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Structural Analysis of Dome Structure by STAAD Pro

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Abstract: There are different types of domes and different types of failures for the domes. This work includes design and analysis of monolithic dome having a substructure of auditorium.
They are designed for uniform loading over the plates. In this study by applying point loads over the nodal joints analysis and design of concrete dome structure will be done using STAAD.Pro. The dome for the different span and the height of the column are modeled in the present work. The displacement, reactions, beam forces, shear stress, membrane stress, principal stress, von mis stress and tau stress are presented for all the models. The model no-V gives the maximum results in terms of the displacement as compared to the other models.
Keywords: Dome, STAAD.Pro, Nodal Joint Load, Shear Force and Bending Moment

I. INTRODUCTION

A large monolithic dome (from Greek mono- and -lithic, meaning "one stone") is a structure cast in a one-piece form. The form may be permanent or temporary and may or may not remain part of the finished structure. It is the form of monolithic architecture. Domes are ambient structure developed from A.D periods which are constructed for getting large volume from the structure. Domes can be design to fit any architectural homes, cabins, churches, school, gymnasiums, arenas, stadium bulk, auditorium, landlord dwelling and other various privately and publicly owned facilities. They are cost-efficient, earth-friendly, extremely durable and easily maintained. Most importantly, a Monolithic Dome uses about 50% less energy for heating and cooling than a same-size, conventionally constructed building.

II. REVIEW OF LITERATURE

Chandiwala, A. [1] studied in this investigation by applying point loads over the nodal joints analysis and design of concrete dome structure was done using STAAD.Pro. An 8.49m rise with 30m diameter dome and a support height of 14m was considered for the design.

Iimura, S., et al [3] carried out study shows the result of static analysis and design of geodesic tunnel dome. The authors collected the dimension of an auditorium, the length is 40m & width of the inner side is 20m with the height of the crown is 10.63m. They built the model required for the project.

Kubik, M. et al [5] carried out researched on the Acoustic of monolithic dome structures. Which describes the Analyse monolithic structures including being cost-efficient, earth-friendly, extremely durable, and easily maintained. Regarding climate, the monolithic domes are easily constructed and are cost effective on constructing.

III. MODELING

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

The following models are prepared in the project

1) Model-I: (base diameter-15m, Column-7m)
2) Model-II: (base diameter-16m, Column-7m)
3) Model-III: (base diameter-17m, Column-7m)
4) Model-IV: (base diameter-18m, Column-7m)
5) Model-V: (base diameter-22m, Column-7m)

