



IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 Issue: II Month of publication: February 2022 DOI: https://doi.org/10.22214/ijraset.2022.40154

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Dynamic Seismic Analysis of Multi Storey Buildings in Seismic Zone V

Mr. Mohsin Aakib Shamim Akhtar Civil Department, RTMNU University, Nagpur, India

Abstract: In India, multi-storied buildings area unit sometimes created because of high value and deficiency of land. Earthquake could be a phenomenon which might generate the foremost harmful forces on structures. Buildings ought to be created safe for lives by correct style and particularisation of structural members so as to possess a ductile sort of failure. To protect such civil structures from significant structural damage, the seismic response of these structures is analyzed along with wind force calculation and forces such as support reactions and joint displacement are calculated and included in the structural design for a vibration resistant structure. The primary objective is to make associate earthquake resistant structure by enterprise seismal study of the structure by static equivalent methodology of study and do the analysis and design of the building by using STAAD PRO software in both static and dynamic analysis

Keywords: Dynamic Seismic Analysis, Staad.Pro.

I. INTRODUCTION

Structural analysis is very important process for any structure as it ensures the stability, durability and economy of the structure. It is mainly concerned with the behavior of structure when it is subjected to external and internal forces. Frame structures (such as Concrete frame structures and Steel frame structures) entail various structural components such as stairs, ramp, beams, slabs, columns, foundation etc. vertical loads are the loads which act throughout the life span of buildings but horizontal loads may or may not act on the building. These loads are transferred from slabs to beams and then to columns. Then from columns, these loads are transferred to foundations and then ultimately to the soil. Soil must have enough bearing capacity to withstand the total load of the building without any deformations. Various tests are conducted on the soil in order to get the bearing capacity of the strata. Once the bearing capacity is known, then the type of foundation is decided. There are different types of foundations, shown in Figure 1. Which are being used according to the soil strata.



Figure 1. Types of Foundations.

Struts and columns, they both are basically the compression structural components which can resist compressive forces as well as lateral forces generating within the structure. Struts, unlike column, are an inclined member. Conventionally, struts were used in steel structures such as buildings, bridges etc but now they are being used in RCC frame structures also. This imparts large strength to the structure and helps in making it safe and economical. A strut can collapse due to buckling not by crushing. In simple words, a strut may be defined as a long, inclined colu



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II. METHODOLOGY

A. Phase I: Modeling

For performing the current research work, total 6 models were prepared using Staad.Pro Software and they are mentioned as under:

Table 1. Description of Various Models			
Туре	Storey	Struts (bracing)	
Туре	16 storey	None	
А	Building		
Туре	16 storey	Single Cross	
В	Building	Bracing	
Туре	16 storey	Double Cross	
С	Building	Bracing	
Туре	20 storey	None	
D	Building		
Туре	20 storey	Single Cross	
Е	Building	Bracing	
Туре	20 storey	Double Cross	
F	Building	Bracing	

Other parameters of modeling are being represented in the table given below:

- Height of each storey = 3.3 m
- No. of bays in X-direction = 8 •
- No. of bays in Z-direction • = 6
- Panel of each bay = 5.5 m x 6.5 m

5.5 m	5.5 m	5.5 m	5.5 m	5.5 m	5.5 m	5.5 m	5.5 m
6.5 m							
6.5 m							
6.5 m							
6.5 m							
6.5 m							
6.5 m							



Figure 2. Plan of Building.

Figure 3. Location of Struts (Single Cross-Strut) in Plan.



International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue II Feb 2022- Available at www.ijraset.com



Figure 4. Location of Struts (Double Cross-Strut) in Plan.



Figure 5. Rendered View of Type A Building.



Figure 6. Rendered View of Type B Building.

Figure 7. Rendered View of Type C Building.



International Journal for Research in Applied Science & Engineering Technology (IJRASET)

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue II Feb 2022- Available at www.ijraset.com



Figure 8. Rendered View of Type D Building.

Figure 9. Rendered View of Type E Building.



Figure 10. Rendered View of Type F Building.

