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Seismic Effect of Infilled Wall with and without on RC Frame

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Abstract: *The main purpose of the presented paper is the investigation of the dynamic parameters of reinforced concrete frames with and without infill walls. Moreover, lateral strength, stiffness and time of collapse of the frames are also studied. In order to achieve the purpose a G+6 storey building was designed and then IDARC software was used to observe the influence of infill walls on RC frame structure. In the pressent study seismic effect of infilled wall with and without on G+6 RCC frame such as Complete filled Frame,Bared frame, soft storey frame and partially infilled frame . The Non linear time history analysis for Elcentro and sanfernando earthquake is done and result are interpreted & compared for drift ratio, Storey drift, floor displacement, storey shear,and overall damage index.*

Key words: *Drift ratio, storey drift, storey shear, displacement, overall damage index.*

1.Introduction:

In Reinforced concrete structure the masonry infill walls are treated as nonstructural element in structural analysis and only the contribution of its mass for is considered and it's structural parameters like strength and stiffness is generally ignored in practice, such an approach may lead to an unsafe design. The effect of masonry infill panel on the response of RC frames subjected to seismic action is widely recognized and infill behaves like compression strut between column and beam and compression forces are transferred from one node to another. Infill walls resist lateral loads but because of the openings in the infill wall the resistance may slightly reduce. The IS code provisions do not provide guidelines for the analysis and design of RC frames with infill wall and for different percentage of openings. So it is essential to consider the effect of masonry infill for the seismic evaluation of moment resisting reinforced concrete frame. Though it has been understood that the infills play significant role in enhancing the lateral stiffness of complete structure, the past experience in various earthquakes have proved that the partially infilled framed structures somehow are affected adversely.

Many of the residential & commercial building are constructed with parking floor open without the infill, these structure lead to soft storey problem. To avoid these soft storey problem the many techniques are adopted such as diagonal bracing in parking area, provision of infill, increase of column size in lower floor etc. but these technique are not being adopted in large scale. Because of practical problem like space utilization of parking, reduction in parking space, and also obstruct the runway of parking vehicle. Due to the considerations of occupancy and architectural appearance, especially in the entrance floor and on one of the intermediate levels, inner sections between columns and outer walls are not constructed in the way they are done in other storeys or rigidity of the single structures in the storey are different. These sections in the buildings are generally used for covered parking space, for installations and lightening, for commercial aspects etc.Form the studies and investigation of the Earthquake results; it is observed that partitioning walls and beam increase the stiffness of that floor. Although irregularities in mass make the structure soft, it is observed that most of the damage constructions suffered result in this kind of soft story failure. In the current study the focus, depending on the investigations on soft storeys analysis effect and its remedial approach to minimise the damage of structure.

This paper includes the Non linear time history analysis of G+6 storey building with different infill structure such as Completely filled (CF), Bared frame (BF), Soft storey frame (SS) and partially infilled frame (PI).The analysis is done for different earthquake frequency like Elcentro, sanfernando and result are interpreted. The parameter like Drift ratio (%), storeys drift (KN), Displacement of all floors (mm) and storey shear (KN) for all the configurations. These results are generated from IDARC software.

2. Objectives:

Considering the review of all literature the work is having following objectives.

1. To study effect of irregular masonry infill distribution in RC elevation under seismic loading.
2. To retrofit the masonry infill RC frame under seismic loading To understand the effect of infill panels/walls during the earthquake.
3. To assess the R/C frames with infill walls with different configuration of infill.
4. To assess the irregular masonry infill distribution in R/C frame under seismic loading.
5. To assess the R/C frame for soft storey with normal frame option
6. Come up with the decision making conclusion to avoid the dynamic analysis

3.Investigation and Load calculations:

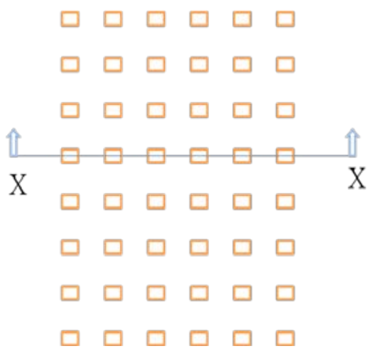
The plan and verious configuration of of frame such as completely filled (CF), bared frame (BF), soft storey frame (SS), partially filled (PI) are analysed by using IDARC software with cosidaration of following.

