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Comparative Analysis of PEB Structure with Varying Ridge Angle

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Abstract: The concept of pre-engineering construction provides systems of steel buildings that are pre-designed and prefabricated. As the name suggests, this concept involves preliminary engineering of structural elements, using a predetermined register of building materials and manufacturing technologies that can skillfully meet a wide range of structural and aesthetic design requirements. The basis of the PEB concept is to provide a site only in accordance with the requirement at that location. The sections can vary along the entire length according to the bending moment diagram. This study analyzes the structure of PEB using STAAD-PRO software when the angle of the spine changes.
Keywords: Ridge angle, PEB, beam forces, moment and steel

I. INTRODUCTION

Sustainable construction of environmentally friendly infrastructure has been a priority for global researchers. The introduction of modern technology in the metallurgical industry has allowed designers to gain the desired control over the shapes and profiles of steel sections, which has led to the efficient use of building material and production energy needed to make these materials.

A healthy trend in the form of growing demand for construction work in the residential, commercial, institutional, industrial and infrastructure sectors has been observed over the last decade. Modern structures are much more complex and complex compared to the previous period. One of the main changes that everyone is experiencing is that the current structures are higher and thinner. The current requirement of structures is that they should be lighter, but not jeopardize functionality. Civil engineering is under constant economic competition between steel, concrete and other building materials.

In all parts of the earth, the almost metallurgical industry is growing rapidly. When there is a situation of availability of resources, the use of steel structures is an economical solution, here the word " economic " is used taking into account the duration and costs. The more important aspect in steel structures is time; they are built in a very minimal length of time. For construction for a short duration, one of these methods is a pre-designed construction structure. These are buildings consisting of steel sections, more steel is avoided by considering the conical section in accordance with the requirements of different analysis. Many more people do not know about such structures, but someone has to think about its perspective. Regular steel construction requires a long and higher cost, so the construction stages spend more time and expense, which leads to uneconomical.

II. LITERATURE REVIEW

Jatin D. Takar and P.G. Patel (2013) analyzed and designed a pre-engineered building with different design widths using STAAD Pro. They considered a building 25m, 30m and 40m wide, and a height of 6m. To test the savings of each case in terms of steel takeoff, they change the distance between bays as 4.5 m, 5.5 m, 6.5 m and 7.5 m. The results show that the amount of steel increases for secondary members who are purlin, shirts and rafters as the distance increases, but for the primary amount of steel decreases .The PEB composition, which has a distance of 6.5 m, has a smaller steel takeoff compared to other housings.

Pradeep V and Papa Rao G (2014) analyzed and designed a conventional steel building with a concrete column, ordinary steel with a steel column and a pre-designed building. They believed that the building had a length of 44 m, a span width of 20 m, a height of 5.5, a distance between the bays of 4 m and a roof slope of 5.71 and 21.8 for PEB and CSB, respectively. The results show that the bending moment for PEB is insignificant compared to CSB with a concrete and steel column. The structure of the PEB roof is almost 26% lighter than the structure of the CSB, as Z purlins are used and the cost will be 30% lower than conventional buildings.

Sagar D. Wankhade and P. S. Pajgade (2014) compared and designed a pre-engineering building and a conventional building, changing the distance between the bays. Houses measuring 14m x 31.50m, 20m x 50m, 28m x 70m, row spacing 5.25m, 6.25 m and 7 m and the fixed support in the base are developed using IS 800-2007 (LSM).

And dead load, live load, wind load and load combination. The total weight of the pre-engineering building is 116.3 KN, and the weight of steel farms is 183.45 KN, which is much higher than PEB due to the weight of the canal purlin, the weight of steel farms.
G. Durga Rama Naidu et al. (2014) conducted a comparative study and design of pre-engineered buildings (PEB) and conventional steel frames using STAAD Pro. They considered two industrial buildings 25 m wide and 6 m high of different distances between bays and dynamic analysis, taking into account wind loads. The result shows that the steel take-off for the PEB design, which has a distance of 6 m, is 76% less than the structure of the CSB, and for a structure with a distance of 8 m, it is 74.4% , therefore, the weight of the PEB depends on the distance of the bay, when increasing the distance of the bay to a certain distance, the weight decreases.

