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Study of Wind Load of different height of Building Frame

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Abstract- In this research paper, the effect of wind velocity and structural response of building frame on has been studied. Considering various frame geometries and various wind velocities. Combination of static and wind loads are considered. For combination, 15 cases in different wind velocity and three various heights of building frames are considered for study. STAAD-Pro v8i software has been used for study all this cases. Results are gathered in terms of axial force, Shear force, moment, support reaction, Storey-wise drift and Displacement which are critically analyzed to evaluate the effects of various wind velocities.

Keyword*:* structural frame, wind load, different wind velocity.

1. INTRODUCTION

Wind load is one in all the necessary hundreds for engineering structures. For tall buildings, long span bridges and high towers or mast (tall column) structures, wind load may even be taken as a crucial loading, and complex dynamic wind load effects management the structural style of the structure. So data of the dynamic characteristics of a vital structure beneath wind loading becomes a demand in engineering style and in tutorial study. At intervals the continued research on tall buildings, the study of wind-induced demands is categorized as: along-wind and air current responses. These demands area unit caused by totally different mechanisms. Moving on the wind-induced is attributable to the results of turbulence impact whereas the perpendicular part is claimed to the results of storm. On the opposite hand the impact of wind load on tall structures not solely distributed over the broader surface however conjointly it's higher intensity. what is more, in high risk unstable zone the unstable performance of structures area unit thought of as a result of the primary importance that influence different hand in unstable zones, may even be the impact of impact forces ensuing from earth movement larger than the forces caused by wind hundreds and consequently, unstable loading determines type and final style of the structure (with this assumption that with relevancy the all international codes and standards, wind and earthquake hundreds ne'er at the same time apply on the structure).

At intervals the trendy time, such Multi-storied building frames area unit designed victimization STAAD-Pro v8i computer code (staad professional could also be a structural analysis and magnificence computer code application). This motivation has crystal rectifier to the current study on impact of varied sloping angle in Multi-storied building frames (3D-Frames).

Fig1: Google reference

1.1OBJECTIVE

There are following objectives which are considered during study

1. Study of the effect on buildings frames due to wind load.

2. Study of the effect on buildings frames due to different wind velocity.

3. Study of the effect of wind on 3 different heights of building frame with respect to 5 wind velocity. As per IS 875 (part-3):1983

2. METHODOLOGY AND PROBLEM FORMULATION

There are following types of problems are occurred due to wind load and ground slope

- Static wind effect
- Dynamic wind effect
- Ground condition
- Environment

For comparative study, three different sizes of structures and 5 types of wind velocity have been considered.

<u>To achieve the objective following step-by-step procedures are followed:-</u>

- Building geometry is selected as, 4 bays and 10, 15 and 18 story of 3D frame.
- Five wind zones are selected (39, 44, 47, 50 and 55 m/s) as per IS- 875 (part-III):1987.

3. BUILDING FRAMES MODELING

3.1. MODELING OF BUILDING FRAMES USING STAAD PRO SOFTWARE

STAAD-Pro 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 calculations to obtain the analytical results

c. Result verification is all facilitated by tools contained in the program's graphical environment.

CASE-112m×12m in plan area and 10 storey's high.

(Study of 3D-frame in critical condition)

CASE-2: 12m×12m in plan area and 15 storey's high.

(Study 3D-frame in critical condition)

CASE-3: 12m×12m in plan area and 18 storey's high.

3.2. MATERIAL AND GEOMERICAL PROPERTIES

Following material properties has been taken in modeling: - Density of RCC: 25 kN/m3
Density of Masonry: 18.5 kN/m3
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 300mm x 250mm. (Study 3D-frame in critical condition)

3.3. SELECTION OF THE BUILDING FRAMES

The following assumed three different height of building frame (3D-frame) have been considered for analysis.
a. Type-A: Model30 meter building height, 0^0 inclined footing level.
b. Type-E: Model 45 meter building height, 0^0 inclined footing level.
c. Type-I: Model 54 meter building height, 0^0 inclined footing level.

4. 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/m2
Floor Finish load = 1 kn/m^2
Infill Load = .10 x 3 x 18.5×2 = 11.1 kn/m(ignoring depth of beam)

2. Live Loads: Live Load on typical floors =2 kn/m^2

3. Wind load: Calculation of wind load as per is-code 875 (part-III):1987

The speed of wind depends on several factors. All the building frames are analyzed for 5 wind zones

The wind loads are derived for following wind parameters as per IS: 875(1987).
Wind zones- 39 m/s, 44 m/s, 47 m/s,50m/s, and 55 m/s. Wind Induced Lateral Force on Structure. This will be calculated at every story level and windward direction. This can be calculated by the following method:

Design wind presser

$$P_z = 0.6 v_z^2$$

Where,
Vz = design wind speed in m/s at any height z and;
p_Z = design wind presser in n/m^2 at any height z.

