Seismic Analysis of Multi-Storey Building with Infills Shear Wall Having Floating Column

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Abstract— The masonry infill walls are considered as non-structural element and their stiffness contribution are ignored in the analysis when building is subjected to seismic loads, but it is considered while we studying stability analysis. RC frame building with open ground story, and similar soft story effect can be observed when soft story at different levels of structure are constructed. The building with discontinuity in the stiffness and mass subjected to concentration of forces and deformations at the point of discontinuity which may leads to failures of members at the junction and collapse of building. It is an attempt to study the performance of multi-storeyed reinforced concrete building frame due to influence/provision of masonry infill's and shear wall, eleven (11) building models (15 storey each).

Key words: Effluent- ESA (Equivalent Static Analysis) & (RSA) Response Spectrum Analysis

I. Introduction

Reinforced concrete frames with masonry infills are a popular form of construction of high-rise buildings in urban and semi urban areas around the world. The term infill frame is used to denote a composite structure formed by the combination of a moment resisting plane frame and infill walls. The masonry can be of brick, concrete units, or stones. The behavior of masonry in filled frame structures has been studied in the last four decades in attempts to develop a rational approach for design of such frames (Al-Chaar, 2002).

Nowadays high rise buildings are becoming more and more slender, leading to the possibility of more sway in comparison with earlier high rise buildings.

In the present study, seismic performance of 3D building frame with intermediately infill frames and shear wall at various positions was studied. Performance of R.C. frame was evaluated with ground soft storey and intermediate soft story.

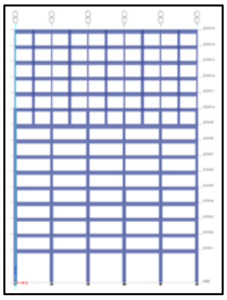
II. Discription of Structural Model

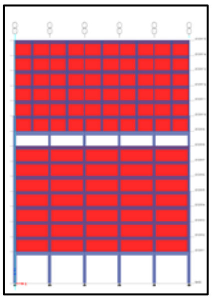
For the study of 11 different models of different fifteen 15 storey building are considered, the building has 5 bays of 10m in x-direction and 9 bays of 6m in y-direction with plan dimension of 50 x 54m and a storey height of 7m, 3.1m of storey1 and remaining all storey respectively considered following type of structure such as bare frame, both ground and intermediate floor as soft storey are considered, swastika, L, U, C, I, H, pattern shear wall at corner of the plan provided. The building is considered in zone 5 and medium strength soil. Response reduction factor is 5.

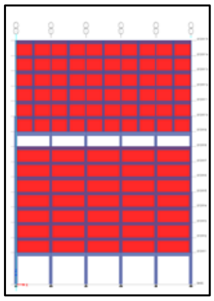
III. Models Considerd for Analysis

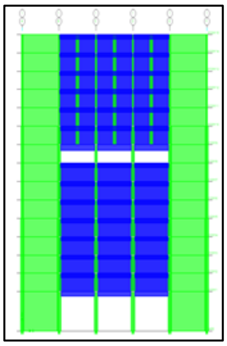
Following 11 Models are analyzed by equivalent static method and response spectrum method using ETAB software

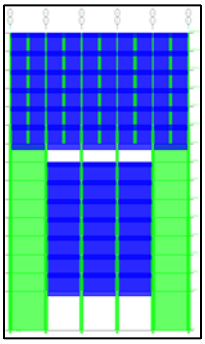
1) Model 1: Building modeled as bare frame, however the masses of brick masonry infill walls (230mm thick) are included.
2) Model 2: Full infill masonry model, building model has full brick infill masonry wall of 230mm thick in all stories excluding the ground storey.
3) Model 3: Building has one full brick infill masonry wall in all storeys except ground storey and intermediate storey (9th storey).
4) Model 4: Building model is similar as model 3, further L shaped shear wall (200mm thick) is provided at corner (shear wall up to top storey)
5) Model 5: Building model is similar as model 3, further L shaped shear wall (200mm thick) is provided at corner i.e. till intermediate storey (shear wall up to 9th storey)
6) Model 6: Building model is similar as model 3, further C shaped shear wall (200mm thick) is provided at corner.
7) Model 7: Building model is similar as model 3, further U shaped shear wall (200mm thick) is provided at corner.
8) Model 8: Building model is similar as model 3, further H shaped shear wall (200mm thick) is provided at corner.
9) Model 9: Building model is similar as model 3, further I shaped shear wall (200mm thick) is provided at corner.
10) Model 10: Building model is similar as model 3, further T shaped shear wall (200mm thick) is provided at corner.
11) Model 11: Building model is similar as model 3, further swastika shaped shear wall (200mm thick) is provided at corner.

