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Behaviour of Different Configuration of RC Frame Plan Under Seismic Analysis with Shear Wall

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Abstract. As increasing demands of structure requirements, structural engineers nowadays must deal with a variety of situations. In which various geometrical constructions are on demand. As per the different requirements, structural safety is preferred in all ways. The current study compares regular and irregular configurations in the plan of different RC frames. In this research, four models were compared. A different model has been created with the help of ETABS software. Model 1 is a bare RC frame, Model 2 is a L shape RC frame, Model 3 is a L shape RC frame with a shear wall at each corner, and Model 4 is a L shape RC frame with a shear wall in its centre. In the study Squared shaped plan frame is compared with L shaped frame and after by installing different shapes of shear wall was applied to L shaped frame. Analysis of mentioned different models has been carried out with the dynamic analysis method which is response spectrum method. Analysis has been done in ETABS software and different seismic parameters has been studied and compared with analysis results. Parameters like base shear, time period, storey drift has been compared.

1. Introduction

High-rise structures should have adequate stiffness to resist lateral loads and seismic disturbances. Reinforced concrete shear walls are ideal for structures in seismic zones due to their high carrying capacity, ductility, and stiffness. High-rise buildings have large beam and column dimensions, resulting in heavy reinforcement at the joins. This causes clogging and makes it difficult to place and vibrate concrete, compromising building safety. To address practical challenges, high-rise structures should have shear walls.Buildings with structural walls are often stronger than framed constructions, decreasing the risk of excessive deformation and damage. RC multi-story structures can withstand vertical and horizontal loads.

1.1. Shear Wall

The construction should be capable of resisting various loads. A shear wall is a vertical element designed to withstand lateral stresses, including seismic and wind loads. Uplift forces occur when horizontal forces are applied to the top of a wall. Shear barriers counteract two sorts of forces: uplift and shear. Shear forces are caused by both earth movement and exogenous factors such as wind.

1.2. Response spectrum method

The reason the earthquake force is called a dynamic force is because its magnitude and direction vary and it moves back and forth in an approximate period of time. Provided that, the dynamic analysis approach is the most effective way to determine how resistant the buildings are to an earthquake. One popular technique for improving the accuracy of building seismic assessments is response spectrum analysis. This study's improved version of the modal analysis used to determine the vibration period in the earlier static equivalent analysis is the dynamic response spectrum analysis. Given that the main objective of dynamic response spectrum analysis is to examine the vibration range's reaction as a result of the design earthquake load

2. Modelling Of Different RC Frame

Model 1 – Bare RC Frame
Model 2 –L shape RC Frame
Model 3 – L shape RC Frame with Shear wall at Corner
Model 4 – L shape RC Frame with Shear wall at Center

2.1. Design Data:

Building Height – 45m
Storey Number – G+14
Floor to Floor Height – 3m
Grade of Concrete – M25
Grade of Steel – Fe500
Depth of Slab – 150mm
Beam Size – 300 mm X 450 mm

Column Size – 300 mm X 500 mm
Shear Wall Thickness – 230 mm
Seismic Zone – V
Seismic Zone Factor: 0.36
Importance Factor (I): 1 (Table 8) (Is Code 1893–2016)
Soil Type: Medium
Response Reduction (R)5 (Table 9) (Is Code 1893–2016)

