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Study on Seismic Behaviour of Multistory Building with And Without Soft Story Effect using Masonary Strut

[1]Minal U. Pawar, [2]Prof. M. R. Nikhar, [3]Prof. M. M. Lohe

Abstract— Construction of multi-story buildings with open first stories is common practice in India. This is an unavoidable feature and is generally adopted for parking or reception lobbies. Multistoried buildings with open ground floors are inherently vulnerable to collapse due to earthquake load. This construction is still widespread in developing nations due to the social and functional need for providing car parking space at ground level or at the intermediate story. The engineering community warned against such buildings from time to time it is also known as a weak story due to less substantial resistance than the above story or below. Along with gravity load structure has to withstand lateral load which can develop high stresses which leads to the destruction of buildings. In this paper, the R.C.C. building is modeled and analyzed in two cases. I) Model with in-filled frame single strut approach from 1st story. II) Model with in-filled frame single strut approach with soft story effect. Response spectrum analysis is used for analyzing building models in ETABS. The performance of the building is evaluated in terms of story drift, story displacement, and time period. It is found that the steel braced system significantly contributes to the structural stiffness and reduces the maximum inter-story drift, lateral displacement of R.C.C building. The results of different systems are discussed and conclusions are made.

Keywords— Story Drift, Story Displacement, Time Period, Response Spectrum Analysis, Soft Store

I. INTRODUCTION

Earthquake is a spontaneous event and behaves quite differently. The force generated by seismic action of earthquake is different than other types of loads, such as, gravity and wind loads. It strikes the weakest spot in the whole three dimensional building. Now a day high rise buildings have become a trend and, moreover, they have paved the way to world competition in constructing tall buildings to exhibit the symbol of power and technology possessed by its population. Construction of multi-storey building with open first story is common practice in India. This is unavoidable feature and is generally adopted for parking or reception lobbies. Such as building in which the upper story have brick infill wall panel and open ground story is called as stilt building and open story is called stilt floor or soft story. A soft story is also known as weak story it is the story in which that has less substantial resistance than above story or below. Soft stories are subjected to larger lateral loads during earthquakes and under lateral loading. This lateral force cannot be well distributed along the height of structure. This situation causes the lateral forces to concentrate on the story having large displacement. In such buildings, the stiffness of the lateral load resisting systems at those stories is quite less than the stories above or below.

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Minal U. Pawar, *PG Student, Bapurao Deshmukh College of Engineering, Sevagram, Wardha, India.*
Prof. M. R. Nikhar, *Assistant Professor, Bapurao Deshmukh College of Engineering, Sevagram, Wardha, India.*
Prof. M. M. Lohe, *Assistant Professor, Bapurao Deshmukh College of Engineering, Sevagram, Wardha, India*

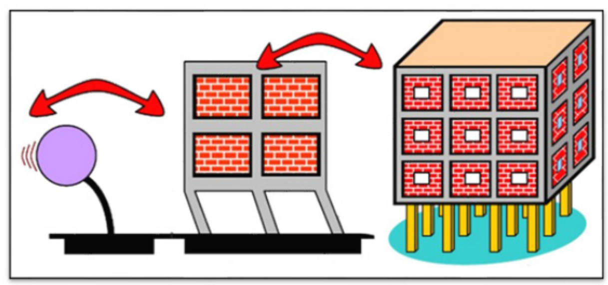


Figure 1: Behaviour of Soft Story Building as Inverted Pendulum.

II. OBJECTIVES OF STUDY

1) To study the different seismic parameters like story displacement, story drift and time period.
2) To find the optimum result of with and without infill wall having soft story effect in RC structure during earthquake.

III. METHOD OF ANALYSIS

Seismic analysis is a major tool in earthquake engineering which is used to understand the response of buildings due to seismic excitations in a simpler manner. In the past the buildings were designed just for gravity loads, but now a day seismic analysis is a recent development in design area which is very important. It is a part of structural analysis and a part of structural design where earthquake is prevalent.