Design wind speed is given by

$$V_Z = V_b \times K_1 \times K_2 \times K_3$$

Where

Vz = design wind speed at any height (z in m/s);
V_b=basic wind speed (m/s)
K_1= probability factor (risk coefficient);
K_2= terrain, height and structure size factor; and
K_3= topography factor

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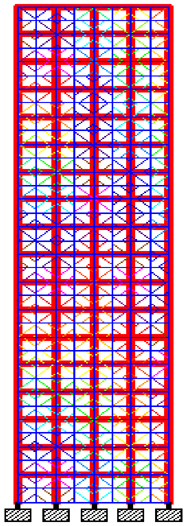

Fig 1.1 wind ward face of the structure

5. RESULT AND CONCLUSION

5.1 maximum shear forces

The result of maximum shear force is shown below

WIND VELOCITY	30m	45m	54m
39M/S	11.078	16.099	22.524
44M/S	14.103	25.619	28.675
47M/S	16.092	29.232	32.658
50M/S	18.214	33.085	37.036
55M/S	22.039	40.034	51.551

Table 5.1.1: max shear force and velocity for beam

WIND VELOCITY	30m	45m	54m
39M/S	9.914	12.816	17.334
44M/S	12.612	20.395	22.069
47M/S	14.402	23.272	24.952
50M/S	16.3	26.339	28.502
55M/S	19.724	31.871	39.684

Table 5.1.2: max shear force and velocity for column

5.2 maximum bending moments

WIND VELOCITY	30m	45m	54m
39M/S	17.208	25.019	35.012
44M/S	21.907	39.814	44.573
47M/S	24.996	45.429	50.765
50M/S	28.292	51.417	57.507
55M/S	34.234	62.216	80.133

Table 5.2.1: max bending moment and velocity for beam

WIND VELOCITY	30m	45m	54m
39M/S	**22.616**	**29.626**	**40.278**
44M/S	**28.78**	**47.147**	**51.281**
47M/S	**32.84**	**53.798**	**58.032**
50M/S	**37.168**	**60.887**	**66.23**
55M/S	**44.976**	**73.677**	**92.21**

Table 5.2.2: max bending moment and velocity for column

5.3 maximum axial forces

WIND VELOCITY	30m	45m	54m
39M/S	**68.502**	**135.047**	**220.373**
44M/S	**87.198**	**214.895**	**280.536**
47M/S	99.494	245.202	319.733
50M/S	112.613	277.516	362.302
55M/S	136.264	335.807	503.175

Table 5.3: max axial force and wind velocity

5.4 maximum displacements

WIND VELOCITY	30m	45m	54m
39M/S	20.08	42.997	74.14
44M/S	25.552	68.425	94.38
47M/S	29.152	78.076	107.57
50M/S	33.013	88.819	121.90
55M/S	39.93	107.31	163.24

