Effect of Wind Load on High Rise Buildings Different Terrain Category

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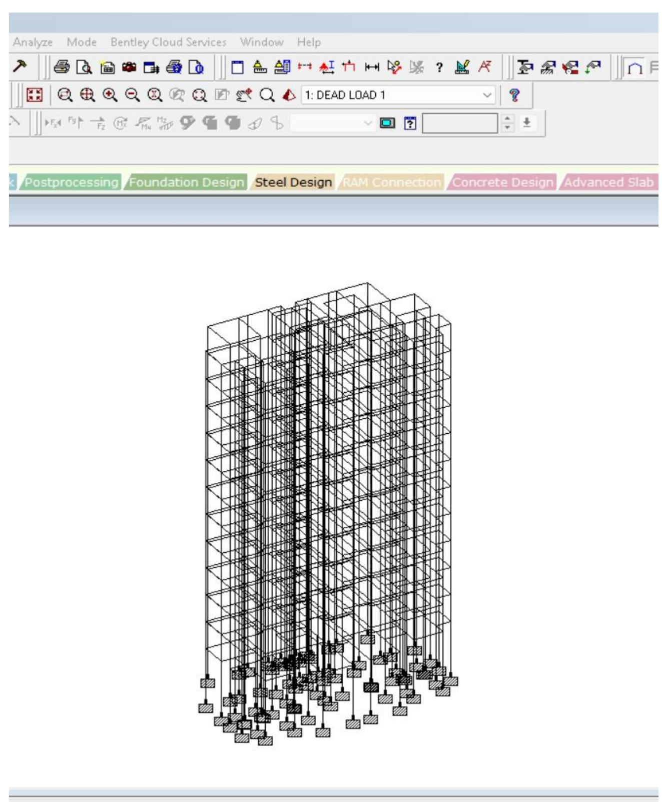
ABSTRACT: *Any Tall building can vibrate in both the directions of along wind and across wind caused by the flow of wind. Modern Tall buildings designed to satisfy lateral drift requirements, still may oscillate excessively during windstorm. These oscillations can cause some threats to the Tall building as buildings with more and more height becomes more vulnerable to oscillate at high speed winds. Sometimes these oscillations may even cause discomfort to the occupants even if it is not in a threatening position for the structural damage. So an accurate assessment of building motion is an essential prerequisite for serviceability. There are few approaches to find out the Response of the Tall buildings to the Wind loads. Wind is a perceptible natural motion of air relative to earth surface, especially in the form of air current blowing in a particular direction. The major harmful aspect which concern to civil engineering structures is that, it will load any and every object that comes in its way. Wind blows with less speed in rough terrain and higher speed in smooth terrain. This paper presents story drift, story shear, and support reactions accour in High rise due to wind in different terrain category. G+10, are analyzed using STAAD PRO Software. Present works provides a good source of information about variation in drift, shear are compared as height of model changes and percentage change in drift, shear of same model in different terrain category.*

KEY WORDS: Tall Buildings, drift, story shear, STAAD PRO, different terrain category.

1. INTRODUCTION

Wind has two aspects. The first beneficial one is that its energy can be utilized to generate power, sail boats

and cool down the temperature on a hot day.The other a parasitic one is that it loads any and every object that comes in its way. The latter is the aspect an engineer is concerned with, since the load caused has to be sustained by a structure with the specified safety. All civil and industrial structures above ground have thus to be designed to resist wind loads. This introductory note is concerning the aspect of wind engineering dealing with civil engineering structures.



A Building on Staad pro

IMPORTANCE OF WIND LOADS ON TALL BUILDINGS

Buildings are defined as structures utilized by the people as shelter for living, working or storage. As now a days there is shortage of land for building more buildings at a faster growth in both residential and industrial areas the vertical construction is given due importance because of which Tall Buildings are being build on a large scale.

