COMPARTIVE STUDY ON THE EFFECT OF WIND VELOCITY ON TALL BUILDINGS IN DIFFERENT TERRAIN CATEGORY

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Abstract-The structures which are designed and construct as per earlier code provision do not have satisfied requirements for wind velocity effects .Thus many of the structures in seismic areas are suffering from hazards. Therefore the new code provisions are made for such cases. The purpose of this work is to compare the analysis of wind velocity for different terrain categories. The aim and grit is also to make proper work guidelines that can be used in practice within the early state of the design of high rise buildings as well as to find the wind induced acceleration in the top floor of skyscrapers. The wind effect analysis is carried out for seismic zone-II and III i.e., Bangalore and Chennai. The program used for modeling and analysis is ETABS V 15. The structural parameters such as column axial force, displacement changes and story shears are studied. This paper concludes that the column axial forces of structural elements depend on the terrain categories. In this project work, there has been gathered information and method has been shown to evaluate the effects of wind velocity at early state design.

Key words;**high-rise buildings, wind velocity, staticanalysis, wind design, axial force**.

1. INTRODUCTION

1.1 General

Tall buildings are those structures which are more than ten storeys or high-rise building is defined as structures which have height more than 35 mtrs. The direction of wind flow interacts only with the external shape of the structure for static structure. If the height of the buildings being constructed today is inspected, it is clearly evident that the structures in the long-term will be higher and higher. Presently, skyscrapers are being constructed constantly all over the world. As a result the height of the tallest building changes year by year. With this development that buildings are getting taller, there will be a much concern for the occupants comfort due to wind induced acceleration in the higher floors of a tall buildings. Additionally, these days tall buildings are constructed such that they sway a lot in wind that the people complains about movement and even motion illness.

The structural systems of tall structures are generally sensitive to the wind outcomes. With the growing need to enhance the overall performance of construction facilities it has placed a great importance on the problem of wind effects on the structures. The available literature is worth big. It can be felt that researchers and designers working in this aspect will benefit from a conclusion devoted to the fundamentals of wind effect on tall buildings.

1.2 Basic Aspects of Wind Design

When designing a tall structure to counteract the effect of wind load the following basic design criteria need to be satisfied primarily.

- Structure should be stable against falling down, uplift, overturning and sliding of the as a whole. Hence stability should be maintained overall.
- Structural components of the building should be strengthened such that it should withstand imposed loads without failure during the entire period of the structure.
- The Ultimate Limit State method satisfies stability and strength requirements, for wind speed in most international codes.
- Serviceability of the structure should be within permissible limit. The overall deflection should be within acceptable limits. An additional criterion to be carefully pondered upon is the control of sway acceleration which should be

considered particularly in wind sensitive structures. These criteria are based on human tolerance to provide vibration of discomfort in the upper stories of structure

2. OBJECTIVES

- To study the literature on wind velocity and its effect on tall buildings. To obtain the information about the design of tall buildings, wind velocity effects on tall buildings and its consequences by collecting the required journals and get the idea about the research done in the respective field.
- To study the wind effect response considering the variation in terrain categories and for different regions for the same structure.
- To study the existing literature on wind effects on tall buildings.
- To study the response of the structure to wind velocities in different regions and terrain categories.
- To compare the results of analysis between Chennai and Bangalore region under different terrain categories.
- The model developed will be simulated in E-TABS with the wind effects data and the model is simulated to different terrain categories varying I,II,III,IV for both Bangalore and Chennai region with load cases referring accordingly to IS 1893(Part 3): 2002.

3. METHODOLOGY

3.1 Wind effects analysis and its requirements

The static analysis is carried out according to IS 1893(Part 3): 2002 by using ETABS V15 software. The main parameter that was focused on was column axial force for each terrain category for the two adopted region. . Major part of this literature mainly encompasses the comparison of behavior of tall structures under different regions having higher and lower wind velocity. The obtained values are then compared with each different category and between the Bangalore and Chennai region.

The structural engineers who are in charge of design of a high rise structures should give priority for considering the potential problems of excessive building motions. Initially the designer must predict the probable motion and should find out the tolerable limits. If it is failed at first by knowing the predicted motion is unacceptable, then the design should be revised again to decrease the potential movements.

