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# Effect of Wind on RC Structure Resting on Sloping Ground & Analysis Done using Etabs Software

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**ABSTRACT:** In this research paper, the effect of wind velocity and structural response of building frame on sloping ground has been studied. Considering various frame geometrics and slope of grounds. Combination of static and wind loads are considered. For combination, different cases in different heights of building frames are analysed. Etabs software has been used for analysis purpose. Results are collected in terms of axial force, Shear force, moment, support reaction, Storey-wise drift and Displacement which are critically analysed to quantify the effects of various slope of ground

**KEYWORDS:** Building geometry Different heights, Bending moment, Different wind velocity, Sloping ground, Wind load.

## I. INTRODUCTION

Wind load is one of the important design loads for civil engineering structures. For long span bridges, tall buildings and high towers or mast structures, wind load may be effects controls the structural design of the structure. Therefore knowledge of a dynamic characteristics of an important structure under wind loading becomes a requirement in engineering design and in academic study. In the ongoing research project on tall buildings, the study of wind-induced demands in categorized as: along-wind and crosswind responses. These demands are caused by different mechanism. Moving along the wind induced is due to the effect of turbulence impact while the particular component is related to the effects of windstorm. On the other hand the effect of wind load on tall structures not only disturbed over the wider surface but also it has higher intensity.

Calculation of ground slope is fundamental to many traditional Geographical Information Systems (GIS) applications. Slope is important component in scientific, military and civilian analyses. Various methods exists for calculating slope. Manual slope generation based upon contour line information, is a long established and generally acceptable method. Multi-storied building frames on sloping ground will be coming up in large number in future times. In this regard realistic analysis and design of this building frames on sloping ground are of paramount importance.

In the modern time, such Multi-storeyed bulid frames are design using Etabs software. This motivation has led to this study on effect of different sloping angle in Multi-stoeeyed building frames. Various configuration of building frames of sloping ground profile layout have been considered along with various load combination of dynamic analysis along with direction and wind forces.

**There are three main objectives of the study:**

1. To study the effect of wind on sloping ground buildings.
2. To study the effect of different wind velocity on sloping ground buildings.



3.To study the effect of wind on three different heights of building frame on sloping ground as per IS 875 (Part III):1987.

## II. METHODOLOGY AND PROBLEM FORMULATIONS

This thesis deals with comparative study of wind behaviour of high rise structure building with three different geometrical configuration and different slope ground, under the wind effect as per IS 875(Part-III) :1987 static analysis. A comparison of analysis result in terms of maximum displacement, wind forces, maximum bending moments, maximum axial force, maximum shear force, drift and reaction has been carried out. These study attempted in following three steps:

- 1.Selection of building geometry, 3 bays and 8, 12 and 16 storey of 2D frame.
- 2.Selection of sloping angle of ground of( 0 degree,5 degree, 15 degree types).
- 3.Selection of 5 wind zones (33,39,44,47 and 55 m/s as per IS(Part III):1987
- 4.Modelling of building frames using Etabs software.
- 5.Analysis considering different heights of building frame and different building angle sloping ground frame models, wind zones and each load combinations.
- 6.Comparative study of results as wind forces, maximum bending moments,maximum axial force, maximum displacement, story wise displacement,maximum shear force,drift and reaction.

### Wind analysis of building frame

#### Modeling of building frames using Etabs Software:

Etabs is a general purpose program for performing the analysis and design of a wide variety of types of structures. The basic three activities which are to be carried out to achieve that goal-

- a) Model generation
- b) The calculation to obtain the analytical result.
- c) Result verification is all facilitated by tools contained in the program's graphical environment.

a) Table 1.1 - Story Data

Name	Height mm	Elevation mm	Master Story	Similar To	Splice Story
Story9	3000	27000	Yes	None	No
Story8	3000	24000	No	Story9	No
Story7	3000	21000	No	Story9	No
Story6	3000	18000	No	Story9	No
Story5	3000	15000	No	Story9	No
Story4	3000	12000	No	Story9	No
Story3	3000	9000	No	Story9	No
Story2	3000	6000	No	Story9	No
Story1	3000	3000	No	Story9	No
Base	0	0	No	None	No



**MATERIAL AND GEOMERICAL PROPERTIES:** Following material properties has been taken in modelling: -

Density of RCC: 25 kN/m<sup>3</sup>

Density of Masonry: 18.5 kN/m<sup>3</sup>

The foundation depth is considered at 1.50m below sloping ground level and the typical storey height floor to floor is 3.0m. The sections of columns are considered of 350mm x 350mm, and the section of beam size is 350mm x 350mm.

