International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Structural Analysis of High Rise Building with Core and Outrigger System using STAAD-PRO software

Mr. Abdul Danish[1], Prof. Ishan Dahat[2]

[1]PG Scholar, Department of Civil Engineering, G H Raisoni University, Amravati, Anjangaon Bari Road, Amravati-444701

[2]Assistant Professor, Department Of Civil Engineering, G H Raisoni University, Amravati, Anjangaon Bari Road, Amravati-444701

ABSTRACT:-

A tall building like a skipping rope has always been a vision of dreams and technical progress with new types of equipment leading to the progress of construction in the world. To date, the Tall building has become a more convenient option for residential and commercial housing due to the rapid growth of urbanization. Tall buildings are designed for residential and office use. This is the main reaction to the rapid growth of the urban population and the demand for business. Much of our country is prone to damage to seismic hazards due to earthquakes. Therefore, it is necessary to take into account the seismic load for the design of a high - lifting structure. This paper provides a structural analysis of a high-rise building with a core and disembarkation system using STAAD - PRO software.

Keywords- Irregularity, Seismic, displacement and buildings

01. Introduction

A conventional exposure system, beam or exhaust farms are connected directly to the bearing frame or sliding walls near the core and to the overlapping columns located outside the core. Mostly, but it's not necessary, the columns are on the outer edges of the building. The strings that connect to the columns, the core suspension, and the core prevent the core from rotating and turn part of the moment into a vertical pair near the (Fig.05) columns. The number of outriggers above the height of the building can vary from one - three or more. Deformation of farms and shortening and lengthening of columns will allow some rotation of the core at the outlet. In most structures, the rotation is small enough that the core undergoes an inverse curvature below the exposure.

02. Literature Review

S. D. Hoenderkamp[6] studied five three-dimensional models 60 − are subjected to earthquake load, analyzed and compared to detect a decrease in lateral displacement associated with the location of the outrigger and belt system. For the two-dimensional model 40 − 65%, the maximum reduction in movement can be achieved by providing the first screwdriver in the upper and second landings in the middle of the height of the structure. For the three-dimensional 60 − floor structural model that has been subjected to earthquake load, about 18% reduction in maximum displacement can be achieved by optimally locating OTC farms located at the top and 33- level.

Rada et al. [7] concluded that an autrigger system is proposed in this study to improve the performance of a building under seismic load. This paper contains a comparative study of regular construction with and without outsourcing and improper construction with centralized rigid wall and steel mounting as a exposure.

Doctor. S. AND. Halkude et al [8] in the study observed that: 1) Maximum reduction of lateral displacement 31.18%, when on the 10th floor there is a shutdown due to wind load. 2) From the drift results in the store it is concluded that a decrease of 42.59% when the autrigger is placed on the 40-floor, ie at the top of the building. 3) The use of an autrigger did not show significant changes in the baseline shift, as the total force acting on the structure does not change with the addition of an autrigger.

03. Methodology

The different models are modeled using STAAD-PRO as follows.

1. Model-1: Building with core shear wall and bracings outrigger at system at 7th floor (EQ zone-4)
2. Model-2: Building with core shear wall and bracings outrigger at system at 7th floor (EQ zone-5)
3. Model-3: Building with core shear wall and bracings outrigger at system at 10th floor (EQ zone-4)
4. Model-4: Building with core shear wall and bracings outrigger at system at 10th floor (EQ zone-5)
5. Model-5: Building with core shear wall and connected slab outrigger at system at 3rd floor (EQ zone-4)
6. Model-6: Building with core shear wall and connected slab outrigger at system at 4th floor (EQ zone-5)
7. Model-7: Building with core shear wall and connected slab outrigger at system at 3rd& 5th floor (EQ zone-4)
8. Model-8: Building with core shear wall and connected slab outrigger at system at 3rd& 5th floor (EQ zone-5)
9. Model-9: Building with core shear wall and connected slab outrigger at system at 3rd, 5th& 7th floor (EQ zone-4)
10. Model-10: Building with core shear wall and connected slab outrigger at system at 3rd, 5th& 7th floor (EQ zone-5)