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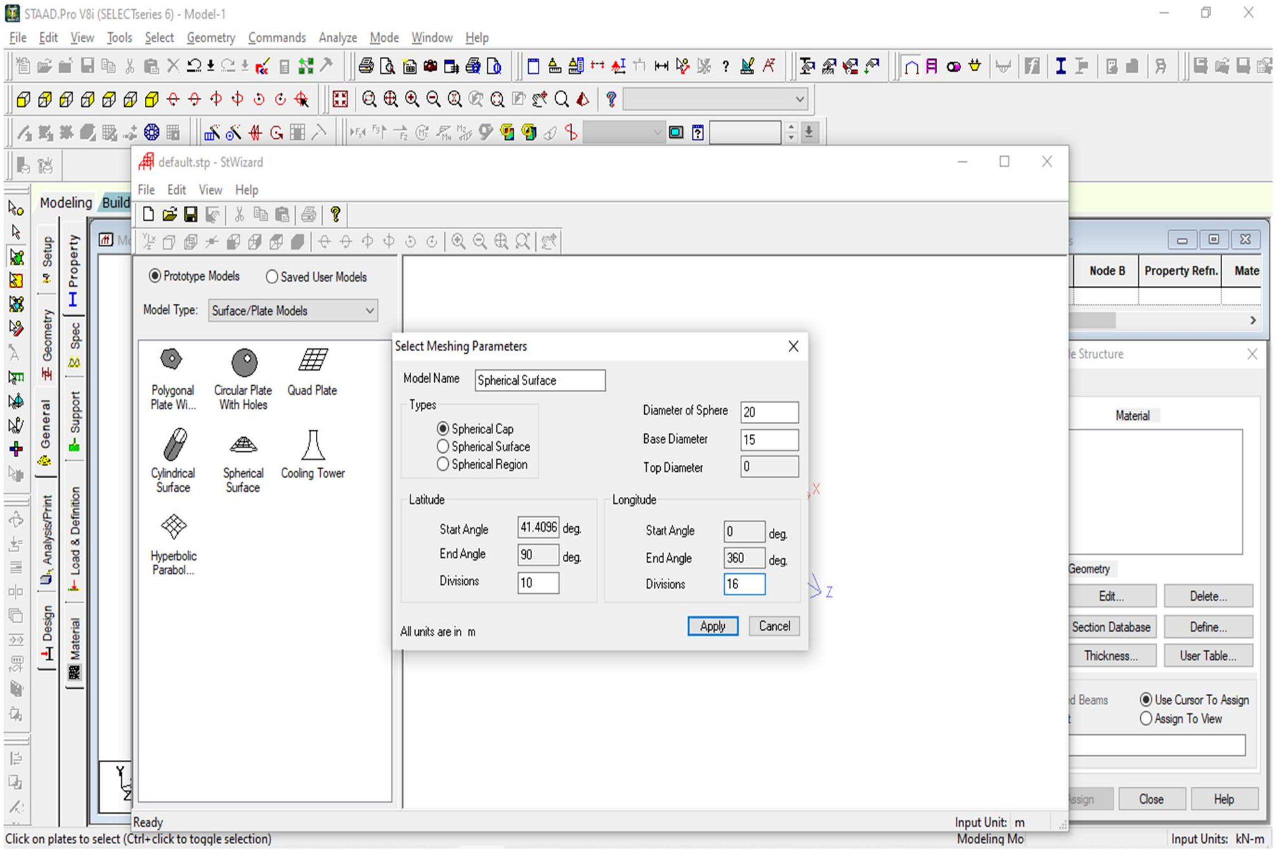

