iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** V **Month of publication:** May 2021

DOI: https://doi.org/10.22214/ijraset.2021.34317

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

Structural Analysis of Tall RC Chimney with different Heights

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Abstract: ***Reinforced chimneys are used in power plants to remove hot and poisonous flue gases at high altitudes. They are high and slender structures designed primarily to withstand lateral forces such as wind and earthquake, as well as thermal voltages of flue gases. An attempt is made to understand the oscillations of the lateral deviation in the upper part of the chimney, changing the height of the chimney above 275 m. CED 38: 7892 Code of Practice for the Design of a Reinforced Concrete Chimney (Third Edition IS 4998: 1992 [Part I]) is used for analysis. From the results it is observed that the Principal stress (top) for the model-5 is higher as compared to other models and have the value which is obtained as 410 N/mm2. Also it is observed that the Von-Mis stress (top) for the model-5 is higher as compared to other models and have the value which is obtained as 360 N/mm2.***
Keywords: Chimney, tall, RCC and analysis

I. INTRODUCTION

As large-scale industrial developments take place around the world, a large number of high chimneys will need to be built every year. The main function of the chimney is to discharge poisonous gases to a greater height so that the gases do not pollute the surrounding atmosphere. Due to the growing demand for air pollution, the height of the chimney has been growing since the last few decades. However, chimneys tend to have high slender structures with round cross sections, they have various related structural problems, and therefore they should be treated separately from other forms of tower structures . The analysis and design of the chimney depends on various factors, such as wind force, environmental conditions, types of materials used and the cross-sectional area of the chimney. Chimneys 150 m high are considered high chimneys. High RC chimneys are an important part of the main industries and power plants. Damage to chimneys leads to the closure of industry and power plants. The chimney achieves a simultaneous decrease in the concentration of pollutants.

II. REVIEW OF LITERATURE

Alok David John (2011) A detailed literature review is conducted as part of this study of wind energy, design and analysis of the reinforced concrete chimney. An assessment of wind exposure, such as wind and wind methods, is studied. No literature on the effects of stress due to the presence of smoke channels is published.

B.R. Jayalekshmi et al. (2015) All criteria involved in the analysis and design of reinforced concrete chimneys were considered and analyzed. All loads to be considered during the chimney analysis phase were taken into account. Of all the cargoes considered to be the most important, wind loads were detected.

Vickery B.J. etc. (2003) The unified conical section, subject to wind analysis, shows more movement, as observed by the schedules of movement to all heights. And we can conclude that the movements obtained for chimneys increase with increasing height of the slender structure. Up to one third of the chimney height is 300 m, all types of displacement values

III. MODELING

The modeling is carried out in the STAAD software, mentioned as follows.

A. Model-I (Concrete chimney-height 60 m)
B. Model-II (Concrete chimney-height 70 m)
C. Model-III (Concrete chimney, height-80m): compared manual calculations
D. Model-IV (Concrete chimney-height 100 m)
E. Model-V (Concrete chimney - 120 m)