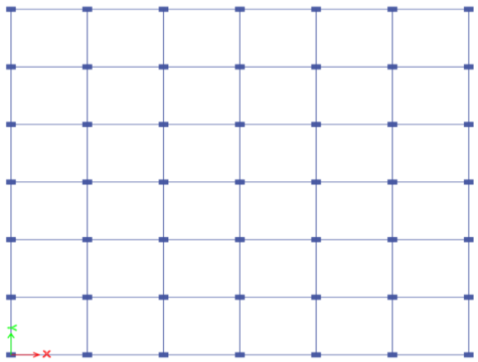

Fig.1 Model 1

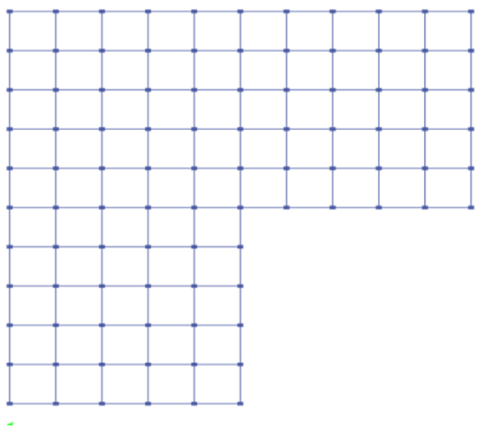

Fig.2 Model 2

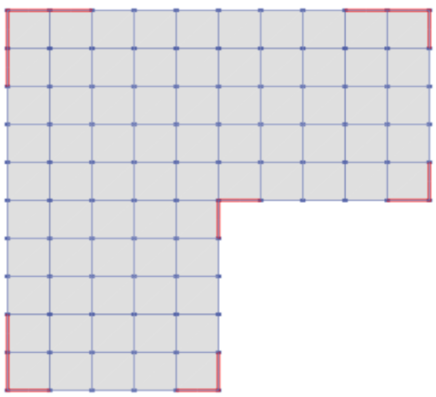

Fig.3 Model 3

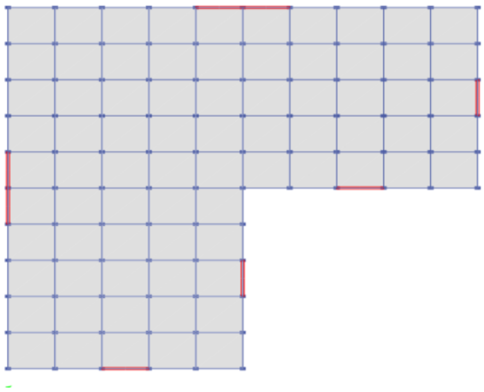

Fig.4 Model 4

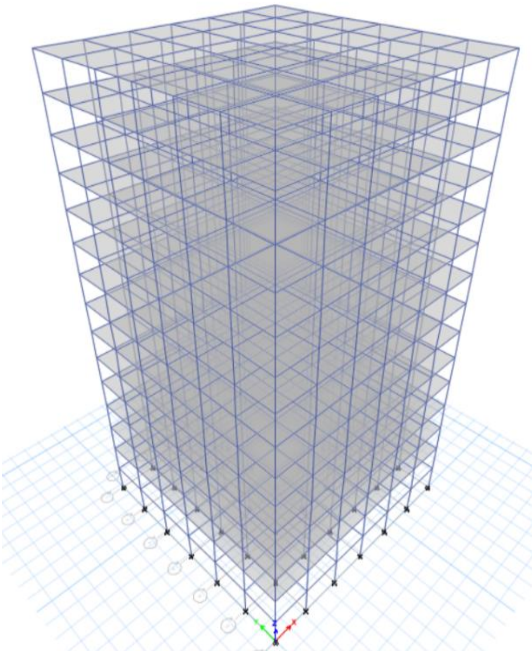

Fig.5 Model 1

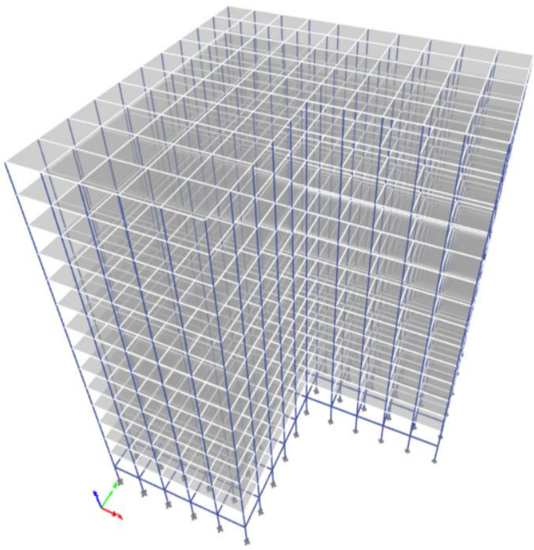

Fig.6 Model 2

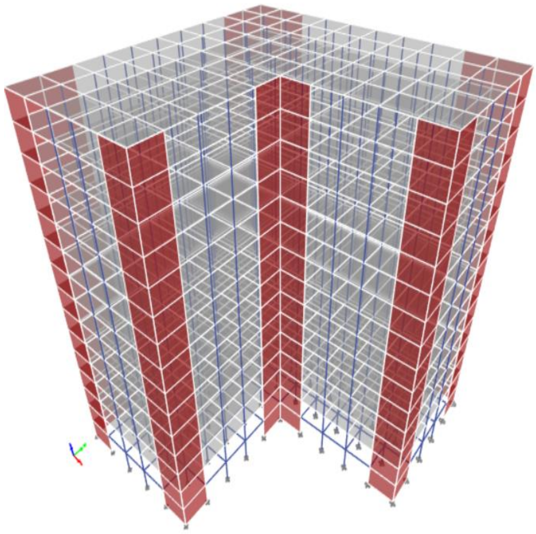

Fig.7 Model 3

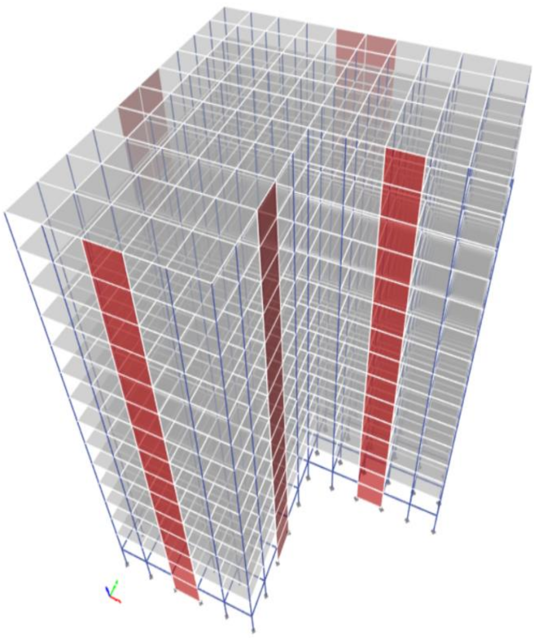

Fig.8 Model 4

3. Results

3.1. Base Shear

Table.1 Base Shear variation in Different Model

MODEL	DIRECTION	
	X	Y
MODEL 1	2773	2773
MODEL 2	5376.2	5376.2
MODEL 3	7039.005	6663.78
MODEL 4	5769.8	5769.8

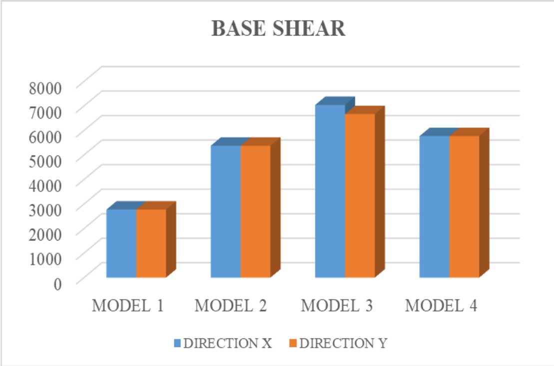

Fig.9 Base Shear variation graph

3.2. Time Period

Table.2 Time period variationin different model

MODEL	DIRECTION	
	X	Y
MODEL 1	3.609	3.967
MODEL 2	3.542	3.886
MODEL 3	1.786	1.887
MODEL 4	2.346	2.59

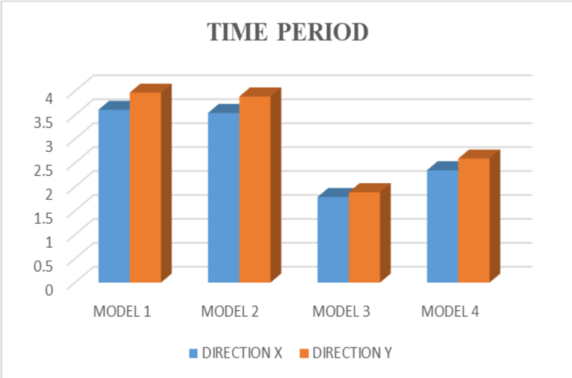

