IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 6.252

Volume 2, Issue 1, June 2022

An Investigation on Seismic Analysis of High-Rise Building with and Without Floating Columns and Strut

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Abstract: *Recently, multi-storey buildings in urban areas should have free space due to lack of space, population, as well as aesthetic and functional requirements. For these buildings there are floating columns in one or more floors. These floating columns are very unprofitable in a building built in seismically active areas. Earthquake forces developing at different floor levels in the building must be transferred to the ground in the shortest way. Deviation or rupture of this load transfer path leads to low productivity of the building. This work consists of an investigation into the seismic analysis of high-rise construction with and without floating columns. The results obtained in terms of maximum horizontal (X) displacement are observed for the model - 9, which has a value of 47.8 mm. The maximum displacement of the result is observed for the model - 1, which has a value of 49.7 mm. The maximum horizontal reaction (Fx) is observed for model-10, which has a value of 62.5 kN.*

Keywords: Base Shear, Equivalent static method, Response spectrum method, Storey Shear

I. INTRODUCTION

The floating column is used for the purpose of architectural inspection and situations on site and the maximum possible area on the site within the permissible bylaws. Because balconies are not included in the floor area index (FSI), the upper floors of the building have balconies that overlap outside the printing areas of the column foot in soil history, canopies up to 1.2 m to 2.0 m in the plan are usually provided on each side of the building. In such cases, floating columns are provided along the perimeter of the building. For the most part, the architect requires an aesthetic view of the building, in such cases also many columns end on certain floors and floating columns are introduced. But providing floating columns resting on the tip of the hinged rays increases the vulnerability of the lateral load resistance system due to the vertical gap.

This type of construction does not create any problems in vertical load conditions. But during an earthquake, a clear load path is not available for the transfer of lateral forces to the foundation. The lateral forces accumulated on the top floor during the earthquake must be transmitted using the predicted cantilever beams. Thus, rotating forces predominate the columns of the first floor. In this situation, the columns begin to deform and fasten, which leads to a total collapse. This is due to the primary lack of strength of the speakers on the ground floor, the design of the console beams and the plastic detail of the connection of the beam column. In the case of a floating column, the offset is induced to transfer forces to another low-level rest element.

II. LITERATURE REVIEW

Related Work:

T. Chandra Shehar, Prasad J., (2016), a comparable seismic analysis of a building with a floating column and a normal building using ETABS-2013. In this residential building with 6 floors and 12 floors are analyzed by columns, beams and slabs. Houses are analyzed and designed with and without edge columns on the base floor. The houses are analyzed in two earthquake zones with medium soil.

Mahesha M, Lakshmi K., (2015), studied the importance of direct perception of proximity to floating columns and the importance of explicit recognition of presence with and without a floating column in the study of the building, in addition, along with the floating column, several difficulties were considered for G + 16 floors in another alternative location.

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Sabari S (2015) proposed to reduce the disturbances introduced by the floating column. They create a 2D multi-storey frame with and without a floating column to study the reactions of the structure under different earthquake excitations with different frequency content, maintaining a constant PGA frequency and time duration.

Badgir W. S, Sheikh A. N., (2015) analyzed the RCC frame (G + 10) with floating columns in different places and investigated the base shift and drift between the floating columns located on the outer periphery (4 sides & 2 Parties). It is concluded that the probability of failure of the floating column is greater in the case of floating columns located on the periphery on the longer side than the floating column on the periphery on the shorter side.

III. METHODOLOGY

. The present work consists of the analysis of the building having floating column with the help of STAAD-PRO software. Following models are considered:

1. Model-1: Regular building with floating column at one side-EQ Zone-IV
2. Model-2: Regular building with floating column at other side-EQ Zone-IV
3. Model-3: Regular building with floating column at core-EQ Zone-IV
4. Model-4: Irregular building with floating column at one side-EQ Zone-IV
5. Model-5: Irregular building with floating column at other side-EQ Zone-IV
6. Model-6: Irregular building with floating column at core-EQ Zone-IV
7. Model-7: Irregular building with floating column at corner-EQ Zone-IV
8. Model-8: Irregular building with floating column at one side-EQ Zone-V
9. Model-9: Irregular building with floating column at other side-EQ Zone-V
10. Model-10: Irregular building with floating column at core-EQ Zone-V