Fig. No.1:Geometry of the Model-I

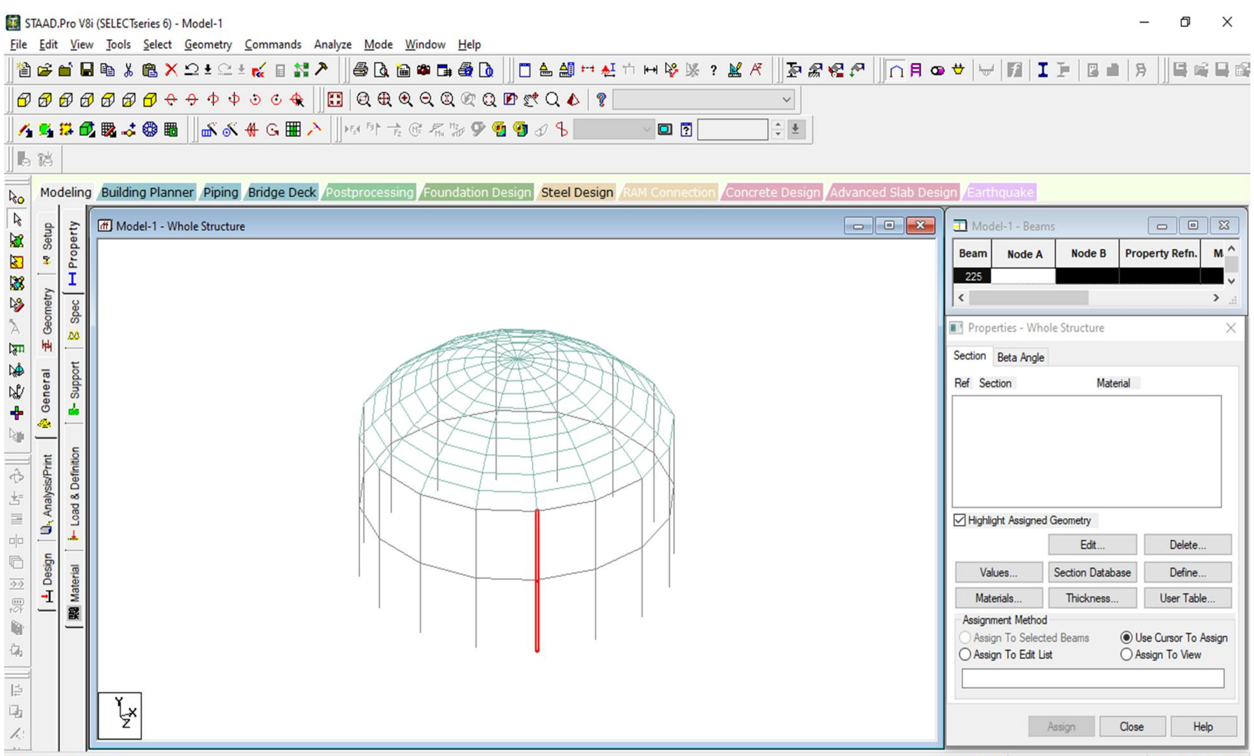

Fig. No.2: Dome structure of the model-I

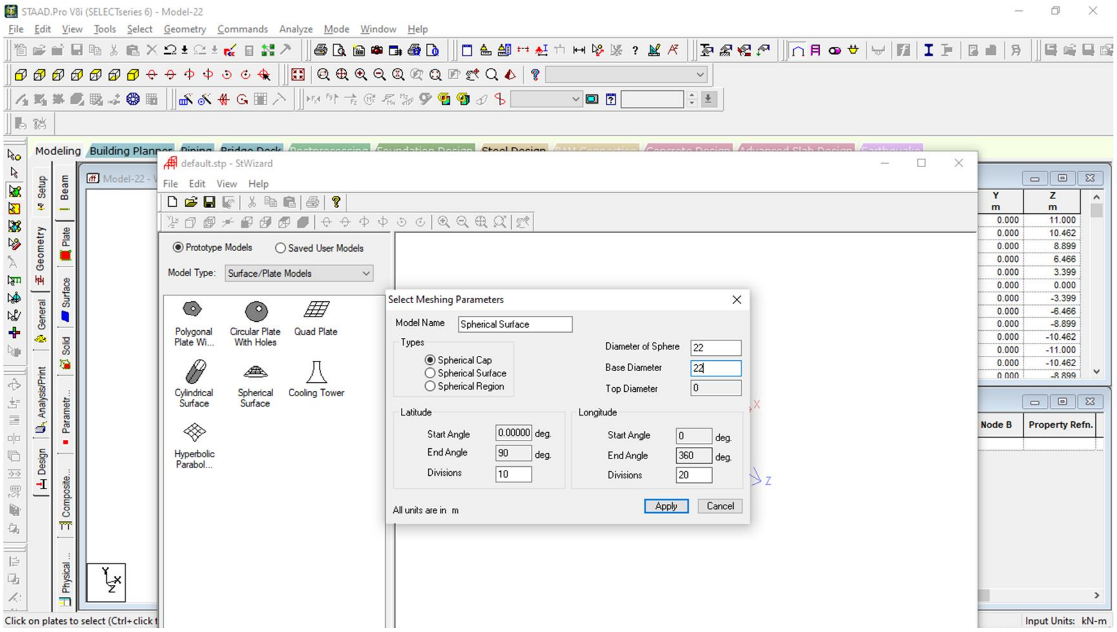

Fig. No. 3: Geometry of model-IV

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.

