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Effect of Wind Load on High Rise Buildings Considering Aspect Ratio

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Abstract: ***The rapid increase of the urban population in developing countries such as India, has forced the re-evaluation of the importance of high rise buildings[8]. The impact of wind loads are to consider for the design of high rise building. There are many failures of structures have occurred in India due to wind. The wind loads on different types of structures are considered by IS 875 Part-3. The present study focuses on 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 Effect of wind load on height of building by varying the no. of stories with increasing in the Aspect Ratio. The analysis of multistory building for Class A and Class B zones for wind forces in terrain categories TC2 and TC3 is carried out. 3-D model is prepared for G+5 and G+11 multistory building in STAAD-Pro.***

Keywords: High- rise building, Wind effects, Aspect ratio, STADD PRO-V8i, Building class, Terrain Category

I. INTRODUCTION

A. General

Wind is air in motion relative to the surface of the earth. It varies with time and space. Due to the unpredictable nature of wind, it is necessary to design the tall structures by considering the critical effects of wind on the structure. Wind force depends upon exposed area of the structure[8]. The wind force depends upon terrain and topography of location as well as the nature of wind, size and shape of structure and dynamic properties of building. It is very important to consider fluctuating component of wind pressure while designing. The development of modern materials and construction techniques has resulted in the emergence of a new generation of structures that are often, to a degree unknown in the past, remarkably flexible 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.

B. Definition of high rise building:

A building is an enclosed structure that has walls, floors, a roof, and usually windows. A tall building is a multi-story structure in which most occupants depend on elevators [lifts] to reach their destinations. The most prominent tall buildings are called high-rise Buildings. According to The National Building code 2005 of India “A Building having height more than 15m is called as High rise building”[7]

II. MODELLING DETAILS

A. Design Wind Speed

The basic wind speed (Vz) for any site shall be obtained from IS: (875(Part 3)-1987) and shall be modified to include the following effects to get design wind velocity at any height (Vz) for the chosen structure:

1) Risk level
2) Terrain roughness, height and size of structure; and
3) Local topography

Vz = Vb.k1.k2.k3
Vz= hourly mean wind speed in m/s, at height z
Vb = regional basic wind speed in m/s
k1 = probability factor (risk coefficient) (Clause 5.3.1 of IS: 875(Part 3)-1987)
k2 = Terrain and height factor (Clause 5.3.2 of IS: 875(Part 3)-1987)

k3 = topography factor (Clause 5.3.3 of IS: 875(Part 3)-1987)

B. Design Wind Pressure

The design wind pressure at any height above mean level shall be obtained by the Following relationship between wind pressure and wind velocity:

$Pz=0.6\ Vz^2$

Where, Pz= Design wind pressure in N/m^2 at height 'z' m

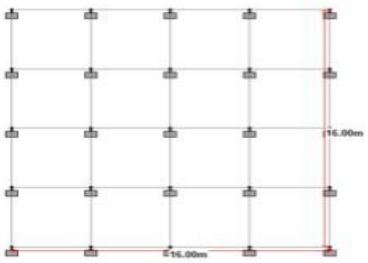
Vz= design wind velocity in m

III. WIND DATA

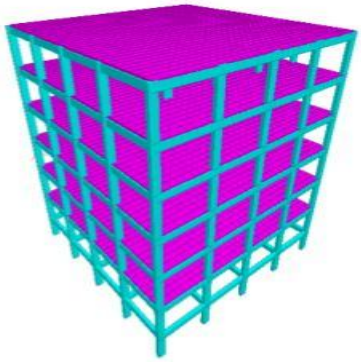
City: Nagpur,
Basic wind speed: 44 m/s,
Opening in the building: 5-20%,
Terrain category: 2 and 3,
Risk coefficient: 1,
Wind in X-direction

IV. MODEL DATA

The Stadd pro software is used to develop 3D model and to carry out the analysis. The wind loads to be applied in the buildings are based on the as per (IS-875 (PART-3):1987)



Plan- Base dimensions 16-16



3D View 16-16-18

Model 1 :- 16-16-18

V. PLAN ASPECT RATIO

TABLE I :- DIFFERENT ASPECT RATIO STRUCTURE	ASPECT RATIO	BUILDING CLASS	TERRAIN CATEGORY
16-16-18	1	CLASS A	2 3
8-16-18	2	CLASS A	2 3
24-24-36	1	CLASS B	2 3
24-48-36	2	CLASS B	2 3