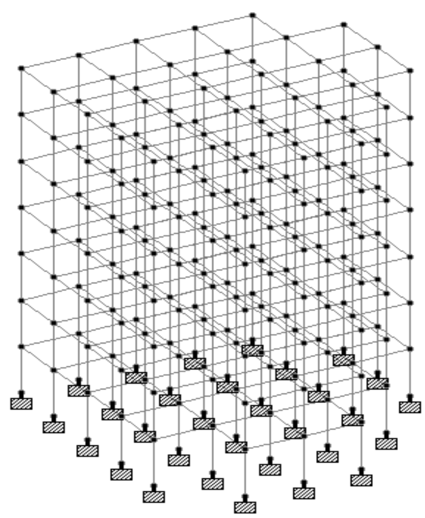

Figure 1:Geometry of the model

The geometry of the details is mentioned in the above figure, this has been generated through STAAD-PRO software.

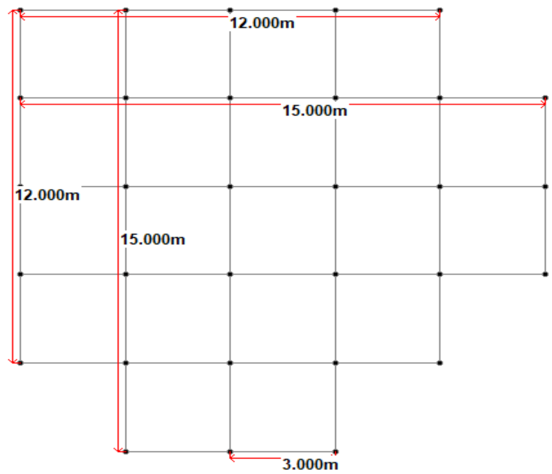

Figure 2:Plan of the model

The Plan of the details is mentioned in the above figure, this has been generated through STAAD-PRO software.

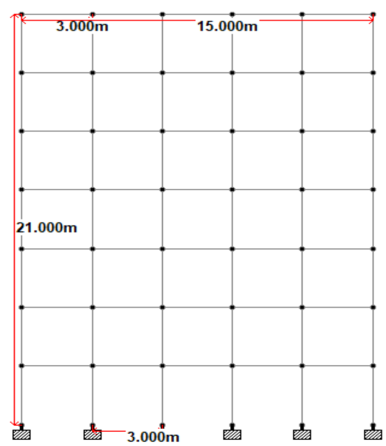

Figure 3:Elevation of the model

The elevarion of the details is mentioned in the above figure, this has been generated through STAAD-PRO software.

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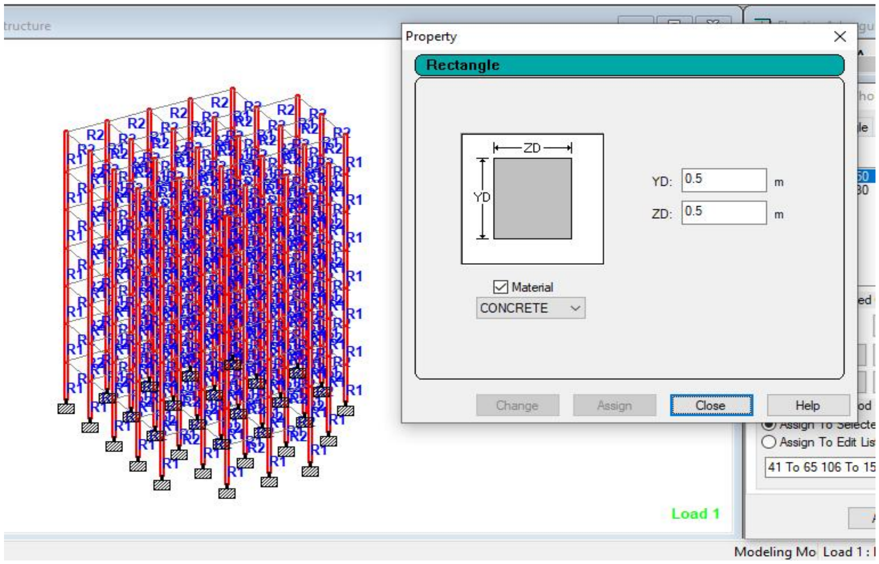

Figure 4:Column Properties of the model

The Column Properties of the details is mentioned in the above figure, this has been generated through STAAD-PRO software.