III. PROBLEM FORMULATION

The models are modelled and analysed using STAAD-PRO software, the models are as follows
1) *Model-1:* 5m bay spacing, slope of 1 in 10
2) *Model-2:* 5m bay spacing, slope of 1 in 15
3) *Model-3:* 5m bay spacing, slope of 1 in 20
4) *Model-4:* 6m bay spacing, slope of 1 in 10
5) *Model-5:* 6m bay spacing, slope of 1 in 15
6) *Model-6:* 6m bay spacing, slope of 1 in 20
7) *Model-7:* 7m bay spacing, slope of 1 in 10
8) *Model-8:* 7m bay spacing, slope of 1 in 15
9) *Model-9:* 7m bay spacing, slope of 1 in 20

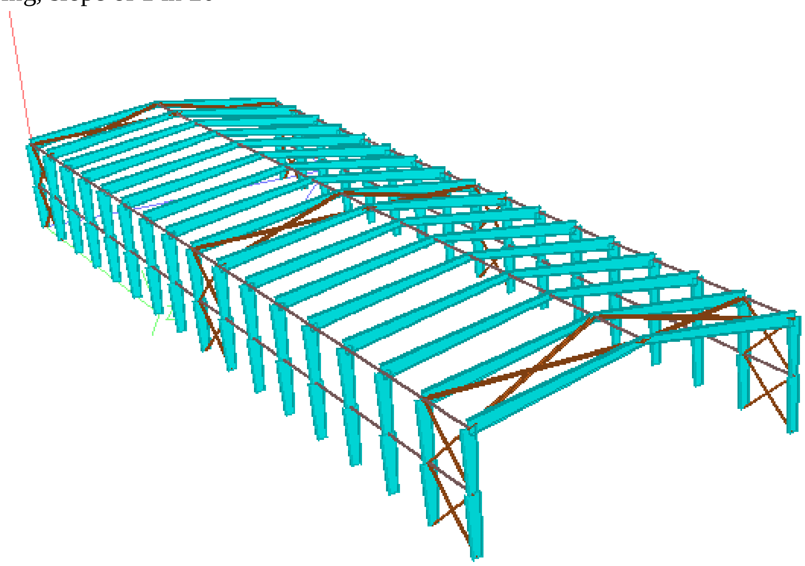

Figure 1: 3-D Details of the model

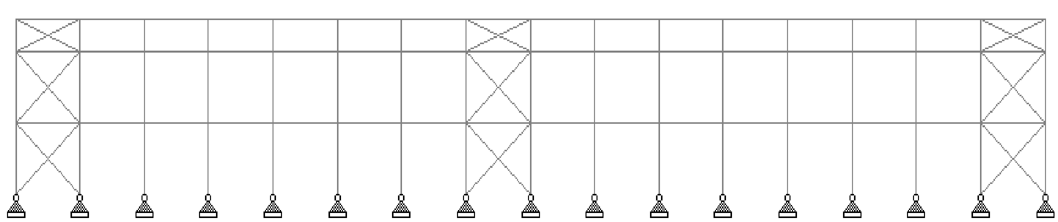

Figure 2: Side-Elevation of the model in STAAD software

The above diagram shows the elevation of the model in the STAAD software. The model having the elevation where there are two columns at the end while the tapered section is also provided to rest on the column. The support considered is pinned support in the software.

IV. RESULTS

The following results are obtained.

TABLE **ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**.1:DISPLACEMENT FOR MODELS WITH RIDGE ANGLE OF 1 IN 10

Parameters		5m-1 in 10	6m-1 in 10	7m-1 in 10
Horizontal	X-direction	24.081	28.431	24.148
Vertical	Y-direction	15.709	18.861	16.496
Horizontal	Z-direction	3.066	4.414	3.665

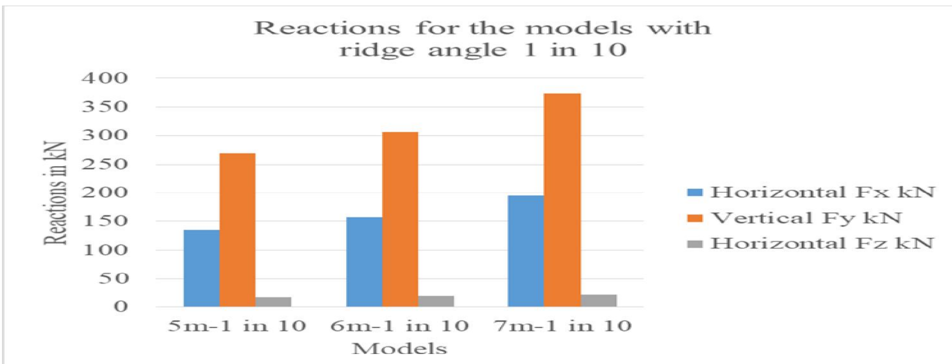

Figure 3: Reactions for models with Ridge Angle of 1 in 10

The above figure 3 shows the Reactions for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.

