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# WIND FORCE ANALYSIS AND DESIGN OF HIGH RISE BUILDING

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**Abstract:**

Now a day's many tall structures and high rise towers are being built all around the world .Wind plays an important role in design of tall structures because of its dynamic nature. Effect of wind is predominant on tall structures depending on location of the structure, height of the structure. In this paper equivalent static method is used for analysis of the effects of wind load on building with different aspect ratios i.e. H/B ratio, where H is the total height of the building frame and B is the base width of the building frame using STADD PRO. From this paper we get the review on the Effect of wind load on height of building by varying the no. of stories with increasing in the Aspect ratio. The analysis is carried out using STAAD PRO.

**Keywords:** Aspect Ratio, Staad Pro , Tall Buildings, Wind Load

## 1. INTRODUCTION

The emergence of modern materials and construction techniques resulted in structures that are often, to a degree unknown in the past, remarkably low in damping, and light in weight. Generally such structures are more affected by the action of wind. The structural engineer should ensure that the structure should be safe and serviceable during its anticipated life even if it is subjected to wind loads. Wind forms the predominant source of loads, in tall free standing structures. The effect of wind on tall structures can be divided into two components they are

1. Along-wind Effect
2. Across-wind Effect

Along wind loads are caused by the drag components of the wind force whereas the across –wind loads are caused by the corresponding lift components.

## 2. WIND LOADS ON TALL BUILDINGS

The action of a natural wind, gusts and other aerodynamic forces will continuously affect a tall building.. Swami studied that if the wind energy that is absorbed by the structure is larger than the energy dissipated by structural damping then the aptitude of oscillation will continue to increase and will finally lead to destruction. Knowledge on the maximum steady or time averaged wind loads can ascertain the overall stability of a structure IS 875part –III deals with wind load. The effect of wind is high in case of buildings over 10 storey. Wind loads must be considered for the design of buildings over 10 storeys.

 

## 3. DETAILS OF PRESENT STUDY

The present study includes the study of nature and variation of static wind pressures. For this study multistoried frames of 10, 15, 20 storeys are considered. From this the variation of static pressures with height will be clearly known. In the present study emphasis is on change of aspect ratio with length and breadth and different heights. The wind load is applied both along and across the building frame. The typical size of column is 0.3m x 0.49 m. the size of beam is 0.3m x 0.4m.The height of each storeys is 3m.Bay length is 5m.

**Wind data:**

Wind zone: basic wind speed 50 m/s

Terrain category: II open terrain with well scattered obstructions having height generally between 1.5m and 10m.

Class of building: general

Topography: flat

## 4. EQUIVALENT STATIC METHOD

The basic wind speed of a region corresponding to certain reference condition shall be modified to include the effect of risk level, terrain roughness, height and local topography. Design wind speed, $V_z$ in m/s at height z for the chosen structure as given below.

$$V_z = V_b \times K_1 \times K_2 \times K_3 \times K_4$$

$$P_z = 0.6 V_z^2$$ Where

$V_z$ =Design wind speed (in m/s) at height z $P_z$= wind pressure in N/m$^2$ at height z

$V_b$= basic wind speed for the site(50 m/s)

$K_1$= probability factor

$K_2$= terrain roughness and height factor $K_3$= Topography factor

$K_4$= importance factor

$K_1$,$K_2$,$K_3$,$K_4$ values are taken from IS 875 part 3

At 30 m wind speed is calculated as follows $V_z = V_b \times K_1 \times K_2 \times K_3 \times K_4$

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V= 50 x1x1.12x1x1

= 56 M/S

Pz=0.6Vz2

= 0.6 x 56x56

=1.88 KN/M$^2$

## 5. MODELING

STAAD PRO is user friendly interface which allows modeling the frames, applying loads of varying dimensions. This software helps in modeling the building frames, analyzing different parameters and changing the properties of all materials which are used for building structures. By changing number of bays, 40 building frames were modeled. Later analysis is carried out by using STAAD PRO software. Fig. 1, Fig. 2, Fig. 3, Fig. 4 ,Fig.5 and Fig 6 shows the typical layout of columns, model of frame, Live Load,Wind load and self weight respectively.

