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Wind Load on A Triangular Cross-Section Tall Building Using Ansys

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ABSTRACT

Due to the scarcity of land these days, there is a growing need for tall straight buildings. With this growing need, architectural planning is becoming more and more unusual as these tall buildings are proposed which makes them very airy. This requires analysing air volume in several buildings and in response to structural disruption due to the presence of other structures next to it. This paper is focused on observing variance in the distribution of pressure on different faces of a triangular plan-shaped tall building and also the velocity distribution. ANSYS CFX is utilized for the analysis of the variance of pressures distribution.

Key Words : High- Rise Building, Wind Effects.

INTRODUCTION

Wind engineering is seen primarily as wind interacting with man-made structures on Earth. The purpose of wind engineering is to analyse the effect of wind energy on these structures and potential structural damage. In the present time due to urbanization, the existing land area is not sufficient as the population grows over time level of exposure, especially in urban areas. So, there have been changes in the shape and size of the buildings from large horizontal structures in earlier times to tall ones unusual and unusual vertical structures shapes in recent times. Such structures are very high simple and soft with new design in a new building materials and construction techniques. High rise buildings are easily ventilated due to basic minute production under lateral action of spiritual, therefore, the effects of spiritual burdens on these buildings should therefore be secured with height level of belief in ensuring their safety. These buildings are often formed by lots and their behaviour as well the reaction is just opposite of that of a individual structure. [1]

Although much information can be found in various international codes about traditional structural responses, for example, IS 875 (Part 3): 2015, no information on unseen properties or disruptive effects can be obtained from any international codes. Various aerodynamic adjustments used in elevated structures to prevent or reduce that air can be divided into major and minor changes. Major changes are the ones that have the greatest influence on architectural ideas, e.g. obstacles to elevation, shrinkage, openness, structural adjustment, receding, structural distortion. Minor changes are the one with moderate effects on architecture and engineering ideas, examples of corner changes such as sharp corners, chamfered corners, economic downturns, rotation of corners and structural position in relation to the general atmosphere. [2] Such tall buildings are easily infested with air due to low-rise construction under indirect wind action, therefore, the effects of air load on these buildings should be guaranteed by a high degree of confidence in ensuring their safety. These structures are often built in many places and their behaviour and reactions are different from that of a single building. [3]

METHODOLOGY

The dimension of triangular shaped building considered in present research work are 100 mm for each side with fillet corners as shown in Fig.1 and with height 500 mm as shown in Fig.2 and plan of building as shown in Fig.3 and domain size as shown in the Fig.4. Such large domain is good enough for vertex generation on leeward side of building to avoid backflow of wind.

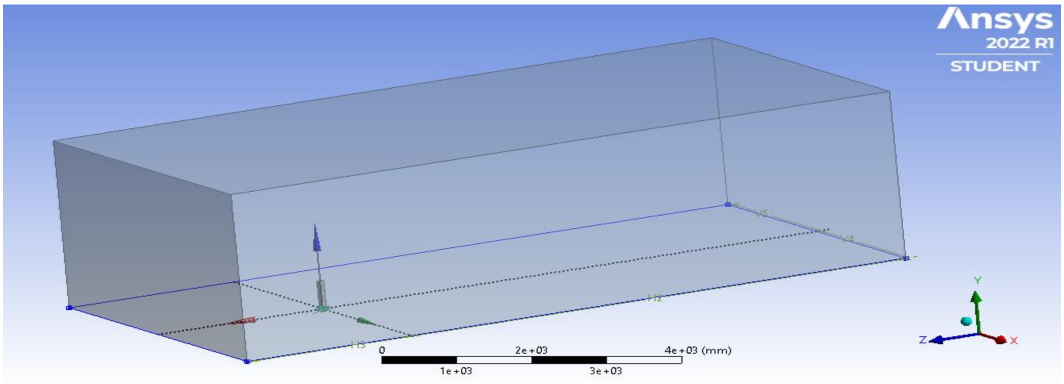

Fig. 1- Cross-section Building with Domain.