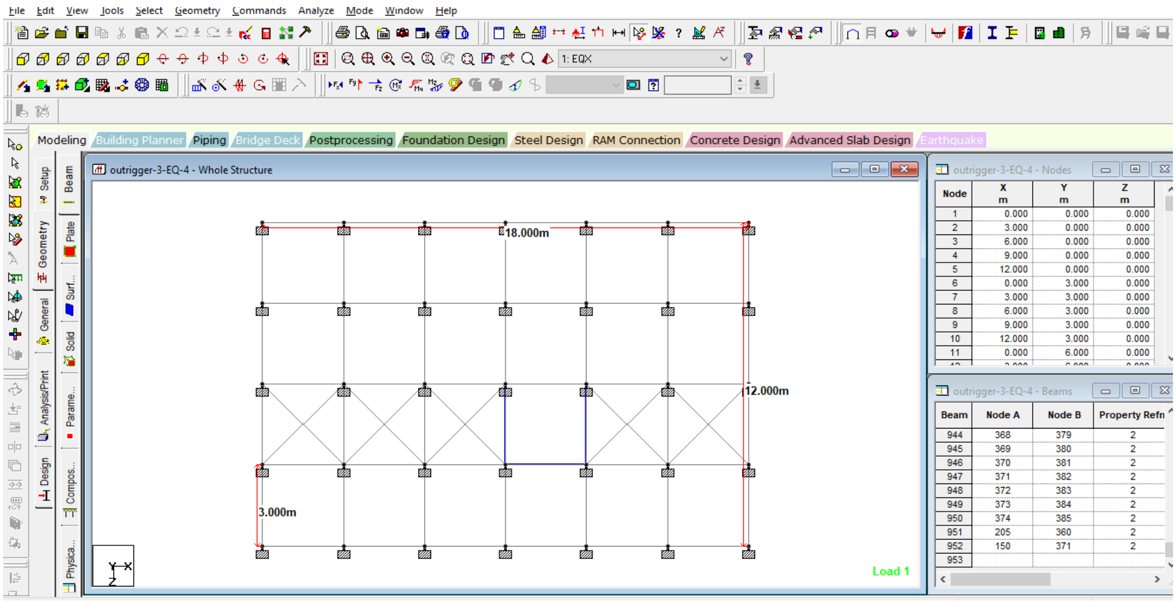

Figure 1:Plan of the building

The above figures is related to the plan of the building as per STAAD-PRO software, the plan is maintained for all the models.