IV. RESULTS & DISCUSSIONS

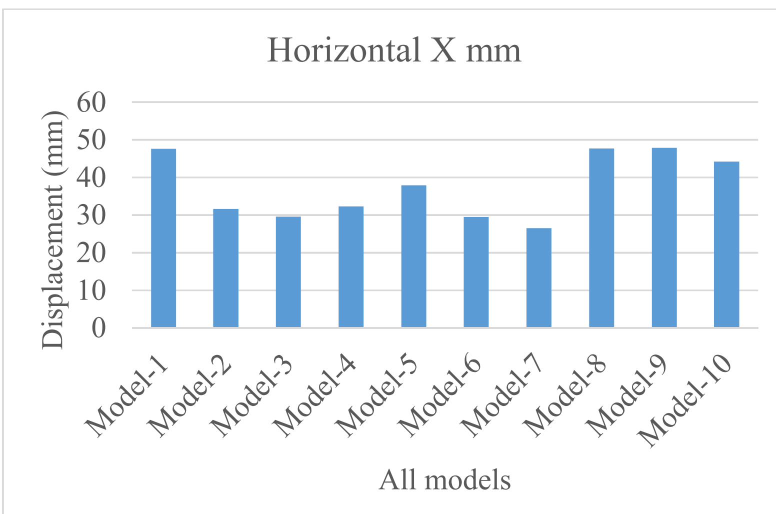

Figure 5:Horizontal (X) Displacement for all the models

The Horizontal (X) Displacement for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum displacement is observed for the model-9 having value of 47.8 mm.

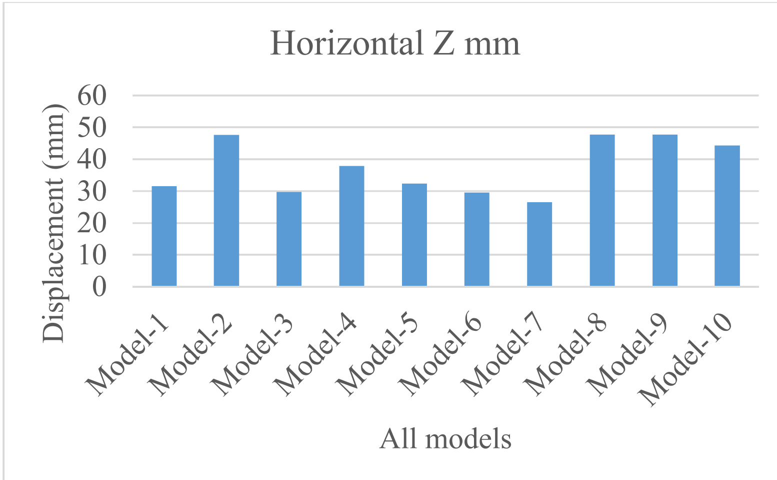

Figure 6:Horizontal (Z) Displacement for all the models

The Horizontal (Z) Displacement for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum displacement is observed for the model-8 having value of 47.8 mm.

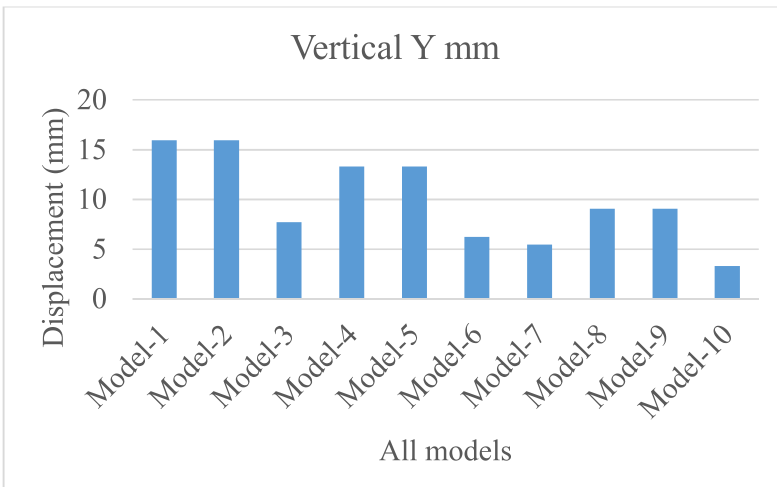

Figure 7:Vertical (Y) Displacement for all the models

The Vertical (Y) Displacement for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum displacement is observed for the model-1 having value of 15.5 mm.