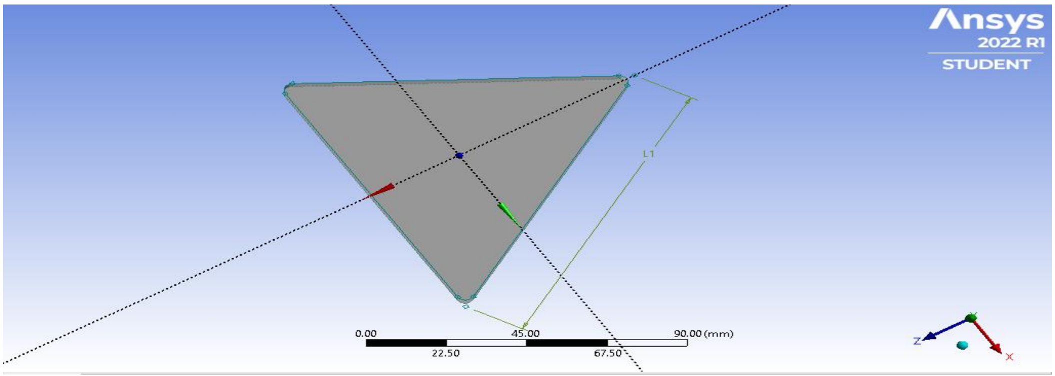

Fig. 2- Plan of triangular cross-section Shaped Building.

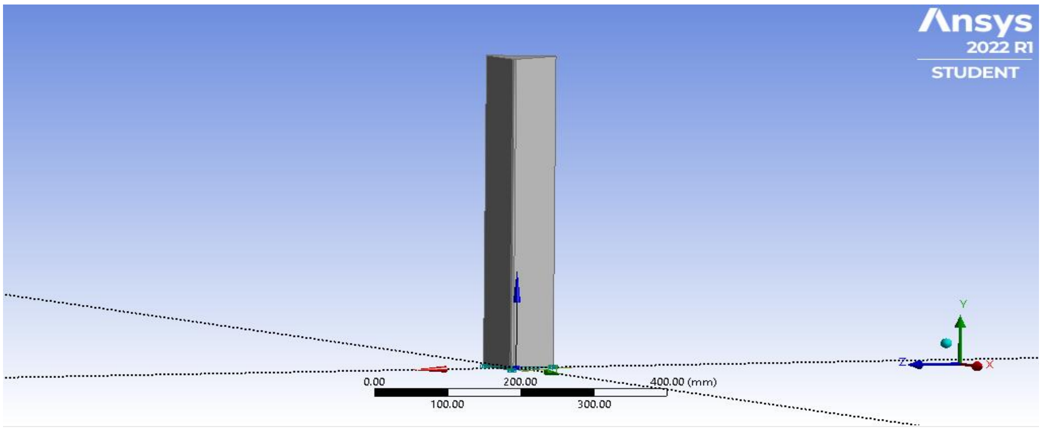

Fig. 3- Elevation of triangular Cross-section Building.

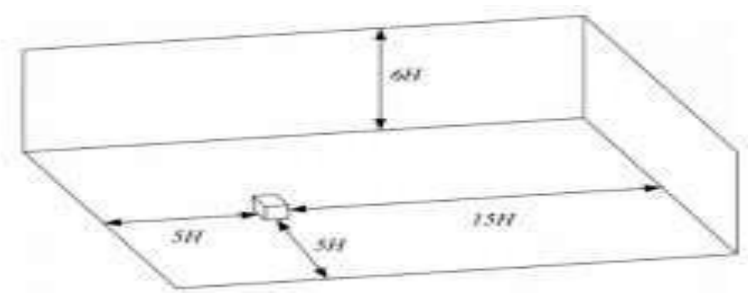

Fig. 4- Domain Dimension.

In general, the mechanism to slow down this movement is caused by movement and it can be divided into two ways

1) Structural Modification 2) Aerodynamic Modification

More than two requirements can be satisfied with these of a mass damper or with a well-designed building like Burj Dubai. As development, the structure of the building is complete directed developmental improvements that can reduce adjusting the swirls and reducing the vortex effect to destroy. [4]

ANSYS CFX is used for purpose of analysis as it mainly focuses to study aerodynamic applications. Meshing of the domain is done using tetrahedral elements. Meshing is done finer near surfaces of building in order to get the better results on surface of building for the pressure as well as velocity as shown in Fig.5.

