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Structural Analysis of Cantilever Retaining Wall using STAAD PRO and Compare with Manual Calculations

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Abstract: Reinforced concrete retaining walls have a vertical or sloping stem cast by the base plate. They are considered suitable for a height of 6 m. It resists lateral pressure on the ground by the cantilever action of the stem, plate on the legs and heel plate. The tendency of the wall to slide forward due to lateral pressure on the ground should be investigated, and a safety factor of 1.5 should be provided against slipping. Consolidated retaining walls are best at a height of 6 m. For a greater height, the pressure on the ground due to the preserved filling will be higher due to the effect of the lever arm, the base produces higher moments, which leads to a higher section for designing stability, as well as to the design structures of the structure. In this paper, structural analysis should be performed in the case of wall retention with different types of joints and span. The cantilever retaining wall and the buttress retaining wall are modeled for different seismic zones.
Keywords: Cantilever retaining wall, stability, sliding, overturning, bearing, pressure, factor, safety

I. INTRODUCTION

Earth-sustaining structures are ubiquitous in a man-made environment. However, their use has increased significantly in recent decades due to the great progress in technological, social and economic developments that have taken place. Reinforced concrete cantilever retaining walls are considered more economical compared to traditional mass concrete or brick gravity wall analogues. This is because, unlike the latter, the material of which is used exclusively for its dead weight, in the cantilever walls the backfill itself significantly contributes to the required dead weight. As a result, the concrete stem can be made relatively slimmer, thus also enhancing the visual appearance and aesthetics of the structure.

II. REVIEW OF LITERATURE

Ghosh, P., [6] the study presented was to compare and contrast the results of the conventional CECP2 method and its variants with the BS8002 boundary design approach when applied to a reinforced concrete cantilever retaining wall. It was found that in all cases stability is achieved against slipping and overturning.

Kaveh, A. et al [9] studied cantilever retaining walls are economically suitable for wall heights up to 6.0 M, and therefore for heights up to 6.0 M, no other alternative is required. Supporting walls for retaining forts are suitable for holding wall heights from 8.0 M to 10.0 M for standard conditions accepted.

Klukinas, P ., etc. [11] studied the dynamic behavior of the cantilever retaining walls during the earthquake is investigated by 1-g table testing, conducted on scalable models in the Bristol Laboratory for Advanced Dynamics (BLAGIC) Bristol University, UK. The experimental program covers different combinations of containment wall geometry, soil configuration and soil input movements.

III. MODELING

The different models are prepared and the step by step procedure is adopted in the STAAD-PRO software as follows.

The models are prepared in this work for cantilever and counterfort retaining wall are as follows

1) Cantilever- Cantilever- Model-I (5m X 5m)
2) Cantilever- Model-II (7.5m X 7.5m)
3) Cantilever- Model-III (10m X 10m)
4) Cantilever- Model-IV (12.5m X 12.5m)
5) Cantilever- Model-V (15m X 15m)
6) Cantilever- Model-VI (5m X 3m)
7) Cantilever- Model-VII (7.5m X 5m)
8) Cantilever- Model-VIII (10m X 7m)
9) Cantilever- Model-IX (12.5m X 10m)
10) Cantilever- Model-X (15m X 12.5m)

