INFLUENCE OF AIRSTREAM LOAD ON THE PHASE RATIO OF THE BUILDING

T. SRAVANTHI*, GUGULOTHU SWARNA**

PG SCHOLAR *,ASSISTANT PROFESSOR**

SAMSKRUTI COLLEGE OF ENGINEERING AND TECHNOLOGY AICTE APPROVED, AFFILIATED TO JNTUH KONDAPUR (V), GHATKESAR(M), RANGAREDDY DISTRICT, HYDERABAD, TELANGANA-501510

ABSTRACT:

In the recent past many tall buildings are being built in India. The impact of wind loads are to be considered for the design of tall multistoried buildings. Several failures of structures have occurred in India due to wind. The IS 875 Part-3 deals with wind loads on different types of structures. Modern Tall buildings designed to satisfy lateral drift requirements, still may oscillate excessively during wind storm. 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. This study presents the wind effects on buildings with different aspect ratio using ETABS. The models are categorized based on storey height and aspect ratio of the building. Frame models with increasing in the aspect ratio from 0.25 to 2 are considered and effect of wind load on gravity load is studied. Also the effect of wind load on height of building is studied by varying number of stories from 3 to 20 storey's. All the frame models are idealized as 3D models, and analyzed using the software ETABS. Variations of bending moment and axial force in columns are considered to study the behavior of frames. From the study it is concluded that wind effect reduces as aspect ratio of the building reduces.

1. INTRODUCTION

1.1 General

The development of modern materials and construction techniques has resulted in the emergence of a new generation of structures that are often, to a degree unknown in the past, remarkably flexible, low in damping, and light in weight [1]. Such structures generally exhibit an increased susceptibility to the action of wind. Accordingly it has become necessary to develop tools enabling the designer to estimate wind effects with a higher degree of confidence than was previously required. Wind engineering is the discipline that has developed, primarily during the last few decades from effects aimed at developing such tools. It is the task of the engineer to ensure that the performance of structures subjected to the action of wind will be adequate during their anticipated life from the standpoint of both structural safety and serviceability. Under the action of wind flow, structures experience aerodynamic forces that include the drag (along-wind) force acting in the direction of the mean wind, and the lift (across-wind) force acting perpendicular to the direction. The structural response induced by the wind drag is commonly referred to as the along wind response.

1.2 Critical Wind Effects on Buildings

The major effects of wind on buildings can be generalized to some degree because the bracketed range of characteristics that cover the most conditions. Some of the general assumptions made are as follows:

• Most buildings are boxy or bulky in shape, resulting in typical aerodynamic response.

• Most buildings present closed, fairly smooth surfaces to wind.

• Most buildings are fit snugly to the ground, Presenting a particular situation for the drag effects of the ground surface

• Most buildings have relatively stiff structures, resulting in a fairly limited range of variation of the structure

2.DESCRIPTION OF THE FRAMED STRUCTURES

In the present study, five frame models having aspect ratio 0.25, 0.5, 1, 1.5, 2 have been considered. Initially 20mts width of the building is considered with 4 bays of 5mts each keeping the width constant the number of bays in X direction is increased such that the aspect ratio of 0.25, 0.5, 1, 1.5, and 2 is obtained. The Typical plan and elevation of the models considered for the study is shown. The details of the building data are shown in Table 1. Wind analysis is carried out considering the 3D frames as per IS-875-Part 3: 1987

Storey height	3.5m
Thickness of slab	0.15m
Beam size	0.3x0.45m
Column size	0.3x0.45m
Thickness of slab	0.15m
No. of Stories considered	3, 5, 10, 15, 20
Aspect ratio	0.25, 0.5, 1, 1.5, 2 (No of storey considered 5)
Wind speed	50m/s
Terrain category	II
Structural class	B
Topography	Flat
Grade of steel	Fe 415
Grade of concrete	M 25
Young's modulus of concrete	$2.5x10^7$ KN/m^2
Live load	4 KN/ m^2