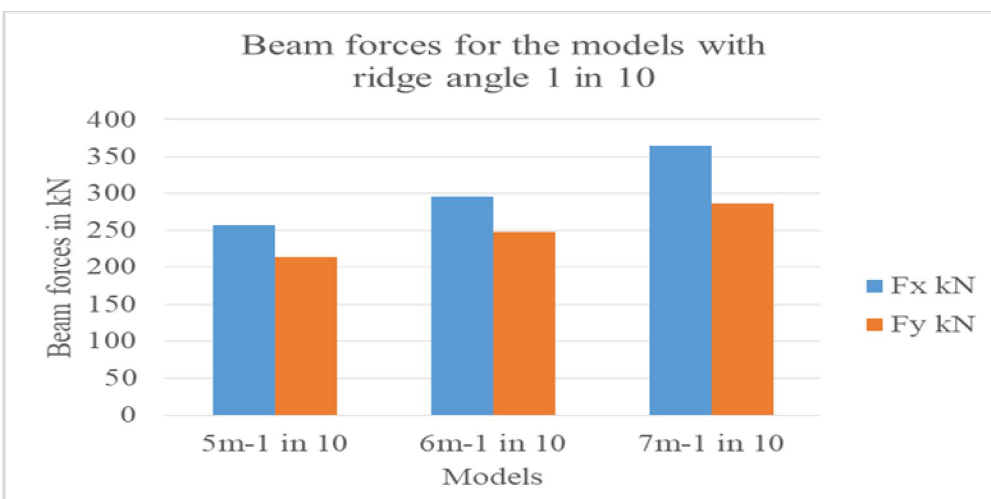

Figure 4: Beam Forces for models with Ridge Angle of 1 in 10

The above figure 4 shows the Beam Forces for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.

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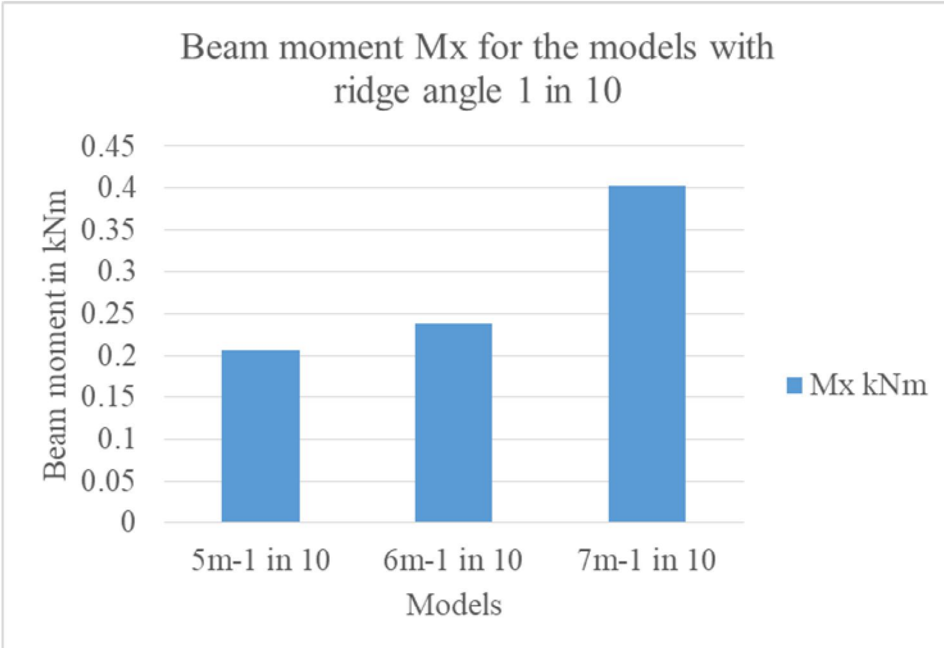

Figure 5: Beam moment Mx for models with Ridge Angle of 1 in 10

The above figure 5 shows the Beam moment Mx for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.