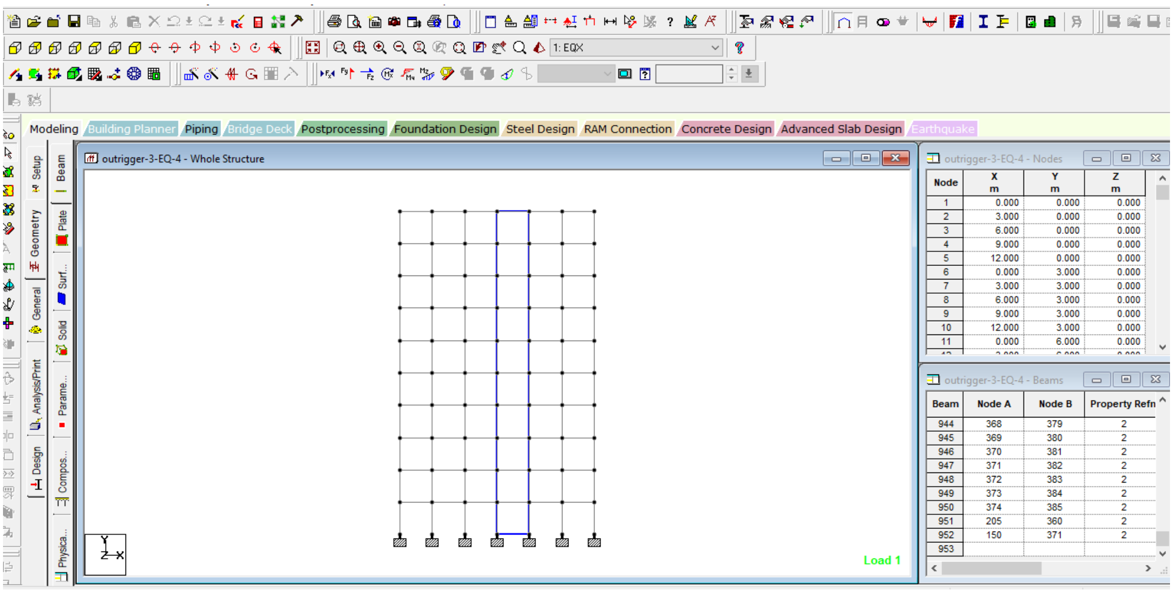

Figure 2:Elevation of the building

The above figures is related to the Elevation of the building as per STAAD-PRO software, the elevation is maintained for all the models.

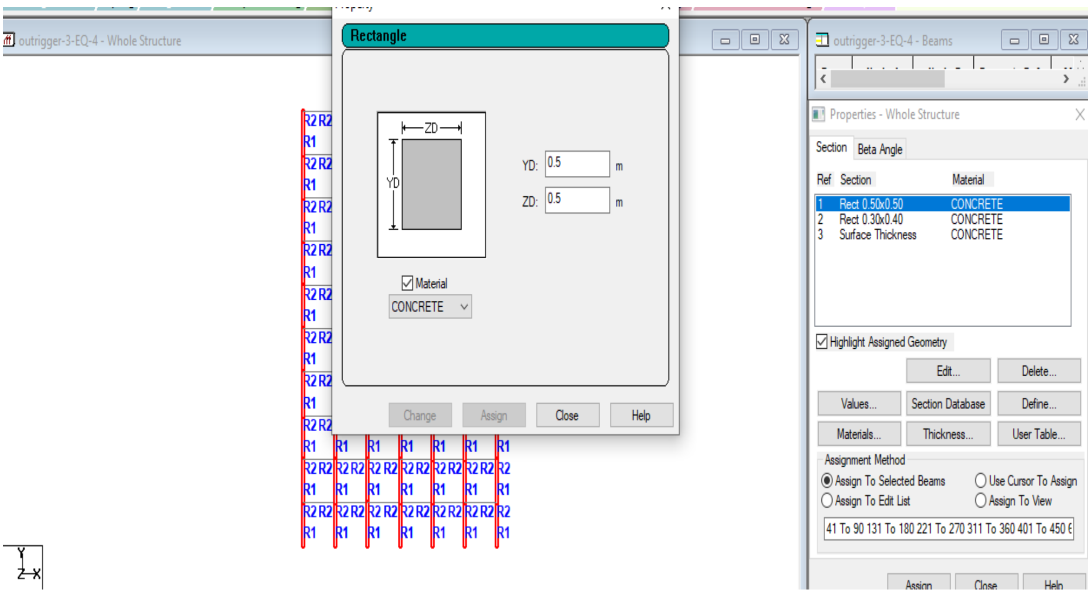

Figure 3:Column-Property assignment to the building

The above figures is related to the Column-Property assignment to the building as per STAAD-PRO software, the column property is maintained for all the models.

