International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

Response of Buildings of Different Plan Shapes Subjected To Wind Vibrations

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Abstract – *Recently there has been a considerable increase in the number of tall buildings. These buildings are subjected to horizontal loads due to wind pressure acting on the buildings. The horizontal wind pressures act on vertical external walls and exposed area of the buildings. The development of new architectural forms of buildings and flexible structural systems are vulnerable to wind action. For desirable performance of these buildings, we require better understanding of interaction between building and wind. This paper presents a comparative study of effect of wind on buildings of various shapes such as Y, Plus and V. Buildings of plan shapes Y, Plus and V are modeled in ETABS 2016 and analyzed. It is observed that the storey force is same for all the buildings, i.e. the storey force does not change with the shape. The lateral displacement is found maximum for V shape building.. The storey drift is observed maximum for Y shape as compared to that of other shapes and the lateral displacement and the storey drift are observed minimum for Plus shape building as compared to Y and V shape buildings and hence it is the most structurally stable shape among the selected shapes.*

Key Words: **Tall buildings, Wind pressure, Lateral displacement, Storey drift, Storey force**

1. INTRODUCTION

Recently there has been a considerable increase in the number of tall buildings, both residential and commercial, and the modern trend is towards taller structures. Tall buildings, which are usually designed for office or commercial use, are among the most distinguished space definitions in the architectural history. Architect's reinterpretations of the building type, the high cost of land in urban areas, the desire to prevent the disorganized expansion, the need to preserve agricultural production, the concept of skyscraper, influence of cultural significance and prestige, have all contributed to force buildings upward.

Many researches and studies have been done in order to understand the performance of tall buildings against wind loads. A careful coordination of the structural elements and the shape of a building which minimize the lateral displacement, may offer considerable savings. Nowadays, the challenge of designing an efficient tall building has considerably changed. The conventional approach to tall building design in the past was to limit the forms of the buildings to a rectangular shape mostly, but today, much more complicated building geometries could be utilized.

1.1 Objectives

i. To study the behavior of tall structures when subjected to wind loads.
ii. To study and analyze the effect of wind load on different shape of the building and assess the most structurally stable shape of a multi storey structure
iii. To determine the effect of wind load on various parameters like storey force, storey drifts and lateral displacements in the building.

1.2 Scope

The scope of the present work includes the analysis of multistoried buildings done by using ETABS 2016 software and the performance was analyzed by varying the shape of Structure.
Different shapes of the building considered are:

a) Y shape
b) Plus shape
c) V shape

2. FINITE ELEMENT ANALYSIS

2.1 DESCRIPTION OF THE MODELS

2.1.1 Geometrical aspects of the buildings

Three dimensional reinforced buildings of various plan shapes are considered. The number of stories of each building is G+11 giving a total height of 34.5m.The height of base storey is 1.5m and that of the others is 3m. Size of the Columns is 450 mm x 450 mm. Size of beams at each floor is 200mm x 600 mm. Thickness of slab is 150mm. All supports were assumed to be fixed.

2.1.2 Properties of materials used

The grade of concrete in columns is M30 and that in beams is M20. Fe 500 grade of steel is used.

2.1.3 Loads considered

The dead loads of the building will be automatically taken in account by ETABS 2016 according to IS 875: part1-1987. The live loads had been taken as 3kN/m^2 at all floors as per IS 875: part2-1987. The super dead load had been calculated and applied as 9kN/m. The wind parameters are taken from IS 875: part 3-1987.

2.1.4 Parameters considered for wind analysis

The structure is considered in Trivandrum region. The parameters considered for wind analysis are:
Terrain Category: III
Structure Class: B
Basic Wind Velocity, V_b: 39 m/s

2.1.5 Models considered for analysis

- Model 1- 12 storied building with Y shape plan
- Model 2- 12 storied building with Plus shape plan
- Model 3- 12 storied building with V shape plan

3. MODELING

3D modeling (or three-dimensional modeling) is the process of developing a representation of any three-dimensional surface of an object via specialized software. Buildings of plan shapes Y, Plus and V are modeled using ETABS 2016.