Material properties which were assigned to different storey buildings are mentioned in table 2.

ruore 2. Francisco el Columnis una Doumis				
Type of building	Floors	Column size (mm)	Beam size (mm)	Strut Size (mm)
Type A, B & C	1 st to 4 th floor	900 x 750 mm	600 x 450 mm	450 x 450 x 12 mm
	5 th to 8 th floor	825 x 650 mm	575 x 380 mm	350 x 350 x 12 mm
	9 th to 12 th floor	750 x 525 mm	450 x 380 mm	450 x 450 x 8 mm
	13 th to 16 th floor	600 x 380 mm	380 x 300 mm	350 x 350 x 8 mm
Гуре D, E & F	1 st to 4 th floor	980 x 875 mm	600 x 500 mm	500 x 500 x 12 mm
	5 th to 8 th floor	900 x 750 mm	600 x 450 mm	450 x 450 x 12 mm
	9 th to 12 th floor	825 x 600 mm	575 x 380 mm	350 x 350 x 12 mm
	13 th to 16 th floor	750 x 525 mm	450 x 380 mm	450 x 450 x 8 mm
	17 th to 20 th floor	600 x 450 mm	380 x 300 mm	350 x 350 x 8 mm

Table 2. Material Properties of Columns and Beams



B. Phase II: Seismic Analysis

Total 6 models (3 for 16 storey building and other 3 for 20 storey building) were prepared in Staad.Pro software using new seismic code IS: 1893-2016 with dynamic seismic analysis. Relative seismic parameters were considered such as seismic zone, type of structure, importance factor etc. Seismic zone V was taken for the present study. After the analysis, all the results were recovered from various sources of software.

III. RESULTS AND DISCUSSION

The so obtained results have been collected from the staad.pro are now represented in various forms such as tables and figures. With the help of such representations, the results were compared between the same storey building having different bracings. Displacement, being the main factor which was used to evaluate the structure's lateral stability, was recorded at three different locations (displacement of corner columns, edge columns and central column) as shown in the figure below.



Figure 11. Location of Columns for Displacement Results.



Results of 16 Storey Building and 20 Storey Building.

Figure 12. Displacement of Type A Building.

Figure 13. Displacement of Type B Building.



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	Max: 40.442 mm	
	Max: 37.509 mm	Max: 40.706 mm
	Max: 34.364 mm	Max: 37.793 mm
Max: 40.611 mm	Max: 31.083 mm	Max: 34.670 mm
Max: 37.692 mm	Max: 27.780 mm	Max: 31.411 mm
Max: 34.563 mm	Max: 24.692 mm	Max: 28.123 mm
Max: 31.300 mm	Max: 21.608 mm	Max: 25.051 mm
Max: 28.010 mm	Max: 18.574 mm	Max. 25.051 mm
Max: 24.937 mm	Max: 15.701 mm	Max: 21.981 mm
Max: 21.867 mm	Max: 13.075 mm	Max: 18.955 mm
Max: 18.845 mm	Max: 10.509 mm	Max: 16.077 mm
Max: 15.975 mm	Max: 8.046 mm	Max: 13.457 mm
Max: 13.358 mm	Max: 5.786 mm	Max: 10.893 mm
Max: 10.799 mm	Max: 3.908 mm	Max: 8.422 mm
Max: 8.338 mm	Max: 2.251 mm	Max: 6.138 mm
Max: 6.065 mm	Max: 0.850 mm	Max: 4.241 mm
Max: 4.178 mm		Max: 2 540 mm
Max: 2.490 mm	В	110X. 2.040 IIIII
Max: 1.026 mm		Max: 1.057 mm
		the second se
A		C

Figure 14. Displacement of Type C Building.

	Max: 62.908 mm	
	Max: 59.141 mm	
ht	Max: 55.066 mm	Max: 63.249 mm
Max: 63.002 mm	Max: 50 831 mm	Max: 59.505 mm
Max: 59.243 mm	Max. 30.031 mm	Max: 55.458 mm
Max: 55.179 mm	Max: 46.613 mm	Max: 51.245 mm
Max: 50.953 mm	Max: 42.678 mm	Max: 47 039 mm
Max: 46.743 mm	Max: 38.743 mm	Max. 47.035 mm
Max: 12 813 mm	Max: 34.861 mm	Max: 43.118 mm
Max. 42.013 mm	Max: 31.187 mm	Max: 39.192 mm
Max: 38.884 mm	Max: 27 822 mm	Max: 35.310 mm
Max: 35.005 mm	Maw 24 405 mm	Max: 31.625 mm
Max: 31.330 mm	wax: 24.495 mm	Max: 28.255 mm
Max: 27.965 mm	Max: 21.219 mm	Max: 24 922 mm
Max: 24.640 mm	Max: 18.073 mm	Max. 24.522 mm
Max: 21.365 mm	Max: 15.211 mm	Max: 21.638 mm
Max: 18 216 mm	Max: 12.415 mm	Max: 18.476 mm
Max. 10.210 mm	Max: 9.706 mm	Max: 15.614 mm
Max: 15.356 mm	Max: 7.147 mm	Max: 12.812 mm
Max: 12.562 mm	Manu A 957 mm	Max: 10.091 mm
Max: 9.855 mm	wax: 4.037 mm	Max: 7 504 mm
Max: 7.292 mm	Max: 2.773 mm	Max. 7.304 mm
Max: 5.002 mm	Max: 0.998 mm	Max: 5.196 mm
Max: 2.909 mm	1	Max: 3.074 mm
Max: 1 100 mm	В	Max: 1.224 mm
Max. 1.105 mm		
22		i la la
1		C

Figure 16. Displacement of Type E Building.