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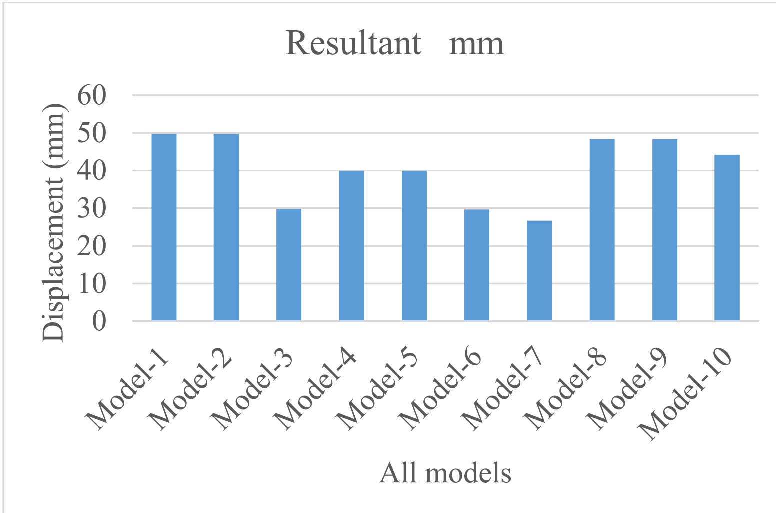

Figure 8:Resultant Displacement for all the models

The Resultant Displacement for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum displacement is observed for the model-1 having value of 49.7 mm.

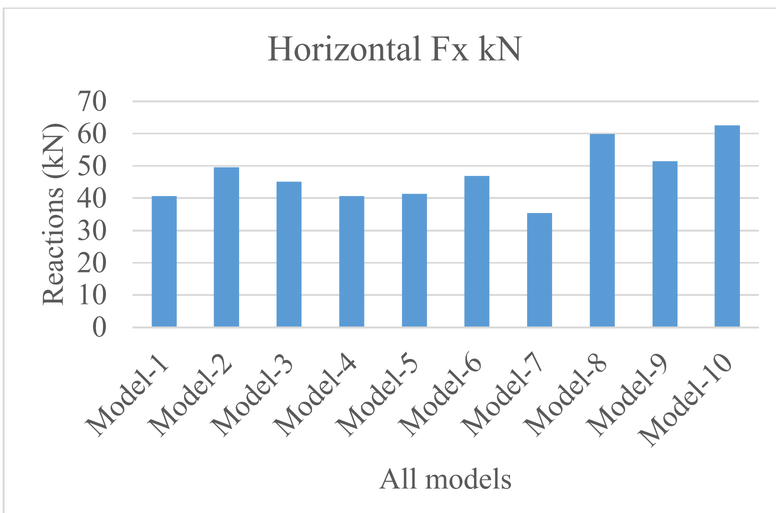

Figure 9:Horizontal Reaction (Fx) for all the models

The Horizontal Reaction (Fx) for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum Reaction is observed for the model-10 having value of 62.5 kN.

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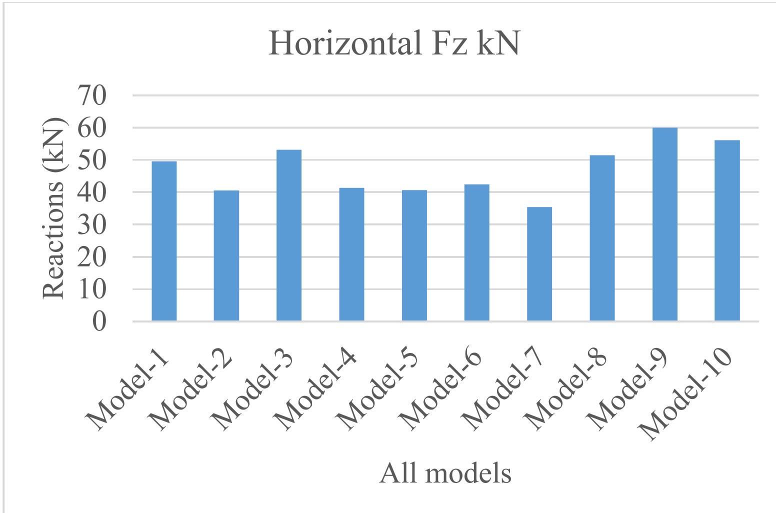

Figure 10:Horizontal Reaction (Fz) for all the models

The Horizontal Reaction (Fz) for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum Reaction is observed for the model-9 having value of 59.9 kN.