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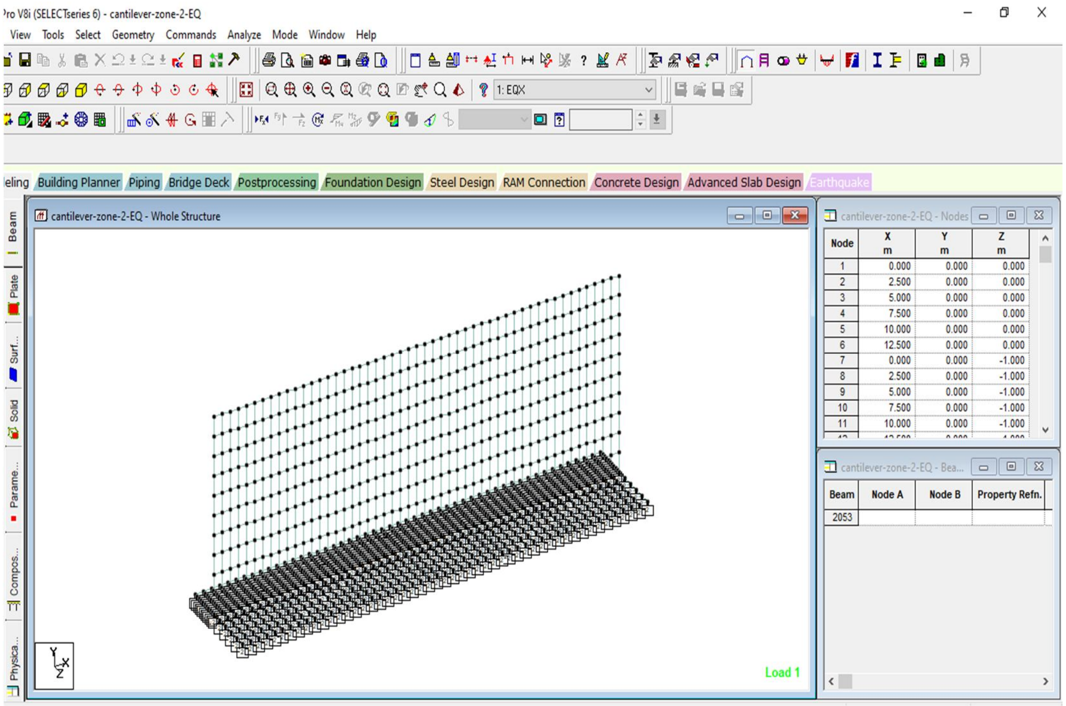

Figure 1: Geometry of the model (Cantilever retaining wall)

The above figure gives the details about the geometry of the structure which is the first step to be followed in STAAD software.