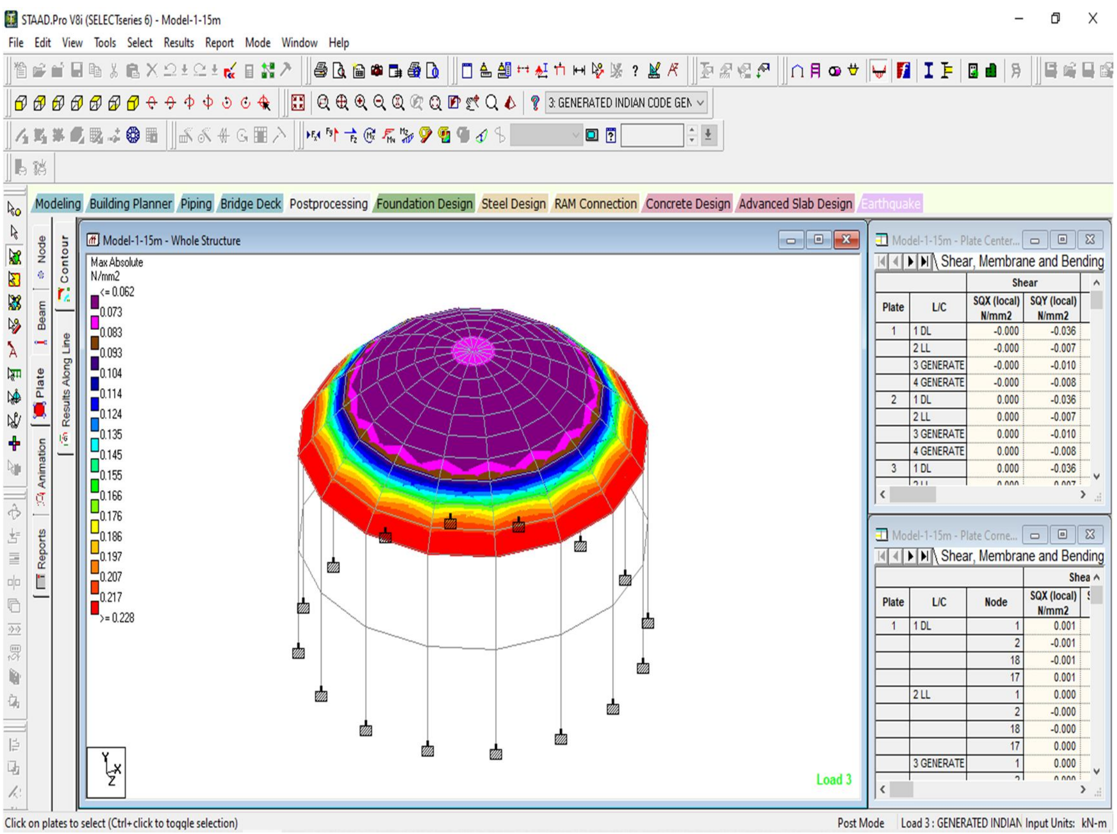

Fig. No. 4: Maximum absolute stress of model-I

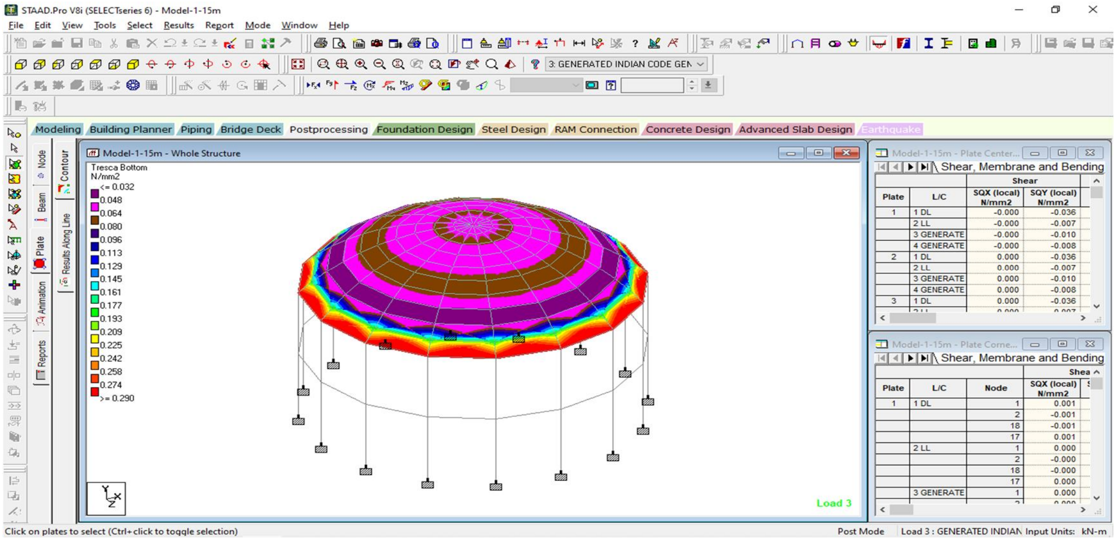

