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Research Paper**COMPARATIVE STUDY OF WIND EFFECTS ON A G+25 TALL BUILDING FOR DIFFERENT ASPECT RATIOS****Akash¹, Jamal Ahmad²**¹M. Tech Student, Department of Civil Engineering, Vivekanand College of Technology & Management, Aligarh, UP, India, 202140¹Assistant Professor, Department of Civil Engineering, Vivekanand College of Technology & Management, Aligarh, UP, India, 202140

Abstract The rapid increase in the population in developing countries such as India has an acute shortage of land and space. To get rid of all these problems, people have resorted to multi-story or tall buildings both for commercial as well as for residential purposes. As the weight of the building increases wind flow is an important consideration for the designers. Tall building considering categories like relative height, proportion, and structural design. Under the Relative height categories, we call a building is tall depending upon the height relative to the surrounding structures. Most importantly from the structural design point of view, those buildings which are subjected to gravity loads are not considered as tall buildings only those which are additionally subjected to lateral loads like wind loads, etc. are referred to as tall buildings. But when we go higher wind excitation becomes one of the most precarious forces acting on the surface of the structure and if the plan geometry is irregular Also direction of wind plays a very vital role in the behavior of the structure.

In this Research study the various types of the aspect ratios of the building and the effect of wind forces on the building and also we study about, 5 building models having different Horizontal Aspect ratios viz. 0.25, 0.5, 1, 1.5, 2 and height of the building is 78m. The results like displacement, storey drift, base shear, time period, frequency, shear force, bending moment, torsion are studied under various aspect ratios as per wind load analysis.

Keywords: Tall building, wind load, aspect ratio, ETABS, displacement, drift, shear force.

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1. INTRODUCTION

Wind is essentially the large scale horizontal movement of free air. It plays an important role in design of tall structures because it exerts loads on building. A building having height more than 15m as per national code 2015 of India is called a high rise building. Wind is caused by air flowing from high pressure to low pressure. Since the earth is rotating, however, the air does not flow directly from high to low pressure, but it is deflected to the right (in the northern hemisphere; to the left in the southern hemisphere), so that the wind flows mostly around the high and low pressure areas.

Variation of wind velocity with height: Near the earth's surface, the motion is opposed, and the

wind speed reduced, by the surface friction. At the surface, the wind speed reduces to zero and then begins to increase with height, and at some height, known as the gradient height, the motion may be considered to be free of the earth frictional influence and will attain its "gradient velocity". Wind effects on Structures: Wind effects on structures can be classified as „static“ and „dynamic“. Static: Static wind effect primarily causes elastic bending and twisting of Structure. Dynamic: For tall, long span and slender structures a „dynamic analysis“ of the structure is essential. Wind gusts cause fluctuating forces on the structure which induce large dynamic motions including oscillations.

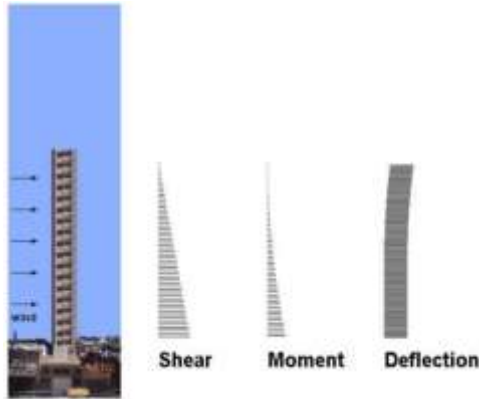
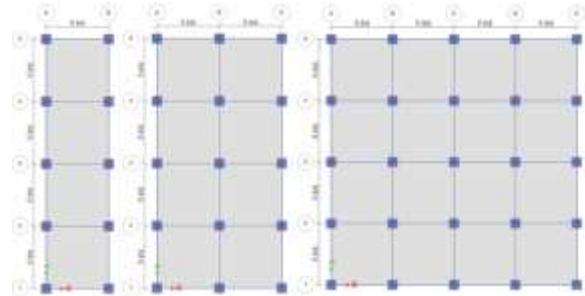


Fig 1: Effect of wind load on tall structure

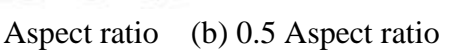
A sufficient tall structure or high rise building is subjected to lateral forces apart from the load of its components. There can be secondary effect on the member due to these forces. One of these forces give rise to p-delta effect, which is geometric non-linearity. This can be influenced by various condition like irregularity in structure mass and stiffness. It causes a destabilizing moments. Structure in real life are flexible and cause a large lateral displacement in unusual circumstances. The lateral displacement is caused by wind, vertical loads and seismic loads. In structure particularly ground reactions results to P delta effect. Wind creates inward and leeward forces. This forces make building unstable forcing it apart if it is too weak to resist it. Such structure should be designed for p-delta.