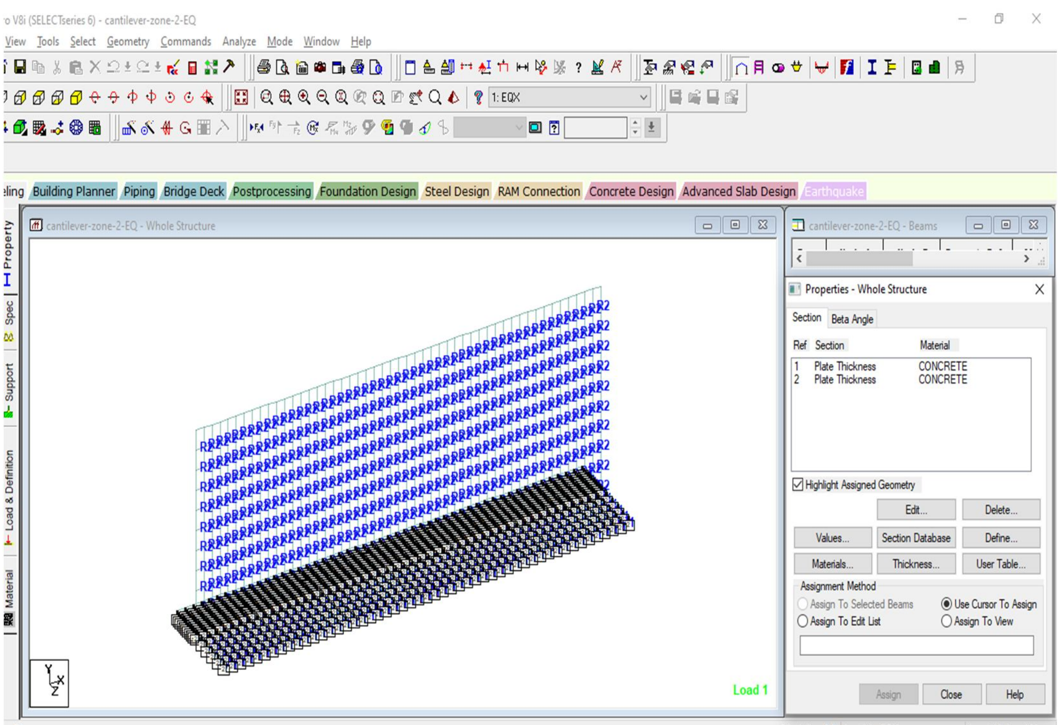

Figure 2: Assignment of the property to the model

The above figure gives the details of the assignment of the property to the model which is the next step after model is prepared.

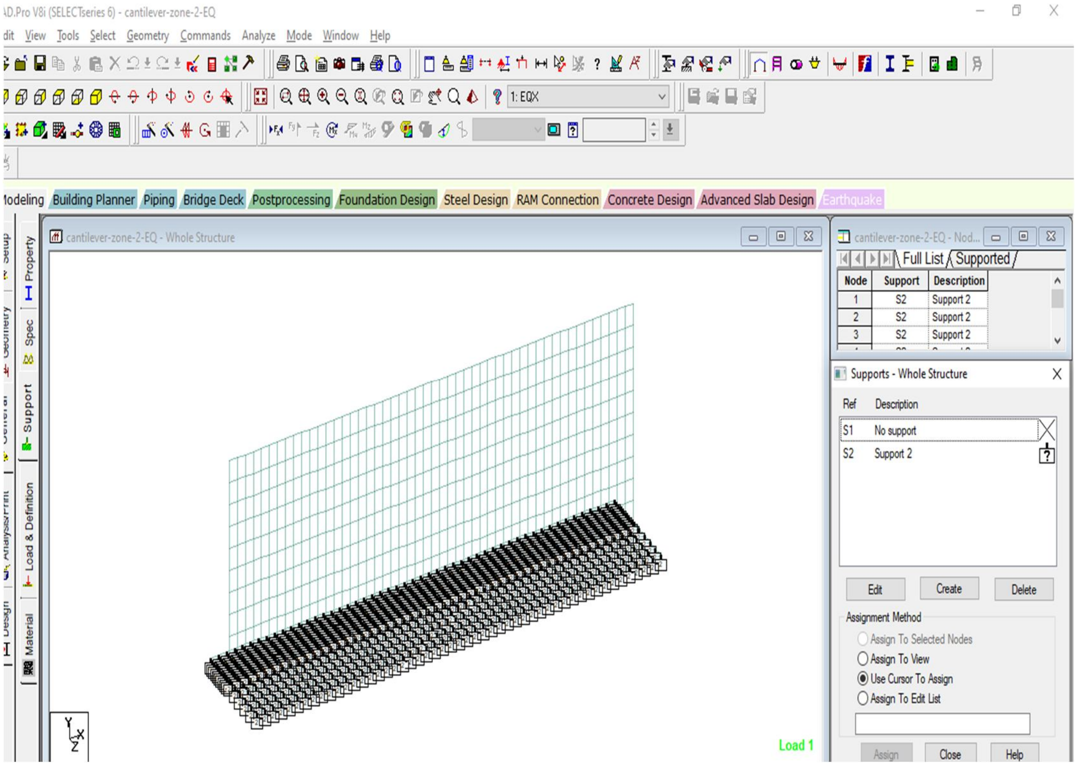

Figure 3: Assigning support to the model

The above figure gives the details of the assigning support to the model after the property is assigned to the model.