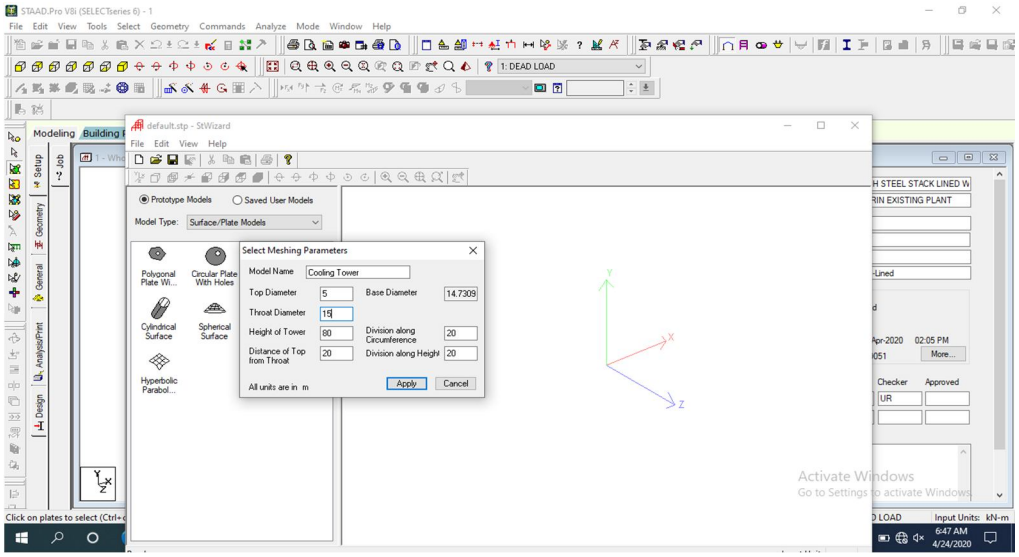

Figure 1: Parameters considered for Chimney

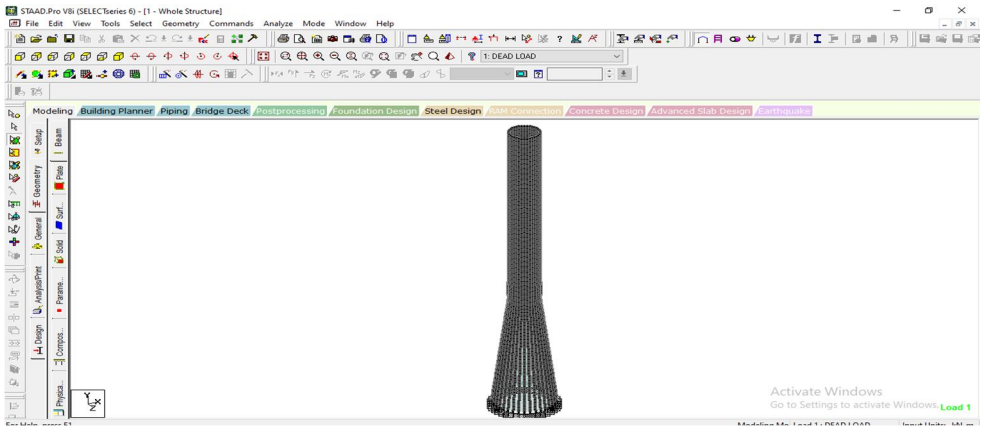

Figure 2: Modeling in STAAD-PRO

IV. RESULTS

The analysis is carried out in STAAD software and the results in terms of shear force, bending moment and other parameter is obtained as follows.

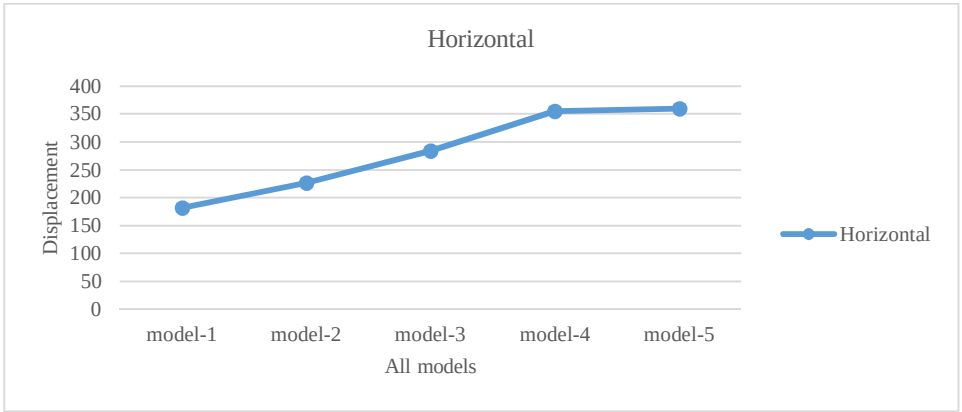

Figure 3: Displacement (X) of models 1 to 5

From the above diagram it is observed that the displacement (X)-direction for the model-5 is higher as compared to other models and have the value which is obtained as 355 mm.