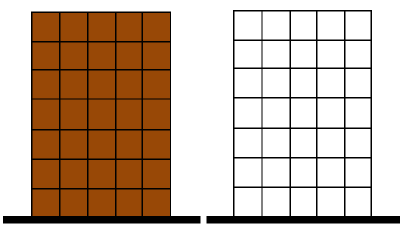
- Column size – (300 X 500) mm
- Beam size –(230 x450) mm
- Material property
  Grade of concrete – M20
  Grade of steel – Fe415

Load calculation

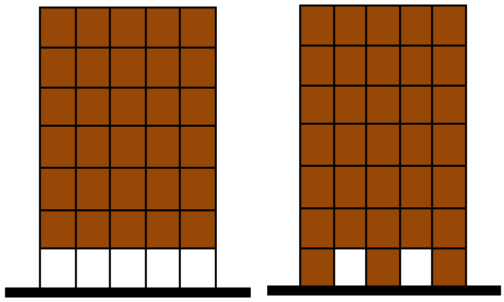
Weight of masonry infilled – 18 kN/m^2

- Dead Load – 3.125 kN/m
- Live load – 3.0 kN/m^2
- Floor finish load – 18 kN/m^2





Completely Infill (CF) Bared Frame (BF)



Soft Storey (SS) partially infilled (PI)

4. Analysis result and discussion

The Non linear time history analysis is performed for Elcentro and Sanfernando earthquake for different configuration of infill also is analyzed in IDARC software. The following results are obtained. These results are compared for different the combination of infill as shown in table. i.e. for Completely filled (CF), Bared frame (BF), Soft story (SS), partially infilled (PI) and results are obtained in the form drift ratio()%, storey drift(KN) ,Floor displacement(mm), Storey shear(KN), Over structural damage Index (OSD).

4.1 Analysis result comparison

1.For Elcentro Earthquake

a) Result of Completely filled frame(CF)

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacement (mm)	Storey shear (kN)
6	0.06	1.6566	53.1087	455.85
5	0.09	2.5613	52.2004	713.18
4	0.11	3.4088	50.3959	905.67
3	0.23	7.0246	40.2870	1148.18
2	0.46	13.8201	40.3928	1398.25
1	0.56	16.8662	27.4545	1470.38
G	0.38	11.3860	11.3860	1563.82

b) Result of Bared frame(BF)

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacement (mm)	Storey shear (kN)
6	0.18	5.4695	131.9825	210.06
5	0.41	12.3928	129.2882	300.56
4	0.69	20.7500	120.0496	353.72
3	0.94	28.2564	100.9382	437.31
2	1.05	31.6258	73.7994	422.96
1	0.94	28.3233	42.2310	384.91
G	0.46	13.5232	13.9252	451.78

c) Result of Soft storey frame(SS)

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacement (mm)	Storey shear (kN)
6	0.04	1.1839	63.4244	339.27
5	0.06	1.8257	62.5170	498.57
4	0.09	2.7270	60.8871	676.50
3	0.11	3.3500	58.5409	827.43
2	0.20	6.1069	55.5705	990.49
1	0.68	20.3284	49.5205	1176.84
G	0.98	29.2518	29.2518	1237.17

d) Result of Partially infilled frame(PI)

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacemen t (mm)	Storey shear (kN)
6	0.05	1.3761	57.3563	390.21
5	0.07	3.3946	55.8634	534.31
4	0.10	5.3652	52.9785	731.36
3	0.17	9.6134	44.6315	983.24
2	0.31	16.6532	43.1632	1106.63
1	0.48	23.3325	33.6973	1263.26
G	0.68	18.2156	18.2156	1350.35

2.For Sanfernandopeer Earthquake

a) Result of completely filled feame(CF)

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacement (mm)	Storey shear (kN)
6	0.07	2.0372	357.5818	487.12
5	0.13	3.8098	353.2351	786.82
4	0.47	14.1700	350.1668	1027.17
3	1.65	49.3789	336.3967	1201.87
2	3.0	89.9015	287.2739	1393.96
1	3.64	109.3147	197.3938	1591.98
G	2.94	88.1187	88.1187	1864.98

b) Result of Bared frame(BF)

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacemen t (mm)	Storey shear (kN)
6	2.19	65.6207	499.6288	442.56
5	2.53	75.9972	487.4644	475.78
4	2.96	88.9434	449.017	530.02
3	3.47	103.9650	376.9883	632.29
2	3.62	108.6874	284.9659	644.94
1	3.42	102.6102	184.6417	728.89
G	2.78	83.4675	83.4675	765.08

c) **Result of soft storey frame(SS)**

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacement (mm)	Storey shear (kN)
6	0.04	1.3355	458.1799	366.81
5	0.08	2.3746	457.4317	684.04
4	0.19	5.6600	456.1801	841.37
3	0.84	25.3200	452.8759	1038.22
2	2.69	80.8198	433.8432	1138.56
1	6.24	187.0505	360.2703	1373.36
G	5.94	178.1256	178.1256	1488.15

d) Result of partially infilled frame(PI)

