Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 2, No. 1, February : 2023

"COMPARATIVE ANALYSIS OF MULTISTOREY BUILDING BY USING SHEAR WALLS AND INFILL WALLS AND IT'S COMBINATION IN SEISMIC ZONE II AND ZONE V "

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ABSTRACT
Earthquake resistant structures are designed to protect buildings from earthquakes. While no structure can be entirely immune to damage from earthquakes, the goal of earthquake-resistant construction is to erect structures that fare better during seismic activity than their conventional counterparts. According to building codes, earthquake-resistant structures are intended to withstand the largest earthquake of a certain probability that is likely to occur at their location.
In the present study a G+12 story is modeled by using ETABS software and analyzed in Response spectrum analysis and the comparison is made between the general building, shear wall buildings, in fill wall building and combination of both shear wall and in fill walls to design the earth quake resistant structures design. The results like story drift, story shear, story moment, building torsion, time period, frequency values and storey acceleration are compared.

Key words: Earthquake, Response spectrum analysis, story drift, story shear, story moment, building torsion, time period, model frequency, storey acceleration.

INTRODUCTION
Earthquakes are considered one in all nature's most high-quality risks to life within the international and function decimated incalculable urban regions and cities on for all intents and purposes every landmass. They are one in every of guy's maximum dreaded regular marvels due to real seismic tremors delivering tremendously instantaneous pulverization of systems and great structures. Furthermore, the damage due to Earthquakes is on the complete connected with synthetic structures. As in the times of avalanches, seismic tremors likewise cause passing with the aid of the harm they instigate in structures, for instance, structures, dams, spans and top notch works of guy. Sadly massive numbers of Earthquakes supply nearly no or no note before taking region and that is one reason why Earthquake constructing is complex.

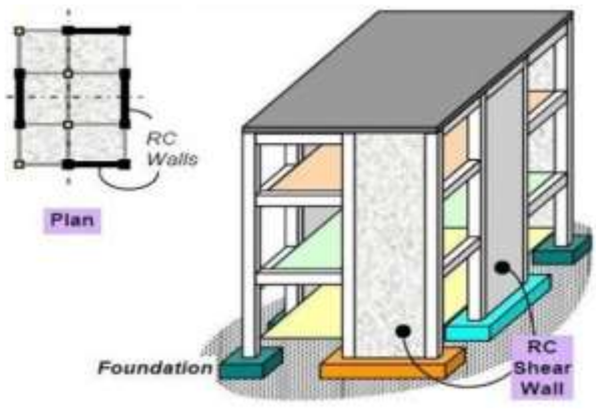

Figure 1. Shear wall

Shear walls are upward solidifying factors intended to look up to parallel forces applied via wind or seismic tremor. The structure and space of shear wall wide spreadly affect their primary direct underneath sidelong hundreds.

Figure 2. Infills Wall

Earthquake is responsible for ground motion in random fashion, both horizontally and vertically, in all directions radiating from the epicenter. Consequently, structures founded in ground vibrate, inducing inertial forces on them. The structures in high seismic areas are greatly vulnerable to severe damages. Apart from the gravity load structure has to withstand to lateral load which may develop high stresses.

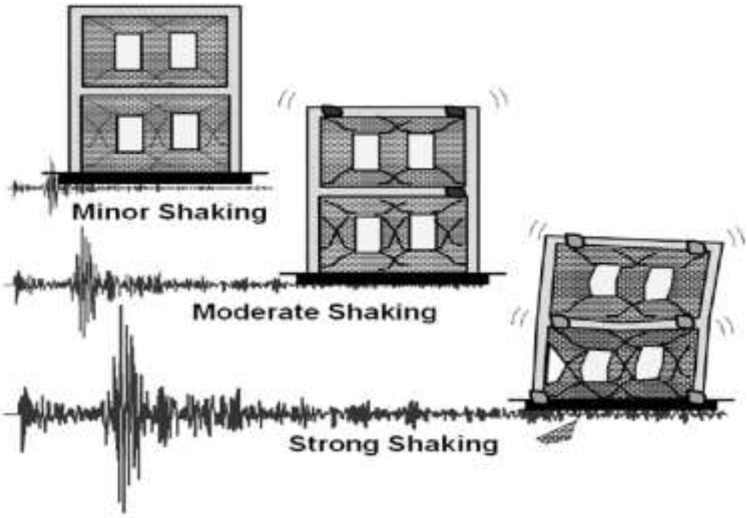

Figure 3 Earthquake resistant design philosophy for different levels shaking

The seismic zone factor, Z, is a value in the code that relates the realistic values of effective peak ground acceleration when MCE and the structure's service life are taken into account. The design approach recommended by IS 1893-2002 is based on the following principles.