Fig. No.5: Tresca bottom stress of model-I

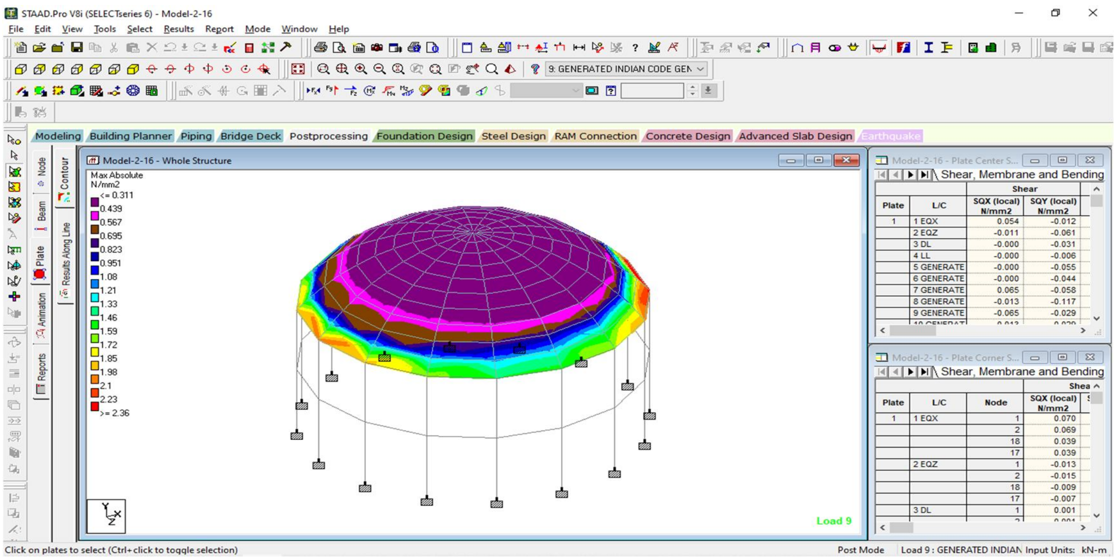

Fig. No.6: Maximum absolute stress of the model-II

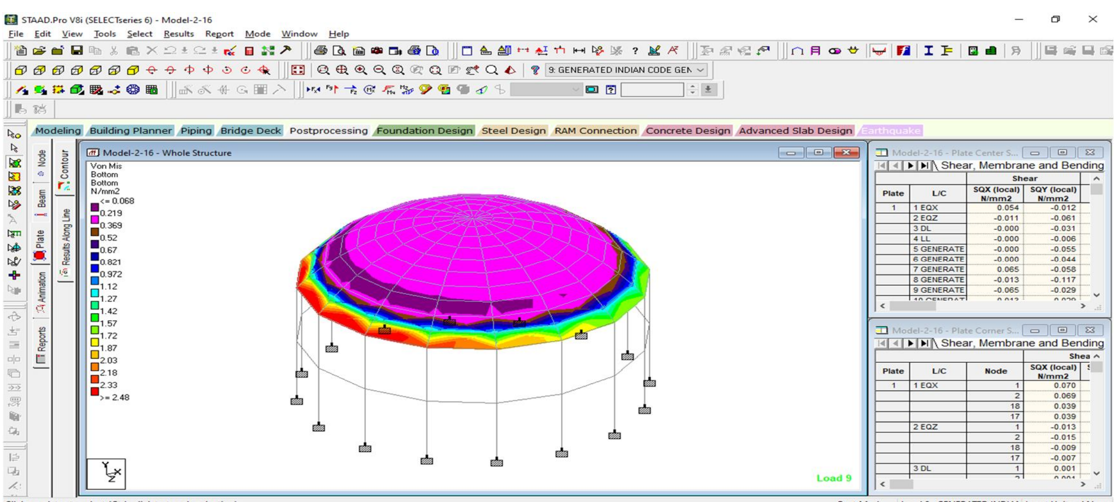