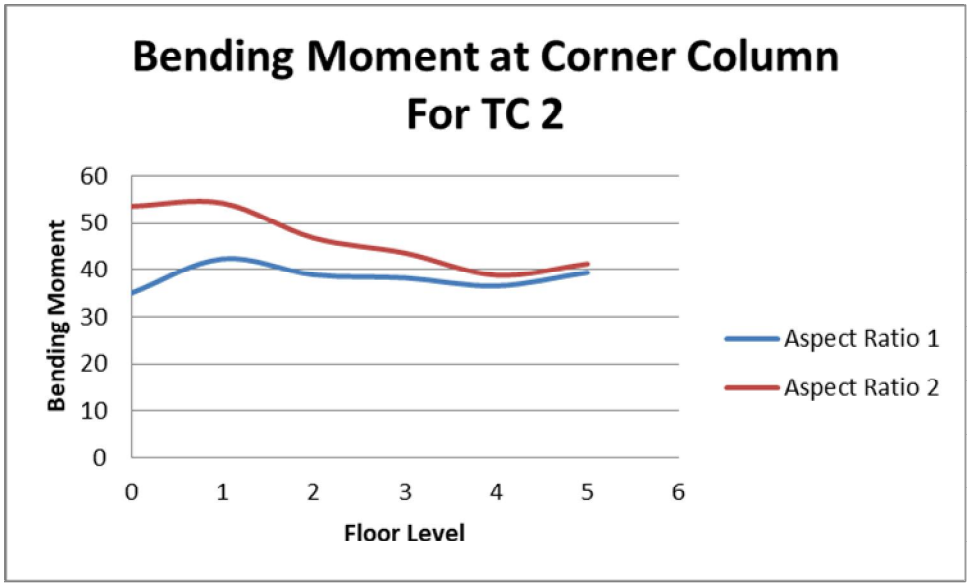


Fig. 1 for floor level and bending moment

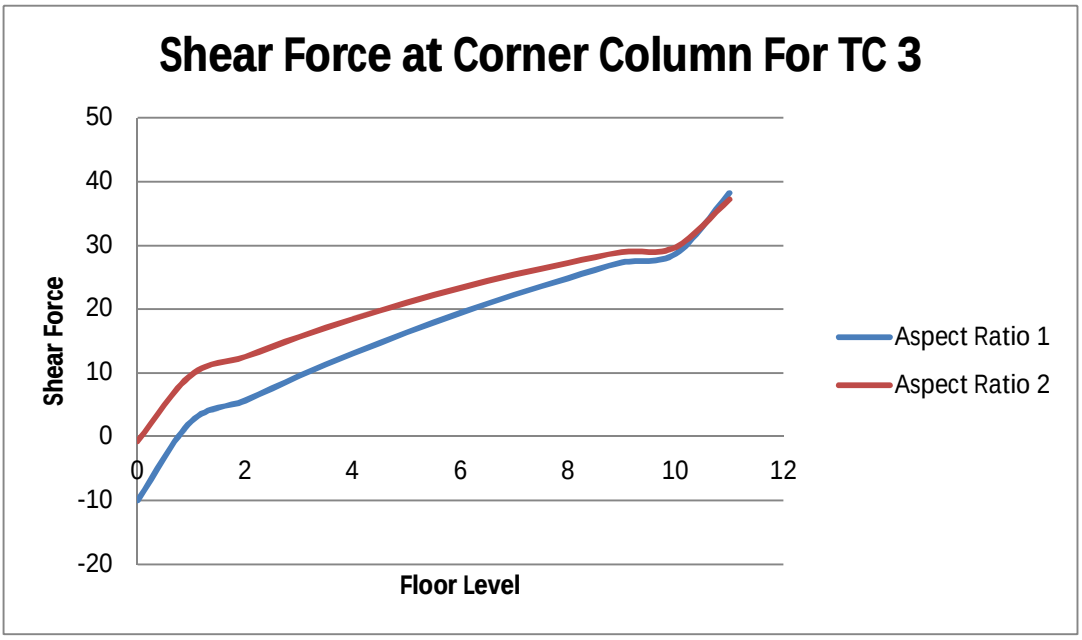


Fig 2:- floor and shear force

VI. REFERENCES

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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 carrie 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. The design methods used in STAAD-Pro analysis are Limit State Design conforming to Indian Standard Code of Practice. They conclude that STAAD-PRO is a very powerful tool which can save much time and is very accurate in designs.

E. Anupam Rajman, Prof Priyabrata Guha (2015)

on this paper they have studied the four different shaped buildings are generally studied namely circular, rectangular, square and triangular. further they explain the definition, design parameters, and lateral load considerations of tall buildings, which is presented in their research paper. Then they concluded about interpreted for different shaped buildings and of different stories of building. Finally they result about shaped of high rise building which is most stable for different conditions and zone.