1. Minor earthquakes smaller than DBE should have no effect on the building's structural integrity.
2. A DBE earthquake should have little effect on the structure, however some non-structural damage may occur.

The building must be able to survive an earthquake of magnitude MCE without collapsing in order to prevent human fatalities.

LITERATURE REVIEW

Ehsan Salimi Firoozabad, Dr. K. Rama Mohan Rao, Bahador Bagheri.,et al[1] (2012)

The major goal of this research is to discover the seismic performance impact of shear wall design. Buildings with varying numbers of storeys and varied layouts based on the same plan have all undergone time history study. All models' top storey displacements have been calculated and compared to see how shear wall design affects seismic performance. The study of model analysis and design based on IS codes was carried out with the aid of SAP 2000 software.

Shahzad Jamil Sardar and Umesh. N. Karadi., et al[2] (2013)
This project presents a study of a 25-story structure in Zone V with some exploration that is studied by altering the location of the shear wall to determine characteristics such storey drift, storey shear, and displacement using the standard programme ETAB. Creation of a 3D building model for linear static and linear dynamic methods of analysis and the effect of the concrete core wall given in the middle of the structure.
Mr.K.LovaRaju, Dr.K.V.G.D.Balaji., et al[4] (2015)
This study examines the non-linear frame analysis for different shear wall locations in a building frame. Identifying an appropriate shear wall placement in a multi-story building is the goal of this research. When it comes to structural systems, model one has a bare frame, while the other three have a dual type system. Buildings in seismic zones II, III, IV, and V are subjected to an earthquake load under Code Provision IS1893-2002. ETABS software was used to do the analysis.
Varsha R. Harne et al[5]., (2014)
The primary goal of this study is to locate the shear wall in a multistory building. Consider a six-story RCC structure in NAGPUR that is vulnerable to seismic loads in zone II. The seismic coefficient technique of IS 1893 (PART–I):2002 is used to determine an earthquake load. STAAD Pro was used to conduct the research. The strength of a multistory building's RC shear wall was tested using several shear wall locations.
R.S.Mishra, V.Kushwaha, S.Kumar,et al[7] (2015)
Structures made of RC (Reinforced Concrete) can move laterally during an earthquake. For the most part, reinforced concrete buildings (RC structures) are only intended to hold up under gravitational loads; they ignore the effects of lateral seismic stresses. The focus of this research is on understanding how seismic activity affects structures (Special Moment Resisting Frame, SMRF). To conduct the research, researchers utilised STAAD.PRO software, as well as ISO 1893:2002, ISO 13920, and ISO 456 standards. Each of the building's five bays has a span of 4 metres, while floor-to-floor heights range from 3 metres to 2.80 metres.
Mohammed Nauman[1], Nazrul Islam[2] et al.,(2014)
In this study two G+11 storeyed structure models are generated. In one structure, brick infill walls are modelled as strut element. These struts act as a compression members. In the other structure, only bare frame structure is modelled. All the parameters i.e. beam sizes, column sizes, floor height; load parameters etc are same for both the structures.
B Neha kumari[1], Tejas D Doshi[2], et al (2017)
A lot of research work is done in last six decades on analysis of infill walls, their behavior when they are subjected to lateral seismic loads, but still there's much more to understand about the behavior of infill walls. The structural designers while designing a structure usually neglect the presence of infill walls in the design and analysis. They are treated as non-structural members. Further the presence of openings in masonry infill walls is an interesting part to be studied. Present work is an attempt to study linear static and dynamic analysis of infill wall with different percentage of openings including shear wall at the building core.