Fig. No. 7: Von mis bottom stress of the model-II

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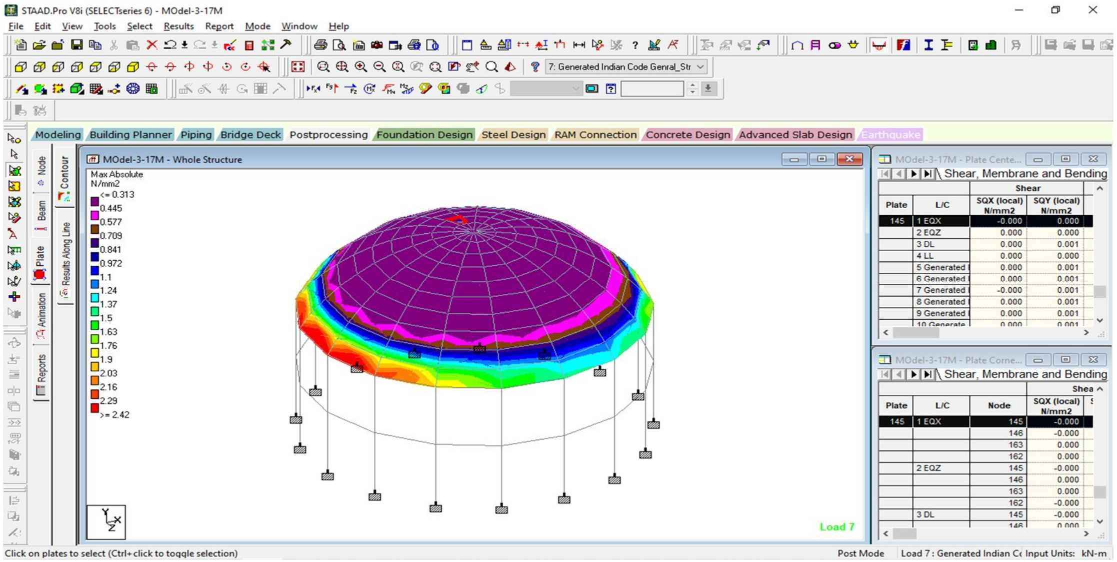