Wind in general has two main effects on the Tall buildings:

Firstly it exerts forces and moments on the structure and its cladding

Secondly it distributes the air in and around the building mainly termed as *Wind Pressure*
Sometimes because of unpredictable nature of wind it takes so devastating form during some Wind Storms that it can upset the internal ventilation system when it passes into the building. For these reasons the study of air -flow is becoming integral with the planning a building and its environment
Wind forces are studied on four main groups of building structures: Tall Buildings

2. OBJECTIVE

- To study the effect of wind on building frame.
- To study the effect of wind velocity on building with zero-degree slope in different Terrain Categories.
- Comparative study of effect of wind on building rests in different terrain categories.
- To study the approach in field of structural engineering.
- Comparative study between deflections in buildings in two different terrain conditions.
- Comparison of wind load on buildings having different importance.
- To model and analyze a structure using STAAD PRO software.
- To compare the results and to check the safety of the structure against allowable limits prescribed for maximum displacements, storey drifts and other references in literature on effects of wind loads on buildings.

3. LITERATURE REVIEW

I) Barkha Verma, Bhavika Baghel, Aditi Chakradhari, Abhishek Agrawal, Prince Wanjari
Their research deals with the concluding remarks drawn from the results of all the analysis and design made for the G+30 storey building with the different type of aspect ratio having same floor area (3600 sq. m) is considered for analysis. The results have been presented in tabular form along with the graphical mode in their research work.

II) P.V. Muley, Jigar M. Senghani, A.S. Radke

This paper is aimed at studying how high rise building structures of different Plan configurations will behave during seismic and wind excitation. Twenty-one models starting with Ly:Lx ratio of 1:1 to 1:3 for G+60 storey structure are modelled. From the present study it can be concluded that, Plan aspect ratio Ly:Lx of the building above 1:2.6 is not feasible for 180m height of the building (G+60).

III) Okafor C. Vincent, Kevin C. Okolie, Mbanusi C. Echefuna, and Okafor C. Pamela

This paper analyzed the effect of wind loadings on high-rise building for different terrain categories. From the result obtained, it was shown that Terrain category IV when compared to other terrain categories recorded lower wind speed and pressure from the ground to a height of about 10m.

IV) Shraddha J. Patil, Mahesh Z. Mali, Dr.R.S.Talikoti

The global urban population is expected to grow approximately 1.84% per year between 2015 and 2020. So to accommodate this large number of world's population in the urban area there is not enough space available on the horizontal ground. In this research they study about how wind load analysis plays an important role in designing and analysis of this high rise buildings.

4. METHODOLOGY

Wind load calculations as per the code is 875 :1987

Design Wind Speed (Vz)
The design wind speed, Vz at any height, Z for the chosen structure: (a) Risk level, (b) Terrain

roughness and height of structure, (c) Local topography, and (d) Importance factor for the cyclonic region. It can be mathematically expressed as follows:

$V_z = V_b K_1 K_2 K_3 K_4$

Where Vz = design wind speed at any height z in m/s
k1 = probability factor (risk coefficient) k2 = terrain roughness and height factor k3 = topography factor
k4 = importance factor for the cyclonic region

Design wind pressure ; **$P_z = 0.6\, V_Z^2$**

pz = wind pressure at height *z*, in Is N/m^2
The design wind pressure pd can be obtained as,

$P_d = K_d K_a K_c P_z$
Kd = wind directionality factor Ka = area averaging factor, and *Kc* = combination factor.

DYNAMIC ANALYSIS OF WIND FORCES ON TALL BUILDINGS:

This paper is an attempt to study behavior of the tall buildings under simulated atmospheric boundary layer and to evaluate various experimental and analytical techniques to compute dynamic response and present a detailed comparison. Researchers have laid down several analytical procedures during last few decades. Even though there are several grey areas which need to be addressed to achieve a better prediction of the response, i.e., a designer is interested in storey wise horizontal forces for dynamic analysis and design of structural frames. Hence, emphasize is given to compute the story wise lateral forces on building by analytical procedure and through base forces obtained by Wind tunnel testing on scaled model of building and surrounding terrain.