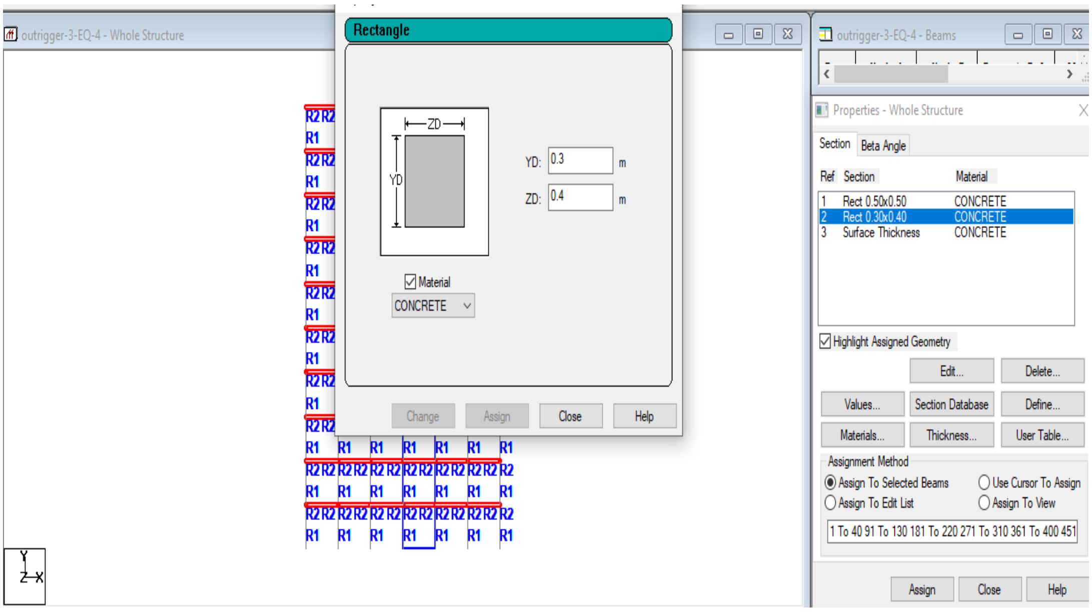

Figure 4:Beam-Property assignment to the building

The above figures is related to the Beam -Property assignment to the building as per STAAD-PRO software, the Beam property is maintained for all the models.

04. Results & Discussions

There are total 10 models are modeled and analyzed using STAAD-PRO software. The results obtained in terms of the displacement, reactions, beam forces and dynamics for all the models and are mentioned in the chapter in tabular and graphical forms.

Table 1: Displacement for all the models

	Horizontal	Vertical	Horizontal	Resultant
	X mm	Y mm	Z mm	mm
Model-1	21.289	2.945	20.329	22.07
Model-2	31.867	2.945	30.263	33.014
Model-3	21.353	2.953	20.791	22.111
Model-4	31.959	2.953	30.931	33.031
Model-5	21.416	3.008	20.344	22.215
Model-6	32.102	3.053	30.415	33.292
Model-7	21.464	3.042	20.411	22.276
Model-8	32.173	3.061	30.512	33.383
Model-9	21.416	3.106	20.295	22.264
Model-10	32.099	3.106	30.331	33.365

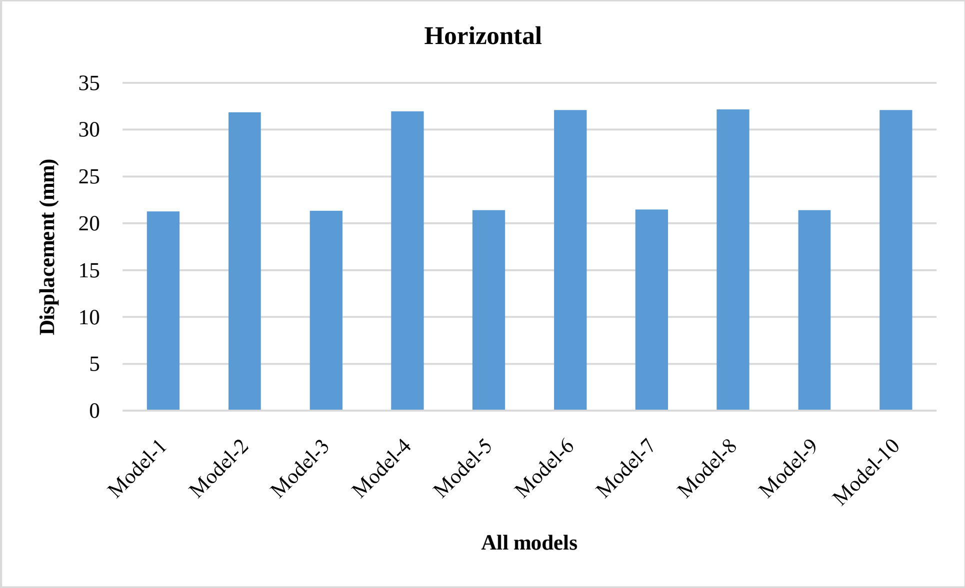

Figure 5:Horizontal (X) Displacement for all the models

The above figures gives the details about Horizontal (X) Displacement for all the models and the comparison is made in graphical form.