Fig. no.8: Maximum absolute stress of model-III

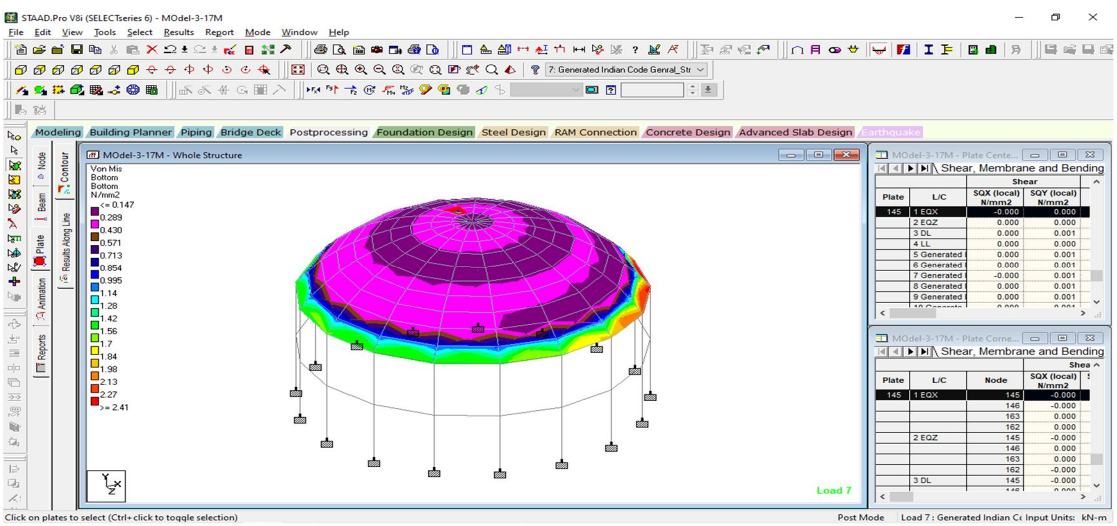

Fig. no.9: Von mis bottom stress of model-III

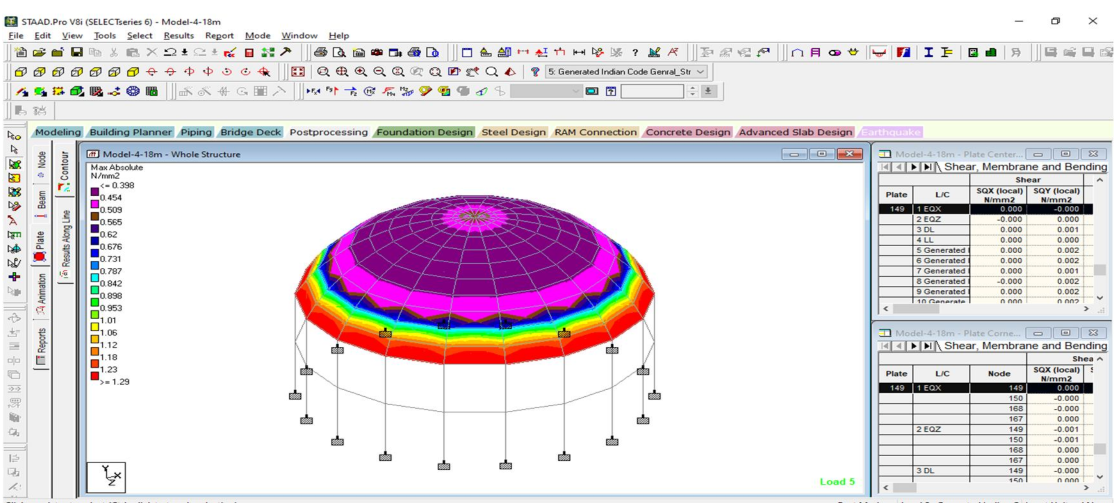

Fig. no. 10: Maximum absolute stress of the model-IV

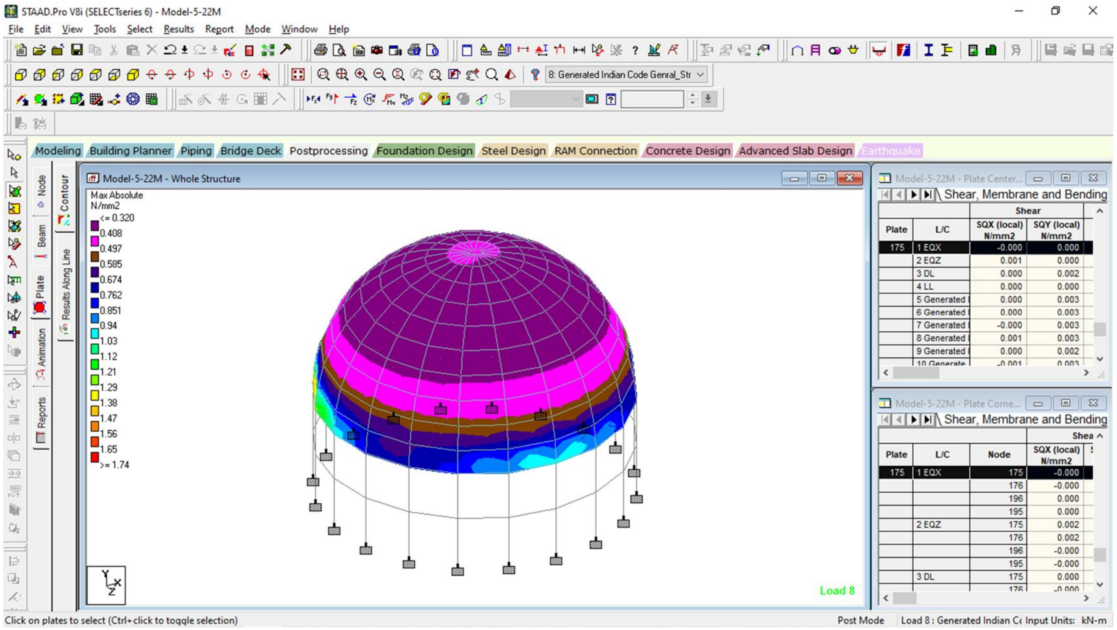

Fig. No.11: Maximum absolute stress of the model-V

V. CONCLUSION

The conclusions from the above study are as follows:

A. The dome for the different span and the height of the column are modeled in the present work

B. The displacement, reactions, beam forces, shear stress, membrane stress, principal stress, von mis stress and tau stress are presented for all the models.