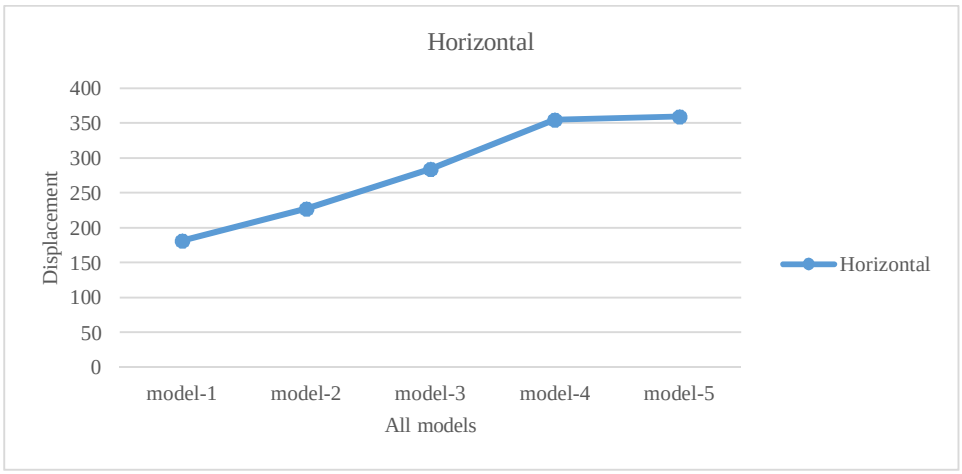

Figure 4: Displacement (Z) of models 1 to 5

From the above diagram it is observed that the displacement (Z)-direction for the model-5 is higher as compared to other models and have the value which is obtained as 355 mm.

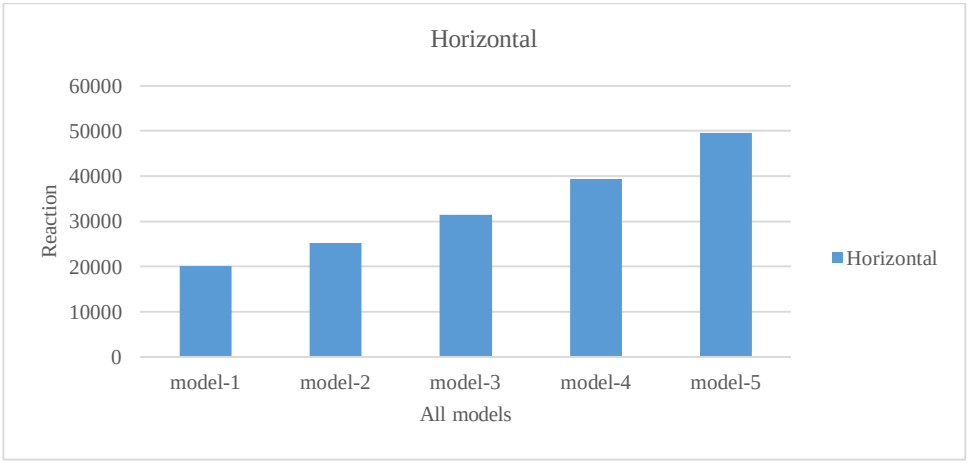

Figure 5: Horizontal Reaction (Fx) of models 1 to 5

From the above diagram it is observed that the Horizontal Reaction (Fx) for the model-5 is higher as compared to other models and have the value which is obtained as 50000 kN.

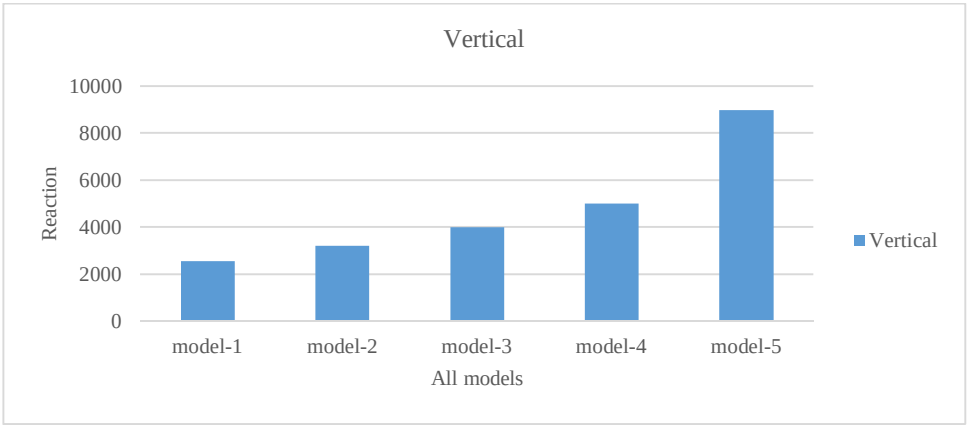

Figure 6: Vertical Reaction (Fy) of models 1 to 5

From the above diagram it is observed that the Vertical Reaction (Fy) for the model-5 is higher as compared to other models and have the value which is obtained as 9000 kN.