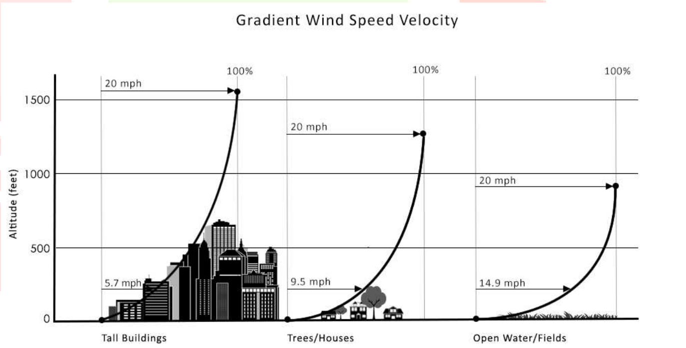


Fig: 3.1 wind speed with respect to altitude

3.2 Software requirements

There are various soft wares depending on computer configurations to carryout pushover analysis they are:

- AUTOCAD
- ETABS

3.3 Details of model

Column axial force for different terrain categories, Displacement changes, Story shears of various parameters are considered in the modeling of structure.

The type of structure and specifications considered:

	Bangalore	Chennai
No of stories	15	15
Seismic zone factor	0.10	0.16
Importance Factor	I	I
Soil type	Hard soil	Hard soil
Response reduction factor	3	3
Wind velocity	33 m/s	50 m/s
Seismic zone	II	III

3.4 models

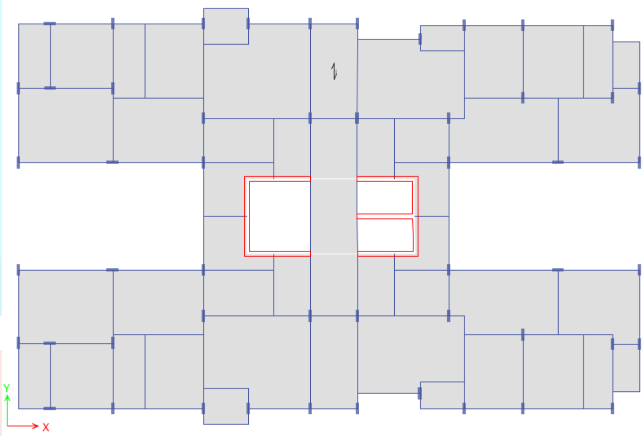


Fig 3.2 E-tabs model plan view

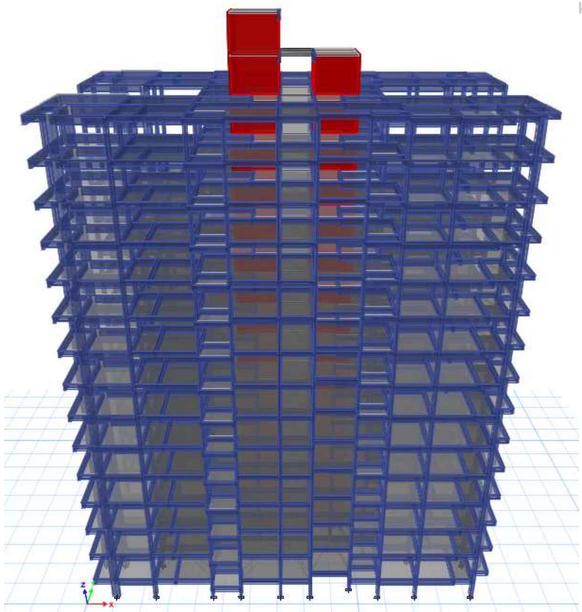


Fig 3.3 E-tabs model 3D- view

3.5 Materials details

M40, M35, M30 & M25 concrete. Fe500 Steel.

Density of concrete-25 KN/m^2. E= $27386*10^3 KN/m^2$..density of block masonry= $20KN/m^3$.

Column (700mm*700mm). Beam (200mm*600mm). Slab=150 mm. Wall thickness =200 mm.

3.6 load intensities

- Live load- $3KN/m^2$. Floor finish-1.5 KN/m^2 (0.75KN/m^2 on roof). Roof live load = 1.5 $KN/м^2$.
- Wall load on members -(h*t*l)*20=4.5 KN/m^2.

3.7 Calculations

Wall load calculations:

Beam depth (mm)	Wall thickness (mm)	Wall height (m)	Wall loads (KN/m)
400	100	3-0.40 = 2.6	2.6 x 0.1 x 20 = 5.2
600	200	3-0.6 = 2.4	2.4 x 0.2 x 20 = 9.6

Parapet wall calculations

Height of wall assumed = 1.5m ,Density of masonry = 20 kN/m^2, Thickness of wall = 150mm

Height x thickness of wall x 1 x density of masonry

= 1.5 x 0.15 x 1 x 20

= 4.5 KN/m

4 RESULTS AND DISCUSSION

The results of the building models for Bangalore and Chennai region with different terrain categories are presented in this chapter.The static analysis is carried out according to *IS 1893(Part 3): 2002* by using ETABS V15 software. The main parameter that was focused on was column axial force for each terrain category for the two adopted region. The obtained values are then compared with each different category and between the Bangalore and Chennai region.