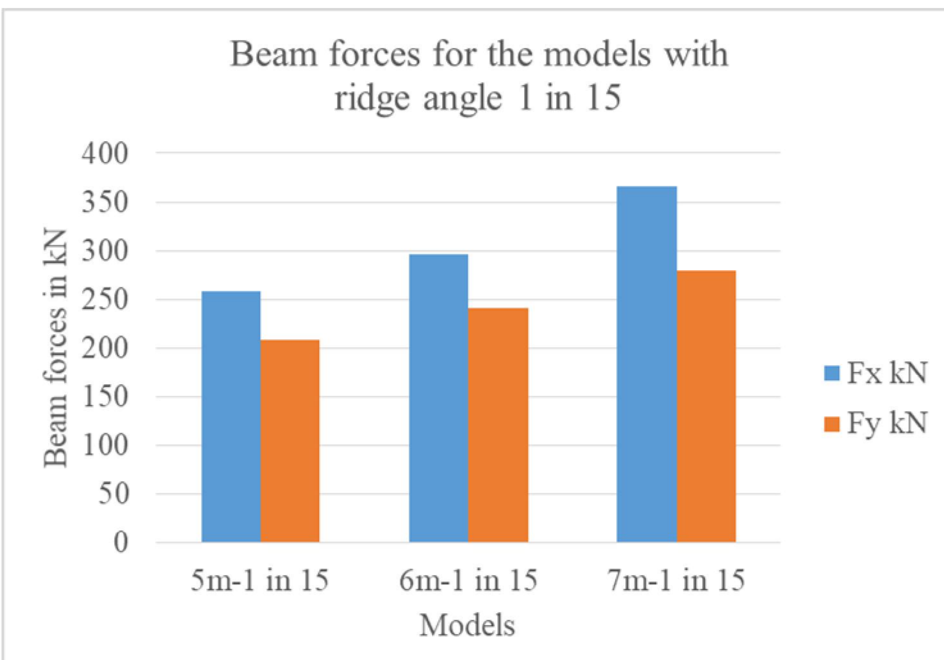

Figure 6: Beam Forces for models with Ridge Angle of 1 in 15

The above figure 6 shows the Beam Forces for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.

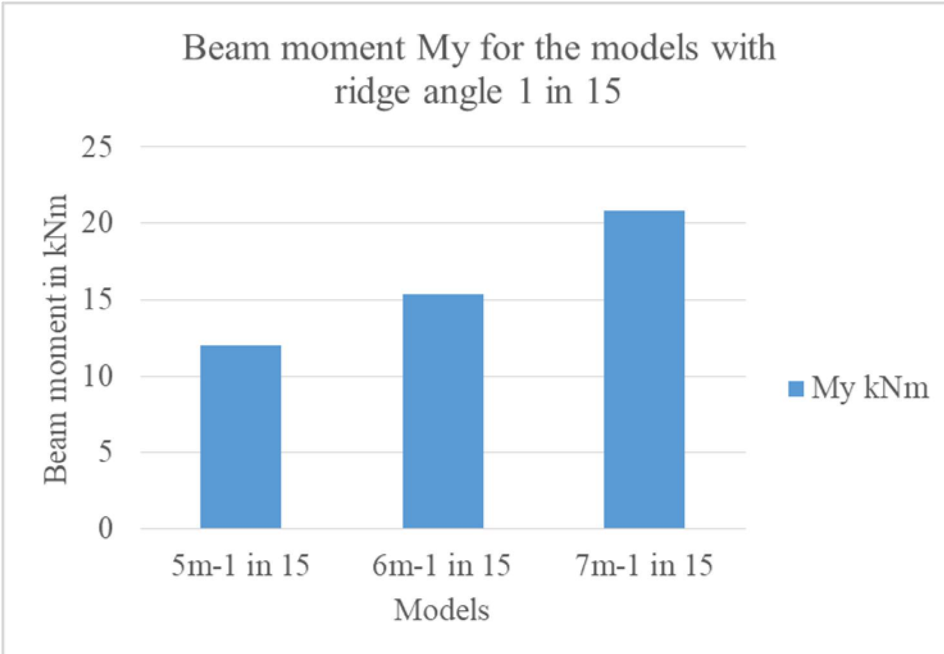

Figure 7: Beam moment My for models with Ridge Angle of 1 in 15

The above figure 7 shows the Beam moment My for models with Ridge Angle of 1 in 15 and maximum value is obtained for the case of model having bay spacing of 7m.