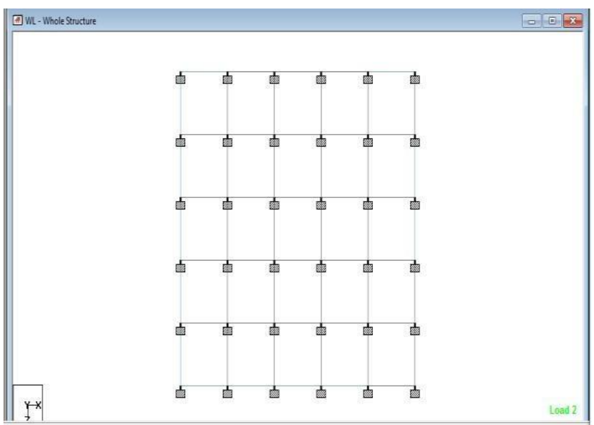


Figure 1:plan view of the building

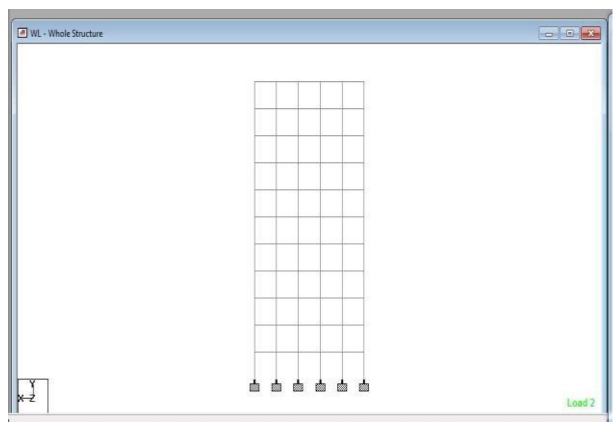


Figure 2:elevation of the building

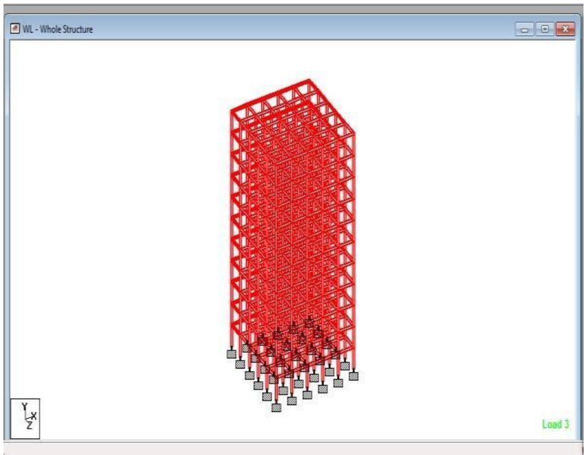


Figure 3:self weight on building

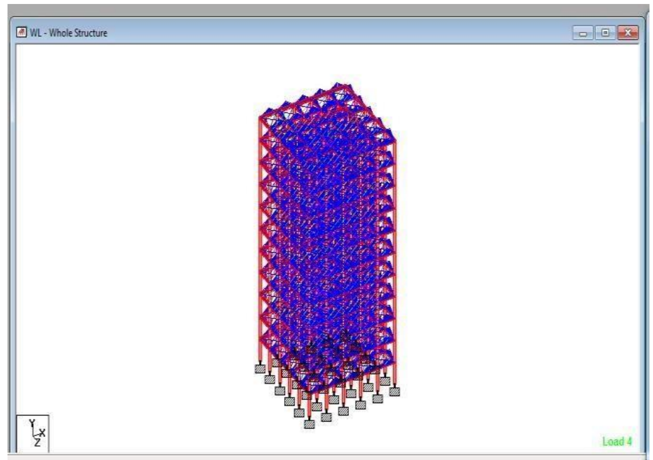


Figure 4 ;live load on the builing

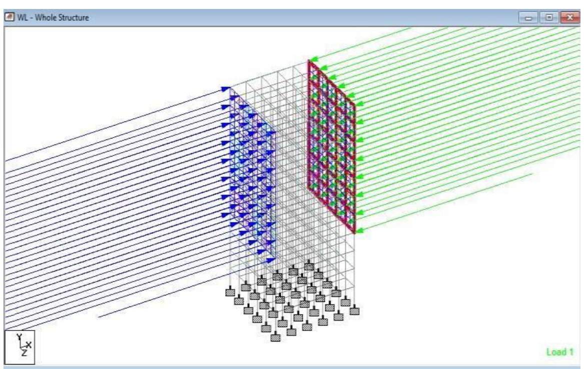


Figure 5:wind load applied on X direction

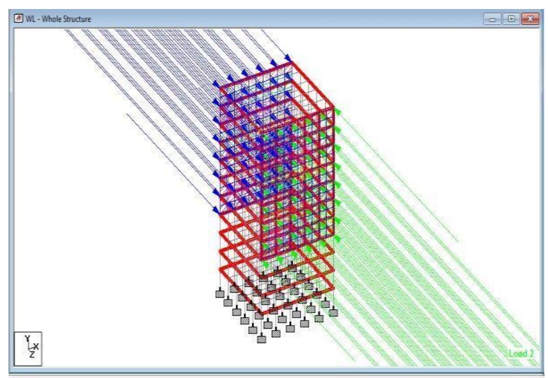


Figure 6 : wind load on Z direction

## 6. RESULTS AND DISCUSSIONS

### A. P. Mendis, N. Haritos, B. Samali, J. Cheun (2007)

Discussed on their paper to provides an outline of advanced levels of wind design, in the context of the Australian Wind Code, and illustrates the exceptional benefits it offers over simplified approaches. Wind tunnel testing, which has the potential benefits of further refinement in deriving design wind loading and its effects on tall buildings, is also emphasized.

### B. K. Vishnu Haritha, Dr.I. Yamini Srivallie (2015)

According to them wind effect is predominant on tall structures depending on location of the structure, height of the structure. Further they discussed their paper is equivalent static method is used for analysis of wind loads on buildings with different aspect ratios. The aspect ratio can be varied by changing number of bays. Aspect ratio 1, 2, 3 were considered for present study. The analysis is carried out using STAAD PRO.

### C. Kiran Kamath, Shruthi (2013)

They explain the effect of different aspect ratios on the seismic performance of the steel frame structure with and without infill. Here, height of the building is kept constant and the base width is varied. Two types of frames are considered for the study, one with similar steel sections for maximum strength required for beam and column and the other with varying steel sections conforming to the strength and serviceability requirements to withstand the specified loading. ETABS is used for analysis and the comparison between the performances of frames with different aspect ratios is made using pushover curves and performance point. It is found that the presence of infill stiffness contributes significantly to the performance of the structure compared to bare frame.