METHODOLOGY
The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2016 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-2016 (part1). The standard response spectra for type of soil considered is applied to building for the analysis in ETABS software. Following diagram shows the standard response spectrum for medium soil type and that can be given in the form of time period versus spectral acceleration coefficient (Sa/g).
This approach permits the multiple modes of response of a building to be taken in to account (in the frequency domain). This is required in many building codes for all except very simple or very complex structures. The response of a structure can be defined as a combination of many special shapes (modes)

that in a vibrating string correspond to the "harmonic" computer analysis can be used to determine these modes for a structure. For each mode, a response is read from the design spectrum, based on the modal frequency and the modal mass, and they are then combined to provide an estimate of the total response of the structure. In this we have to calculate the magnitude of forces in all directions i.e. X, Y & Z and then see the effects on the building. Combination methods include the following:

- absolute - peak values are added together
- square root of the sum of the squares (SRSS)
- complete quadratic combination (CQC) - a method that is an improvement on SRSS for closely spaced modes

The result of a response spectrum analysis using the response spectrum from a ground motion is typically different from that which would be calculated directly from a linear dynamic analysis using that ground motion directly, since phase information is lost in the process of generating the response spectrum.

Figure 4 Grid data

The title of IS 1893-2002 is "Criteria for earthquake resistant design of structures," and part 1 of this code covers general provisions and constructions. The following earthquake magnitudes are taken into account by this code:

1. The design basic earthquake (DBE) is an earthquake that happens at least once within the structure's intended life.
2. Maximum considered earthquake (MCE): According to the code, this is the most severe earthquake that can occur in that location. To get the design basic earthquake, split it by two.

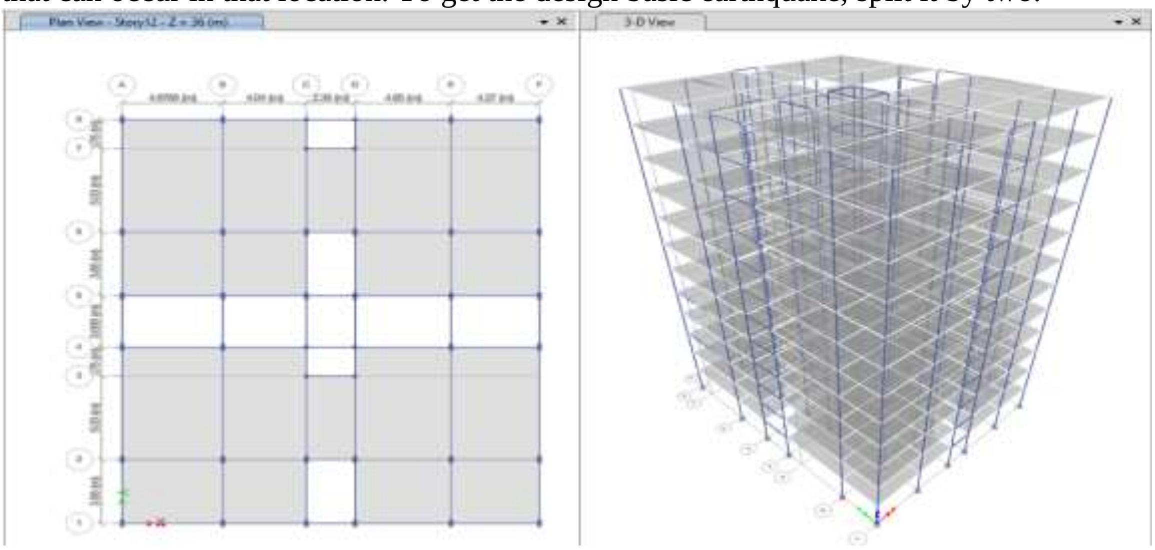

Figure 5 3D Render View of building

Industrial Engineering Journal
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Volume : 52, Issue 2, No. 1, February : 2023

RESULTS AND ANALYSIS

In the present study, analysis of G+ 12 stories building in Zone V seismic zones is carried out in ETABS. Basic parameters considered for the analysis are