**LOADING CONDITIONS**

Following loading is adopted for analysis: -

1. Dead load :- Self wt. of slab considering 125mm thick. Slab 0.125\*25 = 3.125 kN/m

2. Floor Finish load = 1 kN/m<sup>2</sup>

Infill Load - .10 x 3 x 18.5 = 5.55 kN/m

3. Wind load: Calculation of wind load as per IS Code 875(part III):1987.

All the building frames analysed for 5 wind zones. The wind loads are derived for following wind parameters as per IS Code 875(part III):1987. Wind zones -33 m/s, 39 m/s, 44 m/s, 47 m/s, 55 m/s. Wind induced laterally force on structure. This will be calculated at every storey level and windward direction, three cases in this problems

$$P_z = 0.6V_z^2$$

where ,P<sub>z</sub>= wind pressure in N/m<sup>2</sup> at height z, and V<sub>z</sub>- design wind speed in m/s at height z. The design wind pressure p<sub>d</sub> can be obtained.

$$F = C_f * A_e * P_d$$

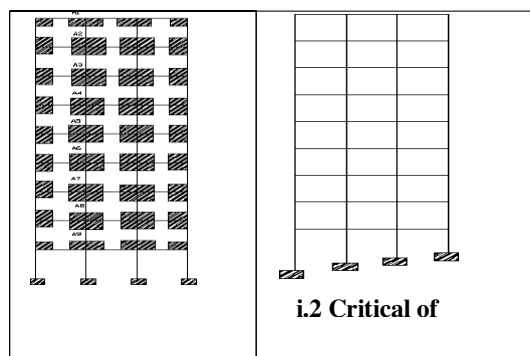
Force coefficient calculations: - Effective area (A<sub>e</sub>) calculations:

A<sub>i</sub>=3.0 x 3.0 = 9m<sup>2</sup>, for intermediate frames

A<sub>z</sub>' 3.0 x 1.5 = 4.5m<sup>2</sup>, for end frames.

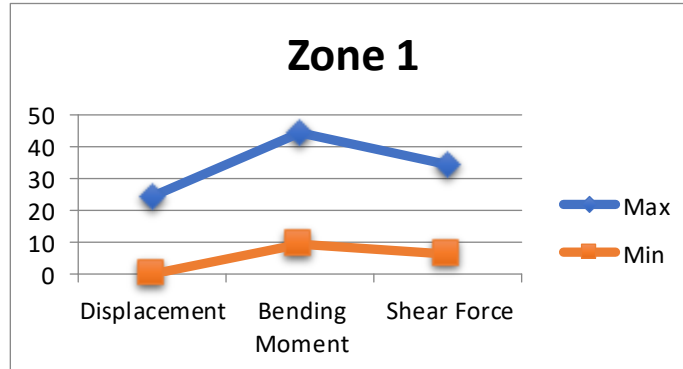
wind force on all building frame as per 875 part-III.