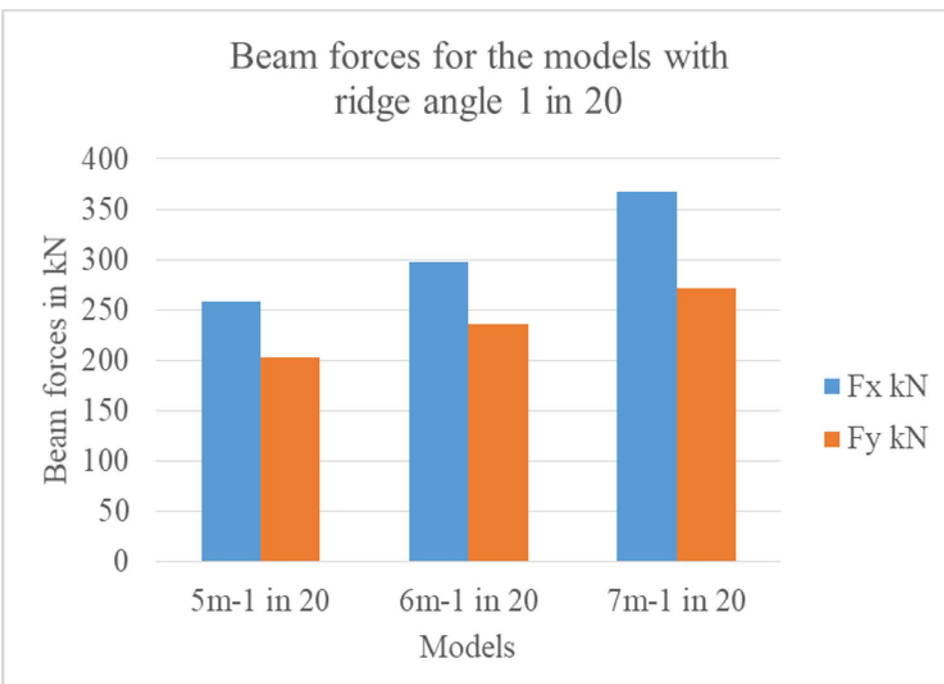

Figure 8: Beam Forces for models with Ridge Angle of 1 in 20

The above figure 8 shows the Beam Forces for models with Ridge Angle of 1 in 20 and maximum value is obtained for the case of model having bay spacing of 7m.

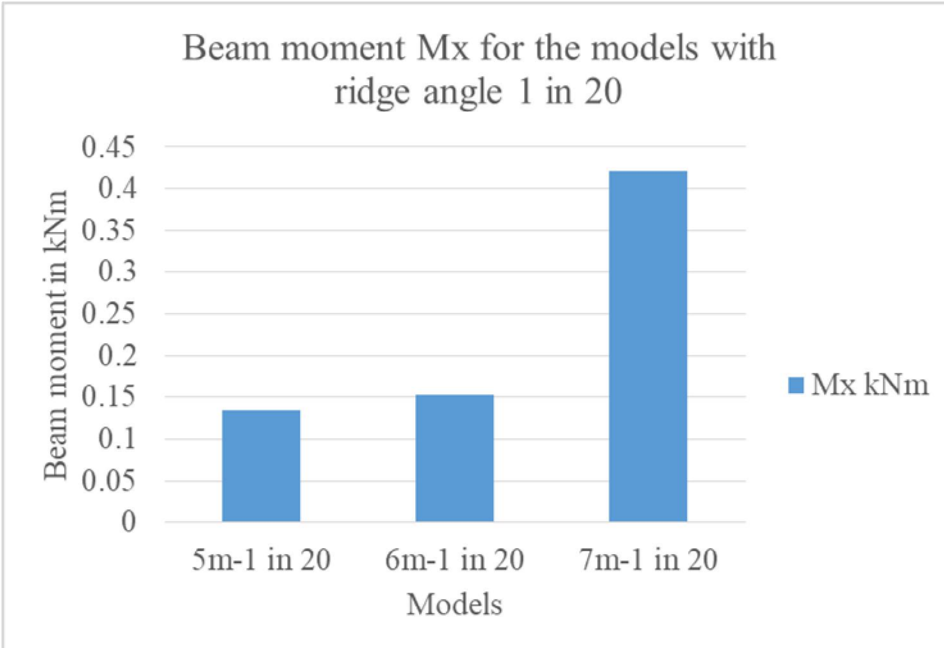

Figure 9: Beam moment Mx for models with Ridge Angle of 1 in 20

The above figure 9 shows the Beam moment Mx for models with Ridge Angle of 1 in 20 and maximum value is obtained for the case of model having bay spacing of 7m.