1. Utility of Buildings : Residential Building
2. No of Storey : 13 Stories (G+10 Building)
3. Grade of concrete : M40
4. Grade of Reinforcing steel : HYSD Fe500
5. Type of construction : RCC framed structure
6. Dimensions of beam : 230mmX460mm
7. Dimensions of column : 230mmX690mm
8. Thickness of slab : 150mm
9. Thickness of Shear wall : 150mm
10. Height of bottom story : 4m
11. Height of Remaining story : 3m
12. Building height :34m
13. Live load : 5 KN/m^2
14. Dead load : 2 KN/m^2
15. Density of concrete : 25 KN/m^3
16. Loads considered in Buildings : Dead load, Live load, Floor load Earthquake ,Wind load
17. Seismic Zones : Zone V
18. Site type : II
19. Importance factor : 1.5
20. Response reduction factor : 5
21. Damping Ratio : 5%
22. Structure class : B
23. Basic wind speed : 44m/s
24. Method of Analysis : RESPONSE SPECTRUM
25. Wind design code : IS 875: 2015 (Part 3)
26. RCC design code : IS 456:2000
27. Steel design code : IS 800: 2007
28. Earth quake design code : IS 1893: 2016 (Part 1).

Analysis of high rise building is done. In the case of high rise buildings which are irregular in shape, the response spectrum analysis method os more efficient. During the seismic analysis, data in both the “X” and “Y” direction is employed in response spectrum analysis, resulting in more accurate and faster evalution of the building.

RSAX Case

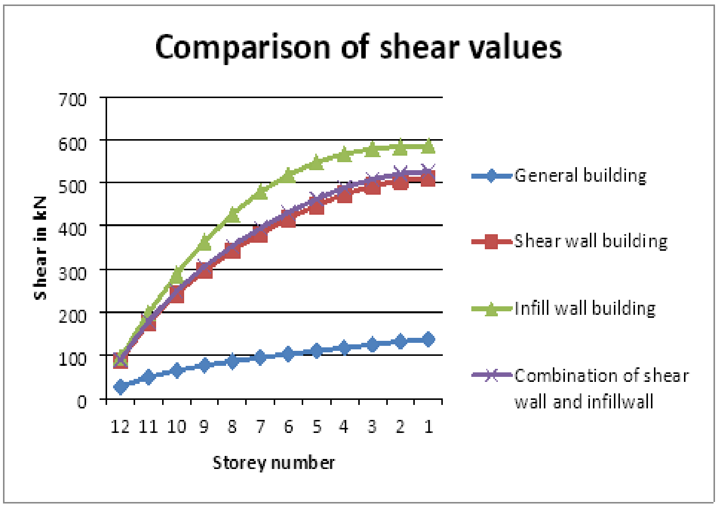
Storey drift

Storey Number	Load case	General building	Shear wall building	Infill wall building	Combination of shear wall and infill wall
12	RS X	0.000123	0.000136	4.00E-06	0.00013
11	RS X	0.000202	0.000137	4.00E-06	0.000131
10	RS X	0.000261	0.000138	4.00E-06	0.000132
9	RS X	0.000305	0.000139	4.00E-06	0.000132
8	RS X	0.000341	0.000138	4.00E-06	0.000131
7	RS X	0.000372	0.000134	4.00E-06	0.000127
6	RS X	0.000399	0.000127	4.00E-06	0.000121

5	RS X	0.000423	0.000116	3.00E-06	0.00011
4	RS X	0.000447	0.000101	3.00E-06	9.60E-05
3	RS X	0.000468	8.10E-05	2.00E-06	7.70E-05
2	RS X	0.00048	5.50E-05	1.00E-06	5.50E-05
1	RS X	0.000369	2.30E-05	1.00E-06	3.20E-05