**FIGURE AND TABLE**

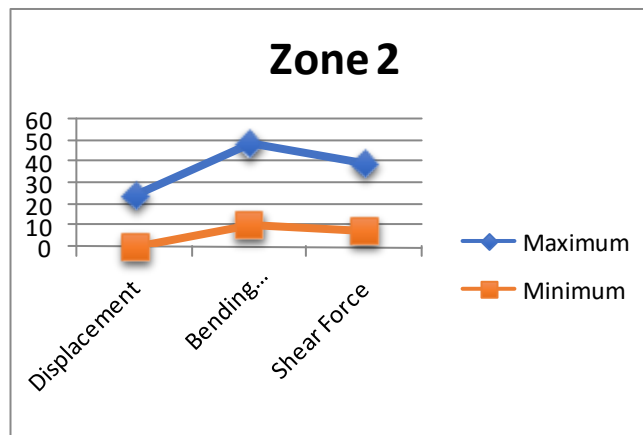




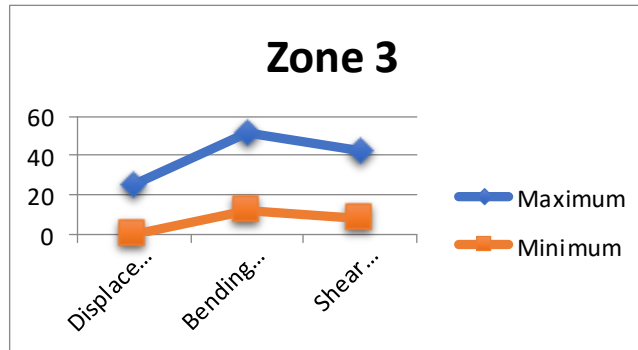
1.FIGURE AND TABLE



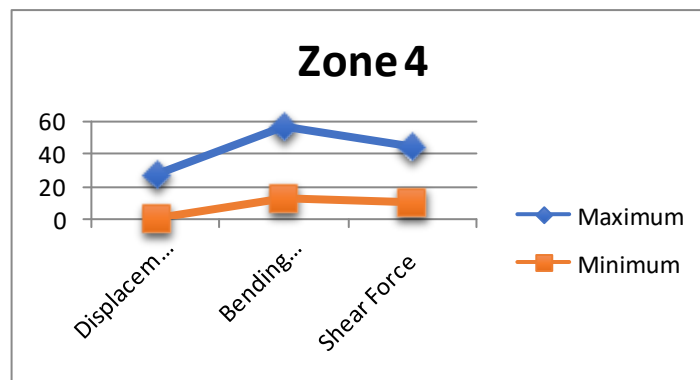
Item	Zone 1	
	Max	Min
Displacement	24.2	0
Bending Moment	44.02	9.28
Shear Force	34.29	6.32



Item	Zone 2	
	Max	Min
Displacement	24.8	0
Bending Moment	48.32	10.46
Shear Force	39.63	7.66



Item	Zone 3	
	Max	Min
<b>Displacement</b>	25.6	0
<b>Bending Moment</b>	51.9	11.97
<b>Shear Force</b>	42.02	8.01



Item	Zone 4	
	Max	Min
<b>Displacement</b>	26.9	0
<b>Bending Moment</b>	56.247	12
<b>Shear Force</b>	43.96	9.763

### III. RESULT, DISCUSSION AND CONCLUSION

As mentioned in the objective of the study, the behavior of multi-storied building frames under the different ground slope. Considered static load and wind load on different heights of the building frame have been analyzed. The results obtained from the analysis are represented by tables and graphs and also plane ground and sloping ground in degree are also compared in tables and graphs as follows:

Follows are the salient conclusion of the study:

**Maximum Axial force:**

1. Max axial force in beams increases with increase in the ground slope.
2. Max axial force in beam is more affected for sloping ground and wind velocity on building frame. It increases at any constant slope is also increases.
3. Maximum axial force in column increases with increasing in height of a building frame.
4. Max axial force in column for 24 m and 36 m height of building frame does not get affected by increase in the ground slope.
5. Maximum axial force in column is minutely affected by increase in ground slope.

**Maximum Shear force:**

1. Maximum shear force in beam for all case of building frame increase with increase in height of the building frame on sloping ground as well as plane ground.
2. Maximum shear force in the beam for all case of building frame increased with increase in the wind velocity and minutely affected on the shear force for increase the ground slope.
3. Maximum shear forces in column increases with increase in the wind velocity as well as increase in the height of building frame.
4. Maximum shear forces in columns increases with the increase in ground slope.

**Maximum moment:**

1. Maximum moment of beams for different building heights increases with increase in the wind velocity.
2. Maximum moment of beam does not affected by increase in the ground slope. It minutely changes along the ground slope.
3. Maximum moment in column increases with increase in the height of building frame.
4. Maximum moment in the column increases with increase in the wind velocity as well as ground slope.
5. Maximum moment of column increases with increase in the slope of ground and the maximum moment in the beam has negligible change due to increase in the slope of ground.

**Maximum Displacement:**

1. Maximum displacement for different heights of building frame increases with increase in the wind velocity at critical load combination 1.5(D.L. +W.L.).
2. Maximum displacement is not affected by increase in the slope of ground from 0 degree to 15degree at critical load combination 1.5(D.L. +W.L.).

**Future study and Scope:**

1. This present study considered to only wind analysis. The same be extended to seismic analysis.
2. In this study wind load considered as BIS Code 875(Part III):1987. This same may be considered for wind load as per ASCE.

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