C. The model no-V gives the maximum results in terms of the displacement as compared to the other models.

D. As the height of the models goes on increasing the forces and stresses found to be increasing

E. As the span of the models goes on increasing the stresses found to be increasing.

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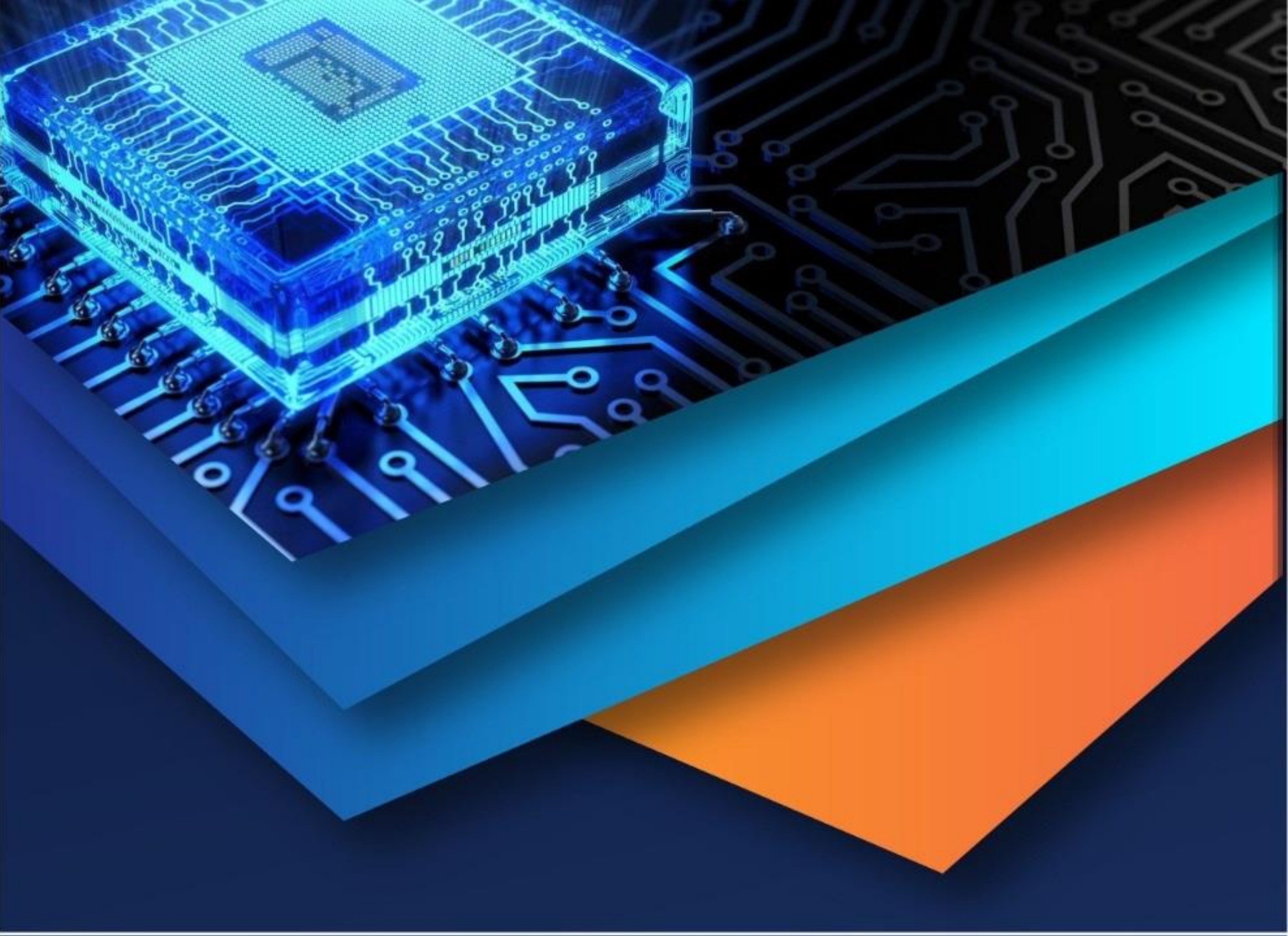

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