1.1 Aspect ratio of the building

Aspect ratio is an assessment of a structure that is able to withstand buckling pressures. Engineers can determine it by dividing the length of the Building by width of the building. These calculations are important for supportive structure dimensions, to make sure they will not fail and put a structure at risk of serious damage or collapse. To determine the aspect ratio, the engineer needs a measurement of the length of the building and width of the building.

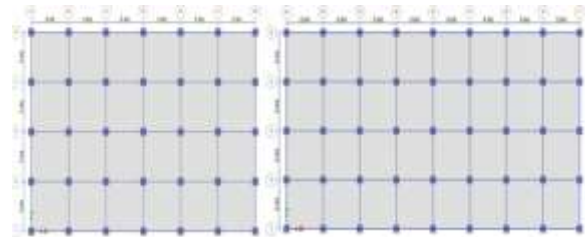


(a) 0.25 Aspect ratio

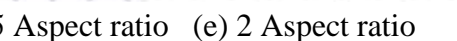


(b) 0.5 Aspect ratio

(c) 1 Aspect ratio



(d) 1.5 Aspect ratio



(e) 2 Aspect ratio

Fig 2: Aspect ratios of building

1.2 Objectives of the study

The following are the objectives of the study considered for the research

1. To examine abnormalities in structures of G+25 storied structure according to code IS 875-Part 3- 2015 Code.
2. Investigate the structures in ETABS programming to compare the results of displacement, storey drift, base shear, time period, frequency, shear force, bending moment and torsion values under action of wind load.
3. To study the building with 0.25, 0.5, 1, 1.5 and 2 aspect ratios.
4. To analyze the buildings under wind load condition using ETABS software

2. LITERATURE STUDY

J.D. Holmes et.al (2010) offer rational approaches for designing structures in regions prone to tropical cyclones. Examining windstorm event characteristics, the paper scrutinizes structural safety and reliability principles in extreme wind environments. The authors propose variations of wind speed with return period, highlighting uncertainties, particularly in high-wind regions crucial for

structural design. Recent data insights offer valuable but limited information. The paper underscores that in cyclone-prone regions, primary uncertainties lie in wind speed, influencing structural safety and reliability. This highlights the need for robust design strategies to mitigate cyclonic impacts effectively.

S. Fawzia, A. Nasir et.al (2011) address the global necessity for taller structures, despite challenges like material costs and timelines. Focusing on high-rise construction complexities, the study explores deflection minimization and frequency control, crucial for cyclonic wind impacts. Findings emphasize plan dimensions' role in structural rigidity, with taller buildings exhibiting reduced lateral stiffness. The research underscores the necessity for additional bracing systems like belt trusses and outriggers to meet serviceability limits. This study provides tailored strategies for varying building heights, enhancing stability and minimizing deflections in high-rise constructions.

Shreyas Ashok Keote et.al (2015) tackle significant challenges posed by tropical cyclones in India, proposing mitigation strategies for coastal areas. Acknowledging inevitable natural disasters, the paper stresses adapting construction practices to minimize impact. It recommends resilient building requirements to withstand cyclonic forces and explores techniques for reducing cyclone intensity. The study critiques existing design provisions, advocating for enhanced cyclone resilience through improved planning and development standards. This comprehensive approach aims to minimize cyclone devastation in coastal regions.

3. PROBLEM STATEMENT AND MODELS USED

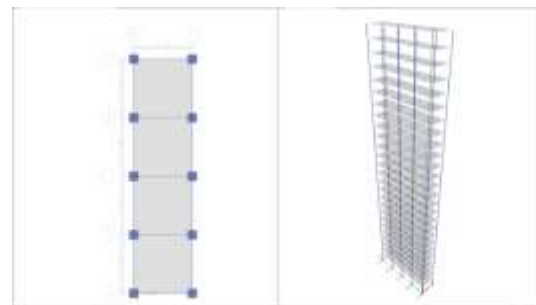
In the present study, analysis of G+25 multi-story building is carried. Basic parameters considered for the analysis are