Analysis for Storey Drift

Comparison of shear value in "X' direction



Base shear in "X' direction

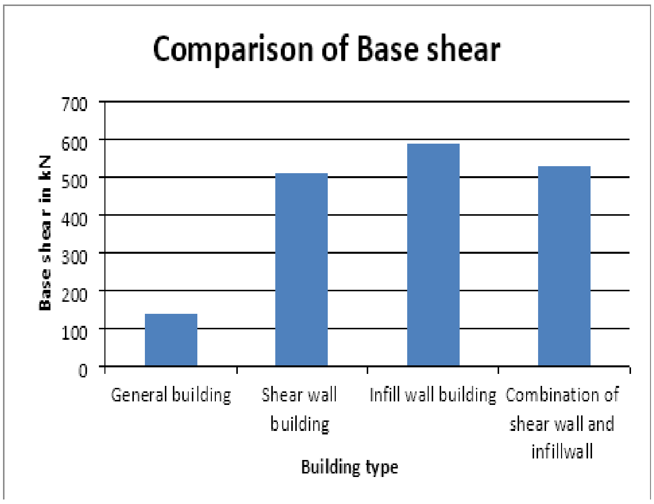


Table 2 Analysis for Storey Shear

Storey Number	General building	Shear wall building	Infill wall building	Combination of shear wall and infill wall
12	27.2437	87.3832	94.5756	89.9927
11	49.4242	174.2403	197.7292	178.8128
10	65.018	242.0659	287.5156	249.0099
9	76.9019	296.382	364.0751	305.9224
8	86.4855	342.0921	427.7479	353.673
7	95.034	381.9864	479.0639	394.9088
6	102.8947	417.0981	518.7551	431.133
5	110.2449	447.7068	547.7797	462.6367
4	117.6309	473.4669	567.3512	488.7925
3	124.964	493.0787	578.9792	508.6589
2	132.3466	504.9837	584.521	521.3196
1	137.2453	509.2556	586.1767	526.6912

Industrial Engineering Journal
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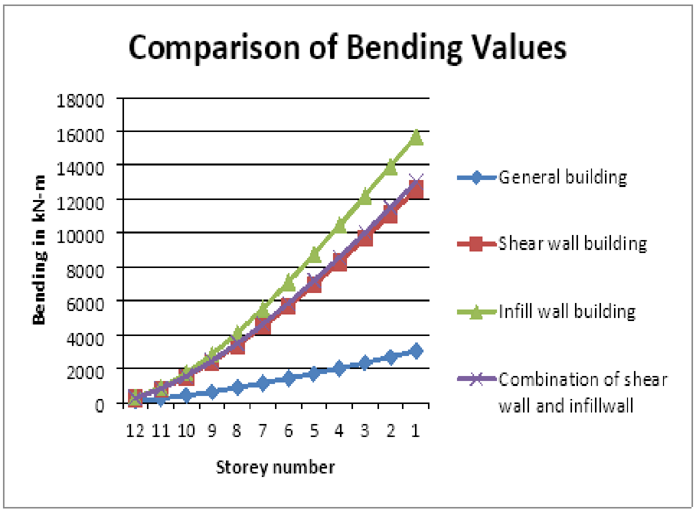
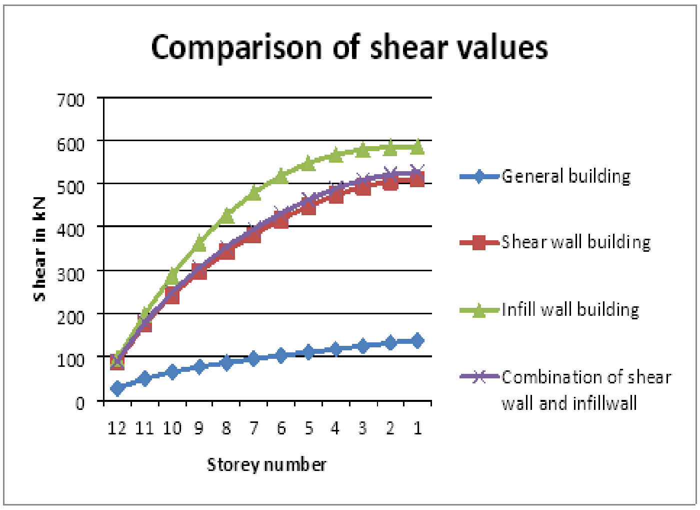