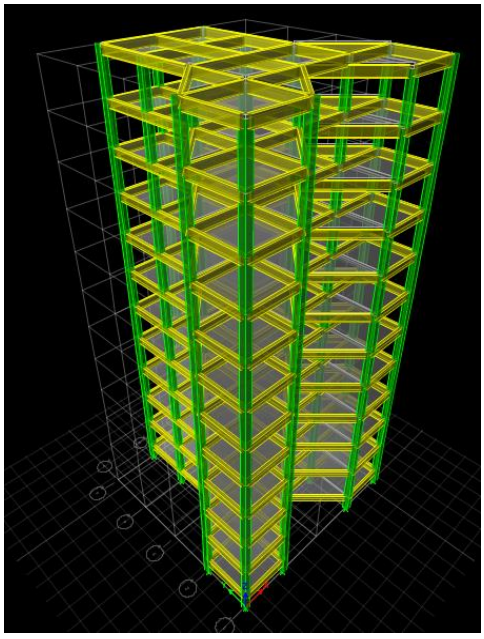

Fig -1: Y shape

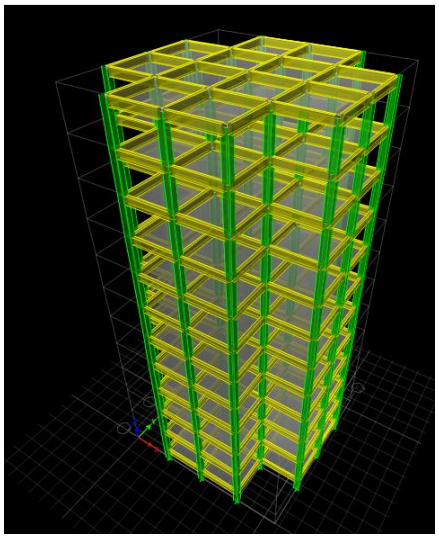

Fig -2: Plus shape

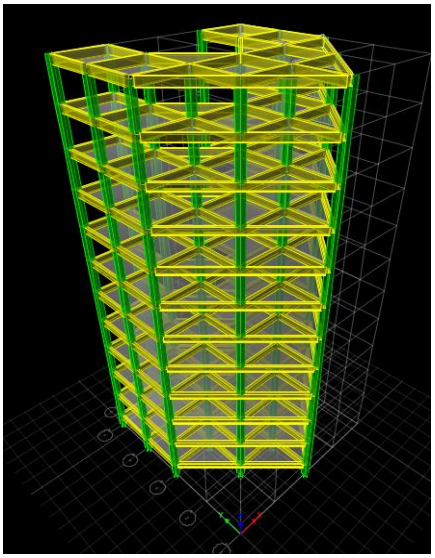

Fig -3: V shape

4. RESULTS AND DISCUSSION

Table -1: Storey force

Height	Y shape	Plus shape	V shape
Storey 1	33.0744	33.0744	33.0744
Storey 2	44.0992	44.0992	44.0922
Storey 3	44.102	44.102	44.102
Storey 4	45.0601	45.0601	45.0601
Storey 5	48.3943	48.3943	48.3943
Storey 6	51.5894	51.5894	51.5894
Storey 7	54.1533	54.1533	54.1533
Storey 8	56.0966	56.0966	56.0966
Storey 9	57.8058	57.8058	57.8058
Storey 10	59.525	59.525	59.525
Storey 11	60.9294	60.9294	60.9294
Storey 12	30.8261	30.8261	30.8261

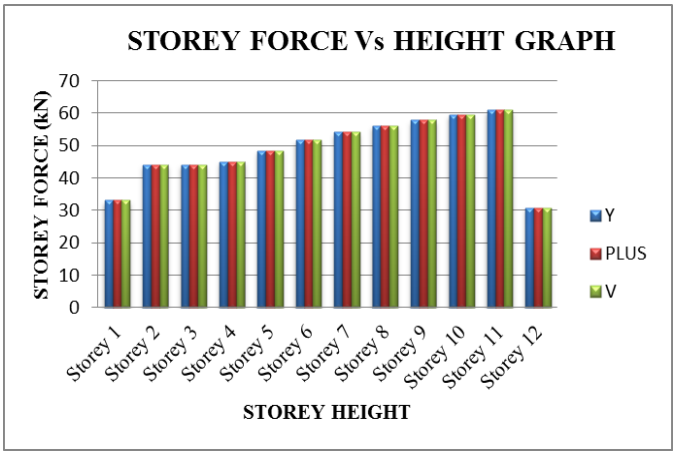

Chart -1: Variation of storey force for different building shapes

Table -2: Lateral Displacement

Height	Y shape	Plus shape	V shape
Storey 1	.402	.215	.415
Storey 2	2.616	2.48	2.717
Storey 3	5.021	4.831	5.145
Storey 4	7.296	6.554	7.418
Storey 5	9.392	8.137	9.5
Storey 6	11.284	9.565	11.37
Storey 7	12.953	10.824	13.009
Storey 8	14.381	11.9	14.402
Storey 9	15.556	12.784	15.535
Storey 10	16.467	13.469	16.399
Storey 11	17.108	13.949	16.987
Storey 12	17.502	14.243	17.56