Table 5.4: max displacement and wind velocity

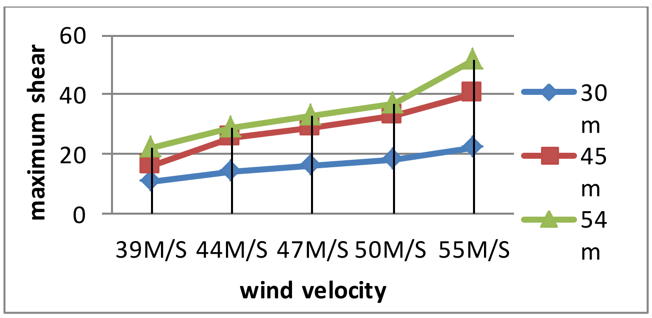

Fig 5.1.1: graph between max shear force and wind velocity for beam

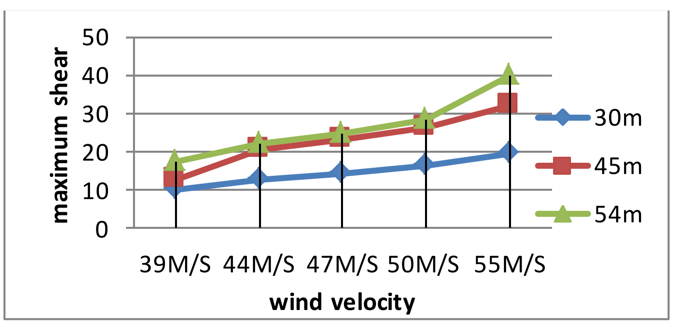

Fig 5.1.2: graph between max shear force and wind velocity for column

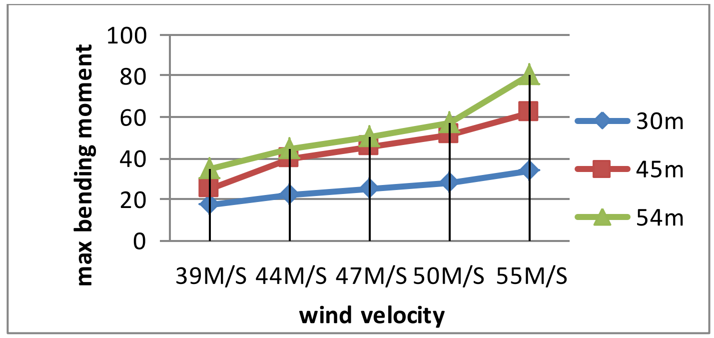

Fig 5.1.3: graph between max bending moment and wind velocity for column

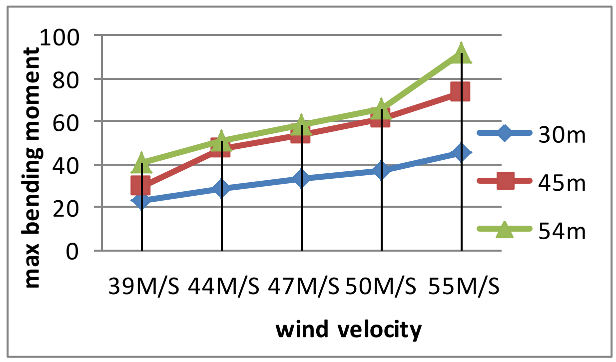

Fig 5.1.4: graph between max bending moment and wind velocity for column

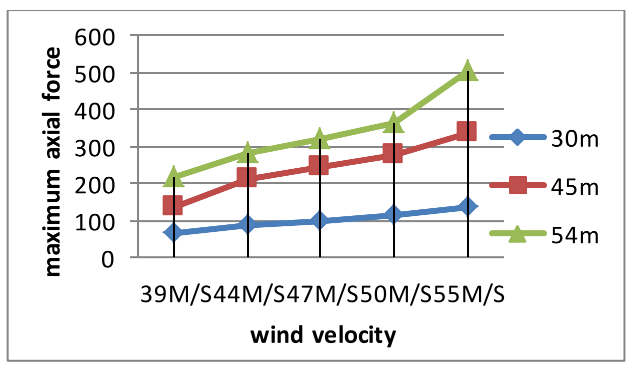

Fig 5.1.5: graph between max axial force and wind velocity

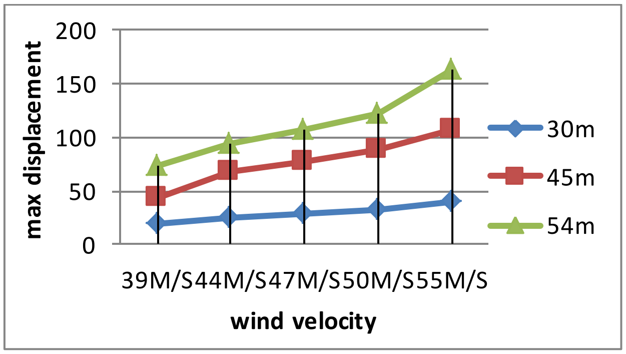

Fig 5.1.5: graph between max displacement and wind velocity

Conclusion

Maximum shear force

- Shear force increased with increase in height.
- In this case shear force is maximum at beams.
- With increase wind velocity shear force is also increases.

Bending moment

- Increase in bending moment should be seen with increase in height.
- Bending moment is greater for columns as compare to beam.
- It is increases with increase in wind velocity.

Axial force

- It is Increase with rise in height
- For this case maximum value of axial force is studied which is at base columns.

Displacements

- Nodal displacement is higher at top stories.
- Joint displacement is higher at base.
- Displacement increased with increase in height.

FUTURE SCOPE

- The present study done only for wind analysis, In future it can be done for seismic load as well.
- This study is done for the frame structure; in future it can be done for the rcc structure.
- The study is done as according to BIS code 875 (part 3): 1987, it can also be done for wind load as per code ASCE

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REFRENCES

1. **Umakant Arya, Aslam Hussain, WaseemKhan**(2014), "wind Analysis of Building Frames on Sloping Ground", *International journal of scientific research and publications*, volume 4,issue 5.

2. **Mohit Sharma, Dr. Savita Maru,volume**(2014), "Dynamic Analysis of Multistoried Regular Building Analysis and design of buildings for static force", *International journal of civil engineering and technology*, volume 2,issue 1.

3. **Anagha Sai Pramod, Dr V R A Saathappan** (2017) "Comparative study of wind analysis of 3-D framed structure on sloping ground using etabs" *International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 05*

4. **Chandwani Vinay, Agrawal Vinay, Gupta and Naveen Kumar** (2012) , " Role of Conceptual Design in High Rise Buildings.", *Vol. 2, Issue 4, July-August 2012, pp.556-560*

5. **Hajra B and Godbole P.N.** (2006). "Along Wind Load on Tall Buildings Indian Codal Provisions." *3NCWE06 Kolkata, pp 285-292.*