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EFFECT OF DIFFERENT COLUMN SIZE ON JOINT DISPLACEMENT OF BUILDING

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Abstract - *This analysis has been executed to examine the wind force influence on high rise multistoried building on different levels or floors. For this analysis we have taken G+7 building located on high velocity wind area like Delhi. Where normal basic wind speed is 47 m/sec as per IS 875: part iii. As we know that the effect of wind is greater in high rise building so we should always review the effect of wind load while designing multistory buildings. All around the world, there is heavy requirement for construction of tall multistory buildings due to increasing urbanization and increasing population, and wind force has the potential for causing the heavy damages to tall structures. Since wind forces are random in nature, the engineering tools need to be improved for analyzing structures under the action of wind forces.*

This analysis put forward to introduce deflection of nodes of building due to wind pressure by using computer software like Staad pro and by this analysis we can find deflection, shear force, bending moment, axial forces on beams and columns of building due to combination of static load and wind load.

***Key Words*: Wind Pressure, Displacement, Multi-storey, Dynamic load, storey shear, Structural design, Staad pro.**

1. INTRODUCTION

Now these days high rise multistoried buildings are extensively adopted in urban areas all over the earth due to the increase in urban population, contraction of land & its high cost. But main consideration is that as the height of structure increases vertically it is widely affected by lateral loads. These lateral loads are mainly in the form of wind load & earthquake load. So, efficient design approach & advance construction techniques are adopted to guard the tall buildings from wind load & earthquake load. Many researches have been done to increase the safety of tall buildings against these loads. So it is essential to study about the behavior of structures with these loads and their effect on multistory in terms of different parameters & thereby finding most suitable design for multistory. Wind forces in normal circumstances principally govern the structural design when building heights are above 100-150 m. Though the other force which effect the majority on high rise building are the lateral forces produced by earthquakes or seismic forces.

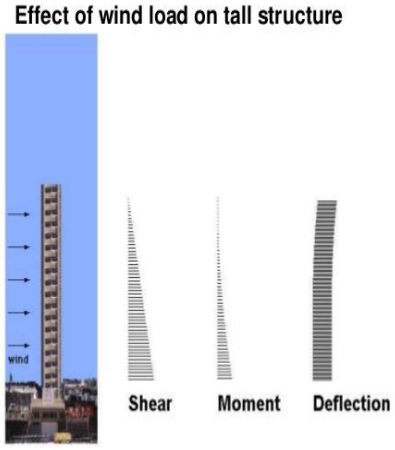

Fig 1: Effect of wind on tall structures

1.1Wind load and pressure calculations

IS: 875 (Part iii) of Indian standard and practice is used to check and design loads for structures ,this standard code govern wind forces and their effects which ought to be thought into consideration while planning design of building and structures. The sustainability of any building or any other structure to high wind pressure depends on geographical location, air flow direction and obstruction as well as buildings characters itself.

Design Speed of wind (V_z): Basic speed of wind (V_b) for any area or location can be found and adjusted to take wind effects to determine designed velocity of wind at any elevation (V_z) for the selected buildings:

a) Risk or Hazard level;
b) Topography roughness, size and height of the structure
c) Local topography.

These factors are expressed mathematically as follows:

Basic speed of wind $Vz = V_b \times k1 \times k2 \times k3$

Where: V_z = designed speed of wind at any elevation z at chosen location;

K1 = probability/Risk coefficient or factor
K2 = topography, structure dimension factor and height factor
K3 = topography (terrain) factor

In our case the basic wind speed (V_b) = 47 m/sec.

Design wind pressure: The design wind pressure for any elevation above mean ground level can be determined by the succeeding connection between wind pressures along with wind velocity;

$P_z = 0.60V_z^2$

Where

P_z : designed wind pressure at any given elevation z in N/m^2
V_z: designed wind velocity at any given elevation z in m/s

2. LITERATURE REVIEW

Ashish Sadh, Ankit Pal, (2018): This study shows the behavior of high rise building against the wind force in building situated in Indore, L shape of the structure was studied and analyzed for specific heights. They used staad pro software for this analysis purpose. They taken a G+19 floors building for this study and also analyzed about different material like RCC or composite material to study behavior against wind loads on building.

Mrs. Gitadevi B. Bhaskar, Miss. Homeshwari V.Gedam, (2018): This study give emphasis on the wind load effect on building with changing aspect ratios i.e. Height/width (H/B) ratio, by using STADD PRO. From this study we got the assessment on the outcomes of wind load on building height by changing the total number of stories while increasing the Aspect Ratio.

