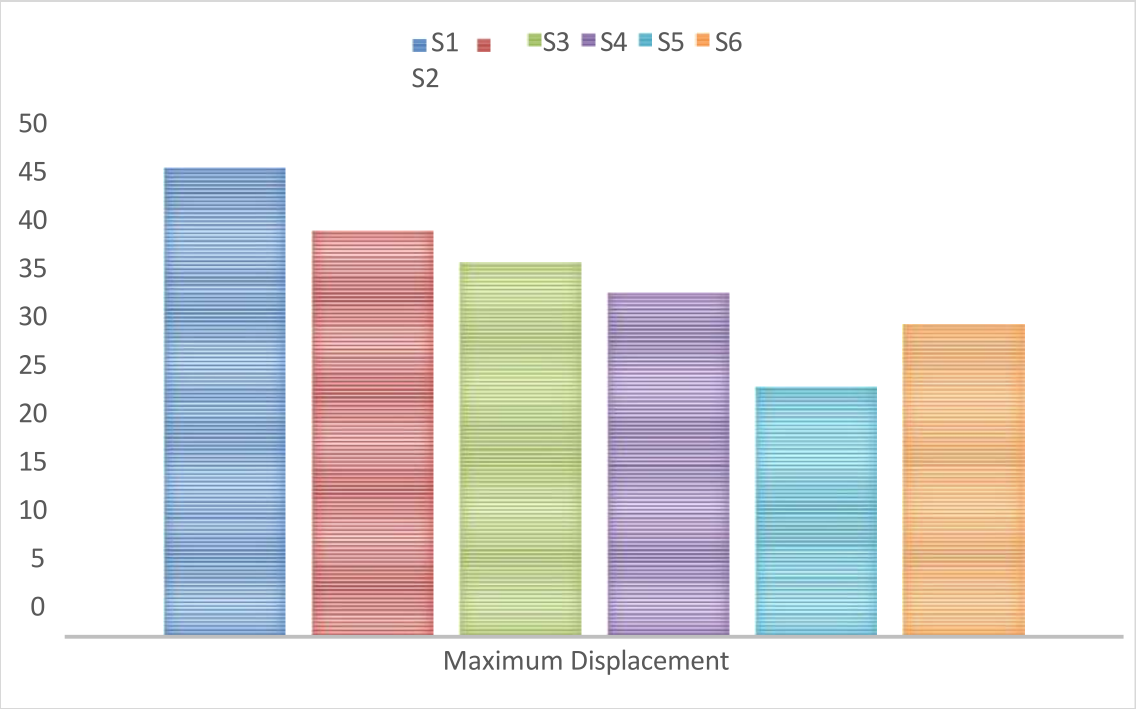


Fig 4.26 Maximum Displacement Observed For Octagonal Shaped Modals

Table 4.1: Results Obtained For Maximum Storey Drift In Square Modal

Type of Structure	Storey Drift
S1	STOREY 7
S2	STOREY 6
S3	STOREY 7
S4	STOREY 7
S5	STOREY 7
S6	STOREY 7

Table 4.2: Results obtained for Maximum Storey Drift in octagaonal modal

Type of Structure	**Storey Drift**
O1	Storey 4
O2	Storey 2
O3	Storey 2
O4	Storey 3
O5	Storey 3
O6	Storey 3

CHAPTER 5

CONCLUSION

With the overgrowing construction industry of high – rise buildings, the analysis of these buildings must be considered to be one of the important tasks in current scenarios. Also, since these structures are more susceptible to be affected wind loads, this study aimed to present a comparative analysis on two different types of plans of high – rise structures with six different types of structural systems.

With a normal square planar section, it was observed that:

- The maximum displacement for a regular building was observed to be 14.23 mm.
- With reference to the regular building, the maximum reduction in the standard displacement was observed to be for Rigid Frame Structural System by 33 percent.
- With reference to the regular building, the minimum reduction in the standard displacement was observed to be for Extended X – Bracing System by 22 percent.
- The Maximum Storey Drift was observed to have a similar trend, showcasing the maximum drift at Storey 7, except for Rigid Frame Structural System.

With a octagonal planar section, it was observed that:

- The maximum displacement for a regular building was observed to be 40 mm.
- With reference to the regular building, the maximum reduction in the standard displacement was observed to be for Belt Truss Structural System by 46 percent.

With reference to the regular building, the minimum reduction in the standard displacement was observed to be for Rigid Frame Structural System by 13 percent.

- The Maximum Storey Drift was observed to have a similar trend, showcasing the maximum drift at Storey 3.

It can be easily observed that as the plan of the building changes, there will be a change in the structural properties of High – rise structures. The maximum displacement was observed to me maximum for Octagonal plan as compared to normal square plan, with mostly double the increment. Also, the behaviour of the behaviour of the structural systems get affected by the plan of the building. With normal square building plan, Rigid Frame Structural System can be considered to the best structural system, though the same had poor results in case of buildings with octagonal plan. While going through the results obtained and if the above choices of structural systems are available, X – Bracing with rolled tube and Opposite Belt Truss Structural Systems can be the optimum choices.

The further enhancement of the study may include the consideration of seismic load as the same can have a significant affect towards vulnerability of High – rise structures due to the property of overturning moment. The existing structural systems may act as an external retrofication method, which will act as a boon towards providing resistant to the structures against both seismic and wind loading

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