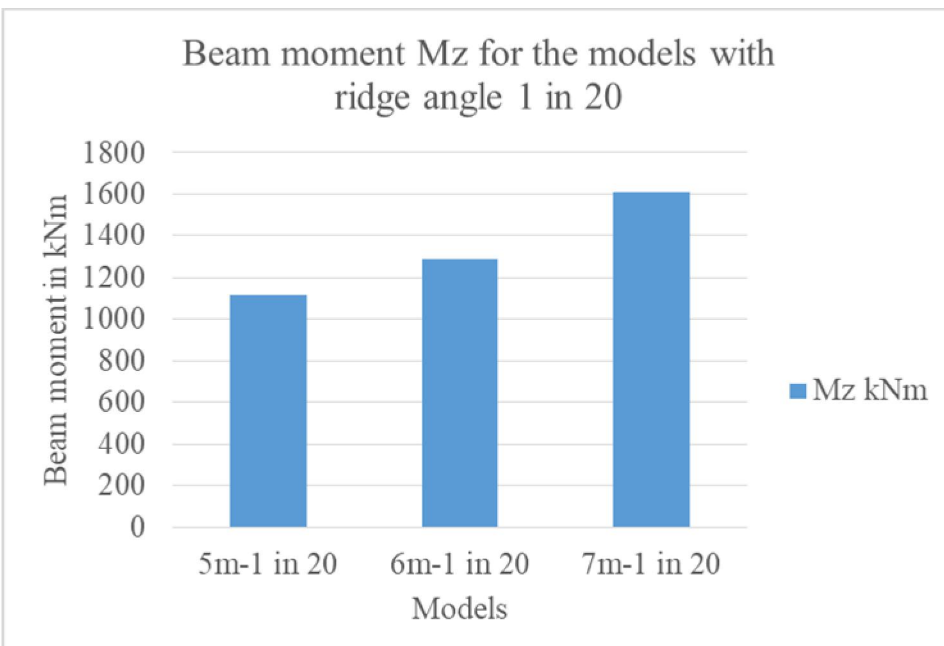

Figure 10: Beam moment Mz for models with ridge angle of 1 in 20

The above figure 10 shows the beam moment Mz for models with ridge angle of 1 in 20 and maximum value is obtained for the case of model having bay spacing of 7m.

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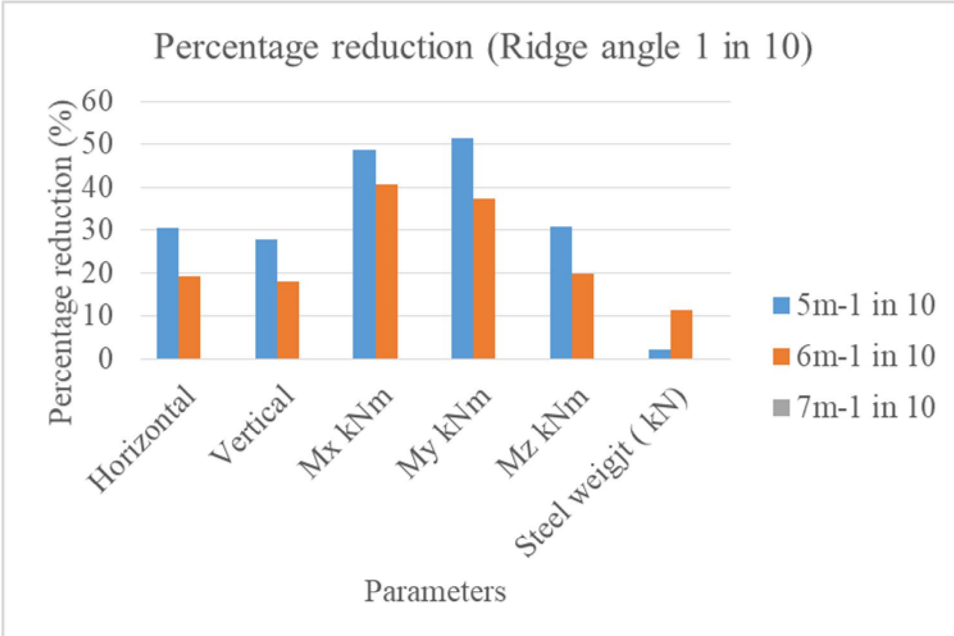

Figure 11: Percentage reduction for the models with ridge angle of 1 in 10

The above Figure 11 gives the percentage reduction for the models with Ridge angle of 1 in 10 and it is observed that the maximum percentage reduction is observed for the model having spacing of 5m.