Fig.10 Time Period variation graph

3.3. Storey Drift

Table.3 Storey DriftVariation in X-Direction

STOREY DRIFT IN X-DIRECTION				
Storey	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Story15	0.000982	0.000959	0.001662	0.001905
Story14	0.001528	0.001493	0.001698	0.00201
Story13	0.002071	0.002025	0.001724	0.002116
Story12	0.002549	0.002493	0.001743	0.002228
Story11	0.002954	0.002889	0.001749	0.002327
Story1	0.00328	0.00321	0.00173	0.00240

0	7	6	6	2
Story9	0.00355 5	0.00347 8	0.00170 1	0.00244 4
Story8	0.00376 4	0.00368 3	0.00164 1	0.00244 3
Story7	0.00391 9	0.00383 5	0.00155 2	0.00239 1
Story6	0.00402 7	0.00394 1	0.00143 3	0.00227 9
Story5	0.00409 2	0.00400 5	0.00127 9	0.0021
Story4	0.00410 6	0.00401 9	0.00109	0.00184 2
Story3	0.00402 2	0.00393 8	0.00086 2	0.00149 4
Story2	0.00362 9	0.00355 6	0.00061 4	0.00104 8
Story1	0.00200 6	0.00195 7	0.00028	0.00046 5

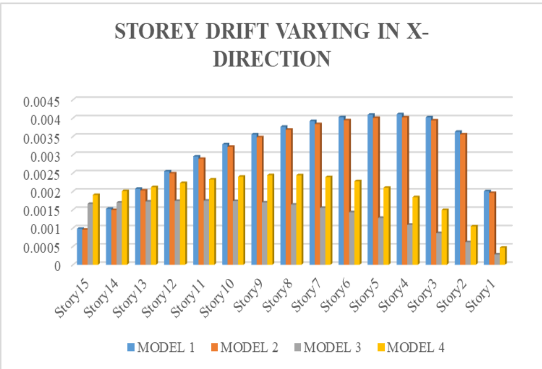

Fig.11 Storey DriftVariation in X-Direction

Table.4 Storey DriftVariation in Y-Direction

STOREY DRIFT IN Y-DIRECTION				
Storey	**MODEL 1**	**MODEL 2**	**MODEL 3**	**MODEL 4**
Story1 5	0.00107 2	0.00103 5	0.00167 8	0.00215 9
Story1 4	0.00177 3	0.00172 1	0.00170 9	0.00225 7
Story1 3	0.00243 3	0.00236 5	0.00173 2	0.00236 1
Story1 2	0.00300 1	0.00292	0.00174 7	0.00246 9
Story1 1	0.00347 8	0.00338 6	0.00174 9	0.00256 4
Story1 0	0.00387	0.00376 9	0.00173 2	0.00263 3
Story9	0.00418 5	0.00407 7	0.00169 4	0.00266 6
Story8	0.00443	0.00431 7	0.00163	0.00265 3
Story7	0.00461 4	0.00449 7	0.00153 9	0.00258 5
Story6	0.00474 2	0.00462 3	0.00141 7	0.00245 5
Story5	0.00482 4	0.00470 4	0.00126 3	0.00225 3
Story4	0.00486 3	0.00474 2	0.00107 4	0.00196 9
Story3	0.00483 8	0.00471 9	0.00084 7	0.00158 9
Story2	0.00458 1	0.00448	0.00060 1	0.00111
Story1	0.00287 5	0.00280 8	0.00027 4	0.00052 7