IV. RESULTS

The analysis is carried out in STAAD-PRO software and the results obtained as follows

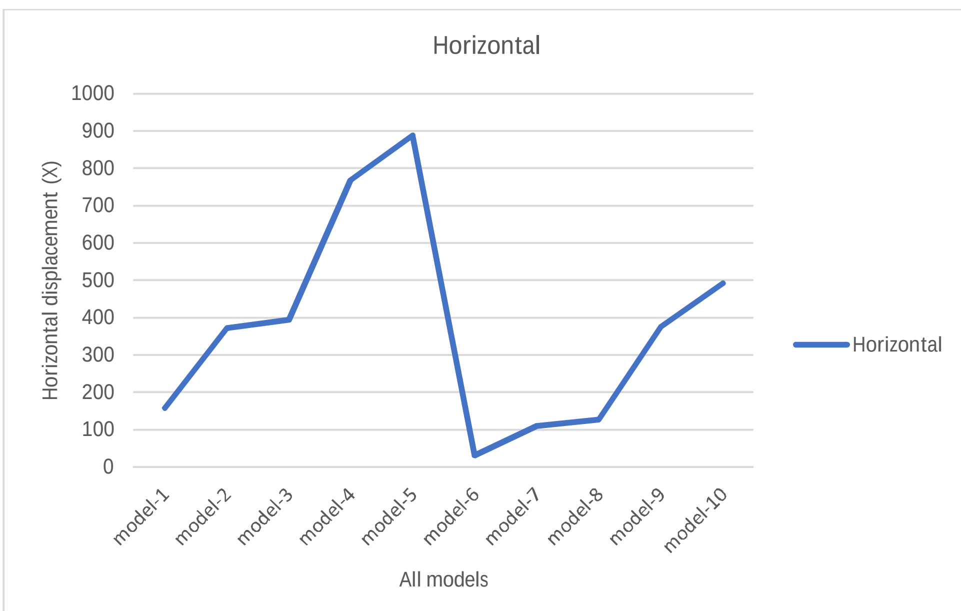

Figure 4:Horizontal Displacement (X) for all models

From the above figure it is observed that the Horizontal Displacement (X) is found to be maximum in the model-5 as compared to other models.

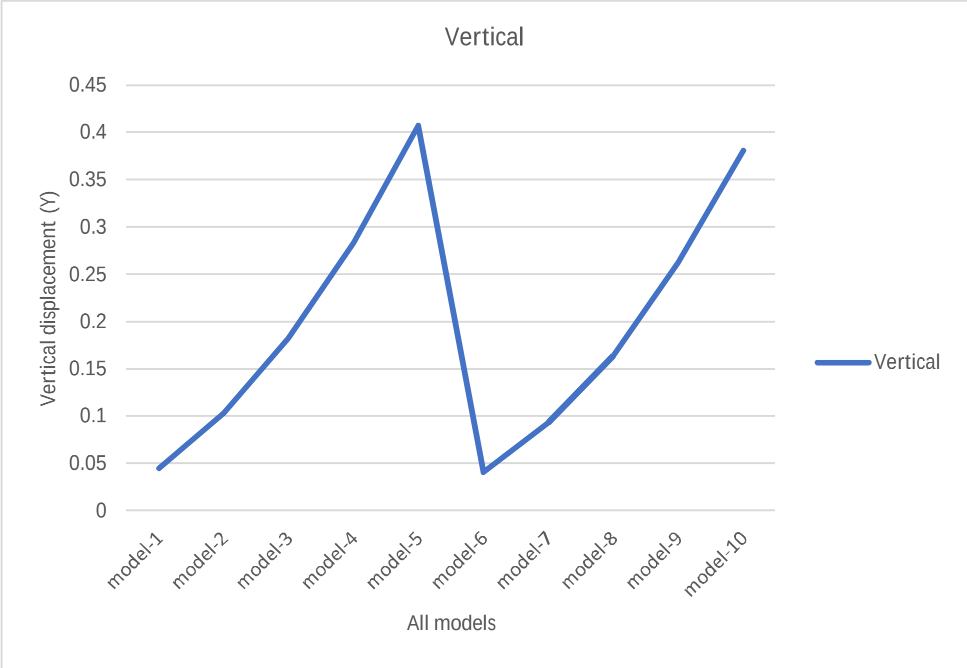

Figure 5:Vertical Displacement (Y) for all models

From the above figure it is observed that the Vertical Displacement (Y) is found to be maximum in the model-5 and minimum in the model-1 as compared to other models.