	Max: 138.514 mm	
	Max: 132.925 mm	
	Max: 125.008 mm	
Max: 138.541 mm	Max: 115.350 mm	Max: 138.514 mm
Max: 132.953 mm	Max: 105.783 mm	Max: 132.925 mm
Max: 125.037 mm	Max: 97.329 mm	Max: 125.008 mm
Max: 115.382 mm	Max: 88.542 mm	Max: 115.350 mm
Max: 105.816 mm	Max: 79.691 mm	Max: 105.783 mm
Max: 97.364 mm	Max: 71.848 mm	Max: 97.329 mm
Max: 88.577 mm	Max: 65.204 mm	Max: 88.542 mm
Max: 79.728 mm	Max: 58.496 mm	Max: 79.691 mm
Max: 71.886 mm	Max: 51.650 mm	Max: 71.848 mm
Max: 65.240 mm	Max: 45.013 mm	Max: 65.204 mm
Max: 58.531 mm	Max: 38.888 mm	Max: 58.496 mm
Max: 51.683 mm	Max: 32.610 mm	Max: 51.650 mm
Max: 45.045 mm	Max: 26.138 mm	Max: 45.013 mm
Max: 38.917 mm	Max: 19.616 mm	Max: 38.888 mm
Max: 32.637 mm	Max: 13.385 mm	Max: 32.610 mm
Max: 26.162 mm	Max: 7.429 mm	Max: 26.138 mm
Max: 19.636 mm	Max: 2.423 mm	Max: 19.616 mm
Max: 13.404 mm		Max: 13.385 mm
Max: 7.445 mm	В	Max: 7.429 mm
Max: 2.435 mm		Max: 2.423 mm
	1	
A	(2

Figure 15. Displacement of Type D Building.

	Max: 44.140 mm	
	Max: 41.542 mm	
	Max: 38.745 mm	Max: 44.700 mm
Max: 44.306 mm	Max: 35.835 mm	Max: 42.122 mm
Max: 41.718 mm	Max: 32.908 mm	Max: 39.335 mm
Max: 38.937 mm	Max: 30 149 mm	Max: 36.424 mm
Max: 36.040 mm	Max: 27 391 mm	Max: 33.492 mm
Max: 33.125 mm	Max: 24.667 mm	Max: 30.732 mm
Max: 30.376 mm	Max. 24.007 mm	Max: 27.971 mm
Max: 27.627 mm	Max: 22.059 mm	Max: 25,235 mm
Max: 24.907 mm	Max: 19.647 mm	Max: 22 613 mm
Max: 22.302 mm	Max: 17.270 mm	Mar. 20.403 mm
Max: 19 893 mm	Max: 14.937 mm	Max: 20.192 mm
Max: 17 518 mm	Max: 12.698 mm	Max: 17.803 mm
Max. 17.510 mm	Max: 10.677 mm	Max: 15.452 mm
Max: 15.185 mm	Max: 8.713 mm	Max: 13.186 mm
Max: 12.941 mm	Max: 6.818 mm	Max: 11.150 mm
Max: 10.922 mm	Max: 5.035 mm	Max: 9.163 mm
Max: 8.958 mm	Max: 3.449 mm	Max: 7.237 mm
Max: 7.060 mm	Max: 2.001 mm	Max: 5.407 mm
Max: 5.264 mm	Max: 0.749 mm	Max: 3 775 mm
Max: 3.667 mm		Max: 2 266 mm
Max: 2.195 mm	В	max. 2.200 mm
Max: 0.893 mm		Max: 0.924 mm
4		С

Figure 17. Displacement of Type F Building.

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ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue II Feb 2022- Available at www.ijraset.com



Figure 18. Maximum Displacement of 16 Storey Building.



Figure 19. Maximum Displacement of 20 Storey Building.

	Concrete	Reinforcement	Steel Section(
	(m3)	Steel Kn	Kn)
Туре	3580.8	3764.36	-
А			
Туре	3580.8	2461.04	4199.82
В			
Туре	3580.8	2293.34	6299.73
С			



International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538

Volume 10 Issue II Feb 2022- Available at www.ijraset.com

	Concrete	Reinforcement Steel	Steel Section
	(m3)	(Kn)	(Kn)
Туре	5046.8	5151.55	-
D			
Туре	5046.8	3736.36	5777.98
E			
Туре	5046.8	3174.66	8339.71
F			

Table 4. Material Quantity of 20 Storey Building.