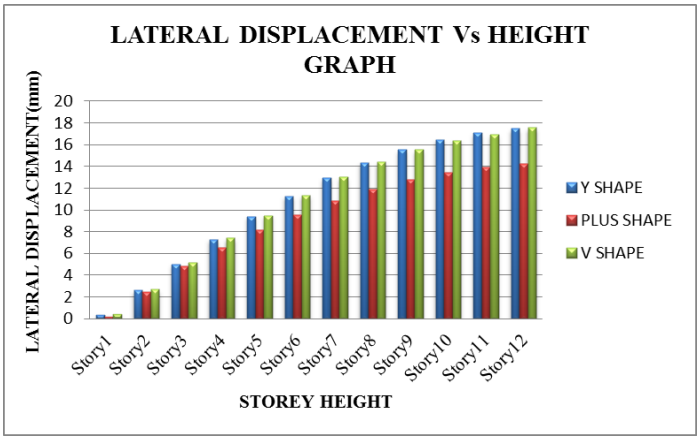

Chart -2 : Variation of lateral displacement for different building shapes

Table -3: Storey drift

Height	Y shape	Plus shape	V shape
Storey 1	.379	.202	.277
Storey 2	.646	.556	.767
Storey 3	.893	.605	.809
Storey 4	.833	.572	.758
Storey 5	.768	.527	.694
Storey 6	.695	.475	.624
Storey 7	.615	.419	.568
Storey 8	.529	.358	.505
Storey 9	.437	.294	.436
Storey 10	.342	.228	.362
Storey 11	.247	.159	.286
Storey 12	.177	.097	.219

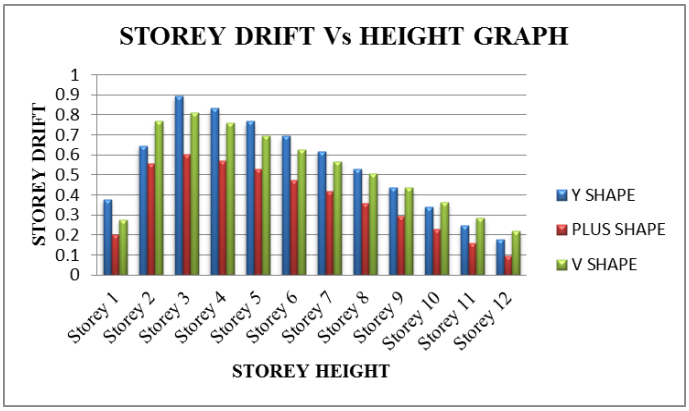

Chart -3: Variation of storey drift for different building shapes

5. CONCLUSIONS

- This study reveals that the lateral displacement and the storey drift of the structure are affected by its plan shape
- The storey force doesn't change with the shape of the building even though the lateral displacement and the storey drift change.
- Maximum lateral displacement is obtained in V shape building and the percentage reduction in lateral displacement in Plus shape building is 18.88% and that in Y shape building is 1.11% as compared to the lateral displacement in V shape building.
- It is observed that lateral displacement is more for V and Y shape building as compared to Plus shape. This is due to the distance of extreme point from the center of gravity is more for V and Y shapes than Plus shape.
- The storey drift is found to be maximum for Y shape building. The percentage reduction in storey drift is found to be 9.41% for V shape and 32.25% for Plus shape as compared to Y shape building.
- Peak storey drift is found to be more for Y shape. This is because the effective area of wind load application is more for Y as compared to V and Plus shape.

- Based on the above results, it is concluded that the shape of structure plays an important role in resisting wind loads. Plus shape building has lesser lateral displacement and storey drift as compared to Y and V shapes and hence it is stable among the selected shapes.

6. REFERENCES

[1] Anupam Rajmani, Prof Priyabrata Guha (2015), "Analysis of Wind & Earthquake Load For Different Shapes Of High Rise Building", International Journal Of Civil Engineering And Technology (IJCIET), vol. 2 , pp.38-45

[2] Bhumika Pashine, V. D. Vaidya, Dr. D. P. Singh (2016), "Wind analysis of multistoried structure with T shape and L Shape geometry", International Journal of Engineering Development and Research, vol.3, pp.2321-9939

[3] B. S. Mashalkar , G. R. Patil , A.S.Jadhav (2015), "Effect of Plan Shapes on the Response of Buildings Subjected To Wind Vibrations", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), pp.80-89

[4] Dr. K. R. C. Reddy1, Sandip A Tupat (2014), "The effect of zone factors on wind and earthquake loads of high-rise structures", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), pp.53-58

[5] Lodhi Saad, S. S. Jamkar (2015), "Comparative study of Wind load Analysis of buildings of various shapes and sizes as per IS 875: (part 3) and ASCE 7-02", International Journal of Emerging Technology and Advanced Engineering, vol.5

[6] M. R. Wakchaure, Sayali Gawali (2015), "Effects Of Shape On The Wind-Instigate Response Of High Rise Building", International Journal of Research in Engineering and Technology, vol.09

[7] IS 875: Part 1- 1987, Indian Standard Code Of Practice For Design Loads (Other Than Earthquake) For Buildings And Structures, Part-1 Dead Loads - Unit Weights Of Building Materials And Stored Materials

[8] IS 875: Part 2- 1987, Indian Standard Code of Practice for Design loads (Other than earthquake) For Buildings and Structures, Part 2- Imposed Loads

[9] IS 875: Part 3- 1987, Indian Standard Code of practice for design loads (Other than earthquake) For buildings and structures, Part 3- Wind Loads