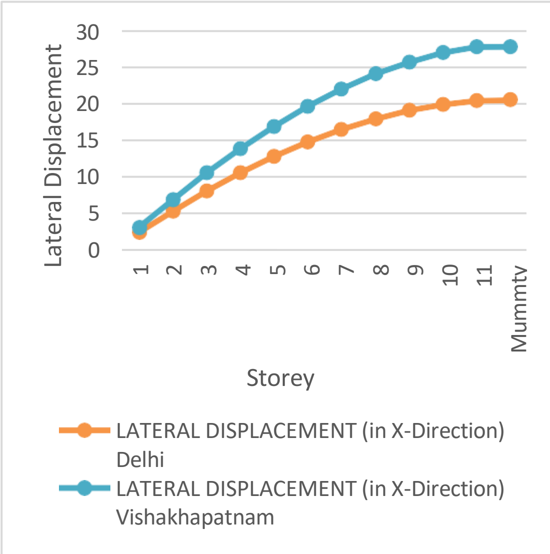
5. SCOPE OF WORK

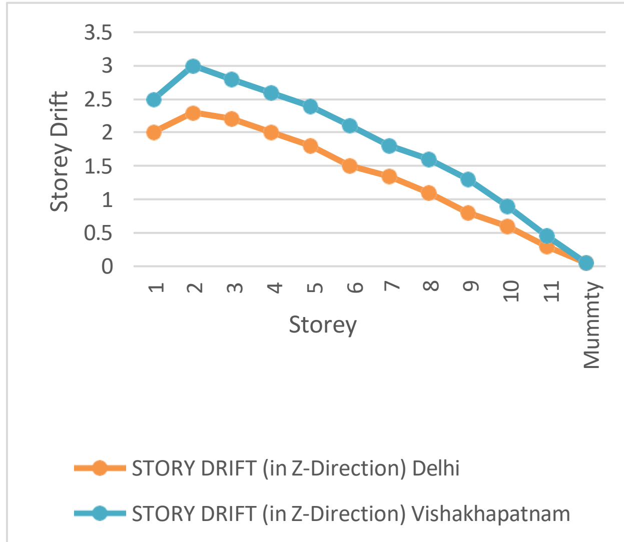
The scope of the present work includes the study of the Wind load estimation on Tall buildings

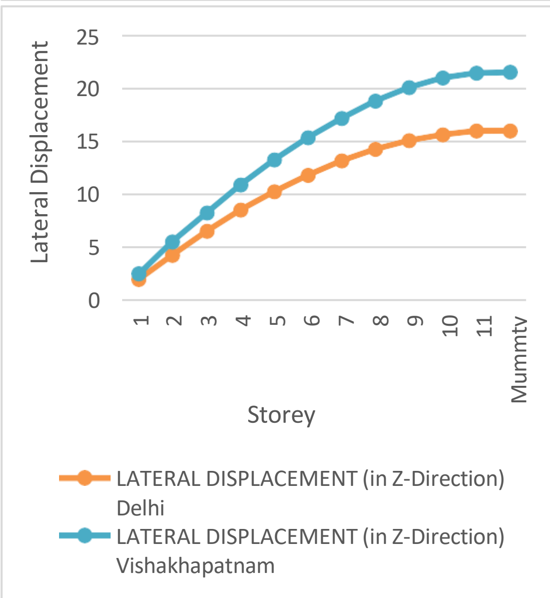
1. Based on project, study was undertaken witha view to determine the extent of possible changes in the wind behavior of RC Building Models.
2. RC framed buildings are firstly designed for gravity loads and wind loads.
3. The study has been carried out by introducing symmetrical bare frame buildingmodels on different wind terrain categories using dynamic analysis method.
4. The study highlights the effect of wind load in different terrains i.e, Terrain 1, Terrain 2, which are considered in the wind evaluation of buildings.
5. The study emphasis and discusses the effect of wind load for 10 storey Buildings are considered.
6. The entire process of modeling, analysis anddesign of all the primary elements for all the models are carried by using STAAD PRO software.