All the faces i.e Face A, Face B, Face C as shown in the Fig.6.

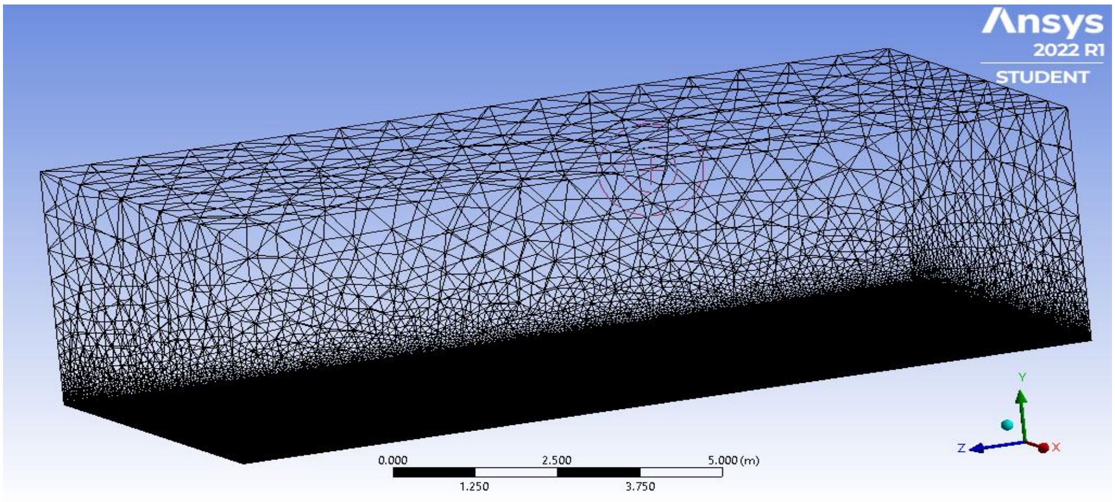

Fig. 5- Meshing of Domain and Building.

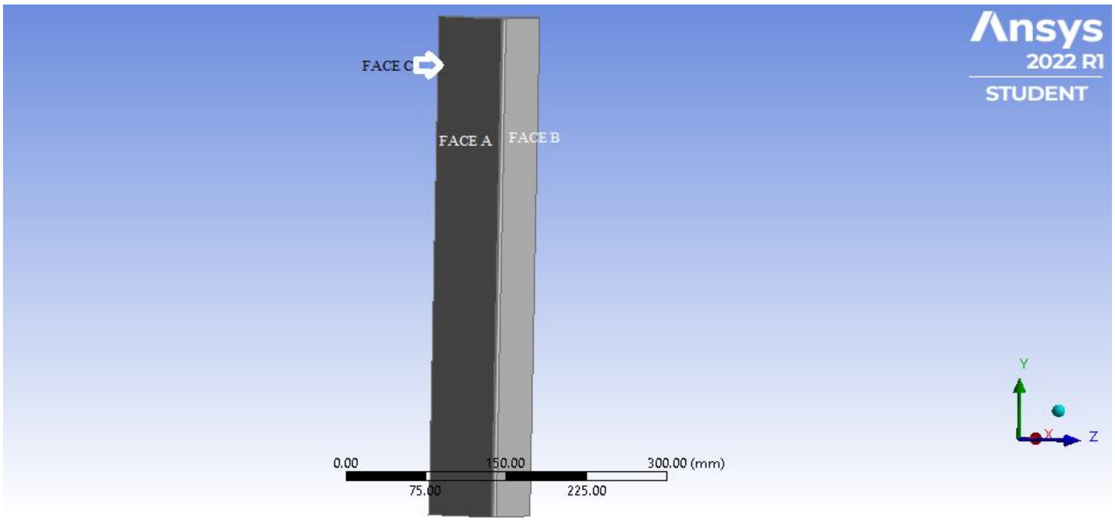

Fig. 6– Faces of Building.