A. Response Spectrum Method

The representation of the maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. The maximum response plotted against of un-damped natural period and for various damping values and can be expressed in terms of maximum absolute acceleration, maximum relative velocity or maximum relative displacement. For this purpose response spectrum case of study are performed according to IS 1893. A response spectrum is simply a plot of the peak or steady-state response displacement, velocity or acceleration of a series of oscillators of varying natural frequency that are forced into motion by the same base vibration or shock.

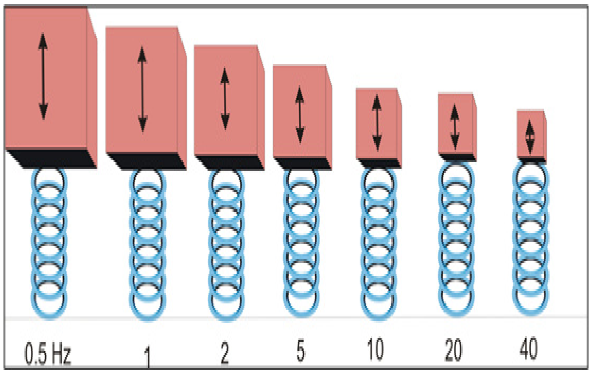


Figure 2: Series of oscillators of varying natural frequency

B. Modelling Of Building

A unsymmetrical building is assumed for seismic analysis that consists of R.C.C. residential building. The multi-story building are modelled in five different configurations are as follows-

Model 1: Model with in-filled frame single strut approach from 1st story.

Model 2: Model with in-filled frame single strut approach with soft story effect.

C. Building Features

Structure	SRMF (R=5)
Floors	G + 6
Ground storey height	3 m
Typical storey height	3 m
Height of building	21 m
Length of building	15 m
Width of building	9 m
Tx	0.487 sec
Ty	0.630 sec
Soil type	Medium (II)
Seismic zone	III
Importance factor	1.2
Live load	3 kN/m^2 (Typical Floor) 1.5 kN/m^2 (Terrace Floor)
Floor finish	1 kN/m^2
Wall load	External wall - 12.74 kN/m Internal wall - 6.371 kN/m Parapet wall - 4.6 kN/m
Size of beam	300 X 450, 300 X 600
Size of column	450 X 450
Size of strut	Width – 230 mm Height – 390 mm

The E-TABS software is used to develop 3D model and to carry out the analysis. Dynamic analysis of the building models is performed on ETABS. The lateral loads generated by ETABS correspond to the seismic zone III and the 5% damped response spectrum given in IS: 1893-2016.

