WIND EFFECTS ON TALL BUILDINGS HAVING SKIP FLOOR USING COMPUTATIONAL FLUID DYNAMICS

[1] TWINSY P. MODI, [2]ATUL K. DESAI

[1]M.Tech Structure, Applied Mechanics Department, Sardar Vallabhbhai National Institute of Technology, Ichchhanath, Surat,
[2]Professor, Applied Mechanics Department, Sardar Vallabhbhai National Institute of Technology, Ichchhanath, Surat
E-mail: [1]twinsymodi18@gmail.com, [2]akd@amd.svnit.ac.in

Abstract - In this study numerical analysis of wind has been carried out on tall building having one skip floor, having two skip floors and tall building without skip floor (basic model) using CFD analysis. In this paper detail examination of pressure coefficient with respect to building height has been found out using code fluent. After that, comparison has been made between these buildings in sense of pressure coefficient to understand behavior of tall buildings with skip floor. To execute study Autocad 2013 and ANSYS Fluent 2015 has been used.

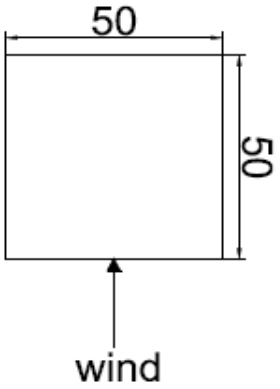
Index Terms - Tall building, Computational Fluid Dynamics (CFD), Wind pressure coefficient, Fluent.

I. INTRODUCTION

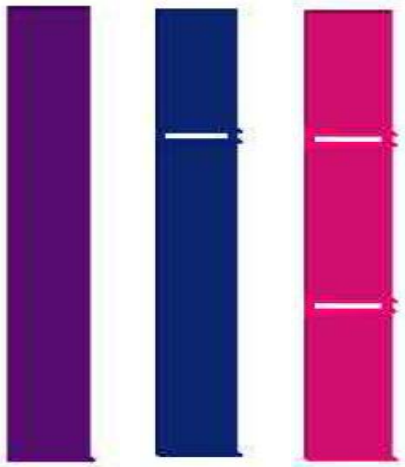
Main stages in CFD simulation are pre-processing, solving and post-processing. Using code FLUENT, CFD on buildings has been accomplish. FLUENT is a general purpose Computational Fluid Dynamics code based on finite volume method. It is used to model flow conditions in and around objects.
Here in this paper attempts are made to study wind pressure coefficient around tall building without skip floor, tall building with one skip floor and tall building with two skip floors simultaneously using code Fluent in Ansys Fluent 2015 And comparison has been made of all these buildings in a manner of change in pressure coefficient with respect to their heights.

II. METHODOLOGY

To carry out modelling, using Autocad 2013 models of tall buildings generated as shown in figure 1.



(a)



Basic model with one skip floor with two skip floors

(b)

Fig. 1: (a) Plan view of Tall buildings with dimensions (all dimensions are in meter) (b) Buildings geometry prepared in Autocad2013

Here, Height of All Buildings is 400 m, 1st skip floor is at H = 130m, 2nd skip floor is at H = 280m and Height of skip floor = 10m according to general consideration.

Tall building with domain size 1449m X 759m X 1500m is prepared in Autocad2013. There are no such rules to fix size of domain [1]. Model is than imported in Ansys Fluent for analysis purpose.

III. ANALYSIS PROCEDURE

After importing geometry, meshing has done as shown in figure 2.

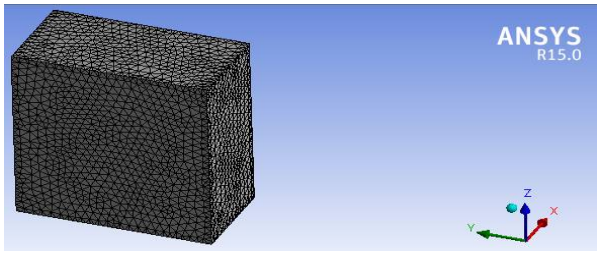


Fig. 2: Meshing of Building and Domain in Ansys2015

After that analysys has been carried out on buildings in ansys fluent and results are found out.