WIND PRESSURE AND VELOCITY DISTRIBUTION

From the lofty abodes of the earth, when the effects of resistance are indifferent and wind movement is present driven by pressure gradients in the atmosphere, which is in line with the effects of physics Flexible star temperature of the earth [5]. This air quality speed is considered because the gradient rotates speed and wind speed is calculated by the given formula as given below

The basic wind speed (V_z) of any site is provided by

$V_z = V_b.k_1.k_2.k_3$

Where,

V_z = wind speed m/s, at a height of z.

V_b = the basic wind speed of the region in m/s.

k_1 = probability factor (risk coefficient).

k_2 = terrain roughness and height factor.

k_3 = topography factor.

We have found the velocity is maximum at the top i.e 16.5 m/s and minimum 0.063 m/s at the bottom of the building.

Design air pressure at any height above normal will be found in the next relationship between air pressure and wind speed:

$P_z = 0.6\ V_z^2$

Where,

P_z = Air pressure designing at N/m^2 at altitude 'z' m.

V_z = design wind speed in m/s.

We have found that the value of pressure is positive on the top i e +80.93 N/m^2 and negative as we move centre to bottom of building, it is found at the bottom is -204.5 N/m^2.

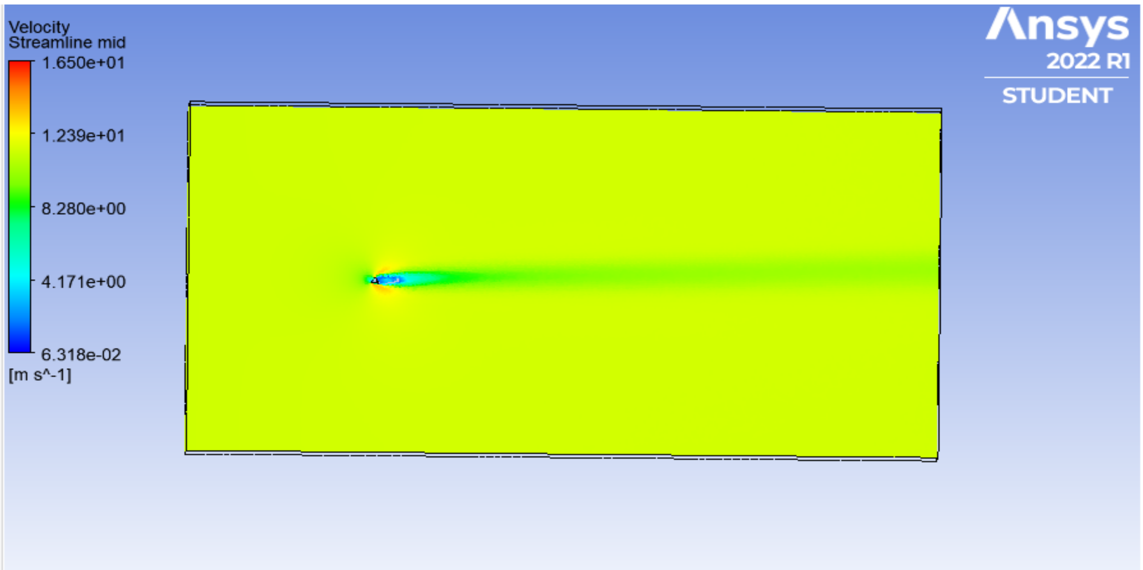

Fig. 7- Velocity distribution.