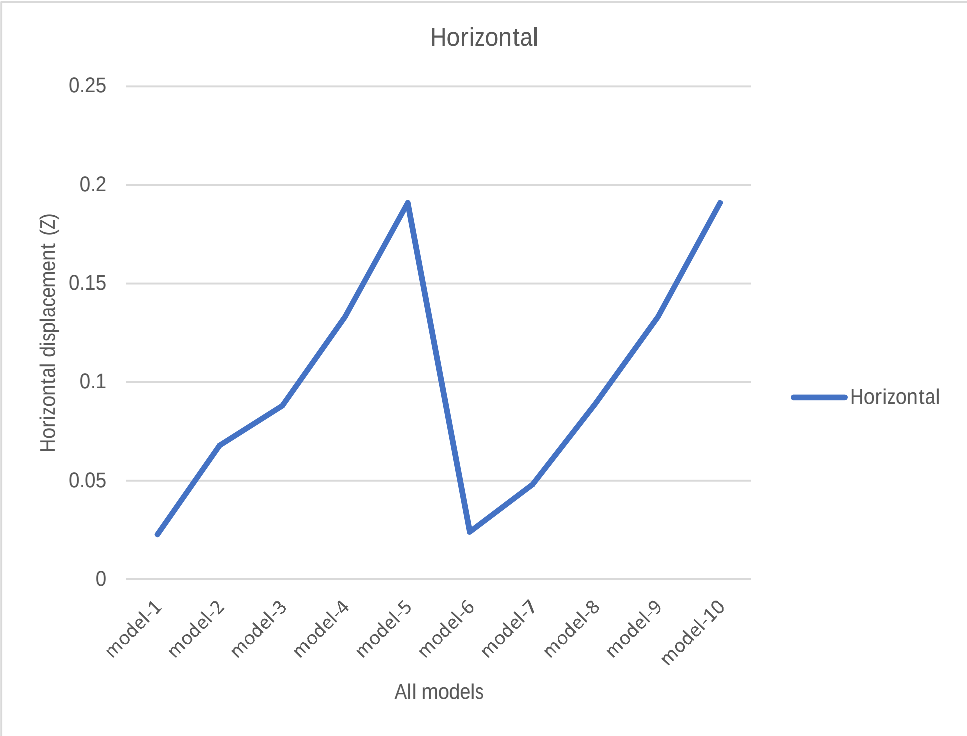

Figure 6:Horizontal Displacement (Z) for all models

From the above figure it is observed that the Horizontal Displacement (Z) is found to be maximum in the model-10 as compared to other models.