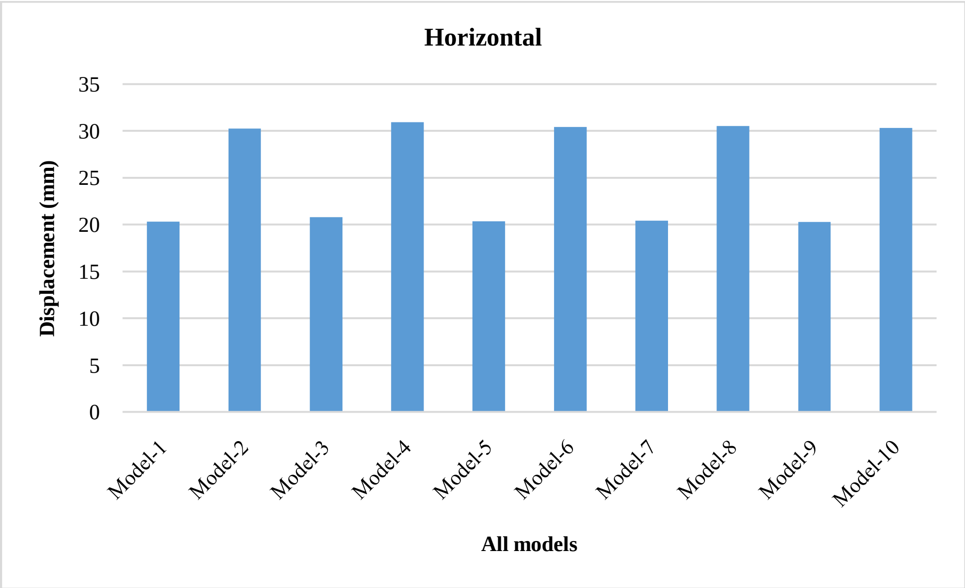

Figure 6:Horizontal (Z) Displacement for all the models

The above figures gives the details about Horizontal (Z) Displacement for all the models and the comparison is made in graphical form.

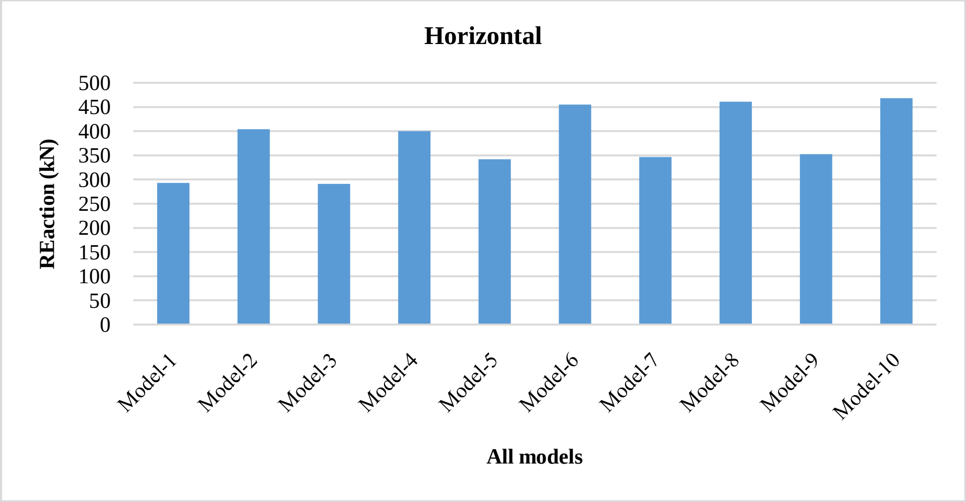

Figure 7:Horizontal Reaction (Fx) for all the models

The above figures gives the details about Horizontal Reaction (Fx) for all the models and the comparison is made in graphical form.