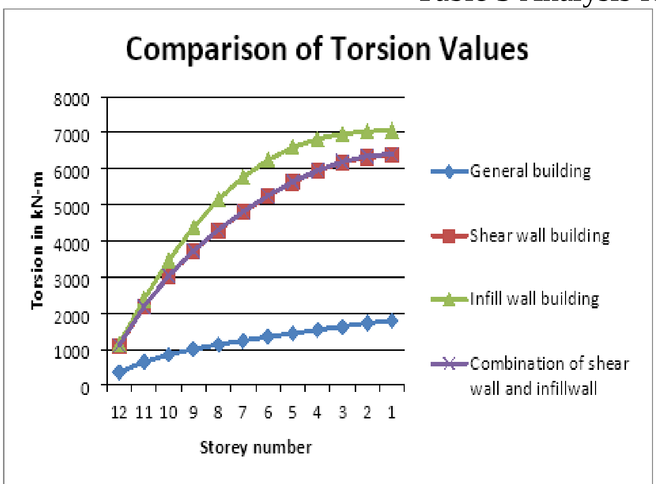


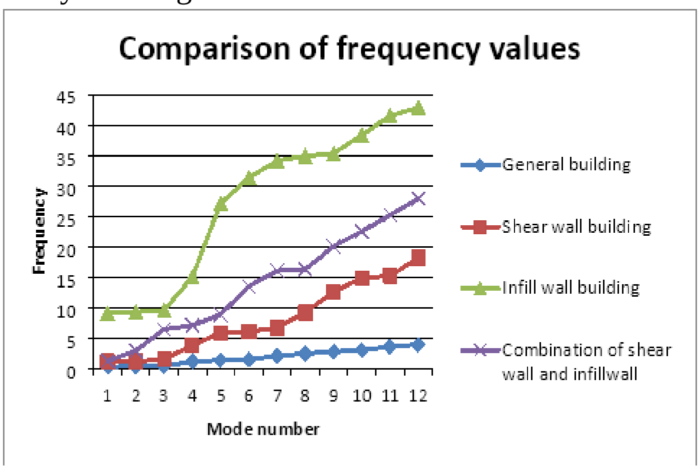
Comparison of bending value in “X” direction

Comparison of shear value in “Y” direction

Storey Number	Load case	General building	Shear wall building	Infill wall building	Combination of shear wall and infill wall
12	RS X	144.11	336.22	386.67	347.28
11	RS X	114.02	269.04	344	277.74
10	RS X	101.3	223.15	300.66	233.78
9	RS X	100.36	201.76	257.42	211.22
8	RS X	101.2	194.34	215.15	198.49
7	RS X	105.68	189.13	177.1	192.67
6	RS X	104.12	182.37	143.68	187.53
5	RS X	107.89	174.97	111.14	174.64
4	RS X	109.88	160.52	79.95	156.87
3	RS X	110.32	130.17	51.44	132.98
2	RS X	106.64	83.38	27.7	100.39
1	RS X	62.81	32	10.85	53.93

Table 3 Analysis for Storey Bending





Mode number	General building	Shear wall building	Infill wall building	Combination of shear wall and infill wall
1	0.427	1.304	9.211	1.381

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2	0.503	1.332	9.384	3.057
3	0.535	1.645	9.656	6.565
4	1.292	3.923	15.134	7.188
5	1.529	5.981	27.171	8.978
6	1.645	6.212	31.336	13.575
7	2.201	6.83	34.148	16.116
8	2.609	9.295	34.926	16.386
9	2.887	12.739	35.315	20.128
10	3.116	14.894	38.356	22.6
11	3.693	15.301	41.475	25.231
12	4.049	18.238	42.819	27.951