Sandeep Tembhurkar, Dr.Valsson Varghese (2014): They calculated and compared the wind load manually with the help of IS 875, part 3 and compared the critical value of axial forces and bending moments for G+19, G+24 and G+29 floors buildings. Hence they found that wind forces were more critical for tall structures i.e. for G+29 floor building. Structures should be designed for loads obtained in both directions independently for critical forces of wind.

Narla Mohan *et al.* (2017): In this analysis seismic & wind analysis was performed on G+ 20 storeys RC building square in shape with four different zones II, III, IV & V. The analysis was done by adopting using ETAB software adopting response spectrum analysis method& wind analysis as per IS 875-1987 part-III. Four models were used for analysis with different bay lengths. The evaluation has been done by taking the parameters like storey shear, storey drift, torsional force & displacement. It was found that the storey drift due to wind load is mainly occurred at the middle of the building structure. Storey Shear is decreased as building height was increased and decreased at top floor in all the building models.

3. BUILDING GEOMETRY AND STRUCTURAL PROPERTY

- Type of structure : multi-storey fixed jointed frame of G+6 storey
- Seismic zone IV IS 1893 (part 1):2002
- Supports ; Fixed end support
- Number of stories 7, (G+6).
- Materials Concrete (M 30) and Reinforcement (Fe500).
- Specific weight of RCC 25kn/m3.

Building Dimensions:
Length: 10 m Width: 10 m Height: 21 m

Size of beam: 300 mm x 450 mm (For both models)

Size of column: 500 mm x 500 mm (For model 1)

Size of column: 600 mm x 600 mm (For model 2)