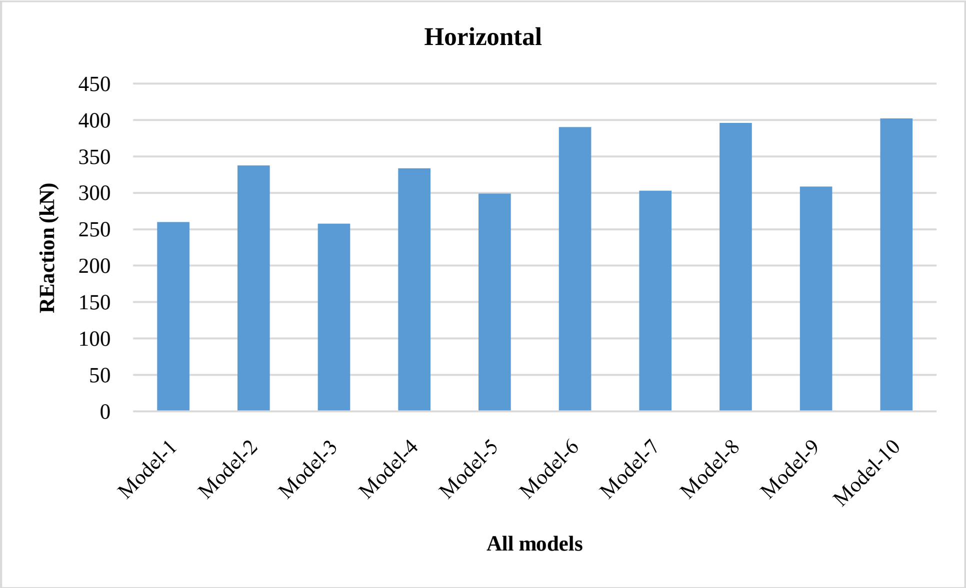

Figure 8:Horizontal Reaction (Fz) for all the models

The above figures gives the details about Horizontal Reaction (Fz) for all the models and the comparison is made in graphical form.

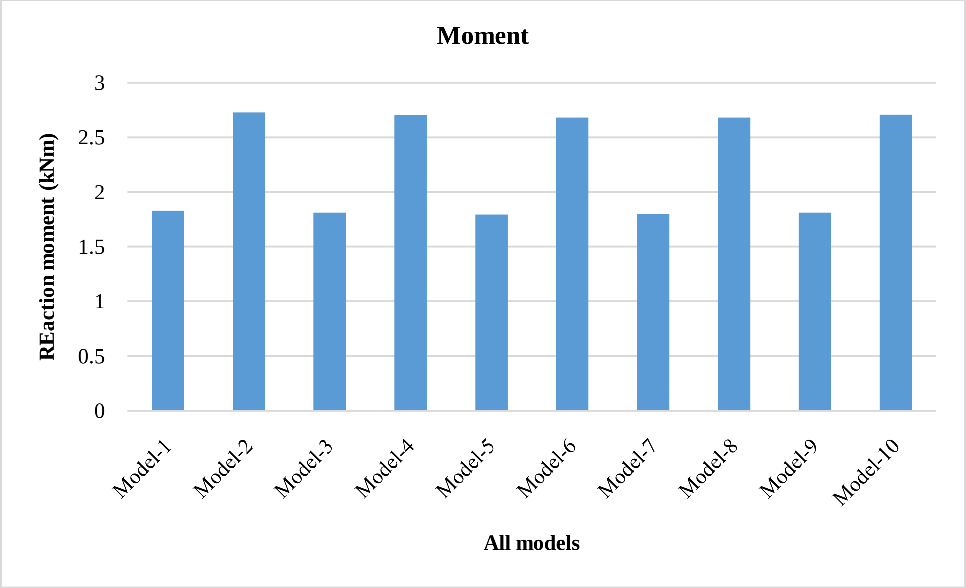

Figure 9:Reaction Moment (My) for all the models

The above figures gives the details about Reaction Moment (My) for all the models and the comparison is made in graphical form.