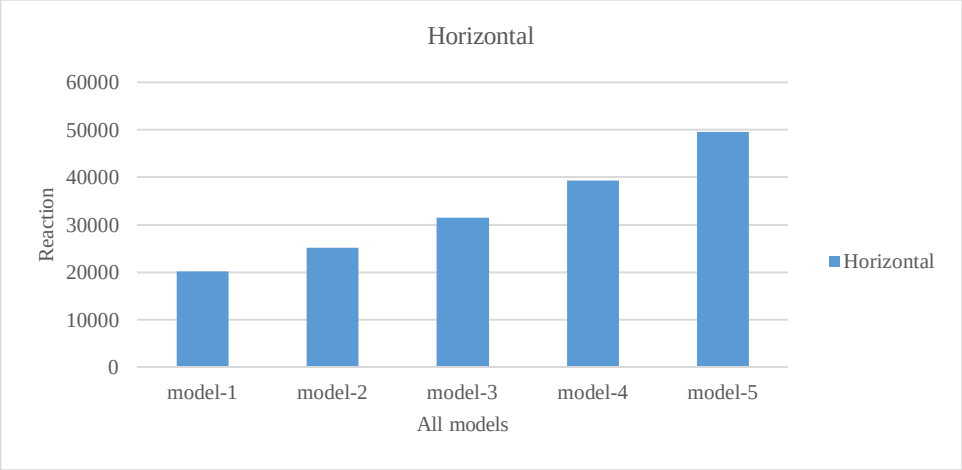

Figure 7: Horizontal Reaction (Fz) of models 1 to 5

From the above diagram it is observed that the Horizontal Reaction (Fz) for the model-5 is higher as compared to other models and have the value which is obtained as 50000 kN.

Figure 8: Moment (Mx) of models 1 to 5

From the above diagram it is observed that the Moment (Mx) for the model-4 is higher as compared to other models and have the value which is obtained as 13000 kNm.

Figure 9: Moment (Mz) of models 1 to 5

From the above diagram it is observed that the Moment (Mz) for the model-4 is higher as compared to other models and have the value which is obtained as 13000 kNm.

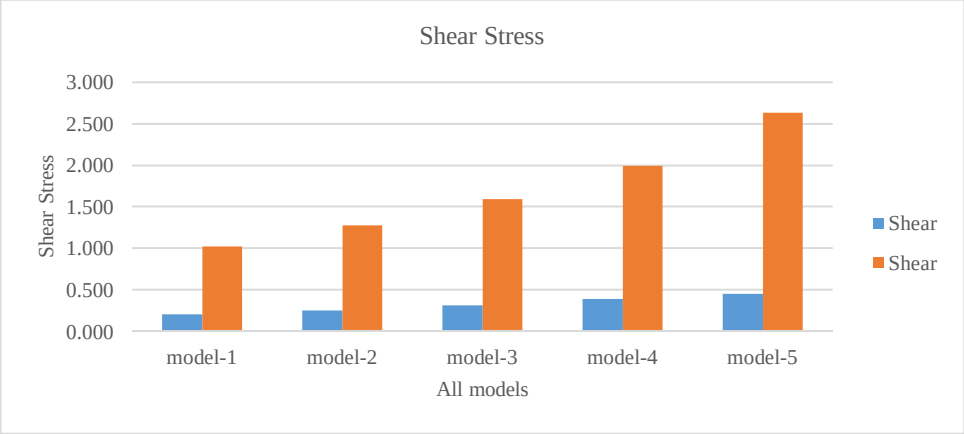

Figure 10: Shear Stress of models 1 to 5

From the above diagram it is observed that the Shear stress (SQx) for the model-5 is higher as compared to other models and have the value which is obtained as 2.6 N/mm^2.