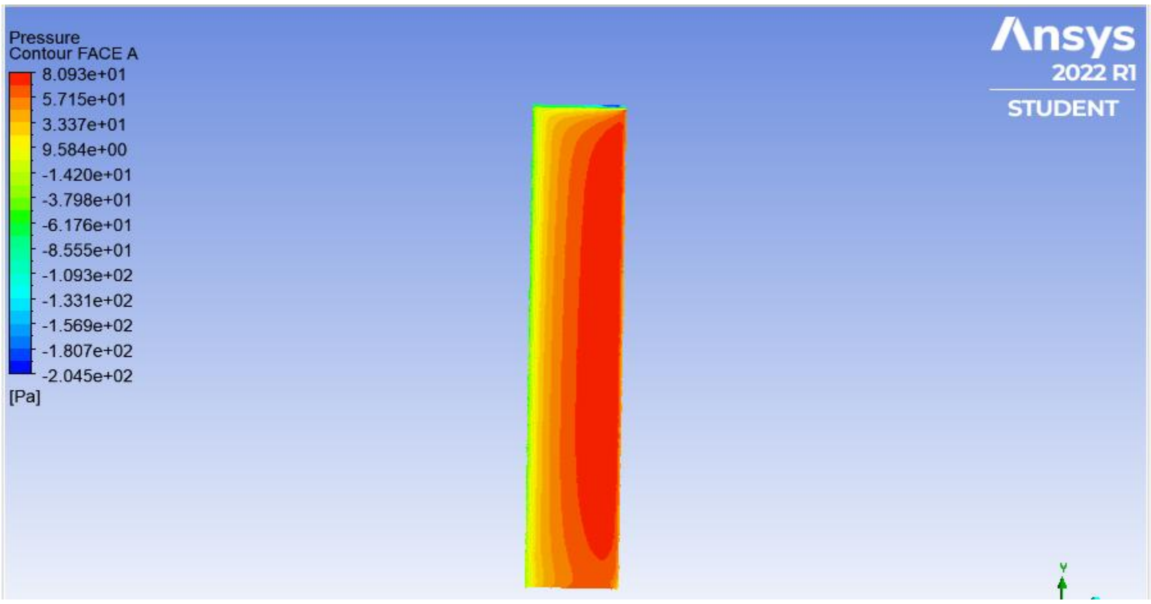

Fig. 8- Pressure for Building Face A.

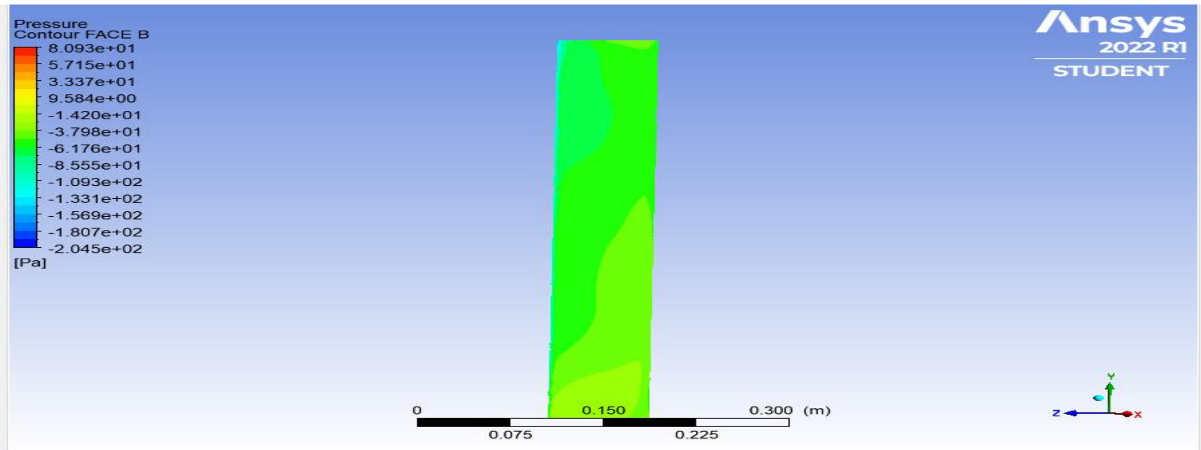

Fig. 9- Pressure for Building Face B.