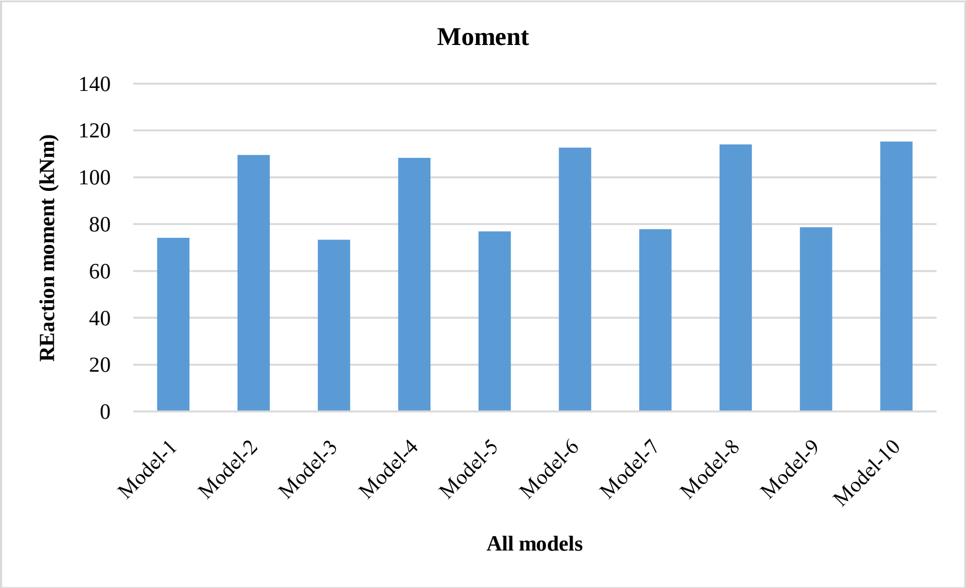

Figure 10:Reaction Moment (Mz) for all the models

The above figures gives the details about Reaction Moment (Mz) for all the models and the comparison is made in graphical form.

05. Conclusions

The following conclusions are drawn based on the present study.

1. The maximum vertical displacement is observed in the model-10 (Building with core shear wall and connected slab outrigger at system at 3rd, 5th& 7th floor (EQ zone-5)) and minimum in the model-1 (Building with core shear wall and bracings outrigger at system at 7th floor (EQ zone-4)).

2. The maximum reaction is observed in the model-10 (Building with core shear wall and connected slab outrigger at system at 3^{rd}, 5^{th}& 7^{th} floor (EQ zone-5)) and minimum in the model-1 (Building with core shear wall and bracings outrigger at system at 7^{th} floor (EQ zone-4)).
3. The maximum beam forces is observed in the model-2 (Building with core shear wall and bracings outrigger at system at 7^{th} floor (EQ zone-5)) and minimum in the model-5 (Building with core shear wall and connected slab outrigger at system at 3^{rd} floor (EQ zone-4)).

References:

[1] Agarwal, P. A S Jagadheeswari And C Freeda Christy, " Optimum Position Of Multi Outrigger Belt Truss In Tall Buildings Subjected To Earthquake And Wind Load", International Journal Of Earth Sciences And Engineering, Vol. 9, No. 3, June 2016. 11

[2] Abbas Haghollahi, Mohsen BesharatFerdous and Mehdi Kasiri: "Optimization of outrigger locations in steel tall buildings subjected toearthquake loads", 15th world conference of earthquake engineering 2012.

[3] Abdul Karim Mulla and Shrinivas B.N: "A Study on Outrigger System in a Tall R.C. Structure with Steel Bracing", International Journal ofEngineering Research & Technology (IJERT) Vol. 4 Issue 7, July – 2015

[4] Alpana L. Gawate J.P. Bhusari: "Behaviour of outrigger structural system for high-rise building", International Journal of Modern Trends in Engineering & Research, e-ISSN No.:2349-9745, Date: 2-4 July, 2015.

[5] Alpana L. Gawate J.P. Bhusari: "Behaviour of outrigger structural system for high-rise building", International Journal of Modern Trends inEngineering & Research, e-ISSN No.:2349-9745, Date: 2-4 July, 2015

[6] C. D. Hoenderkamp and M. C. M. Bakker (2003) "Analysis Of High-Rise Braced Frames With Outriggers" The Structural Design Of Tall and Special Buildings Struct. Design Tall Spec. Build 335– 350 in Wiley Interscience (www.interscience.wiley.com). DOI:10.1002/tal.226.