Storey no.	Drift ratio (%)	Storey drift (mm)	Displacement (mm)	Storey shear (kN)
6	0.06	1.8346	401.3624	416.64
5	0.11	3.0167	396.9857	710.17
4	0.32	11.6976	393.6254	946.32
3	1.15	37.4315	380.3629	1104.98
2	2.80	83.6134	311.1637	1264.34
1	4.20	156.3153	279.8641	1470.69
G	3.43	135.9746	135.9746	1683.49

4.2 Damage index comparison

a) for Elcentro Earthquake

Earthquake	Type of structure	Damage index
Elcentro Earthquake	Completely filled (CF)	0.070
	Bared frame (BF)	0.113
	Soft storey frame (SS)	0.236
	Partially infilled (PI)	0.137

b) for Elcentro Earthquake

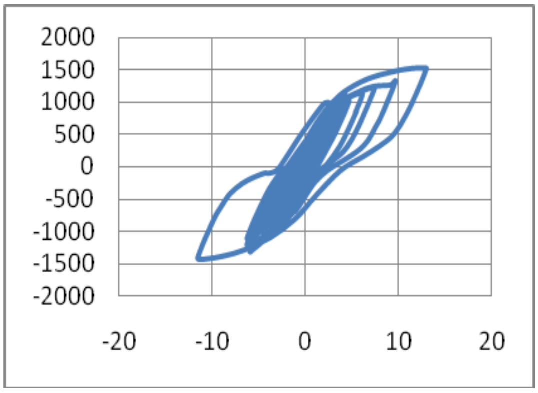
Earthquake	Type of structure	Damage index
Elcentro Earthquake	Completely filled (CF)	0.381
	Bared frame (BF)	0.539
	Soft storey frame (SS)	0.979
	Partially infilled (PI)	0.634

4.3 Hysteric loops for different frame types:

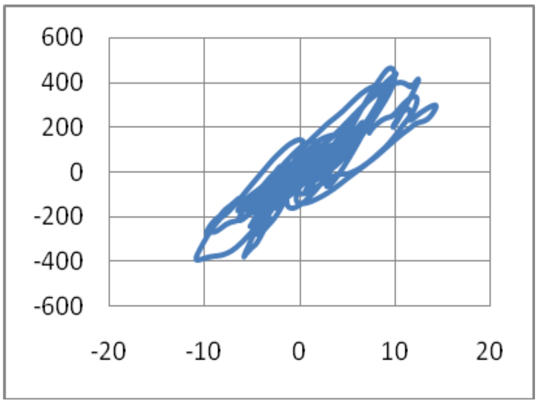
The hysteric behavior is developed for different frame type, shows the graph base shear versus displacement.

1. **For Electro Earthquake**

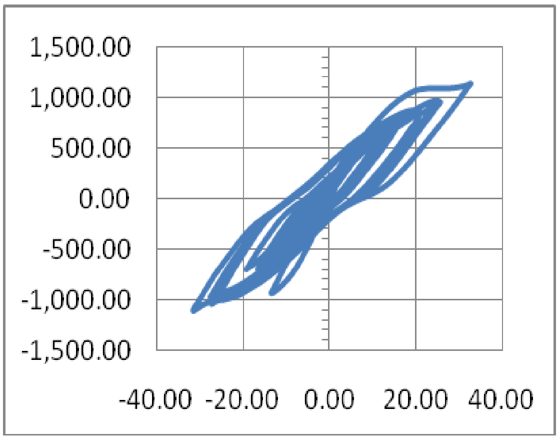
a) Completely filled(CF)



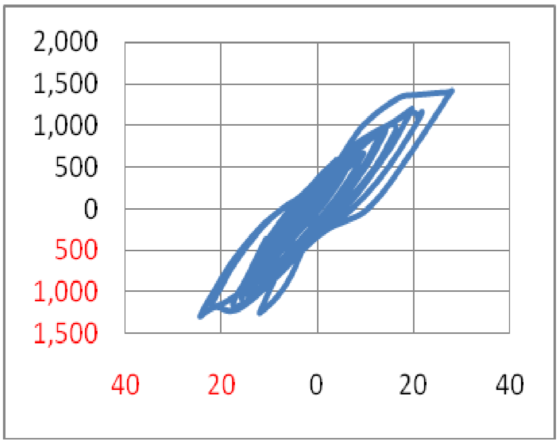
b) Bared frame(BF)



c) Soft storey frame(SS)

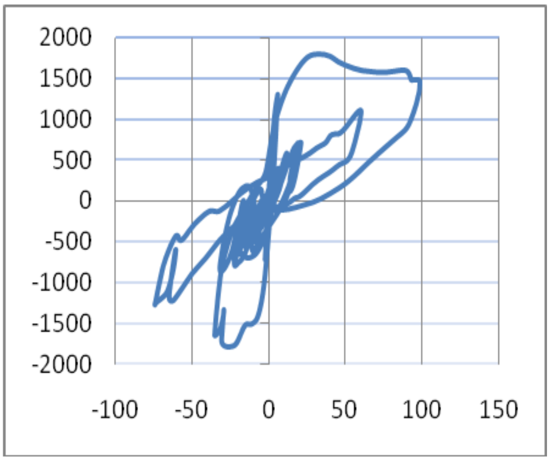


d) Partially infilled(PI)