4.1 Max story displacement for both Bangalore and Chennai region

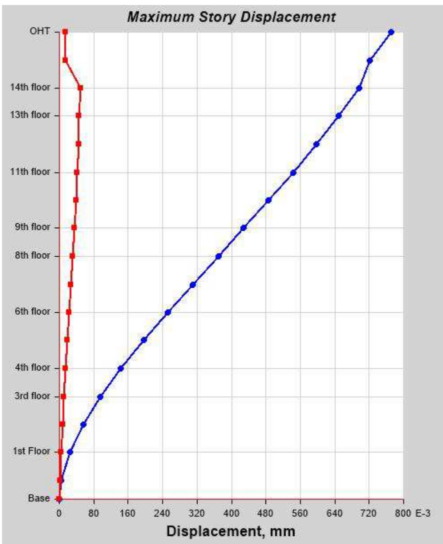


Fig: 4.1.1 Max story displacement

4.2 Story drifts

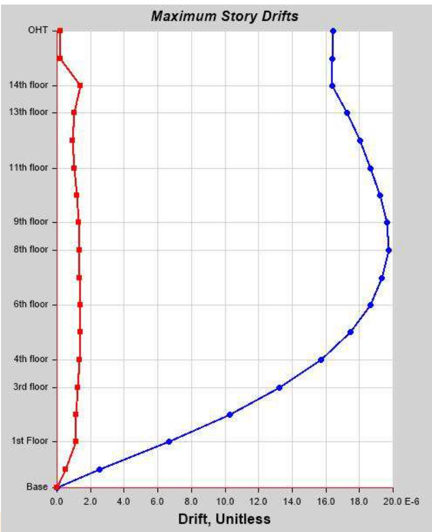


Fig: 4.2.1 Max story drifts

4.3 Story shears

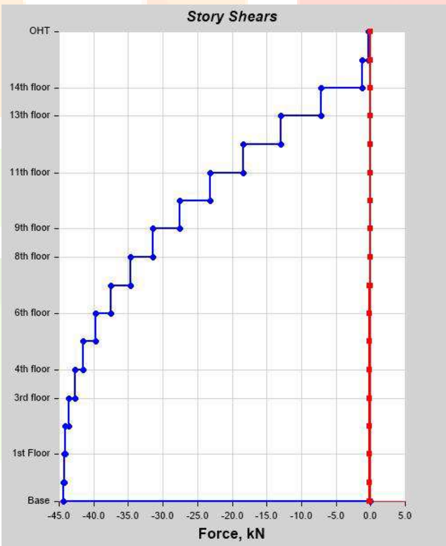


Fig: 4.3.1 story shears

It can be noted that the values of story displacement, story drift and story shears were found to remain same for all the terrains of both Bangalore and Chennai region.