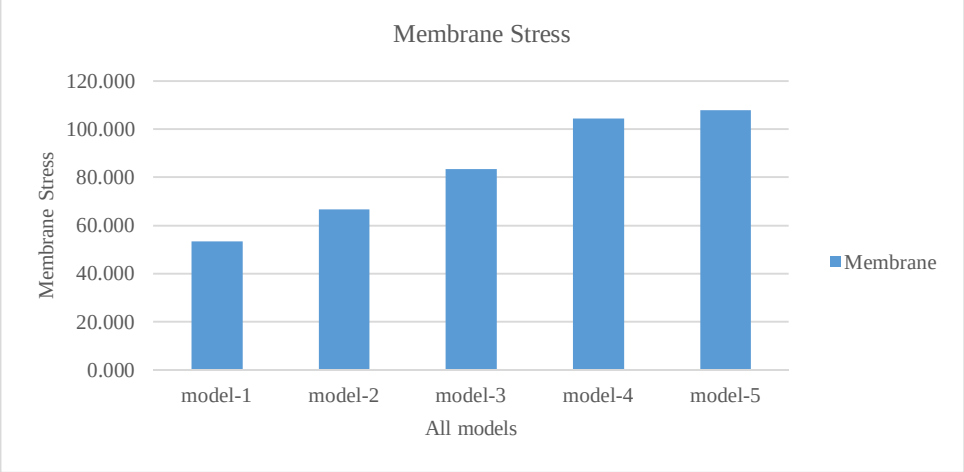

Figure 11: Membrane Stress (Sx) of models 1 to 5

From the above diagram it is observed that the membrane stress (Sx) for the model-5 is higher as compared to other models and have the value which is obtained as 110 N/mm^2.

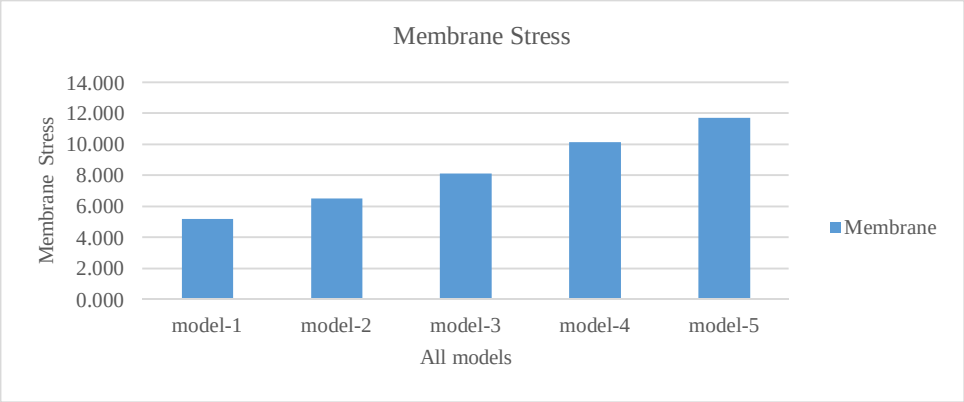

Figure 12: Membrane Stress (Sxy) of models 1 to 5

From the above diagram it is observed that the membrane stress (Sxy) for the model-5 is higher as compared to other models and have the value which is obtained as 11.5 N/mm^2.