1. Utility of building : Residential building
2. Number of stories : G+25
3. Shape of building : Rectangular

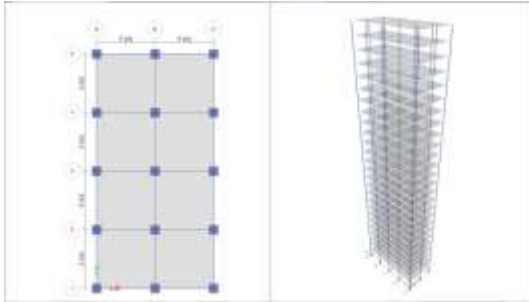
4. Type of walls : Brick wall
5. Geometric details
 - a. Ground floor : 3.3m
 - b. floor to floor height : 3m
6. Material details
 - a. Concrete Grade : M40 (COLUMNS AND BEAMS)
 - b. All Steel Grades : HYSD reinforcement of Grade Fe500
 - c. Bearing Capacity of Soil : 200 KN/m²
7. Type Of Construction : R.C.C FRAMED structure
8. Column : 0.8m X 0.8m
9. Beams : 0.8m X 0.69m
10. Slab : 0.150m
11. Live load : 3kN/m²
12. Dead load : 2Kn/m²
13. Seismic zone : V
14. Soil type : Medium
15. Importance factor : 1.3
16. Response reduction factor : 3
17. Damping Ratio : 5%
18. Structural class : C
19. RCC code : IS 456-2000
20. Steel code : IS 800-2007
21. Seismic code : IS 1893:2016
22. Wind code : IS 875:2015