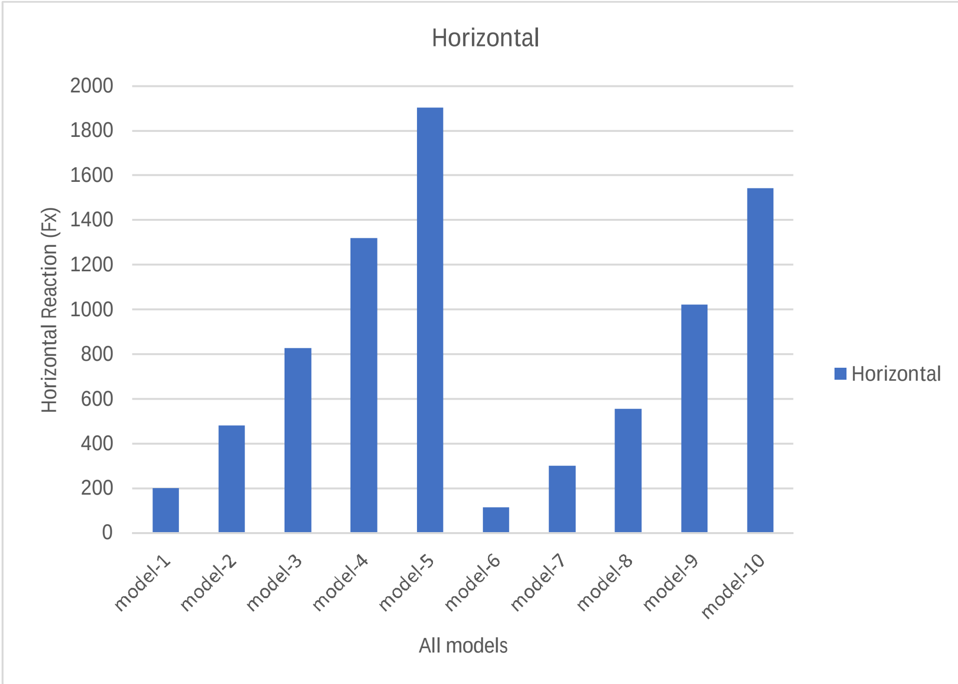

Figure 7:Horizontal (Fx) reaction for all models

From the above figure it is observed that the Horizontal (Fx) reaction is found to be maximum in the model-5 and minimum in the model-6 as compared to other models.

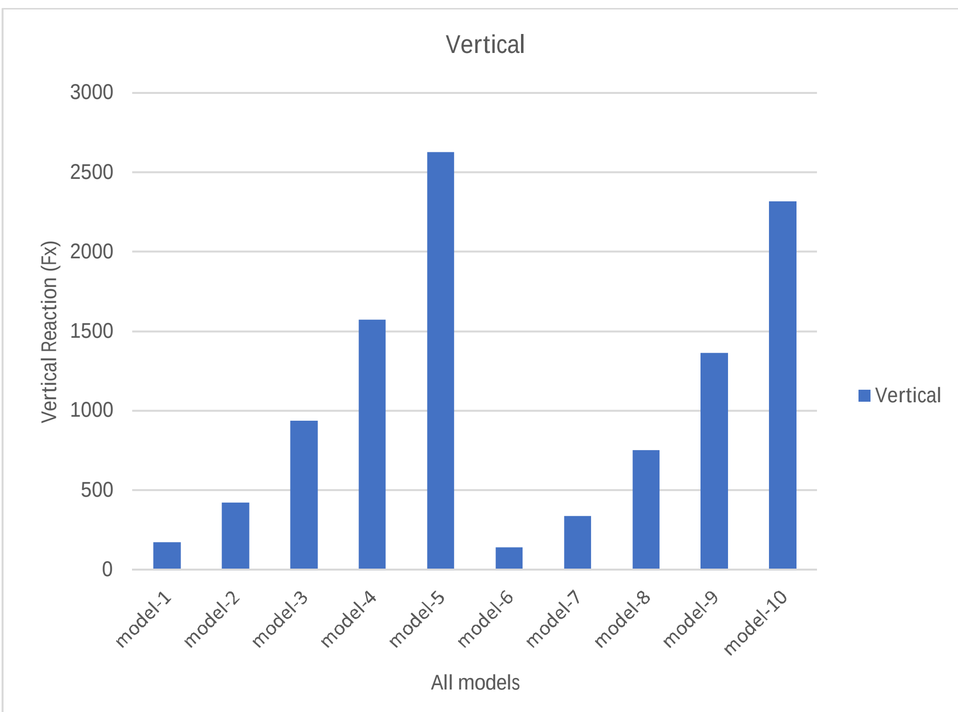

Figure 8:Vertical (Fy) reaction for all models

From the above figure it is observed that the Vertical (Fy) reaction is found to be maximum in the model-5 and minimum in the model-6 as compared to other models.