Table 1 preliminary data

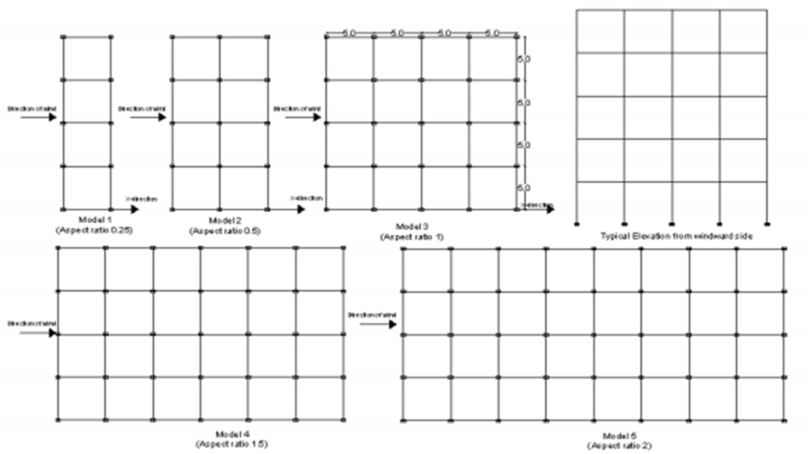

Fig-1: Models with different Aspect ratio considered for the study

RESULTS AND DISCUSSION In structures of normal height, dead and live loads are predominant. The wind loading effects are covered by the increase of permissible stresses as recommended by the I.S. code (IS 875 Part 3). Hence, for the design of buildings of low to medium height the wind effects are usually ignored. As the height of the building increases, the wind effects become gradually considerable. In the case of very tall slender frames they even become predominant compared to dead and live load effects. Very tall slender building frames are flexible in nature and as a result they interact with the wind dynamically and the safety and the stability of structure may become critical. Hence, for design of very tall frames, a thorough study of wind effects and investigation of criticality are very much necessary. This is particularly so in regions where wind is more critical than earthquakes. In order to understand the effect of wind load on the aspect ratio, 5 models with different aspect ratios (0.25, 0.5, 1, 1.5, and 2) are considered. Also 4 different load cases as per IS 875 part 5:1987 are considered. The load cases[5] considered are

- 1.5(DL+LL) – LC-1
- 1.2(DL+LL+WL) – LC-2
- 1.5(DL+WL) – LC-3
- 0.9DL+1.5WL – LC-4

LC-1 is considered to study the effect of DL+LL and LC-2 toLC-4 are considered to study the effect of wind load.

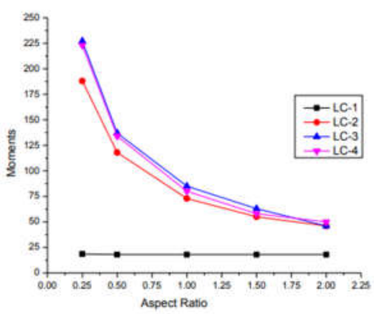

Fig-2 variation of momemts in leeward column with repect to Aspect ratio

Fig-2 shows the variation of moments in leeward column with respect to Aspect ratio, as Aspect ratio increases from 0.25 to 2 the bending moment in the leeward column gradually reduces. The bending moments in the bottom storey column is almost same for all load cases when the aspect ratio is 2 indicating that the wind effect is not significant. However, when the aspect ratio is 0.25, the wind effect is predominant and the bending moment almost increases by 10times.From Fig-2 it is clear that when the aspect ratio is less than 1 wind effects are to be considered also for higher aspect ratio wind effects are to be considered

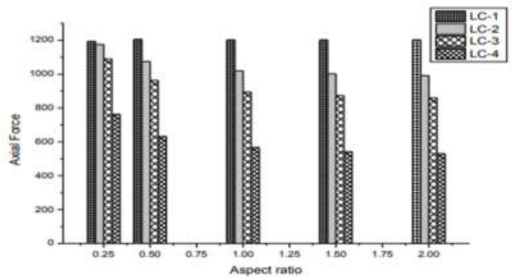

Fig-3 variation of Axial forces in leeward column with repect to Aspect ratio

For all aspect ratio the axial force due to gravity loading (LC-1) is almost same whereas due to wind load (LC-2 to LC-4) axial force gradually decreases as aspect ratio is increasing. Fig-3 shows the variation of axial forces in the leeward column in the bottom storey with respect to aspect ratio.