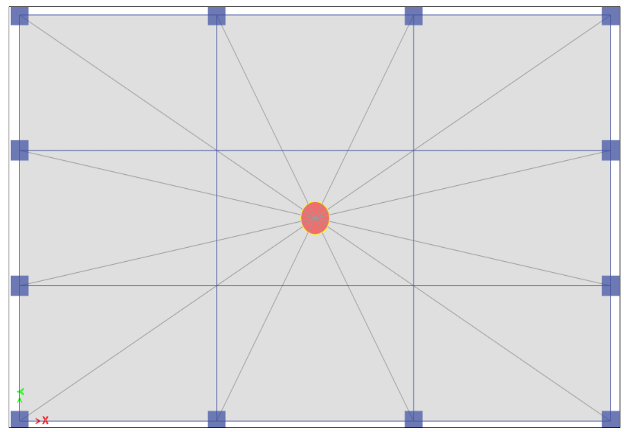


Figure 3: Plan of building

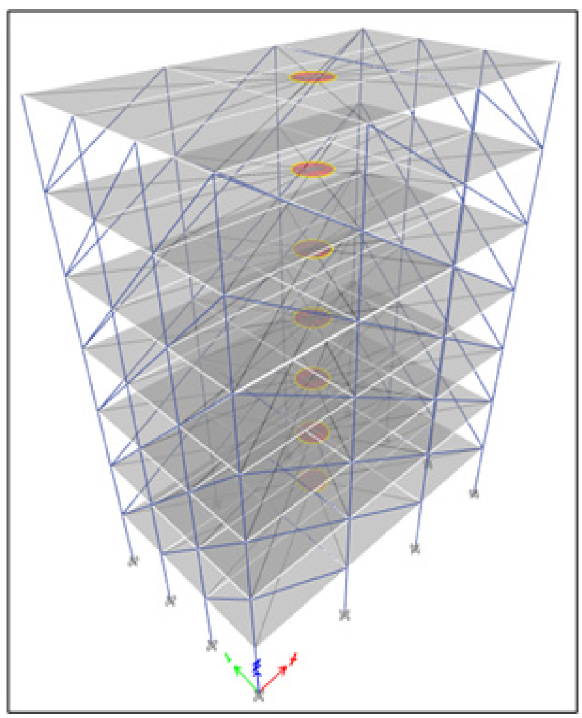


Figure 4: 3D View of Model with in-filled frame single strut approach from 1st story.

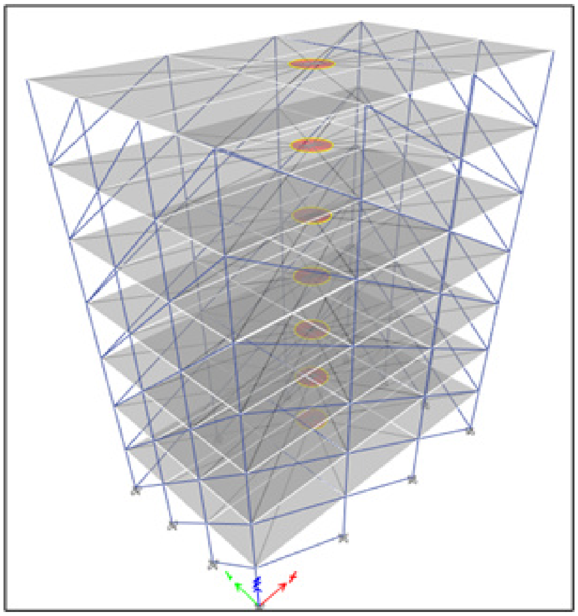
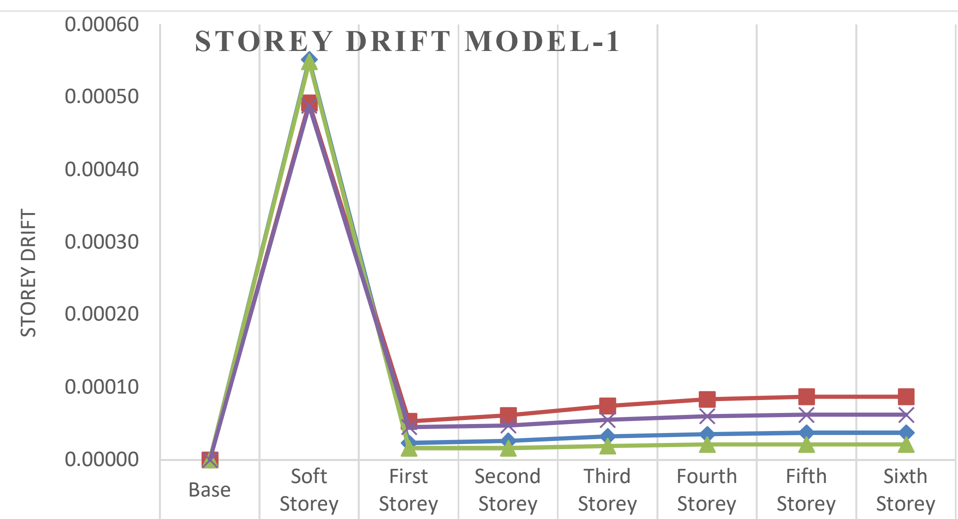


Figure 5: 3D View of Model with in-filled frame single strut approach with soft story effect.