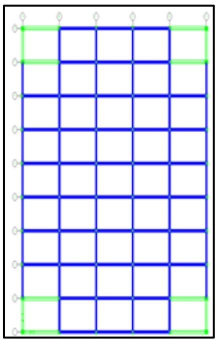

Model 1


Model 2


Model 3


Model 4


Model 5


Model 6

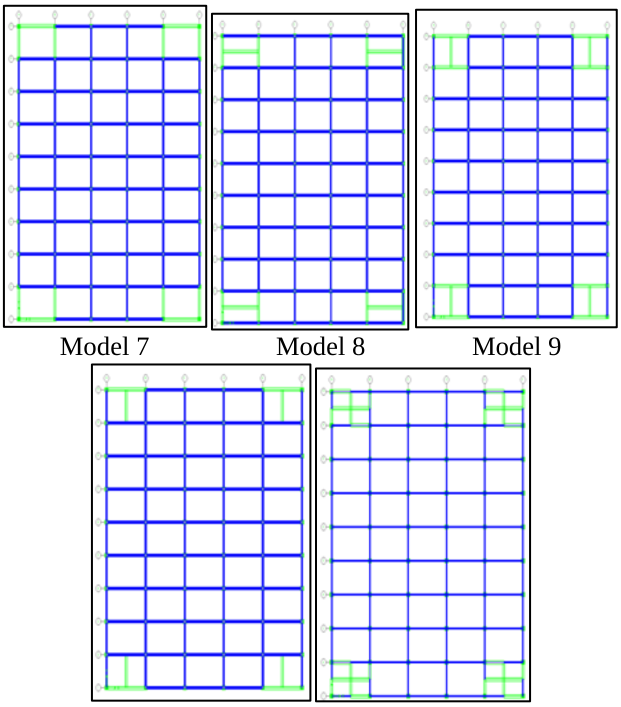


Fig. 1: Models

IV. RESULTS AND DISCUSSION

Fundamental time period in sec	
Model No	Time in sec
1	2.43
2	2.37
3	2.34
4	1.584
5	1.603
6	1.493
7	1.425
8	1.503
9	1.508
10	1.716
11	1.469

Table 1: Fundamental Time Period for All Models

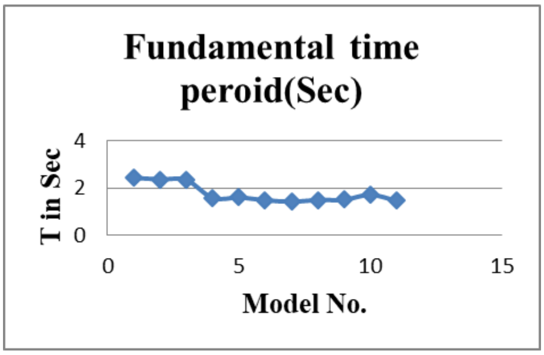


Fig. 2: Model vs. Time period for Different Models

Seismic base shear				
Model No	Equivalent Static		Response spectrum	
	x-	y-	x-	y-
1	16876.64	19691.99	10518.15	11972.22
2	18797.74	21047.54	11777.85	12882.99
3	18622.18	20810.7	11662.3	12715.85
4	34192.65	27651.81	19817.71	16609.4
5	33698.56	27307.8	18869.81	15813.94
6	40121.74	29441.22	21194.29	16946.1
7	37057.56	30814.62	20360.59	17104.58
8	37534.7	29413.34	20633.84	16550.63
9	38655.54	29274.43	20540.87	16937.35
10	32228.54	25647.37	18077.7	15029.55
11	39800.61	30359.66	21131.12	17092.34

Table 2: Comparison of Seismic Base Shear between Equivalent Static Analysis and Response Spectrum Method