IV. DATA CONSIDERED IN CFD ANALYSIS

The data of CFD Analysis is as mentioned below,

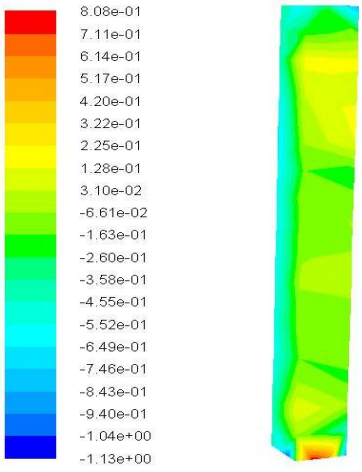
- Size of Fluid Domain : 1449 x 759 x 1500 m
- Type of Fluid : Air
- Density of Air : 1.225 Kg/m^3
- Viscosity of Air : 1.7894e-05 Kg/m sec
- Operating Pressure : 101325 Pascal
- Model : Standard k-ε Model
- Solver : Pressure Based
- Inlet Velocity : 8 m/sec

Boundary Conditions,

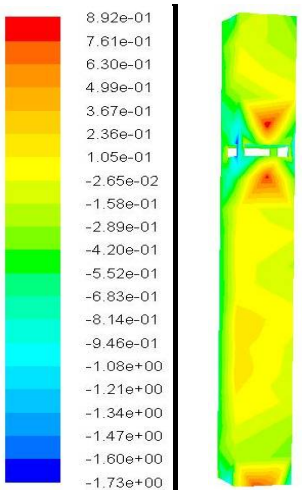
- The ground at the bottom of the computing domain is simulated with no slip condition.
- The free slip boundary conditions with Moving wall are applied to top and side surface of computing domain. The flux normal to the boundary is considered zero.
- The no slip boundary conditions are applied to the surfaces of models.

V. RESULTS OBTAINED

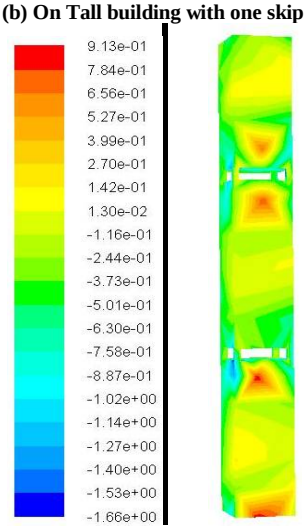
Results obtain after accomplishment of analysis is shown in figure 3 below,