[7] Council on Tall Buildings and Urban Habitat, "Outrigger design for high-rise buildings", an output of the CTBUH Outrigger Working Group. Chicago, IL: CTBUH in conjunction with IIT, 2012.

[8] Dr. S. A. Halkude, Mr. C. G. Konapure and Ms. C. A. Madgundi: "Effect of eismicity on Irregular Shape Structure" International Journal ofEngineering Research & Technology (IJERT) Vol. 3 Issue 6, June – 2014

[9] Goman W M Ho (2016) "The Evolution of Outrigger System in Tall Buildings" International Journal of High-Rise Buildings, Volume No.05, Issue No. 01, pp 21-30.

[10] Hemant B. Dahake&Mohd. Imran Mohd. Azghar, "Optimum Position of Outrigger Systems in Tall Building by Using Reinforced Concrete Shear Walls and Braces", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 8, Issue 5, May 2019.

[11] Hi Sun Choi and Leonard Joseph (2012) "Outrigger System Design Considerations" International Journal of High-Rise Buildings, Volume No.01, Issue No. 03, pp 237-246.

[12] Kiran Kamath, N. Divya, Asha U Rao: "A Study on Static and Dynamic Behavior of Outrigger Structural System for Tall Buildings", Bonfiring International Journal of Industrial Engineering and Management Science, Vol2, No 4, December 2012.

[13] Kiran Kamath, Shashikumar Rao and Shruthi : "Optimum Positioning of Outriggers to Reduce Differential Column Shortening Due to LongTerm Effects in Tall Buildings", International Journal of Advanced Research in Science and Technology, Volume 4, Issue 3, 2015, pp.353-357.

[14] Mr.Gururaj B. Katti and Dr. BasavrajBaapgol: "Seismic Analysis of Multistoried RCC Buildings Due to Mass Irregularity By Time HistoryAnalysis", International Journal of Engineering Research & Technology (IJERT) Vol. 3 Issue 6, June – 2014

[15] N. Herath, N. Haritos, T. Ngo & P. Mendis: "Behaviour of Outrigger Beams in High rise Buildings under Earthquake Loads", Australian Earthquake Engineering Society 2009.

[16] N. Herath, N. Haritos, T. Ngo & P. Mendis: "Behaviour of Outrigger Beams in High rise Buildings under Earthquake Loads",

AustralianEarthquake Engineering Society 2009

[17] Po Seng Kian, Frits TorangSiahaan: “The use of outrigger and belt truss system for high-rise concrete buildings”.

[18] Shivacharan K, Chandrakala S , Karthik N M: “Optimum Position of Outrigger System for Tall Vertical Irregularity Structures”, IOSR Journalof Mechanical and Civil Engineering, Volume 12, Issue 2 Ver. II (Mar - Apr. 2015), PP 54-63

[19] ShrutiBadami and M.R. Suresh: “A Study on Behavior of Structural Systems for Tall Buildings Subjected To Lateral Loads”, International Journal of Engineering Research & Technology (IJERT) Vol. 3 Issue 7, July – 2014.

[20] Smith, R. J., &Willford, M. R. , “The damped outrigger concept for tall buildings”, The Structural Design of Tall and Special Buildings, 16(4), 501–517, 2007.

[21] Thejaswini R.M. And Rashmi A.R.: “Analysis and Comparison of different Lateral load resisting structural Forms” International Journal of Engineering Research & Technology (IJERT) Vol. 4 Issue 7, July – 2015.

[22] Thomsen IV, J. H., & Wallace, J. W. “Displacement—Based Design of Reinforced Concrete Structural Walls: An Experimental Investigation of Walls with Rectangular and T-Shaped Cross Sections”, 1995.

[23] Vijay Kumara Gowada M R And Manohar B C, “A Study On Dynamic Analysis Of Tall Structure With Belt Truss Systems For Different Seismic Zones”, International Journal Of Engineering And Technology, Vol. 4, Issue 8, August 2015.