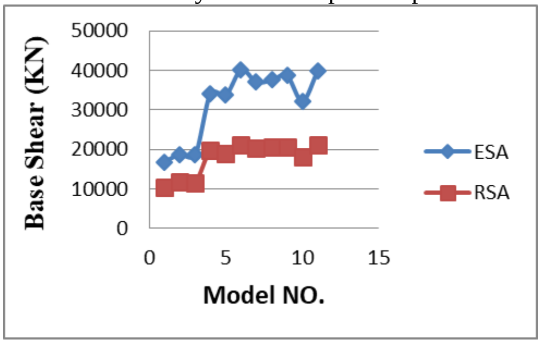


Fig. 3: Comparison of seismic base shear between ESA and RSA in x-direction

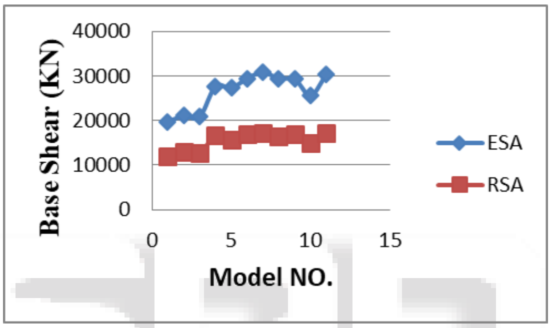


Fig. 4: Comparison of seismic base shear between ESA and RSA in y-direction

Maximum drift				
Model No	Equivalent Static		Response spectrum	
	X-	Y-	X-	Y-
1	9.31	10.57	6.23	5.67
2	9.66	10.52	6.58	5.95
3	9.52	10.92	6.51	5.88
4	3.43	4.76	1.96	2.52
5	3.86	6.07	2.15	2.81
6	4.55	6.50	2.44	2.97
7	5.21	6.77	2.31	3.04
8	4.26	6.60	2.34	2.97
9	4.46	6.44	2.41	2.97
10	3.73	5.68	2.05	2.67
11	4.52	6.70	2.44	3.04

Table 3: comparison of storey drift between ESA and RSA for all models in x and y directions.

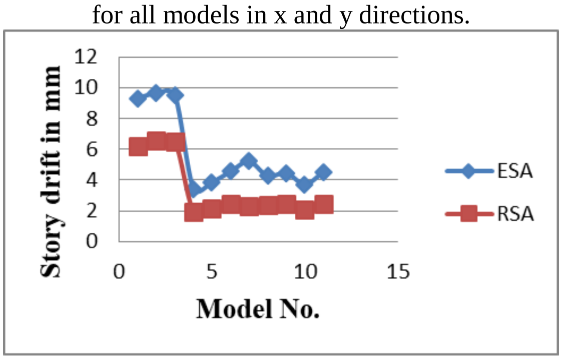


Fig. 5: Storey Drift vs. Model for Different Models along X-Direction by ESA and RSA

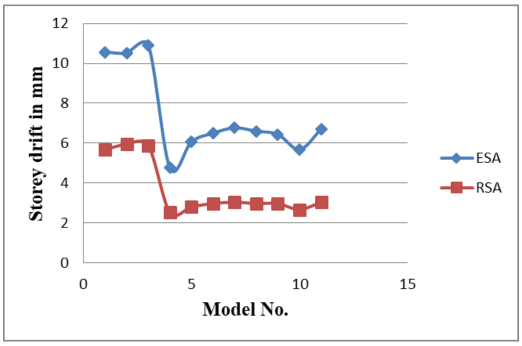


Fig. 6: Storey drift Vs. Model for different models along y-direction by ESA and RSA

Maximum displacement				
Model No	ESA		RSA	
	x-	y-	x-	y-
1	64.11	76.38	36.55	33.87
2	61.34	75.98	35.73	34.27
3	61.27	75.93	35.51	33.99
4	43.95	62.20	22.33	27.66
5	43.92	63.52	22.51	27.65
6	39.59	61.30	19.85	26.44
7	41.35	60.38	20.94	25.34
8	40.17	63.01	20.94	26.57
9	40.15	61.98	20.48	26.89
10	44.79	65.97	23.14	29.08
11	40.23	62.08	20.25	26.12

Table 4: Comparison of Storey Displacement between ESA and RSA for All Models in X and Y-Direction.

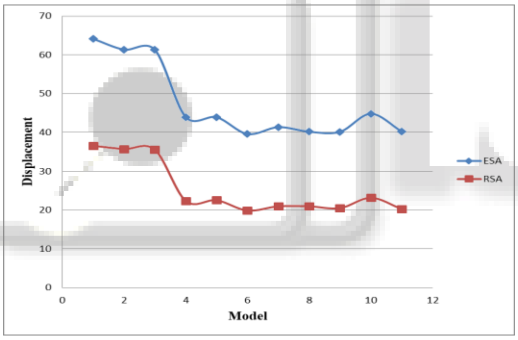


Fig. 7: Storey Displacement vs. Model for Different Models along x-Direction by ESA and RSA