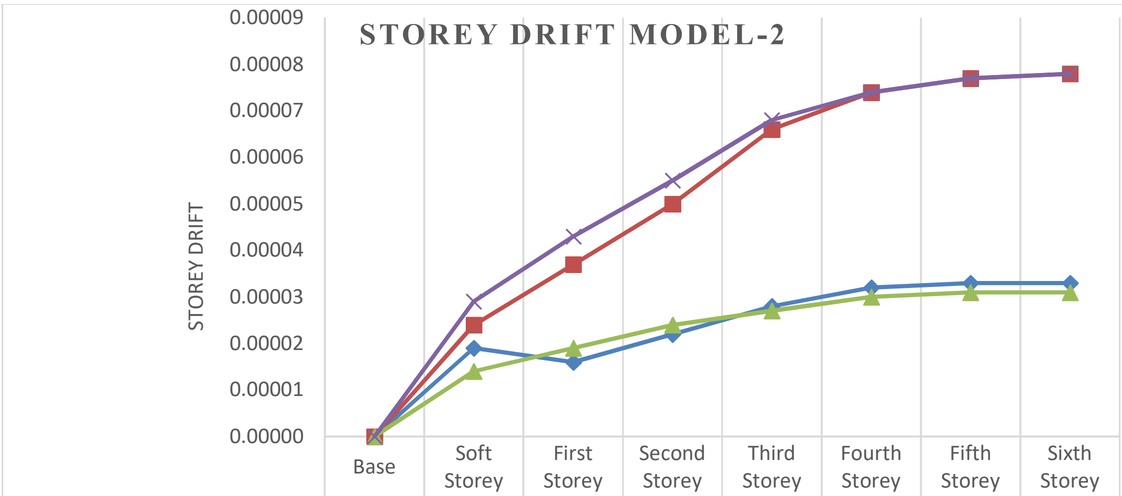
IV. Results

A. Results or Storey Drift



	Base	Soft Storey	First Storey	Second Storey	Third Storey	Fourth Storey	Fifth Storey	Sixth Storey
Static Analysis (EQX)	0.00000	0.00055	0.00002	0.00003	0.00003	0.00004	0.00004	0.00004
Static Analysis (EQY)	0.00000	0.00049	0.00005	0.00006	0.00007	0.00008	0.00009	0.00009
Dynamic Analysis (RSAX)	0.00000	0.00055	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Dynamic Analysis (RSAY)	0.00000	0.00049	0.00005	0.00005	0.00006	0.00006	0.00006	0.00006

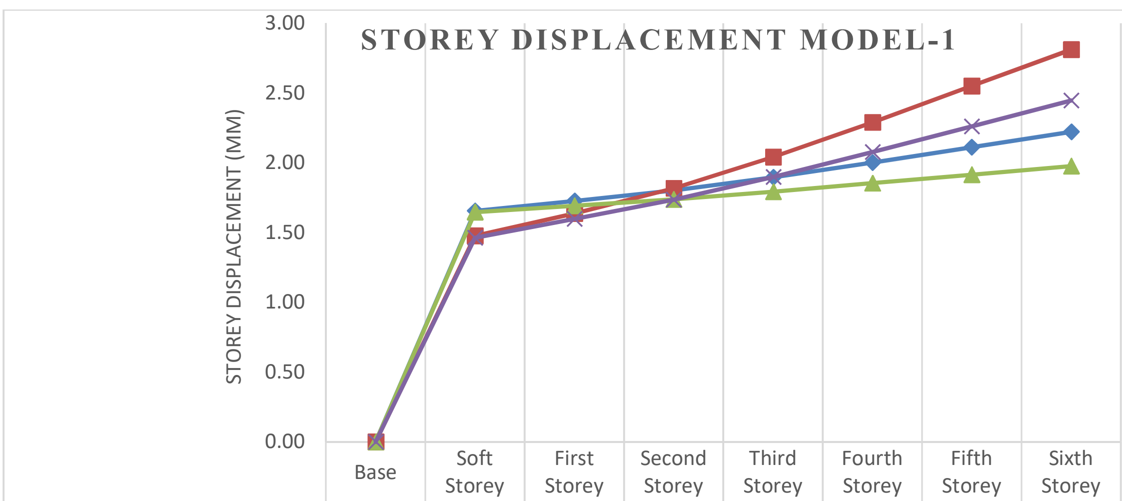
Figure 6: Storey Drift Results for Equivalent Static Analysis and Response Spectrum Analysis. (Model-1)