IV. CONCLUSION

The present investigational study evaluates the high-rise building with and without struts as well as central core, the obtained results were studied carefully. From the represented results, following are the conclusions drawn for this current study:

- For 16 storey building, the maximum displacement of column in Type A building, Type B and Type C building is 124.838 mm, 57.152 mm and 40.702 mm respectively. Therefore, the ratio of displacement of type B to type A is 0.46 and the ratio of displacement of type C to type A is 0.33.
- 2) For 20 storey building, the maximum displacement of column in Type D building, Type E and Type F building is 138.514 mm, 63.250 mm and 44.70 mm respectively. Therefore, the ratio of displacement of type E to type D is 0.46 and the ratio of displacement of type F to type D is 0.32.

Therefore, from the above observations it can be finally concluded that there was a reduction of 54 % in maximum displacement when single cross strut bracing was provided in 16 Storey Building and 20 Storey Building. But with the addition of double cross strut bracing, there was a huge reduction of 67 % in maximum displacement of 16 Storey and 20 Storey Building. Therefore, evaluation of both the buildings reflects that the utilization of cross type strut can be done effectively.

REFERENCES

- Sigmund A. Freeman, "Response Spectra as a Useful Design and Analysis Tool for Practicing Structural Engineers", ISET Journal of Earthquake Technology, Vol. 44, No. 1, pp. 25–37, 2007.
- [2] Amit V. Khandve et. al.; "Seismic Response of RC Frame Buildings with Soft Storeys", International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 3, pp.2100-2108, 2012.
- [3] V. Sadeghi Balkanloua, M. Reza Bagerzadeh Karimib, B. Bagheri Azarc, Alaeddin Behraveshd "Evaluating Effects of Viscous Dampers on optimizing Seismic Behavior of Structures", International Journal of Current Engineering and Technology, Vol.3, No.4, pp-1150-1157, 2013.
- [4] Mohamed A. A. El-Shaer "Seismic Load Analysis of different R.C. Slab Systems for Tall Building", International Journal of Current Engineering and Technology, Vol.3, No.5, pp-2034- 2046, 2013.
- [5] A. E. Hassaballa, Fathelrahman M. Adam, M. A. Ismaeil "Seismic Analysis of a Reinforced Concrete Building by Response Spectrum Method", IOSR Journal of Engineering, Vol. 3, Issue 9, pp-1-9, 2013.
- [6] Umesh.R.Biradar, Shivaraj Mangalgi "Seismic Response of Reinforced Concrete Structure by Using Different Bracing Systems International Journal of Research in Engineering and Technology, Volume: 03 Issue: 09, pp-422-426 (2014).
- [7] B Sri Harsha, J Vikranth "Study And Comparison Of Construction Sequence Analysis With Regular Analysis By Using Etabs" International Journal of Research Sciences and Advanced Engineering, Volume 2, Issue 8, PP: 218 – 227, 2014.
- [8] Er. Raman Kumar et. al.; "Seismic Behaviour of Shear Wall Framed Buildings", International Journal of Engineering Technology, Management and Applied Sciences, Vol. 2, pp. 28-38, 2014.
- [9] Venkatesh S.V. et. al.; "Effect of Different Lateral Load Resisting Systems on 2 X 7 Bays Building Frame Subjected to Lateral (Seismic) Load", Proceedings of the 1st International Conference on Infrastructure Management, Assessment and Rehabilitation Techniques (ICIMART'14), pp. A-1-2, 2014.
- [10] M.E. Ephraim, T.C. Nwofor, "Composite Behaviour of unbraced Multi-Storey Reinforced Concrete Infilled Frames Based on Modified One-Strut Model", M.E. Ephraim Int. Journal of Engineering Research and Applications, Vol. 5, Issue 4, (Part -1) pp.47-58, 2015.
- [11] Abhyuday Titiksh, Dr. M.K. Gupta, "A Study of the Various Structural Framing Systems Subjected to Seismic Loads", SSRG International Journal of Civil Engineering (SSRG-

IJCE), Vol. 2, Issue 4, 2015

- [12] Tejashree Kulkarni et. al.; "Analysis and Design of High Rise Building Frame using Staad Pro" IJRET: International Journal of Research in Engineering and Technology, Vol.05, Issue 04, 2016.
- [13] Deepak, Mr. Vaibhav Gupta, "Seismic Analysis of High-Rise Open Ground Storey Framed Building" International Journal of Engineering Science and Computing, pp. 1713-1719,2016.
- [14] K. Ramakrishna Reddy, Dr. S. Vijaya Mohan Rao, "Seismic Analysis of High Raised Building by Response Spectrum Method", International journal of Advance Technology and Innovative Research, Vol. 08, pp. 4111-4118, 2016.











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