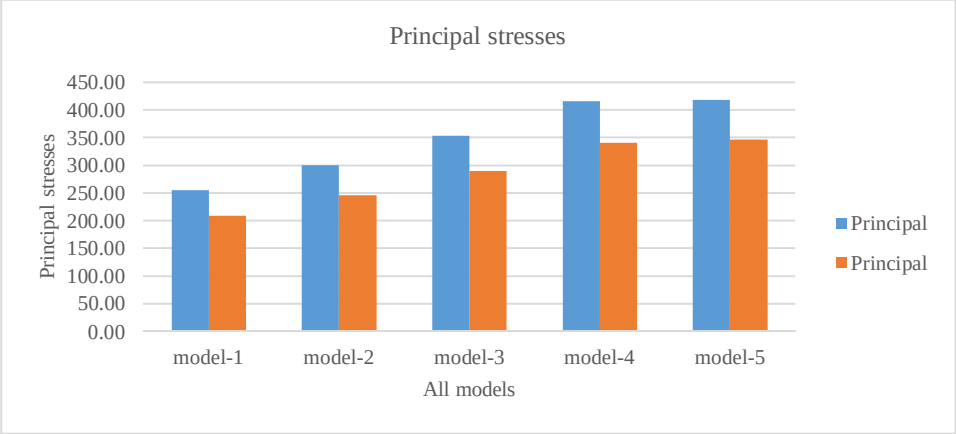

Figure 13: Principal Stress of models 1 to 5

From the above diagram it is observed that the Principal stress (top) for the model-5 is higher as compared to other models and have the value which is obtained as 410 N/mm^2.

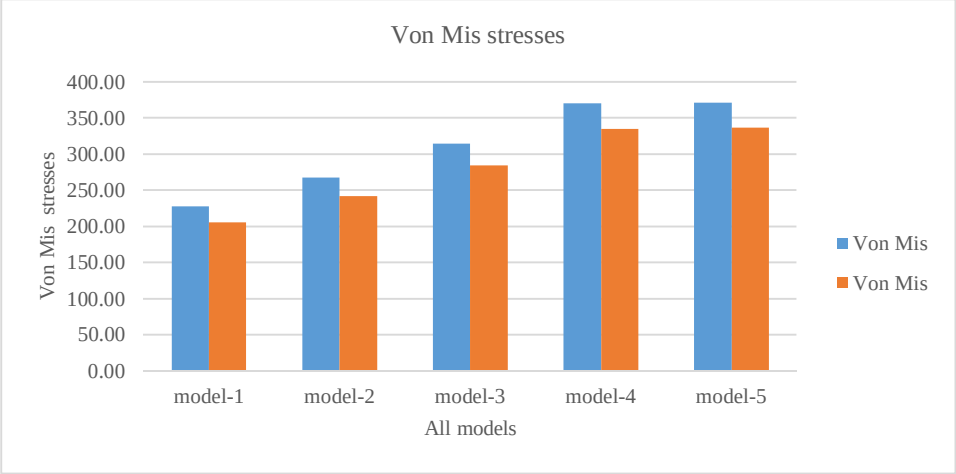

Figure 14: Von-Mis Stress of models 1 to 5

From the above diagram it is observed that the Von-Mis stress (top) for the model-5 is higher as compared to other models and have the value which is obtained as 360 N/mm^2.

Figure 15: Tresca Stress of models 1 to 5

From the above diagram it is observed that the Tresca stress (top) for the model-5 is higher as compared to other models and have the value which is obtained as 410 N/mm^2.

V. CONCLUSION

The conclusions from the above study are as follows:

A. The From the above results it is observed that the displacement (X)-direction for the model-5 is higher as compared to other models and have the value which is obtained as 355 mm. Also it is observed that the displacement (Z)-direction for the model-5 is higher as compared to other models and have the value which is obtained as 355 mm.

B. From the above results it is observed that the Horizontal Reaction (Fx) for the model-5 is higher as compared to other models and have the value which is obtained as 50000 kN. Also it is observed that the Vertical Reaction (Fy) for the model-5 is higher as compared to other models and have the value which is obtained as 9000 kN.

C. From the above results it is observed that the Horizontal Reaction (Fz) for the model-5 is higher as compared to other models and have the value which is obtained as 50000 kN. Also it is observed that the Moment (Mx) for the model-4 is higher as compared to other models and have the value which is obtained as 13000 kNm.

D. From the above results it is observed that the Moment (Mz) for the model-4 is higher as compared to other models and have the value which is obtained as 13000 kNm. Also it is observed that the Shear stress (SQx) for the model-5 is higher as compared to other models and have the value which is obtained as 2.6 N/mm2.

E. From the above results it is observed that the membrane stress (Sx) for the model-5 is higher as compared to other models and have the value which is obtained as 110 N/mm2. Also it is observed that the membrane stress (Sxy) for the model-5 is higher as compared to other models and have the value which is obtained as 11.5 N/mm2.