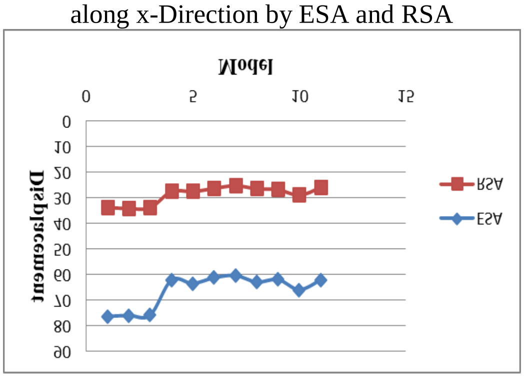


Fig. 8: Storey Displacement vs. Model for Different Models along y-Direction by ESA and RSA

From above table 1 it is observed that the time period is obtained by ETABS analysis. The table shows time period for model 2 reduce by 2.46% as compared to bare frame model 1. For model with intermediate soft storey i.e. model 3 reduce by 1.26% is less than that obtained from model 2. For models with shear walls i.e. model 4,5,6,7,8,9,10 and 11time period reduced by 32.30%, 31.49%, 36.19%, 39.10%, 35.76%, 35.55%, 26.66% and 37.22% respectively compared to model 3 Table 2 shows comparison of seismic base shear between equivalent static analysis and response spectrum method in which equivalent static analysis results show higher values compare to response specturm method. From fig, 3, 4. It is clearly evident that the base shear obtained from RSA procedure is least as compared with ESA. Model 6 (corner C shaped shear wall) yields the highest base shear value from all models in case of ESA (in x-direction and y-direction) and also in case of RSA along x-direction.

Table 3 shows comparison of the highest drift values of all the model by both method of analysis, from that it can be seen that the storey drift in all storey for models (with shear wall) has lower value as compare to that for models (without shear wall) in both the -direction and -directions.

Table 4 shows the comparison of the highest displacement values of all the model by both method of analysis, The average percentage reduction in maximum storey displacement of all the models (from model 4 to 11) is 28.27%, 35.38%, 26.89% (in x-direction) and 18.08%, 20.47%, 13.11% (in y-direction) as compare with model 3 by ESA and RSA respectively.

V. Conclusion

1) The time peroid of bare frame model having higher value as compared to model 3 having masonry infill with soft storey.
2) Fundamental time period reduces when the effect of infill masonry wall and concrete shear wall is considered.
3) Model with U type of shear wall has got least value as compare with bare frame model.
4) By RSA method the base shear value for models with shear walls are higher as compared with model 3
5) As per the code IS 1893(part -1) 2002 the storey drift values are found within the limits.
6) In the upper storeys the presences of floating column reduces storey drift because of increase in stiffness.
7) It is observed that by introducing any type of shear wall the storey displacement is reduce by 50%.
8) The models with C and U shaped shear wall shows lesser storey drift in both x and y-direction.
9) C shaped shear wall show lesser storey displacement in x-direction by RSA
10) It is observed that by introducing any type of shear wall the storey displacement is reduce by 50%.

References

[1] Manju G "Dynamic Analysis of Infills on RC Framed Structures" International Journal Of Innovative Research in Science, Engineering and Technology, Vol.3, Issue 9, September 2014.

[2] Md. Irfanullah, Vishwanath. B. Patil," Seismic Evaluation of RC Framed Buildings with Influence of Masonry Infill Panel", International Journal of Recent Technology and Engineering (IJRTE), Vol.2, Issue-4, pp.117-120, 2013.

[3] WakchaureM R,Ped S. P "Earthquake Analysis of High Rise Building with and without In filled Walls"

International Journal Of Engineering and Innovative Technology (IJEIT) Volume 2,Issue 2,Agust 2012.
[4] Chethan K, "Studies on the Influence of Infill on Dynamic Characteristics of RC Frames", Journal of CPRI, Vol. 5(2), 2009.
[5] Sukumar behera "Seismic analysis of multistorey building with floating column" department of civil engineering national institute of technology Rourkela, odisha-769008, May 2012.
[6] Suchitra Hirde and ganga Tepugade "Seismic performance of Multistorey Building with Soft Storey at Different Level with RC Shear wall", International journal of current engineering and technology Accepted 30 May 2014, Available online 01 June 2014, Vol.4,No.3,June 2014..
[7] P.V.Sumanth Chowdary, Senthil Pandain. M "A Comparative Study on RC Structure with and without Shear wall" International Journal for Science Research & Development Vol.2, Issue 02, 2014.