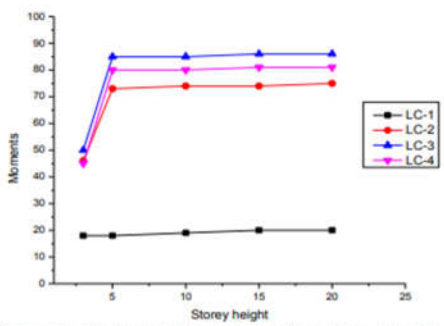

Fig-4 variation of momemts in leeward column with repect to storey height

In order to understand the effect of wind on structures the height of building is increases from 3 to20 keeping the aspect ratio of building equal to 1.Fig-4 shows the variation of bending moments in leeward column with respect to storey height, it is clear that bending moment due to gravity loading do not change as the storey height increases. Whereas moment due to wind increases till five storey building and thereafter it is almost same, however the wind moment are four times more than LC-1 moments indicating the significance of wind effects on tall buildings.

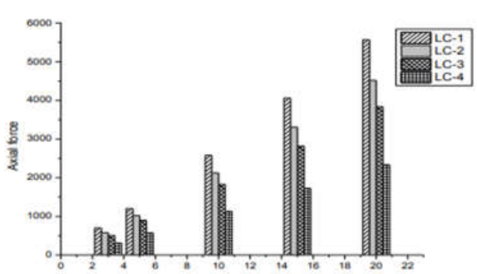

Fig-5 variation of Axial forces in leeward column with repect to Storey height

Fig-5 shows the variation of axial forces in leeward column with respect to storey height. As the height of building increases, the gravity loading effect (LC-1) on building and wind load effect (LC-2 to LC-4) increases. However the Axial force in column is almost same for all load cases when the storey height is less than 5

CONCLUSIONS

Based on the computed results and the discussion made, the following conclusions are drawn:

- As the aspect ratio increases moments in the column decreases considerably for wind load cases. Whereas the moments remain same for all aspect ratio for gravity loads.
- As the height of the building increases moments in the column increases for low rise building and remain constant for medium height buildings.
- Axial forces in the column are almost same for all load cases when the height of building is less than 15mts.
- Column moments are considered critical while designing for the tall buildings.

REFERENCES

1. B. Dean Kumar and B.L.P. Swami, "Wind effects on tall building frames-influence of dynamic parameters", Indian Journal of Science and Technology, Vol. 3, No. 5.May 2010, 583-587.

2. Swati D.Ambadkar, and Vipul S. Bawner, "Behaviour of multistoried building under the effect of wind load", International Journal of Applied Sciences and Engineering Research, Vol. 1, Issue 4, 2012.

3. Jawad Ahmed and H S Vidyadhar, "Wind Analysis and Design of Multi Bay Multi Storey 3D RC Frame" International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 9, September – 2013.

4. IS-875 (1987) Code of practice for design loads for building and structures. Part-3 wind loads. Published by Bureau of Indian Standards.

5. IS-875 (1987) Code of practice for design loads for building and structures. Part-5 load combinations. Published by Bureau of Indian Standards.

6. B.S. Taranath, Structural analysis and design of tall buildings McGraw-Hill Book Company.

7. James ambrose and dimitry vergun, Simplified building design for wind and earthquake forces, JOHN WILEY AND SONS, INC.

8. ETABS (2008), "Analysis Reference Manual", Software for Building Structures, Computers and Structures, Inc., Berkeley, California, USA.

AUTHOR'S PROFILE:

T. SRAVANTHI,PG SCHOLAR

SAMSKRUTI COLLEGE OF ENGINEERING AND TECHNOLOGY AICTE APPROVED, AFFILIATED TO JNTUH KONDAPUR (V), GHATKESAR(M), RANGAREDDY DISTRICT, HYDERABAD, TELANGANA-501510

GUGULOTHU SWARNA, ASSISTANT PROFESSOR

SAMSKRUTI COLLEGE OF ENGINEERING AND TECHNOLOGY AICTE APPROVED, AFFILIATED TO JNTUH KONDAPUR (V), GHATKESAR(M), RANGAREDDY DISTRICT, HYDERABAD, TELANGANA-501510