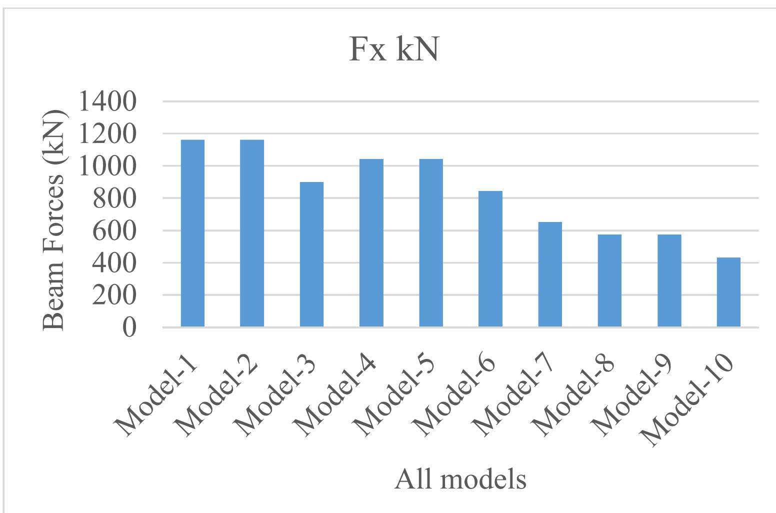

Figure 11:Beam Forces (Fx) for all the models

The Beam Forces (Fx) for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum Beam Forces is observed for the model-1 having value of 1160.63 kN.

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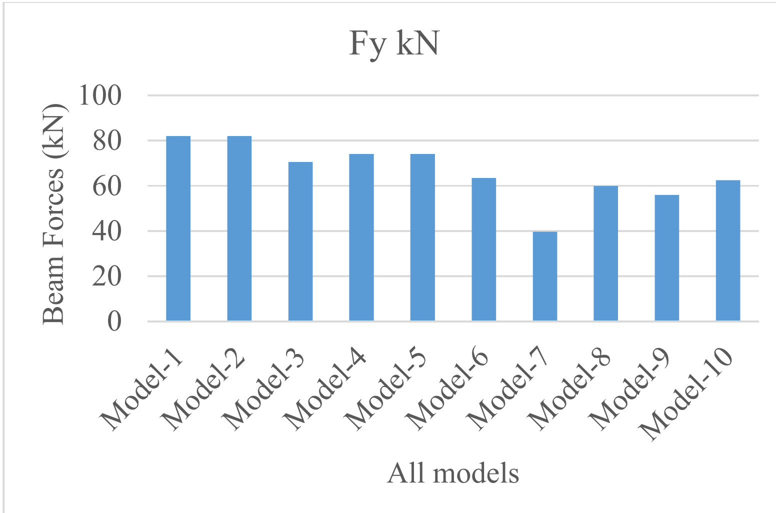

Figure 12:Beam Forces (Fy) for all the models

The Beam Forces (Fy) for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum Beam Forces is observed for the model-1 having value of 81.974 kN.

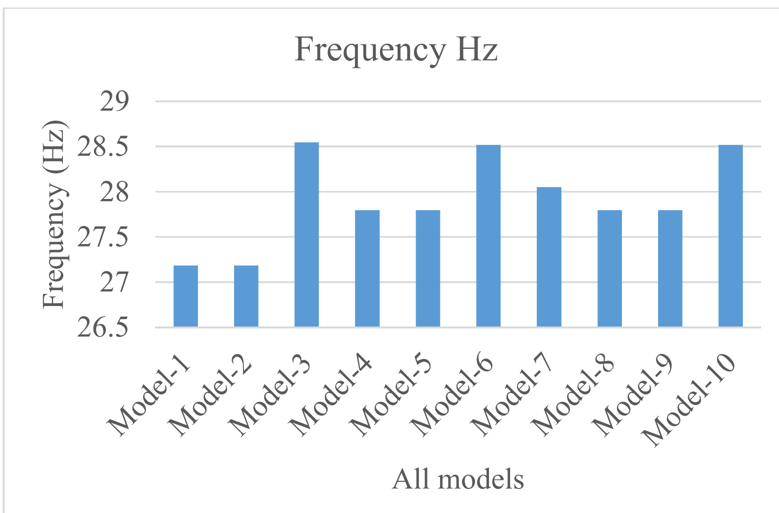

Figure 13:Frequency (Hz) for all the models

The Frequency (Hz) for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum Frequency (Hz) is observed for the model-3,6 & 10 having value of 28.5 Hz.