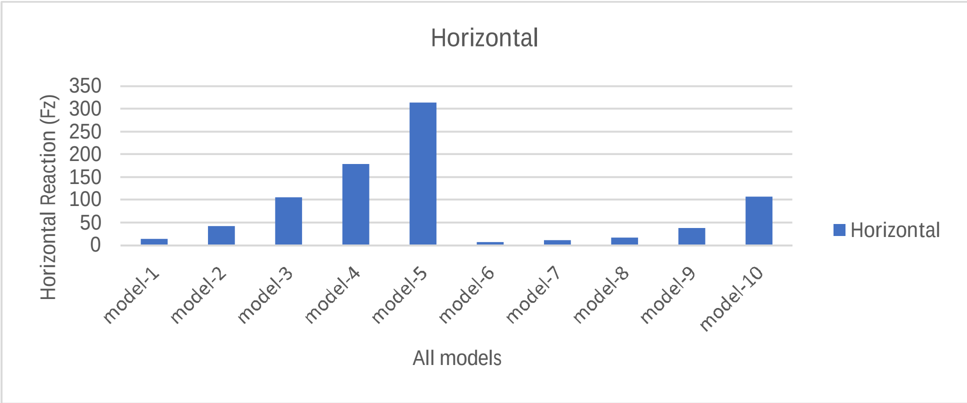

Figure 9:Horizontal (Fz) reaction for all models

From the above figure it is observed that the Horizontal (Fz) is found to be maximum in the model-5 and have the value of 300 kN as compared to other models.

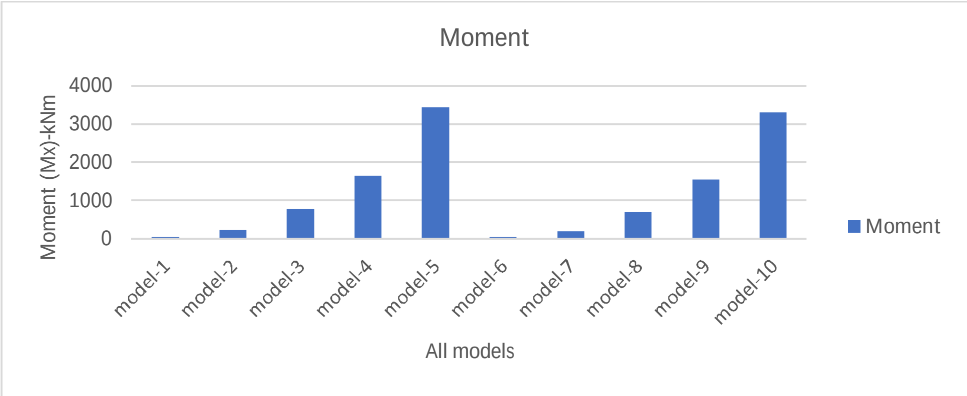

Figure 10:Moment (Mx) for all models

From the above figure it is observed that the Moment (Mx) is found to be maximum in the model-5 and have the value of 3500 kNm as compared to other models.

V. CONCLUSION

The conclusions from the above study are as follows:

A. From the above results it is observed that the Horizontal Displacement (X) is found to be maximum in the model-5 as compared to other models. Also it is observed that the Vertical Displacement (Y) is found to be maximum in the model-5 and minimum in the model-1 as compared to other models.

B. From the above results it is observed that the Horizontal Displacement (Z) is found to be maximum in the model-10 as compared to other models. Also it is observed that the Horizontal (Fx) reaction is found to be maximum in the model-5 and minimum in the model-6 as compared to other models.

C. From the above results it is observed that the Vertical (Fy) reaction is found to be maximum in the model-5 and minimum in the model-6 as compared to other models. Also it is observed that the Horizontal (Fz) is found to be maximum in the model-5 and have the value of 300 kN as compared to other models.

D. From the above results it is observed that the Moment (Mx) is found to be maximum in the model-5 and have the value of 3500 kNm as compared to other models. Also it is observed that the Horizontal (Fz) is found to be maximum in the model-5 and have the value of 6500 kNm as compared to other models.

E. From the above results it is observed that the Moment (Mz) is found to be maximum in the model-5 and minimum in the model-6 as compared to other models. Also it is observed that the Shear stress (Sqx) is found to be minimum in the model-6 as compared to other models.