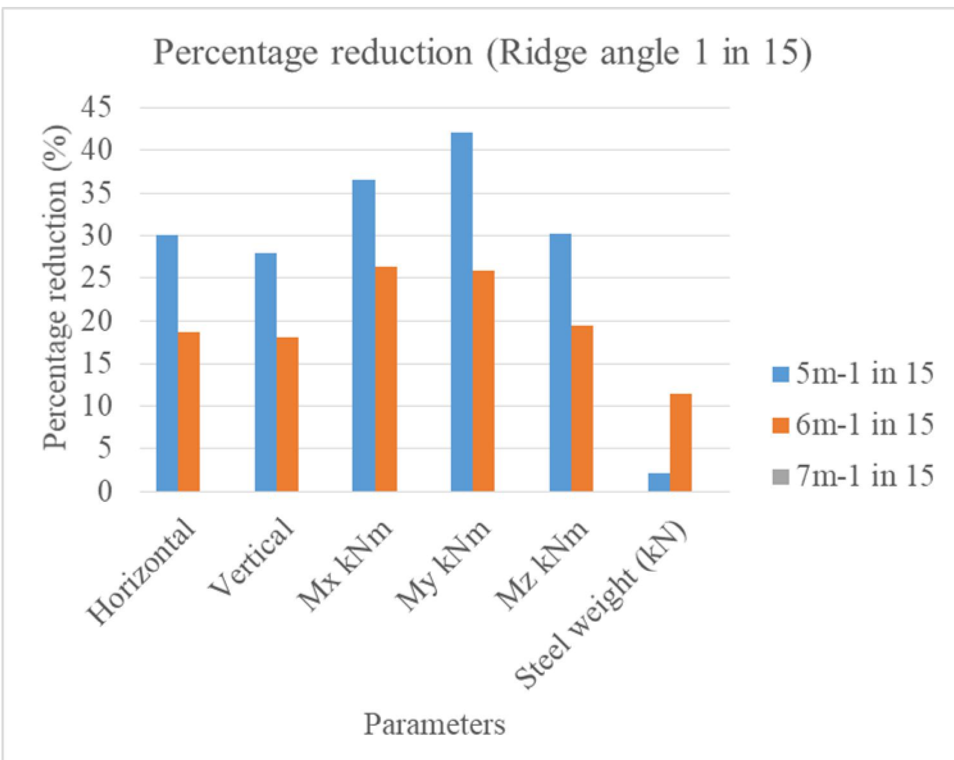

Figure 12: Percentage reduction for the models with ridge angle of 1 in 15

The above Figure 12 gives the percentage reduction for the models with ridge angle of 1 in 15 and it is observed that the maximum percentage reduction is observed for the model having spacing of 5m.

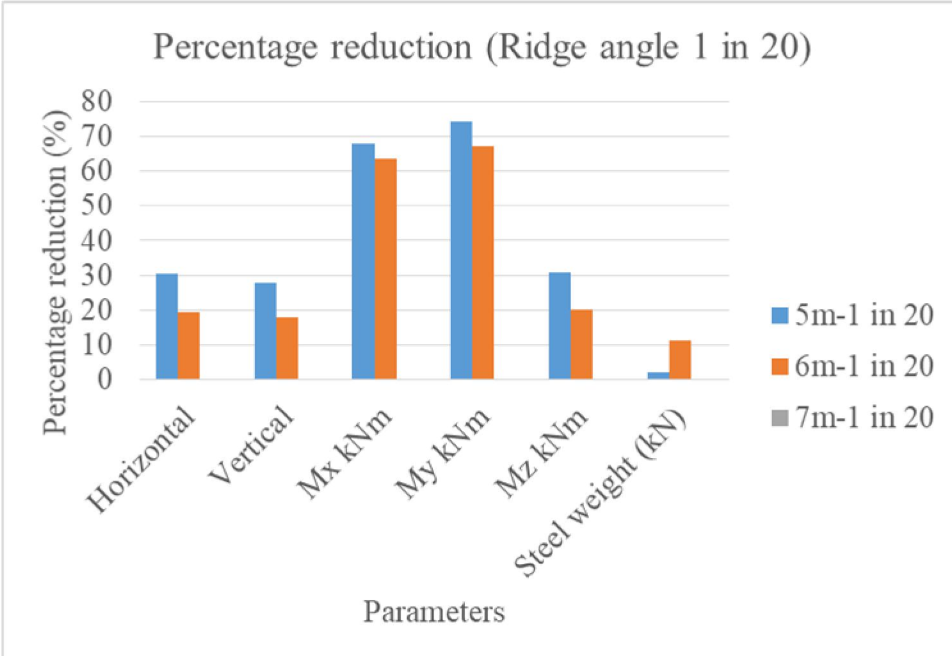

Figure 13: Percentage reduction for the models with ridge angle of 1 in 20

The above Figure 15 gives the percentage reduction for the models with ridge angle of 1 in 20 and it is observed that the maximum percentage reduction is observed for the model having spacing of 5m.