	Base	Soft Storey	First Storey	Second Storey	Third Storey	Fourth Storey	Fifth Storey	Sixth Storey
Static Analysis (EQX)	0.00000	0.00002	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003
Static Analysis (EQY)	0.00000	0.00002	0.00004	0.00005	0.00007	0.00007	0.00008	0.00008
Dynamic Analysis (RSAX)	0.00000	0.00001	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003
Dynamic Analysis (RSAY)	0.00000	0.00003	0.00004	0.00006	0.00007	0.00007	0.00008	0.00008

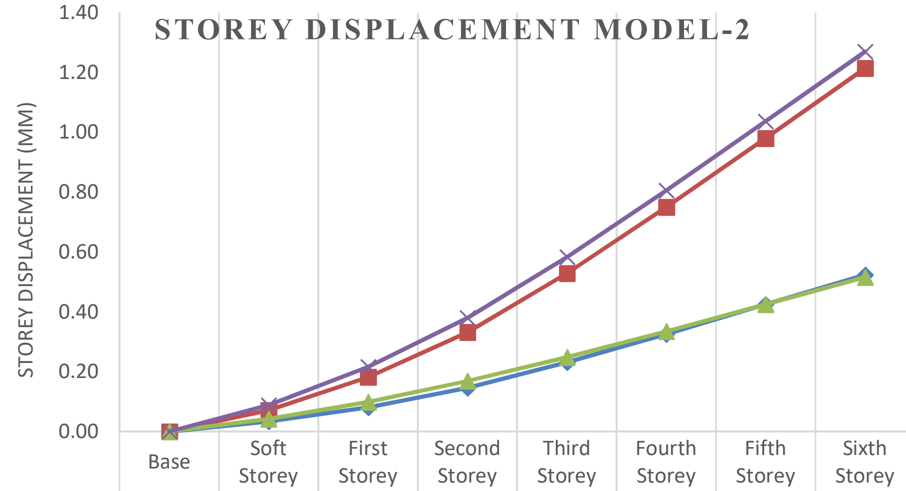
Figure 7: Storey Drift Results for Equivalent Static Analysis and Response Spectrum Analysis. (Model-2)

B. Results for Storey Displacement



	Base	Soft Storey	First Storey	Second Storey	Third Storey	Fourth Storey	Fifth Storey	Sixth Storey
Static Analysis (EQX)	0.00	1.66	1.73	1.80	1.90	2.00	2.11	2.22
Static Analysis (EQY)	0.00	1.48	1.64	1.82	2.04	2.29	2.55	2.81
Dynamic Analysis (RSAX)	0.00	1.65	1.69	1.74	1.79	1.85	1.92	1.98
Dynamic Analysis (RSAY)	0.00	1.46	1.60	1.74	1.90	2.08	2.26	2.45

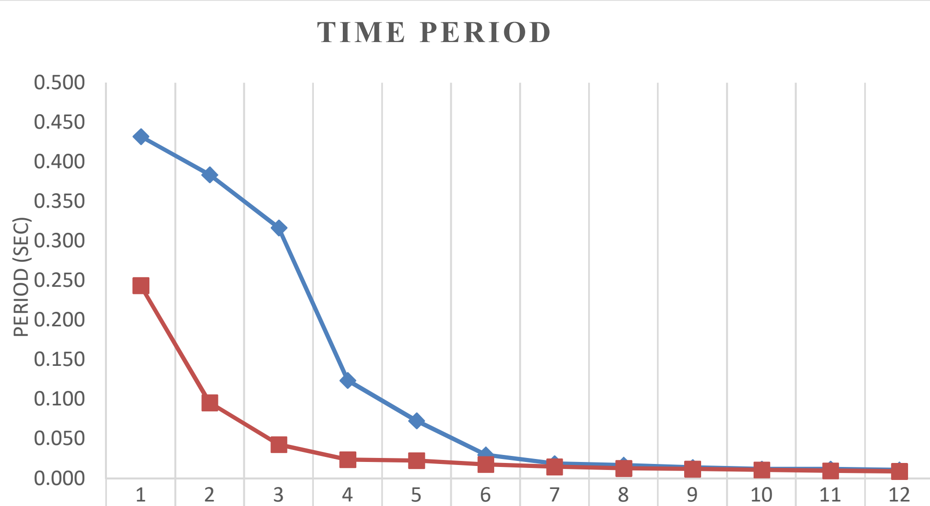
Figure 7: Storey Displacement Results for Equivalent Static Analysis and Response Spectrum Analysis. (Model-1)