4.4 Column axial forces for Bangalore region

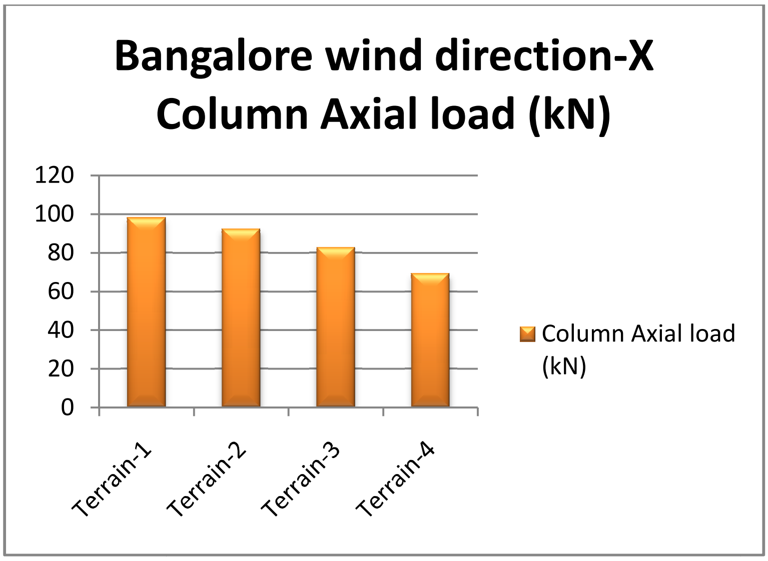


Fig: 4.4.1 axial load graph for Bangalore wind direction-X

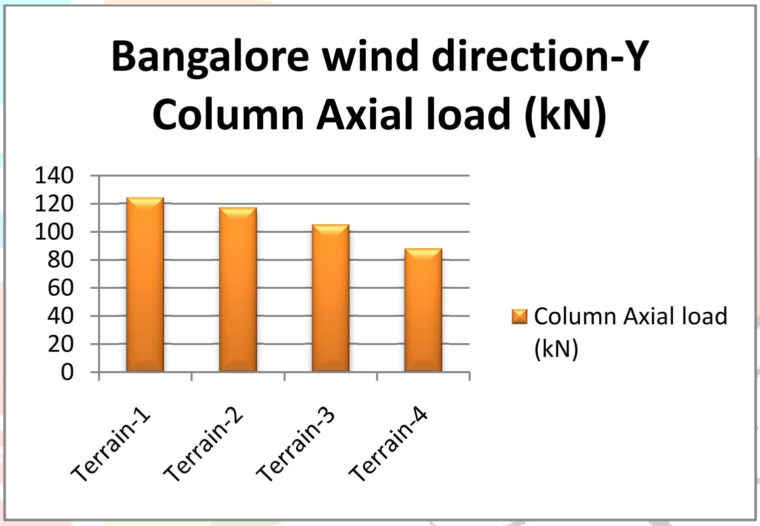
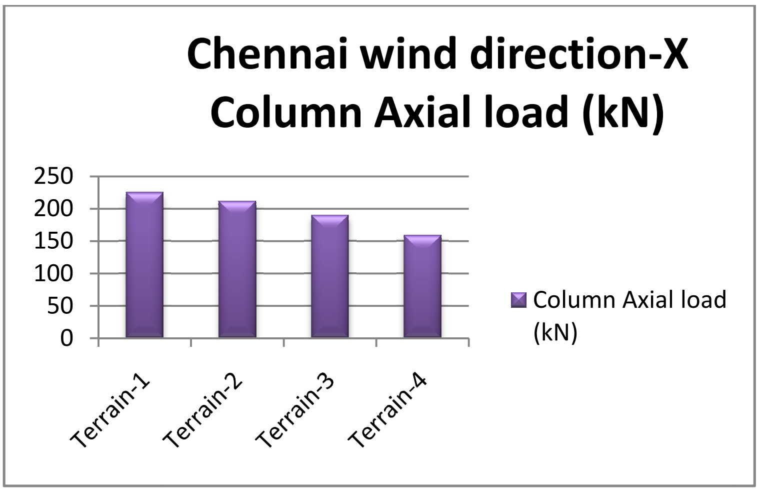
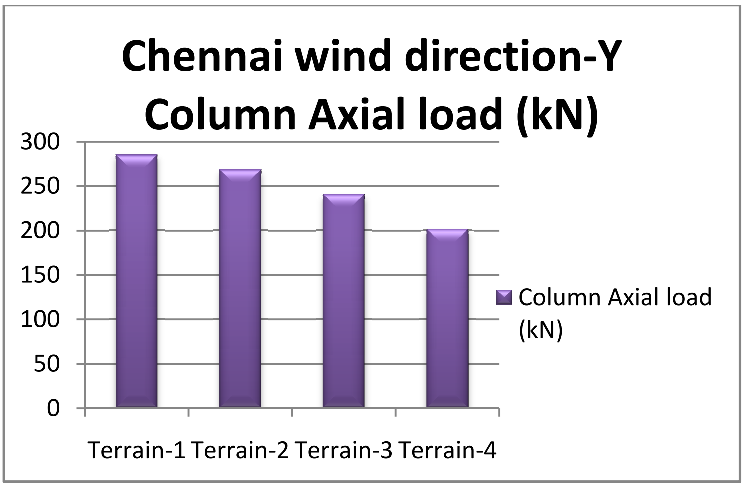


Fig: 4.4.2axial load graph for Bangalore wind direction-Y

4.5 Column axial forces for Chennai region



4.5.1 Axial load graph for Chennai wind direction-X



4.5.2 Axial load graph for Chennai wind direction-Y

5 SUMMARY AND CONCLUSION

- Deflection is found to occur mostly on top storeys.
- It is observed that Story shears and story drifts remain same in both the regions for all the categories**.** However, the axial forces of columns were found to increase by the change in terrain categories..
- The maximum column axial forces were found to be 285.32 KN which was developed at terrain category-1 in Chennai region.
- Column axial load will be higher in terrain-1 and subsequently lower at terrain-4 in both the regions.
- The concluding point of this study is to highlight that, the wind velocity effects should be considered primarily in the early state of design of building.

6 REFERENCES

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