F. Vindeffekter (2007)

They explain the calculation of the first natural frequency of high rise buildings, wind induced acceleration on high rise buildings and how the comfort criteria of acceleration performing on high rise buildings acts on human bodies living in the building. The most important results were that there will be excessive movement in the top floors of Turning Torso so that sensitive people may perceive motion and hanging objects may move. The aim was to make a diploma work that can be used in practice, which can be a guide to design high rise buildings due to wind effects in the early stages of development

VII. CONCLUSIONS

A. In case of Wind force the axial force, shear force, torsion, bending moment and displacements developed in the columns decrease as terrain category is changed from 2 to

B. Wind forces are found to increase with the height but with the increase in base dimensions they are found to reduce significantly.

C. In case of Wind if the height of structure is increased the shear at top floor is found much higher than floor immediately below.

D. As the class of structure increase hence height the difference between shear in Y direction due to wind loading increase with structure with same base dimensions.

VIII. ACKNOWLEDGMENT

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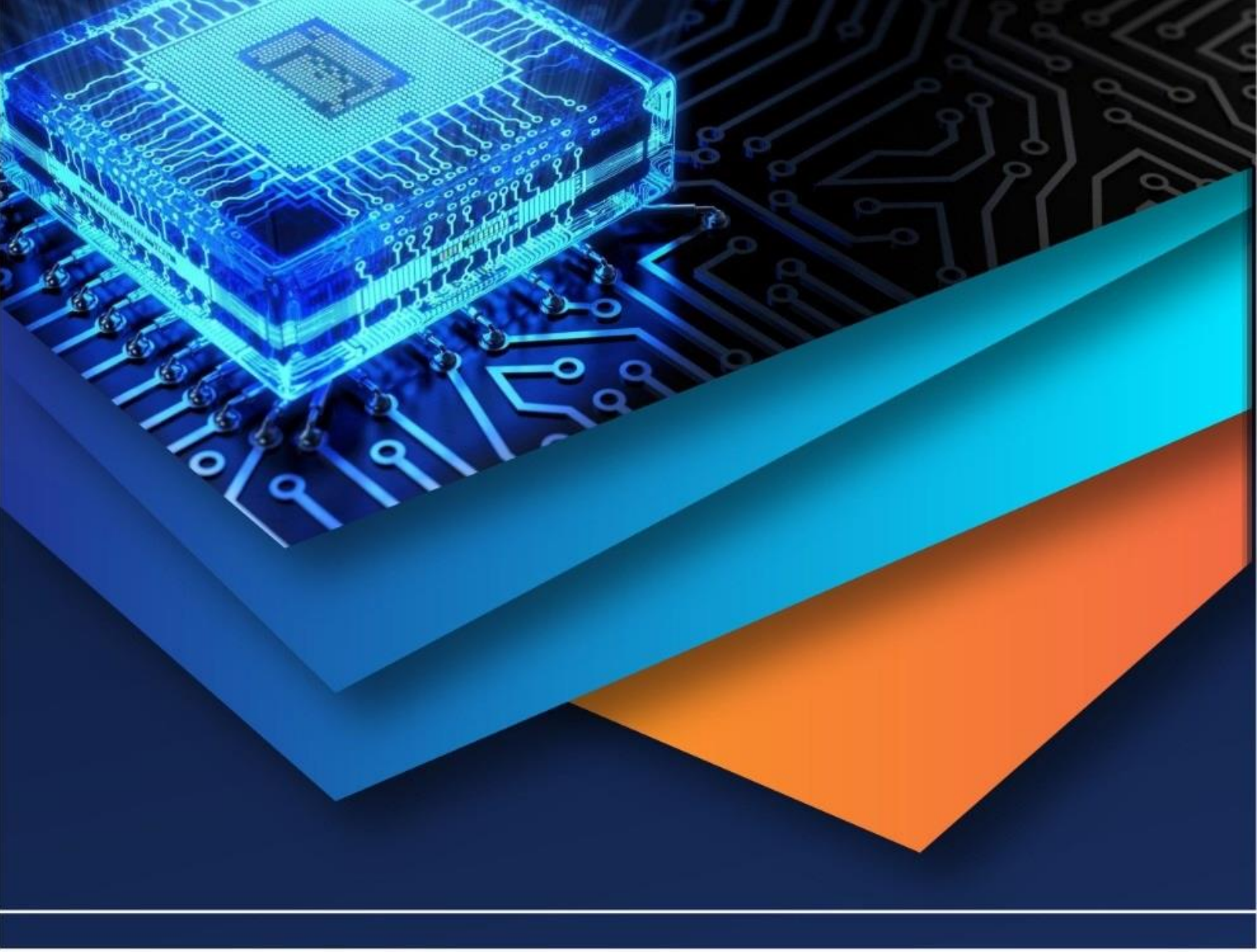

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