	Base	Soft Storey	First Storey	Second Storey	Third Storey	Fourth Storey	Fifth Storey	Sixth Storey
Static Analysis (EQX)	0.00	0.03	0.08	0.15	0.23	0.33	0.43	0.52
Static Analysis (EQY)	0.00	0.07	0.18	0.33	0.53	0.75	0.98	1.22
Dynamic Analysis (RSAX)	0.00	0.04	0.10	0.17	0.25	0.34	0.43	0.52
Dynamic Analysis (RSAY)	0.00	0.09	0.22	0.38	0.58	0.81	1.04	1.27

Figure 8: Storey Displacement Results for Equivalent Static Analysis and Response Spectrum Analysis. (Model-1)

C. Results for Time Period



	1	2	3	4	5	6	7	8	9	10	11	12
Period (Model-1)	0.432	0.384	0.317	0.124	0.073	0.030	0.019	0.017	0.014	0.012	0.012	0.011
Period (Model-2)	0.244	0.096	0.043	0.024	0.023	0.018	0.015	0.013	0.012	0.011	0.010	0.009

Figure 9: Time Period Results for Model-1 and Model-2

V. Conclusion

1) According to the results observed using equivalent static method and response spectrum method, the lateral load is zero at the ground and maximum at the storey for all the structures.

2) As comparison in soft storey floor, storey drift is maximum

for model-1 as compare to model-2 due to absence of masonary strut.

3) The storey drift for all the stories is found to be within the permissible limits as per code.

4) It is observed that the time period for model-2 gets reduced due to presence of strut effect.

5) Soft storey should be design as per code provisions and proper strut should be provided to avoid from damges.

VI. FUTURE SCOPE

1) Different bracing system will be adopting to get more accurate and feasible results.

2) Different shapes of shear wall system will be adopted to get different results.

3) For open storey consideration different location of soft storey will be adopt for future reference.

REFERENCES

[1] B Shivakumara Swamy1, S K Prasad2, Sunil N3"Influence of Strong Column & Weak Beam Concept, Soil Type And Seismic Zone on Seismic Performance of RC Frames From Pushover Analysis", IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308.

[2] Kumbhar S. S 1,Rajguru R. S2"Seismic Analysis of Masonry Infill in Multi-Storey RC Buildings", International Journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 6, June 2015.

[3] C.Rajesh1,Dr.RamancharlaPradeep Kumar2, Prof. SureshKandru3"Seismic performance of rc framed buidlings with & without infill walls", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181IJERTV3IS100280 Vol. 3Issue 10, October- 2014.

[4] C V R Murt1, Sudhir K Jain2 "Beneficial influence of masonry infill walls on seismic performance of rc frame buildings", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181IJERTV3IS100280 Vol. 3 Issue 10, October- 1997.

[5] Basavaraju Y K 1, Dr. B S Jayashankar Babu2"Seismic Performance of Multi Storey RC Frame Buildings with Soft Storey from Pushover Analysis", International Journal of Engineering Science and Computing, July 2016, Volume 6 Issue No. 7.

[6] Kiran Tidke1, Sneha Jangave2 "Seismic Analysis of Building with and Without Infill Wall", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization)Vol. 5, Issue 7, July 2016.

[7] A. Koçak1, A. Kalyoncuo lu2& B. Zengin3 "Effect of infill wall and wall openings on the fundamental period of RC buildings", WIT Transactions on The Built Environment, Vol 132, © 2013 WIT Press doi:10.2495/ERES130101.