F. From the above results it is observed that the Principal stress (top) for the model-5 is higher as compared to other models and have the value which is obtained as 410 N/mm2. Also it is observed that the Von-Mis stress (top) for the model-5 is higher as compared to other models and have the value which is obtained as 360 N/mm2.

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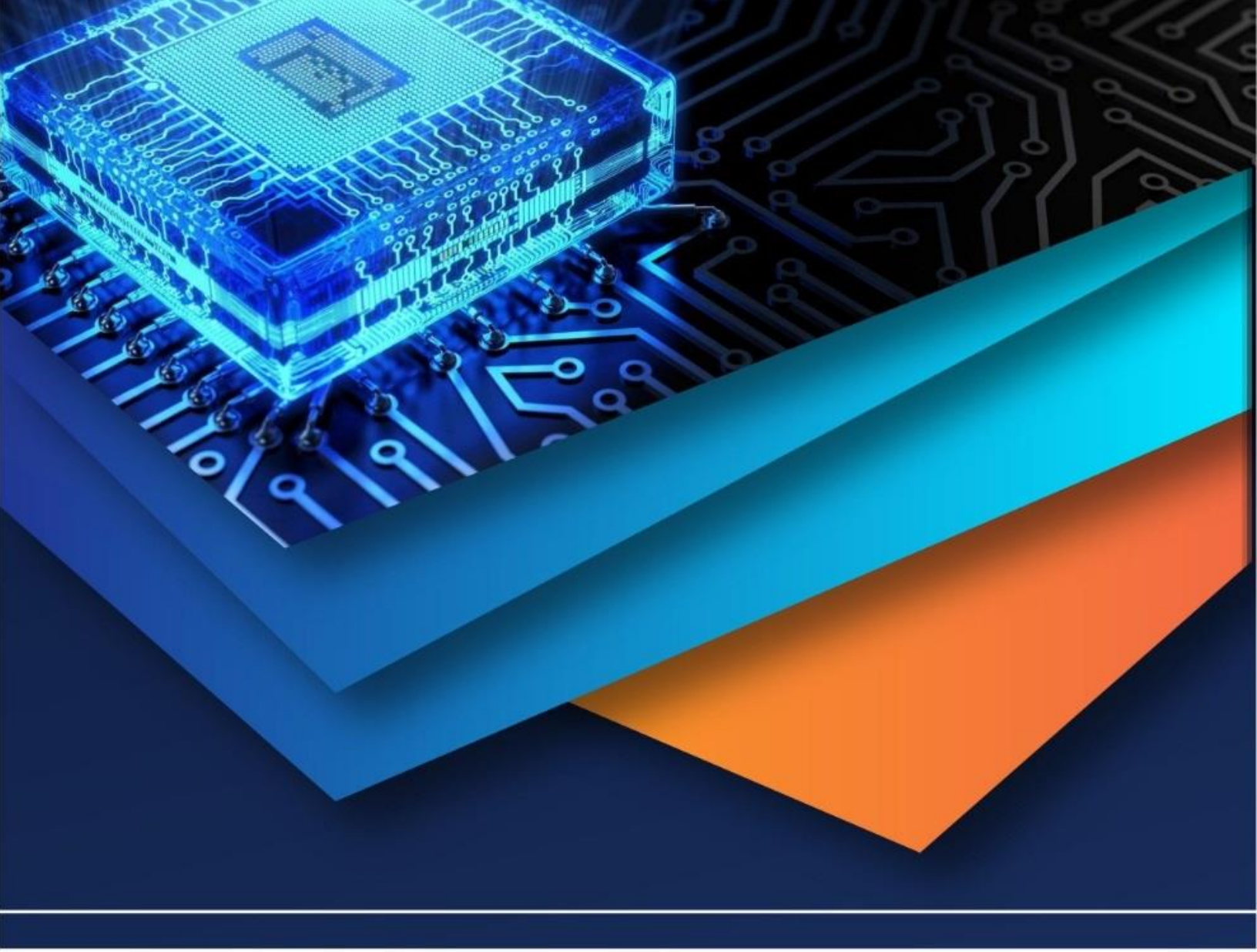

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