(a) On Basic Model of Tall building

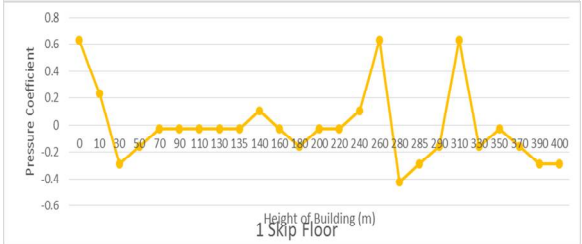


(b) On Tall building with one skip floor



(c) On Tall building with two skip floors

Fig. 3: Wind Pressure coefficient contour



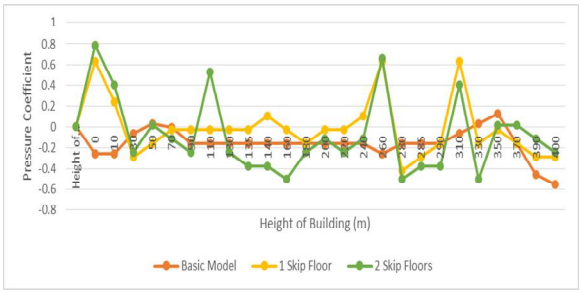


Fig. 4: Graphical representation of Height of Building Vs Pressure Coefficient

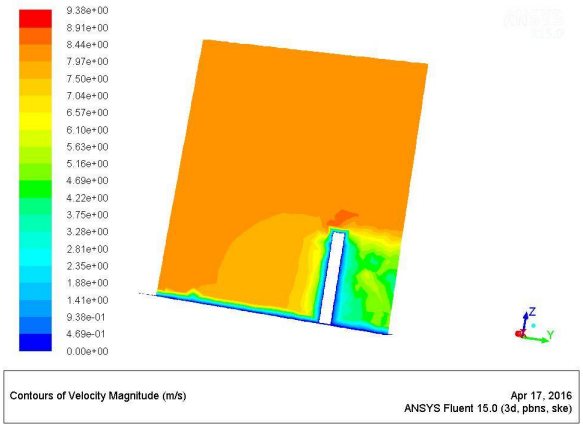


Fig. 5: Contour of Y-Velocity in Vertical Plane of building without skip floor

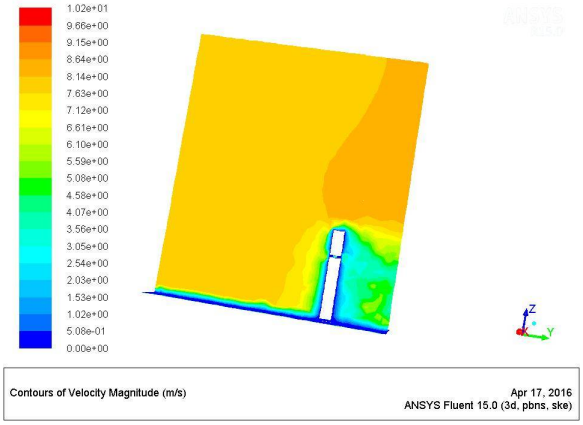


Fig. 6: Contour of Y-Velocity in Vertical Plane of building with one skip floor

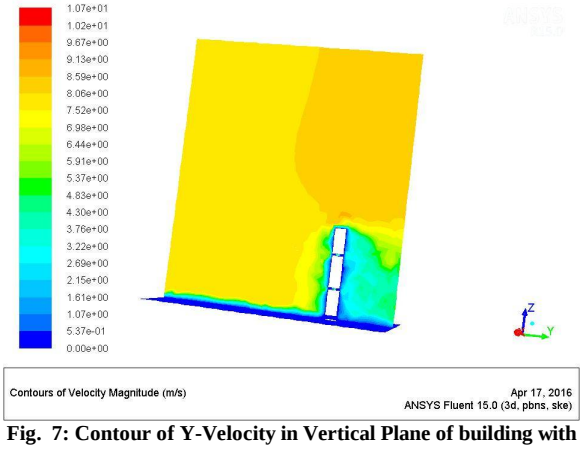


Fig. 7: Contour of Y-Velocity in Vertical Plane of building with two skip floors

CONCLUSION

This study investigated the pressure coefficient of Building without skip floor (Basic Model), with one skip floor and with two skip floors.

It has been found that values of pressure coefficient are more for building having two skip floors than building having one skip floor. More pressure is generated on floors which are adjacent to skip floor. Impulsive behavior of pressure coefficient is clearly observe in case of tall building having skip floor. So more accuracy should be maintained in design of these floors after examine wind effects. And proper design should be adopted.

In case of building having two skip floors more wake region is there at 2nd skip floor. Less wake region in case of building having one skip floor. And very less wake region in case of basic model which is simple and best condition as per figure 5, 6 and 7.

REFERENCES

[1] Bert Blocken, Jan Carmeliet and Ted Stathopoulos," CFD evaluation of wind speed conditions in passages between parallel buildings, effect of wall-function roughness modifications for the atmospheric boundary layer flow", Journal of Wind Engineering and Industrial Aerodynamics, Vol. 95, pp. 941–962, 2007.

[2] Biswarup Bhattacharyya, Sujit K. Dalui and Ashok K. Ahuja," Wind Induced Pressure on 'E' Plan Shaped Tall Buildings", Jordan Journal of Civil Engineering, Vol. 8, pp. 120-134, 2014.

[3] Davenport A. G.," The Generalization and simplification of wind loads and implications for computational methods", Journal of Wind Engineering and Industrial Aerodynamics, Vol. 46- 47, pp. 409-417, 1993.

[4] Frank M. White," Fluid Mechanics", Tata McGraw-Hill Publishing Company Ltd., 7th edition, New Delhi, 2011.

[5] Jigar K. Sevalia, Dr. Atul K. Desai, Dr. S. A. Vasanwala," Numerical Evaluation of Wind Pressure on Surfaces of Bluff Body", International Journal of Engineering Research and Applications, Vol. 2, pp.740-746, Jan-Feb 2012.

[6] Nilesh S. Varkute, R.S. Maurya," CFD Simulation in Township Planning – A Case Study", International Journal of Computational Engineering Research, Vol. 3, pp. 65-72, March 2013.

[7] Y.C. Kim, E.K. Bandi, A. Yoshida, Y. Tamura," Response characteristics of super-tall buildings – Effects of number of sides and helical angle", Journal of Wind Engineering Industrial Aerodynamics, Vol. 145, pp. 252–26, 2015.

★★★