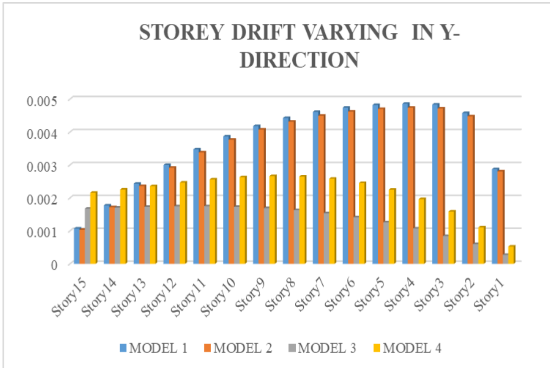

Fig.12 Storey DriftVariation in Y-Direction

4. Conclusion

- After analysis it was found drastic change in base shear nearly 49% of base shear was increased in model 1 compared to model 2 and model 4 and 60% in model 3.
- According to time period results models 1 and 2 doesn't show mush difference but in model 3 and 4 nearly 50% - 55% of time period was reduced compared to model 1.
- Comparison of storey drift it was noticed that model 1 and 2 increases with storey height and decreases further coming till top floor in both X and Y – direction and it was found that in model 3 and model 4 it been increasing till top but its less than model 1 and model 2.

References

[1] Rupali Jadhav, Abhishek Jaiswal, "Study of Effect of Seismic Excitation Angle for the Analysis of Regular and Irregular RC Frame" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 14, Issue 2 Ver. VII (Mar. - Apr. 2017), PP 80-83.

[2] Sarfaraj, M.S. Bhandiwad, "Seismic Analysis of Regular and Vertical Irregular RC Buildings", Bonfring International Journal of Man Machine Interface, Vol. 4, July 2016.

[3] P A Krishnan, N Thasleen, "Seismic analysis of plan irregular RC building frames", IOP Conference Series: Earth and Environmental Science, 2020.

[4] Fadzli Mohamed Nazri, Chee Ghuan Tan, Siti Nur Aqilah Saruddin, "Fragility Curves of Regular and Irregular Moment-Resisting Concrete and Steel Frames", Int J Civ Eng, 2018.

[5] Yasser Alashker, Sohaib Nazar, Mohamed Ismaiel, "Effects of Building Configuration on Seismic Performance of RC Buildings by Pushover Analysis",2015, http://www.scirp.org/journal/ojce.

[6] Mohaiminul Haque, Sourav Ray, Amit Chakraborty, Mohammad Elias, Iftekharul Alam "Seismic Performance Analysis of RCC Multi-Storied Buildings with Plan Irregularity", American Journal of Civil Engineering,2016.

[7] R.C.Bush, Anoop I. Shirkol, J.S. Shruthi, "Seismic analysis of RCC Building with Different Shape of Shear Wall and Without Shear Wall", ASPS Conference Proceedings, 2022.

[8] Harsha N R, Sharath H P, Kavya K M, "Analysis of Vertical Irregular structures with and without Lateral force Resisting System", International Journal of Engineering Research & Technology (IJERT), Vol. 12 Issue 09, September-2023.

[9] Ardian Yolanda, Zulfikar Djauhari, Ridwan, Enno Yuniarto, "Progressive collapse of regular and irregular reinforced concrete moment frame", MATEC Web of Conferences 276, 2019.

[10] Birendra Kumar Bohara, Kafeel Hussain Ganaie, Prasenjit Saha, "Seismic Analysis of Retrofitting of RC Regular Frame with V-Braced Frame", JOETP, July 2021, Volume 2.