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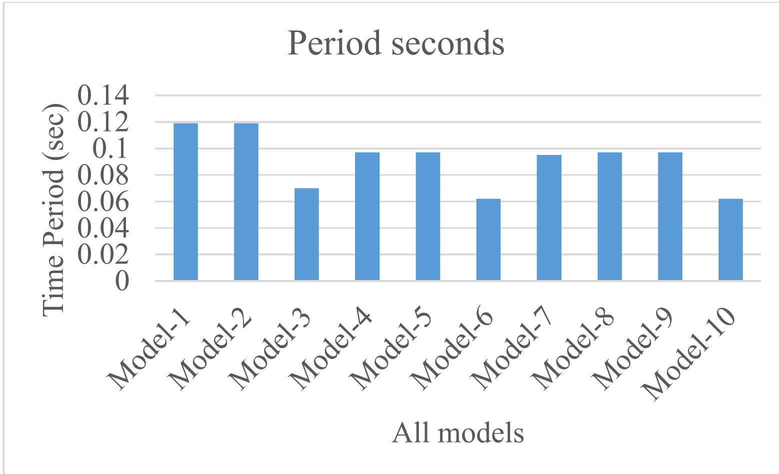

Figure 14:Time Period (sec) for all the models

The Time Period (sec) for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum Time Period (sec) is observed for the model-1&2 having value of 0.12 sec.

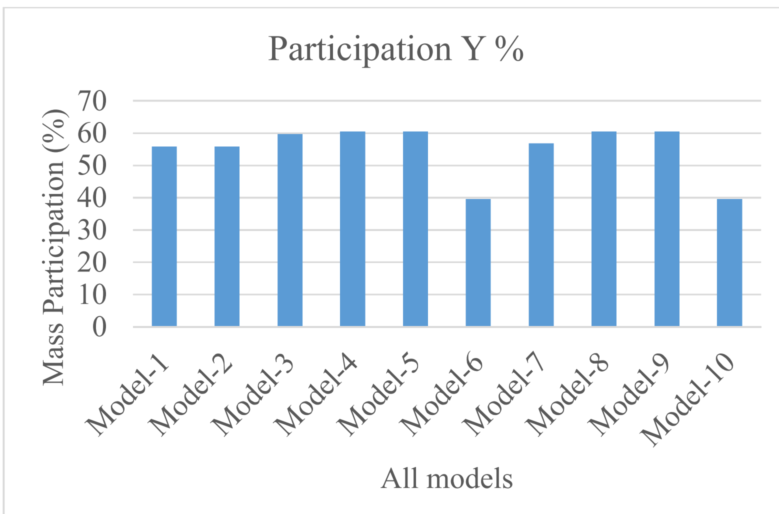

Figure 15:Mass Participation (%) for all the models

The Mass Participation (%) for all the models is obtained through STAAD-PRO software for all the models, the graphical representation is mentioned in the above figure. The maximum Mass Participation (%) is observed to be 60%.

V. CONCLUSION

The present work consists of An Investigation on Seismic Analysis of High-Rise Building With and Without Floating Columns. The models includes Model-1: Regular building with floating column at one side-EQ Zone-IV, Model-2: Regular building with floating column at other side-EQ Zone-IV, Model-3: Regular building with floating column at core-EQ Zone-IV, Model-4: Irregular building with floating column at one side-EQ Zone-IV, Model-5: Irregular building with floating column at other side-EQ Zone-IV, Model-6: Irregular building with floating column at core-EQ Zone-IV, Model-7: Irregular building with floating column at corner-EQ Zone-IV, Model-8: Irregular building with floating column at one side-EQ Zone-V, Model-9: Irregular building with floating column at other side-EQ Zone-V & Model-10: Irregular building with floating column at core-EQ Zone-V. The following conclusions are obtained.

1. The maximum Horizontal (X) Displacement is observed for the model-9 having value of 47.8 mm.
2. The maximum Resultant displacement is observed for the model-1 having value of 49.7 mm.

3. The maximum Horizontal Reaction (Fx) is observed for the model-10 having value of 62.5 kN.
4. The maximum Vertical Reaction (Fy) is observed for the model-10 having value of 62.5 kN.

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