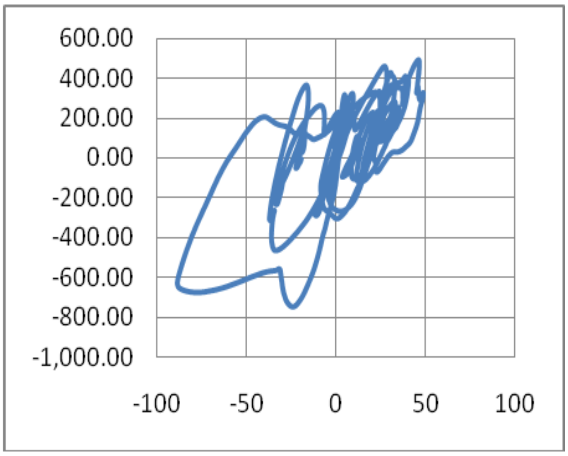


2.For Sanfernandopeer Earthquake

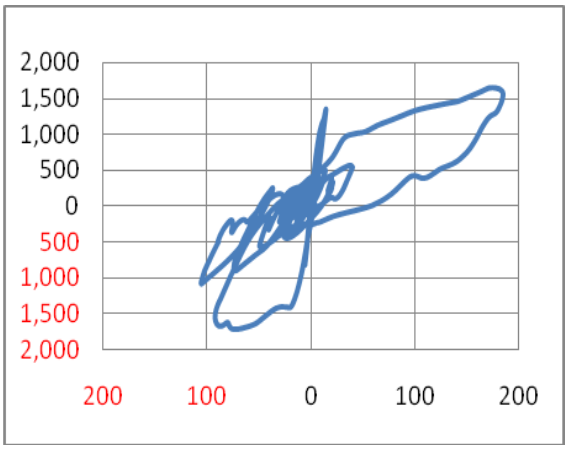
a) Completely filled(CF)



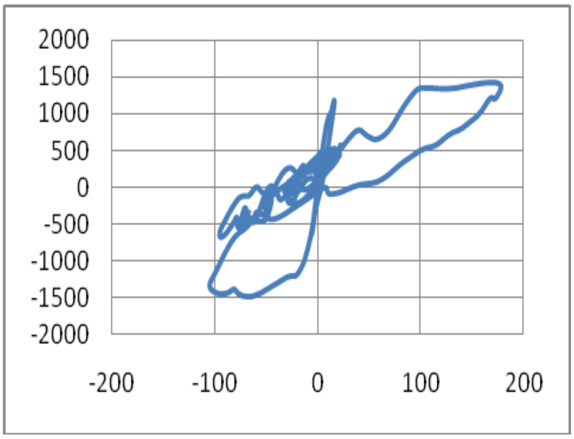
b) Bared frame(BF)



c) Soft storey frame (SS)



d) Partially infilled frame



4.4 Discussion

- BF gives least base shear and CF gives largest base shear and after that PI gives less base shear but greater than SS.
- CF gives least displacement at top and bottom and BF give largest displacement. SS give largest displacement
- BF gives least storey drift and CF gives large storey drift and after that PI gives less storey drift than that of soft storey.
- Performance of the frame can be inhance by adding new infills in soft storey . As in case of improved PI frame.
- The displacement at bottom floor is reduced by adding new infills in soft storey
- The Overall damage index of structure is reduced by providing infilled wall at soft storey.

5. Conclusion

Form the studies and investigation of the Earthquake results; it is observed that partitioning walls and beam increase the stiffness of that floor. Although irregularities in mass make the structure soft, it is observed that most of the damage constructions suffered result in this kind of soft story failure. The structure with soft storey frame perform poor in earthquake, to improve the performance infilled wall can be used effectively In the current study the focus, depending on the investigations on Seismic effect of infilled wall with and without on RC frame with following points

- Completely filled frame gives least displacement at top and bottom, SS give largest displacement
- Completely filled frame ,bared fram frame, partially infilled frame gives least Drift ratio and storey drift at top and bottom, SS give largest Drift ratio and storey Drift.
- BF gives least base shear and CF gives largest base shear and after that PI gives less base shear but greater than SS.
- Performance of the frame can be inhance by adding new infills in soft storey . As in case of improved PI frame.
- The displacement at bottom floor is reduced by adding new infills in soft storey
- The Overall damage index of structure is reduced by providing infilled wall at soft storey.
- The dynamic analysis is avoided for the structure .
- The soft storey failure can be avoided by providing infilled wall at soft storey level.

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