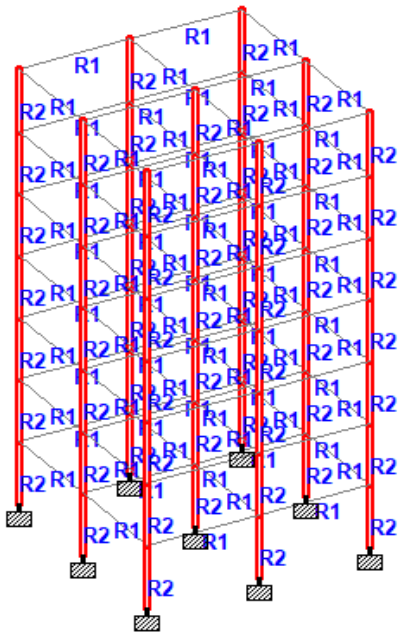

Fig 1: Geometry of structure

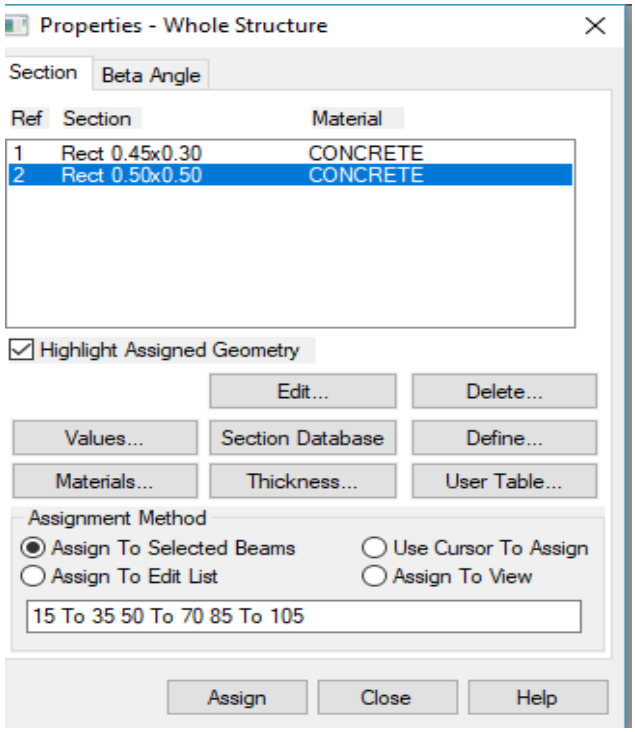

Fig -2: Dimensions for Beam & Column for Model 1

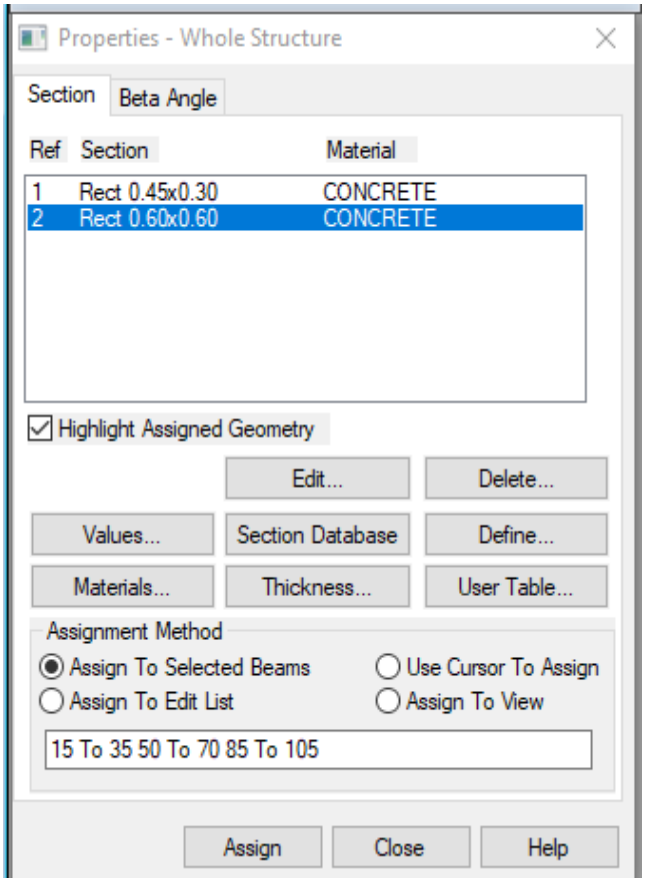

Fig -3: Dimensions for Beam & Column for Model 2

4. RESULTS AND CONCLUSION

Wind forces in normal circumstances principally govern the structural design when building heights are above 100-150 m. Though the other force which effect the majority on high rise building are the lateral forces produced by earthquakes or seismic forces. When buildings start to be taller, they become flexible and they move away from the high frequency waves. This analysis or project describes wind analysis of high-rise structure in several zones of Indian subcontinent.

The structure located on Delhi town (Zone 4) was associated to self weight or dead load and intensities of wind loads were generated by taking into account the known wind intensities at diverse elevations and firmly follow by the specifications of IS 875: part iii (1987). After wind pressure manual input we can click on assign to view option on Staad pro to view effect of wind on multistory. Wind force has been applied in X , -X , Z and –Z directions for both structures.

After analysing wind load in X and Z direction on both type of structure, value of maximum node displacement, shear force, bending moments were compared with respect to increasing size of the columns by 20%. For model 1 we have taken 500mm*500mm column and for model 2 we have taken 600mm*600mm column. Maximum relative node displacement for model 1 and model 2 is as following:

Table 1: Displacement values in mm at different levels of floors for model 1

Floor	Level	Max Displacement @ Corner (mm)	Max Displacement @edge (mm)	Max Displacement @Center (mm)
7th	21 m	11.194 mm	11.728 mm	11.713 mm
6th	18 m	10.624 mm	11.206 mm	11.182 mm
5th	15 m	9.602 mm	10.190 mm	10.167 mm
4th	12 m	8.076 mm	8.625 mm	8.604 mm
3rd	9 m	6.082 mm	6.549 mm	6.529 mm
2nd	6 m	3.737 mm	4.066 mm	4.048 mm
1st	3 m	1.365 mm	1.500 mm	1.495 mm

Table 2: Displacement values in mm at different levels of floors for model 2

Floor	Level	Max Displacement @ Corner (mm)	Max Displacement @edge (mm)	Max Displacement @Center (mm)
7th floor	21 m	9.308 mm	9.845 mm	9.830 mm
6th floor	18 m	8.710 mm	9.281 mm	9.258 mm
5th floor	15 m	7.761 mm	8.330 mm	8.307mm

4th floor	12 m	6.409 mm	6.932 mm	6.911 mm
3rd floor	9 m	4.697 mm	5.128 mm	5.109 mm
2nd floor	6 m	2.765 mm	3.054 mm	3.037 mm
1st floor	3 m	0.941 mm	1.052 mm	1.057 mm

After comparison of both models of multistorey it has been shown that when we have increased our column dimensions up to 20% in both dimensions. The value of nodal displacement has been decreased for model 2 from 17% to 31%. Whereas the reduction in nodal displacement was more on bottom floors as compared to top floors of the building.

With the help of Post processing result of software and the table above we can conclude that with the height of multistory the nodal displacement magnitude also increases and the bending moment for the beam becomes more serious at the top in comparison to the lower part of the structure. That defines the more effectiveness and intensity of wind load at the higher portion of the building.

This study/analysis was conceded out with only wind load was considered as dynamic load. Different load cases and combination can be considered further with different kinds of loading for a multistoried building dynamic loads analysis to check its effect on multistory.

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