Models in ETABS

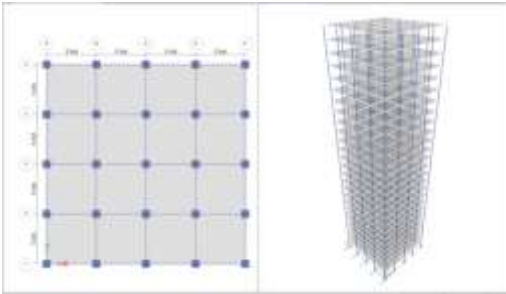
Models in ETABS Software



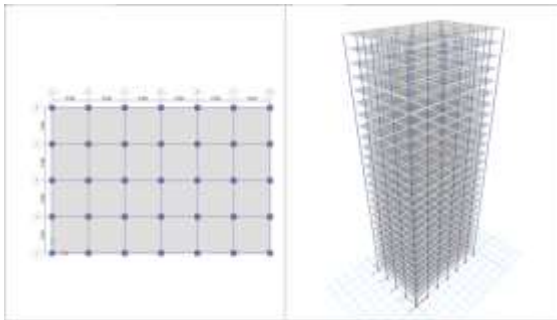
0.25 Aspect Ration Model



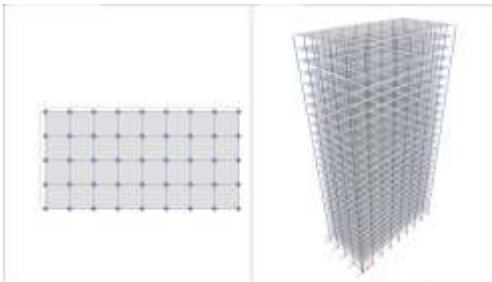
0.5 Aspect Ration Model



1 Aspect Ration Model



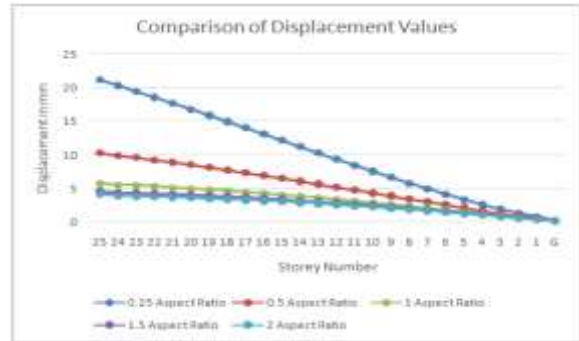
1.5 Aspect Ration Model



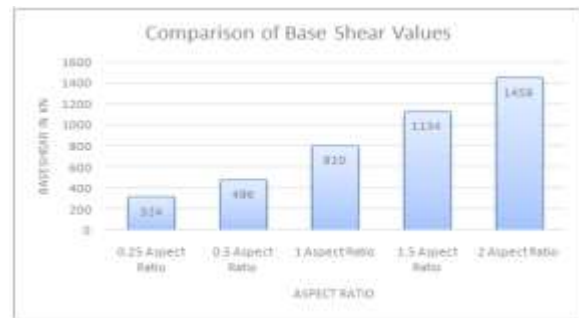
2.0 Aspect Ration Model

4. RESULTS AND ANALYSIS

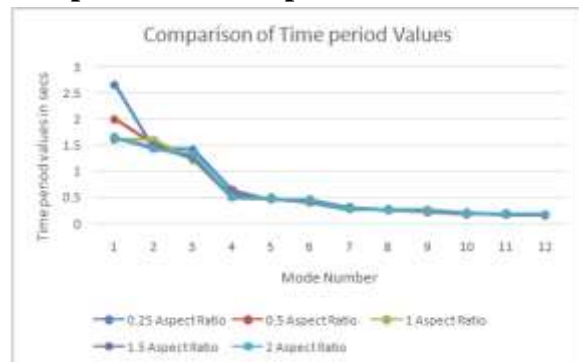
Comparison of displacement Values



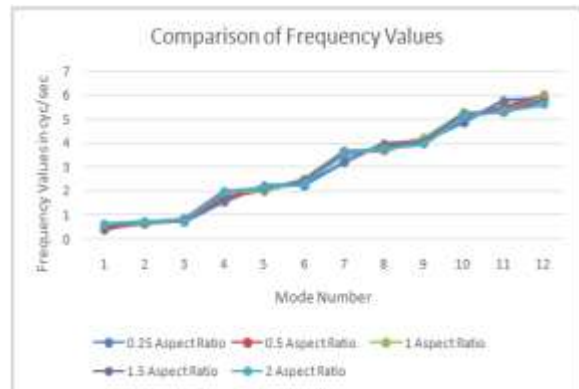
Comparison of Base shear Values



Comparison of time period values



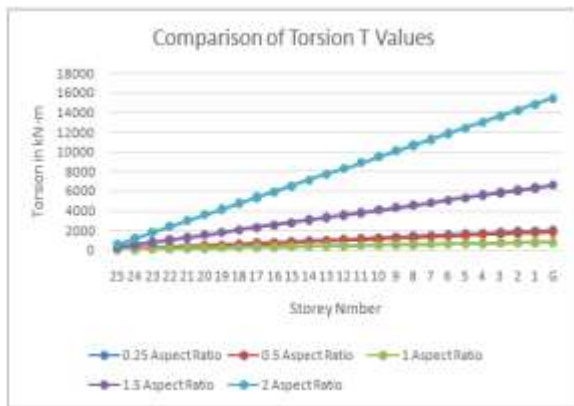
Comparison of frequency values



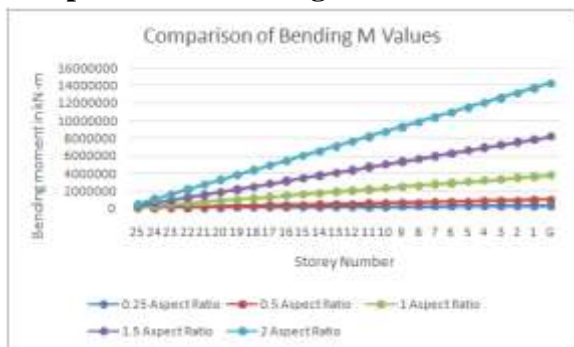
Comparison of Shear Force V Values



Comparison of Torsion T Values



Comparison of Bending M Values



5. Conclusions

From this analysis the following conclusions were made

1. The building aspect ratio is one of the most significant factors affecting the structural behavior of high rise buildings.
2. Building 1 of aspect ratio 0.25, Building 2 of aspect ratio 0.5, Building 3 of aspect ratio 1 Building 4 of aspect ratio 1.5 and Building 5

of aspect ratio 2 are analyzed by using wind load analysis for G+25 building.

3. Due to the effect of wind loading action the storey displacement value is less for 2 aspect ratio than remaining cases like 0.25, 0.5, 1 and 1.5.
4. The storey shear values, storey bending, building torsion has less values for 0.25 aspect ratio than remaining cases like 0.5, 1, 1.5 and 2 aspect ratio.
5. Because of increase in the aspect ration the weight of the structure increases because of this reason the values of shear, bending and torsion are high for aspect ratio 2 than remaining building models.
6. The base shear has less value for 0.25 aspect ratio than remaining cases like 0.5, 1, 1.5 and 2 aspect ratio.
7. It was discovered in this investigation that when the number of spans rises, the base shear increases gradually.
8. The time period values decreases from mode 1 to mode 12 and it has almost same values for all the building models.
9. The model stiffness values increases from mode 1 to mode 12 and it has almost same values for all the building models.

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