### D . D.R. Deshmukh, A.K. Yadav (2016 )

They explain about High-rise structures which need more time for its time consuming and cumbersome calculations using conventional manual methods. Further they used software
i.e. STAAD-Pro which provides a fast, efficient, easy to use and accurate platform for analyzing and designing structures. Their main principle of this project is to analysis and design a multi-storied building G+19 (3 dimensional frame) using STAAD Pro software. The design involves analyzing the whole structure by STAAD Pro. They conclude that STAAD-PRO is a very powerful tool which can save much time and is very accurate in designs.

## CONCLUSION

The performance is based on wind loads which effecting the high rise building. The literature studies the various building on different height with respected their aspect ratio. The Aspect ratio is an important factor for high rise building at various zone. Hence, the design and Analysis are done with by using the codal. After performing the analysis of the building frames using STAAD PRO software, the conclusions obtained are:

1.When wind load is applied along the length of the building frame displacement for 20 storied frames is very high when compared to 10 and 15 storied frames.

2.When wind load is applied across the length of the building frame; as aspect ratio increases, displacement gradually decreases. This displacement reduction is high in case of 20 storied frame compared to 10 & 15 storied frames.

3.For aspect ratio 1, displacement is high for 5X5 frame compared to 10X10 and 15X15 frames.

4.For aspect ratio 2, displacement is more when wind load is applied along the length of the building frame. The displacement decreases when wind load is applied across the building frame.

This study shows that there is a enough changes in the codal provisions on wind effects and wind load and also present a review of design and analysis of high rise building structure. As the stiffness of the member increases the displacement of the frame decreases. The aspect ratio plays a major role in affecting the displacements up to certain height. Further research can be carried out for more accurate results.

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