V. CONCLUSIONS

The following conclusions are obtained.

1) The Reactions for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.
2) The Beam Forces for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.
3) The Beam moment Mx for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.
4) The Beam Forces for models with Ridge Angle of 1 in 10 and maximum value is obtained for the case of model having bay spacing of 7m.
5) The Beam moment My for models with Ridge Angle of 1 in 15 and maximum value is obtained for the case of model having bay spacing of 7m.

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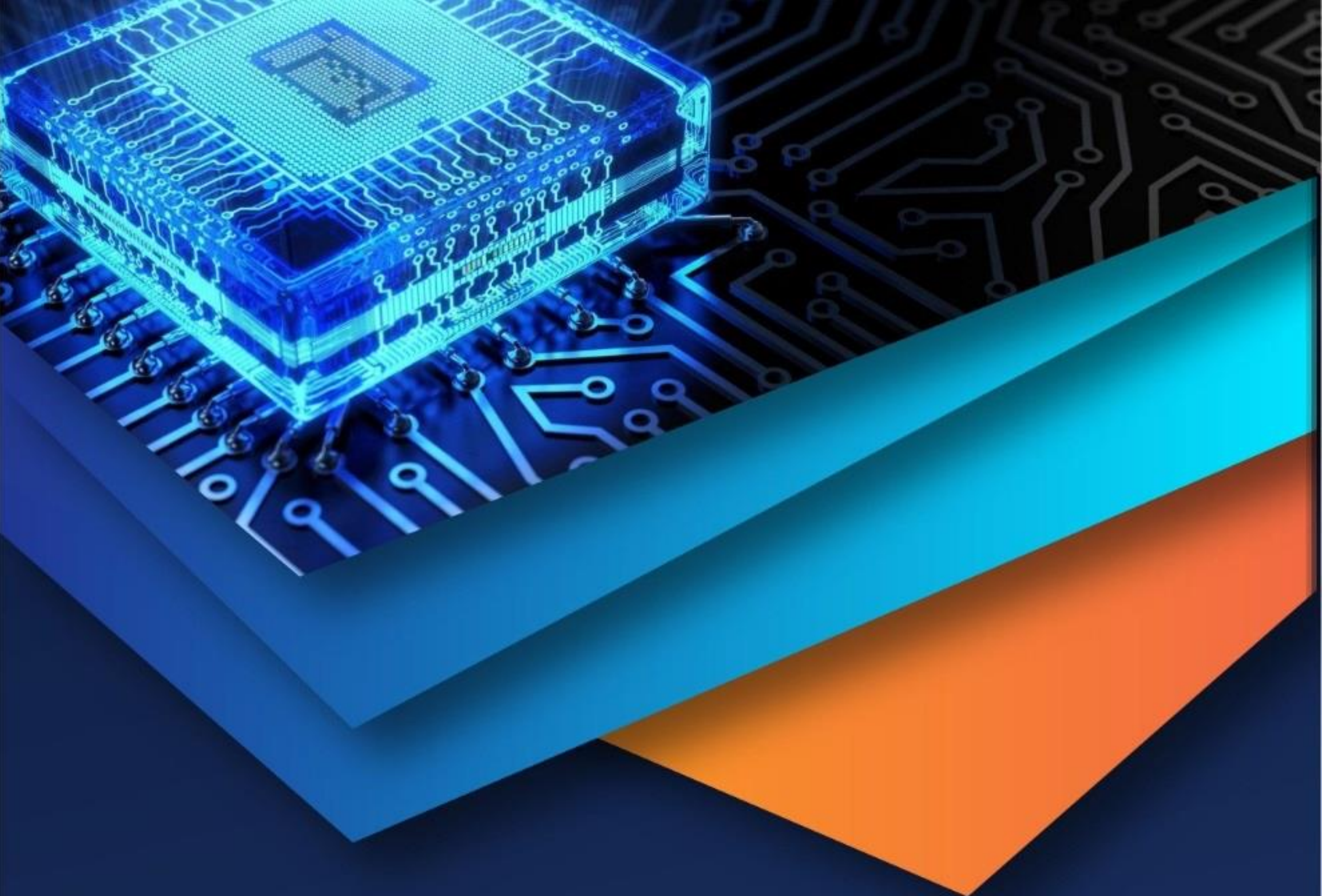

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