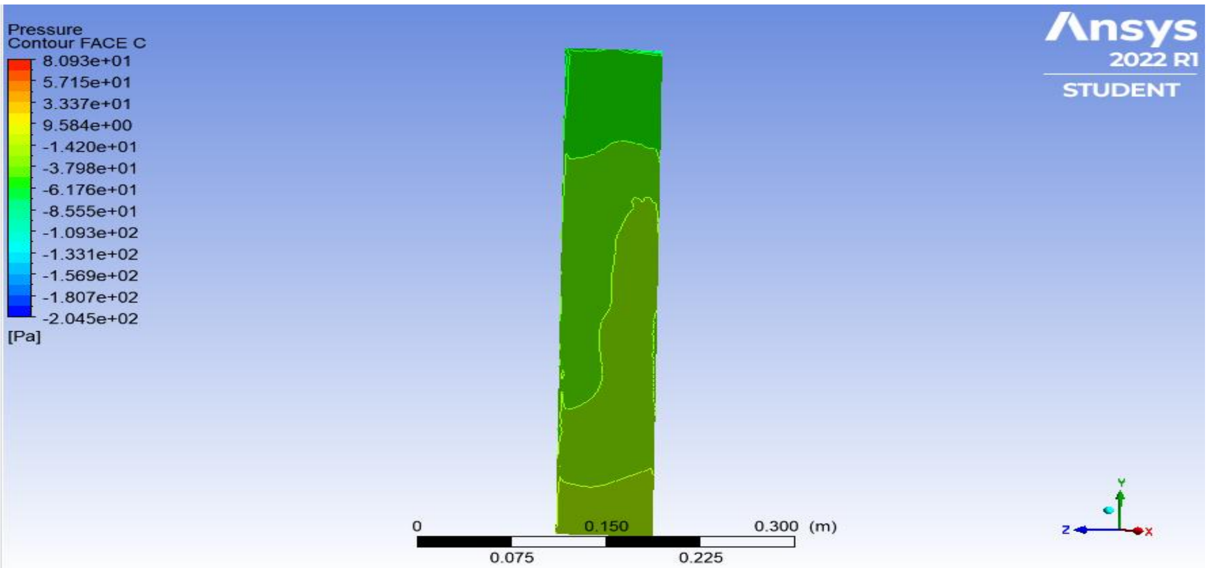

Fig. 10- Pressure for Building Face C.

RESULT AND DISCUSSION

Analysis of model were conducted using ANSYS CFX 2022 R1. Meshing is done using tetrahedron method on a triangular cross section high rise building 100 mm each side. Based on above data in ANSYS results were produced in terms of relative pressure, global pressure, eddy viscosity and temperature etc. Different slip conditions are used no slip wall used for all the faces of building and ground and free slip walls were used for all the walls of domain (inlet, outlet, side walls).

Velocity is maximum at the top i.e 16.5 m/s and minimum 0.063 m/s at the bottom of the building as shown in Fig. 7. We have found that the value of pressure is positive on the top i e +80.93 N/m^2 and negative as we move towards centre to bottom of building and at the bottom -204.5 N/m^2 as shown in Fig. 8 and the authors compared their results with IS 875(Part 3):2015. Pressure contours for the isolated square shaped building as shown in Fig. 9 and Fig. 10 for the different faces of building i.e Face B, Face C also the authors compared their results with Roy and Kumar (2016) [6] and their values for pressure is positive at top 45.493 N/m^2 and negative at the bottom -56.874 N/m^2, As we can see that value is different because of different size of building but nature is same.

CONCLUSION

1. ANSYS The CFX tool is used to perform analysis by creating an atmosphere tunnel as a model. Air flow is

considered to be the liquid that enters air tunnel.

2. Current research is being conducted to investigate the behavior of the height of the building under the wind load around the building for various angles and by using existing transformations.

3. This paper has considered many of the key factors associated with the design of tall buildings in the wind loading effects.

4. The standard design requirements for structural and operational power take on some significance in the case of a tall building design as a significant flexible reaction can be attributed to both the bath and air-conditioning processes.

REFERENCES

[1] IS: 875 (Part 3): 2015. Indian Standard Code of Practice for Design Wind Load on Buildings and Structures, Second Revision, New Delhi, India, 2015.
[2] AS/NSZ 1170.2: 2002. Structural Design Action, Part 2: Wind Actions, Australian New- Zealand Standard, Sydney, Wellington, 2002.
[3] P. Mendis, T. Ngo, N. Haritos, A. Hira, Wind Loading on Tall Buildings, The University of Melbourne, Australia, 2007.
[4] J. Revuz, D.M. Hargreaves and J.S. Owen, On the domain size for the steady-state CFD modelling of a tall building, The University of Nottingham, Nottingham, UK, 2012.
[5] Mohammad Javed1, Satish Kumar2Enhancementof Tall Buildings Under the Wind load department of Civil Engineering, Rama University Kanpur India, 2022.
[6] K. Roy and A. Kumar Bairagi, Wind pressure and Velocity around stepped unsymmetrical plan shape tall building using cfd simulation a Case study, 2016.