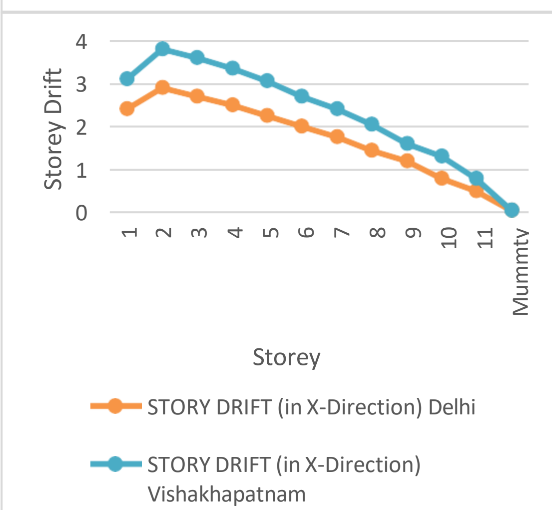
6. RESULT AND DISCUSSION

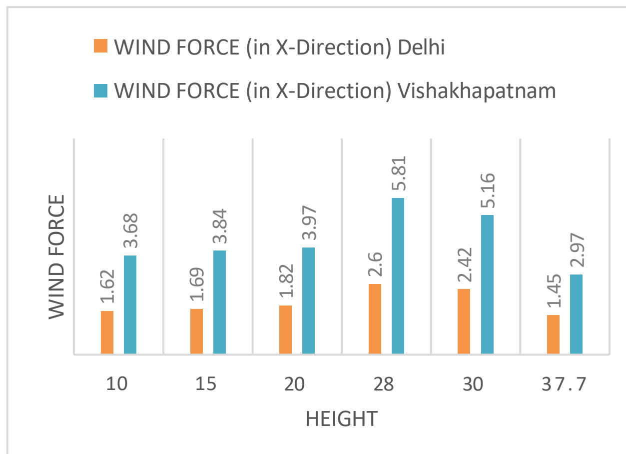
By Manual Calculation, we found that there is a difference of almost 2.5 times in Wind force between Delhi and Vishakhapatnam for the same staging and area of building. This difference is occurring because of having different terrain categories and importance factors.
Now we analyzed these buildings on software to compare the results and to check the safety of the structure against allowable limits prescribed for maximum displacements, storey drifts and other references in literature on effects of wind loads on buildings.
The results have been shown in graphical and tabular forms below. And all the outcomes have been Concluded below them as per software responses.

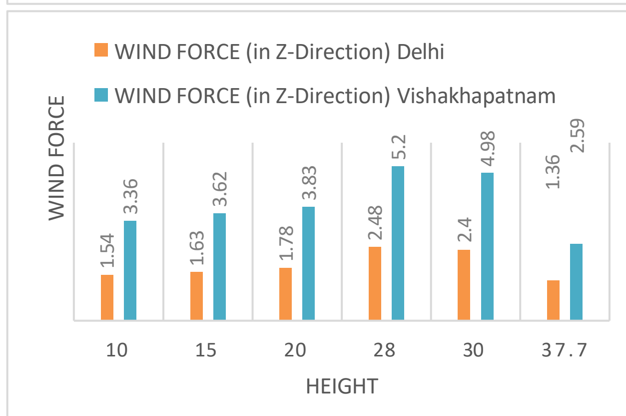












7. CONCLUSION

The maximum deflection in X - direction at the top most storey is 27.81mm for structure which is designed in Vishakhapatnam and 20.5mm for

structure which is designed in Delhi as per IS – 875 (Part-3, 2015).
The maximum deflection in Z - direction at the top most storey is 21.5mm for structure which is designed in Vishakhapatnam and 16 mm for structure which is designed in Delhi as per IS – 875 (Part-3, 2015).

Wind Force has been increased and decreased at last when it is almost near the top of the building. Wind force has been decreased in Delhi as compared to Vishakhapatnam.

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