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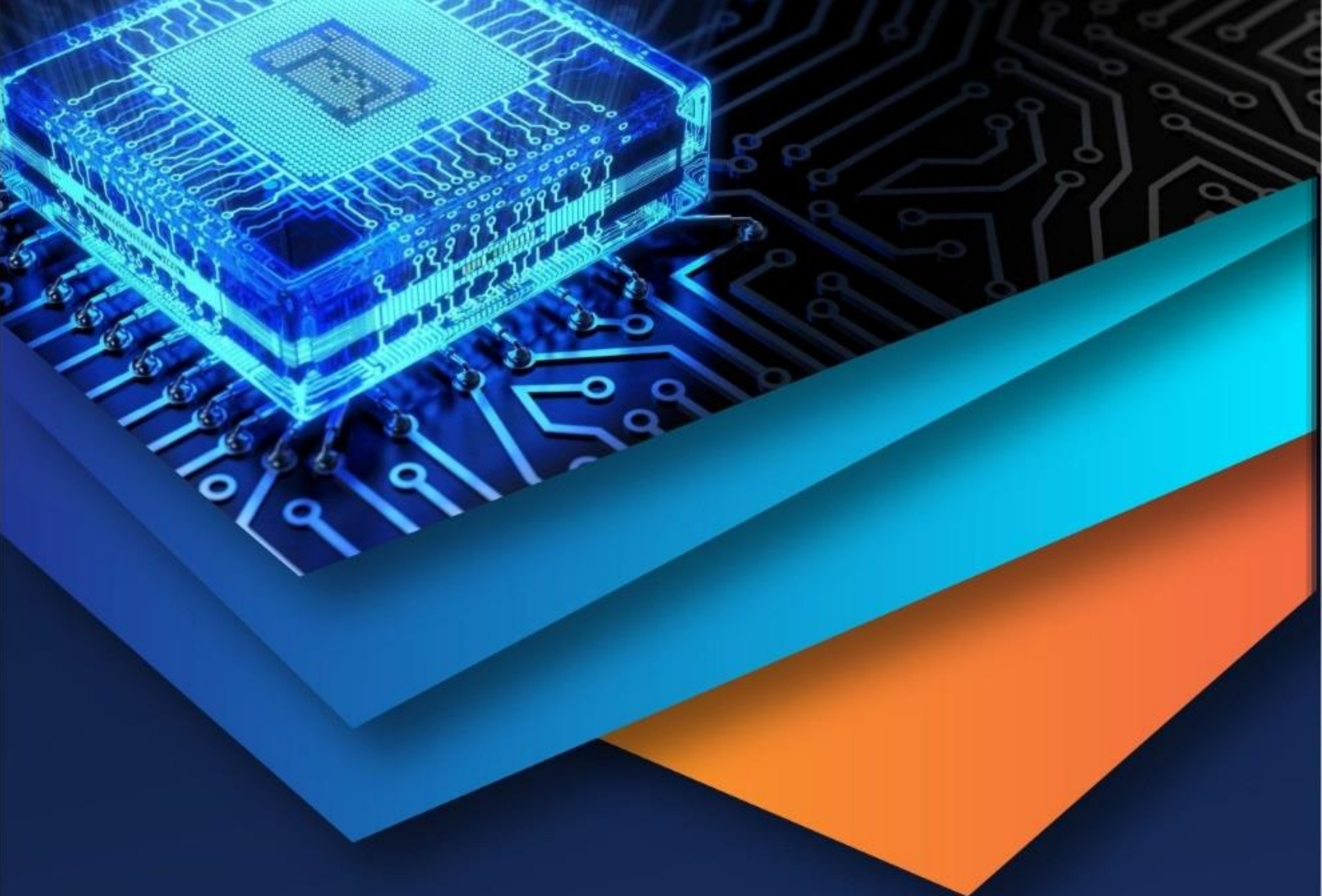

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