Table 4 Analysis for Storey Torsion

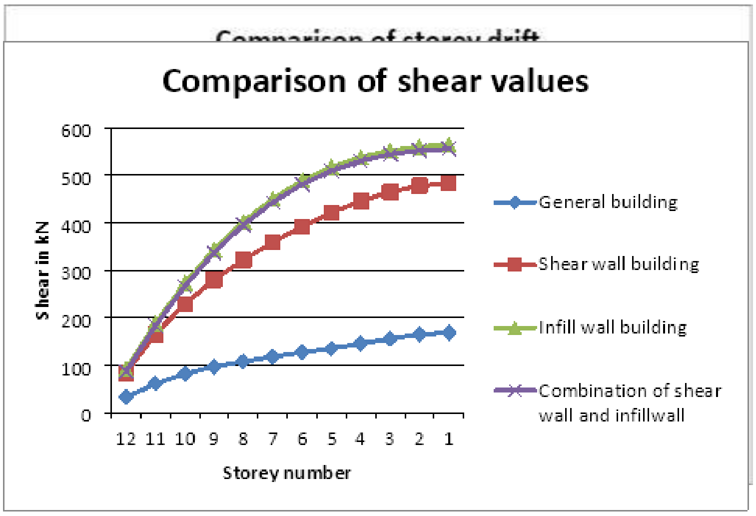
RSAY Case
Storey drift

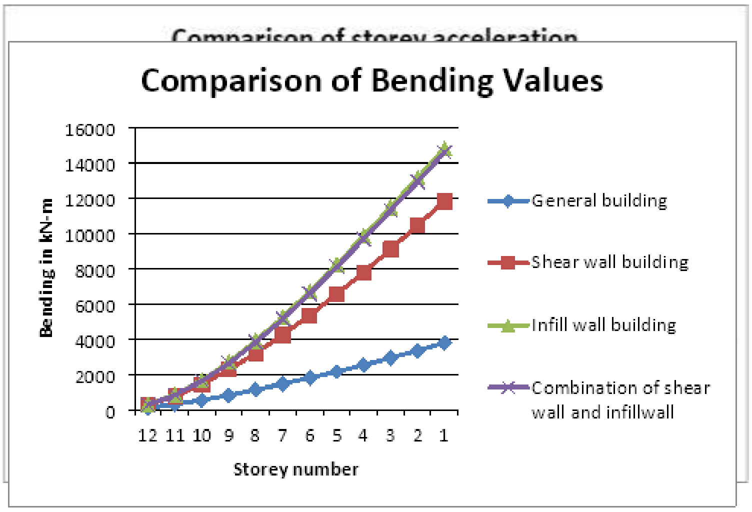
Storey Number	Load case	General building	Shear wall building	Infill wall building	Combination of shear wall and infill wall
12	RSAY	0.0001	0.000151	5.00E-06	6.00E-06
11	RSAY	0.000153	0.000155	5.00E-06	6.00E-06
10	RSAY	0.000198	0.000157	5.00E-06	6.00E-06
9	RSAY	0.000232	0.000158	5.00E-06	6.00E-06
8	RSAY	0.000257	0.000156	5.00E-06	5.00E-06
7	RSAY	0.000278	0.000152	5.00E-06	5.00E-06
6	RSAY	0.000296	0.000144	4.00E-06	5.00E-06
5	RSAY	0.000313	0.000132	4.00E-06	4.00E-06
4	RSAY	0.00033	0.000115	3.00E-06	4.00E-06
3	RSAY	0.000343	9.30E-05	2.00E-06	3.00E-06
2	RSAY	0.000332	6.40E-05	2.00E-06	2.00E-06
1	RSAY	0.000201	2.80E-05	1.00E-06	1.00E-06

Table 5 Storey Drift in RSAY

Storey drift in "Y" direction

Storey acceleration in "Y"direction

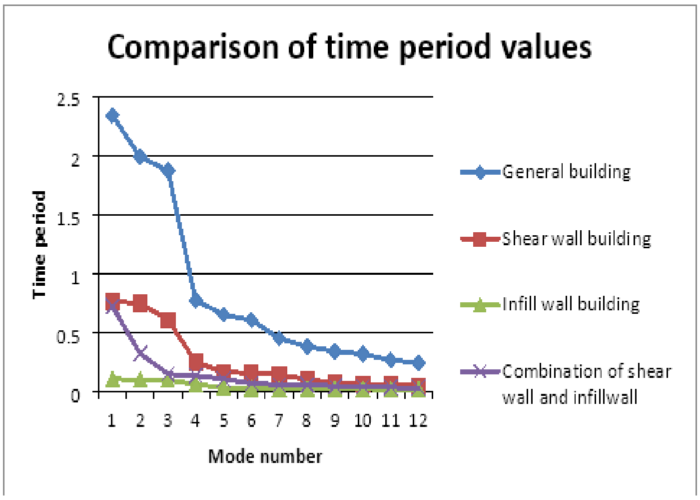




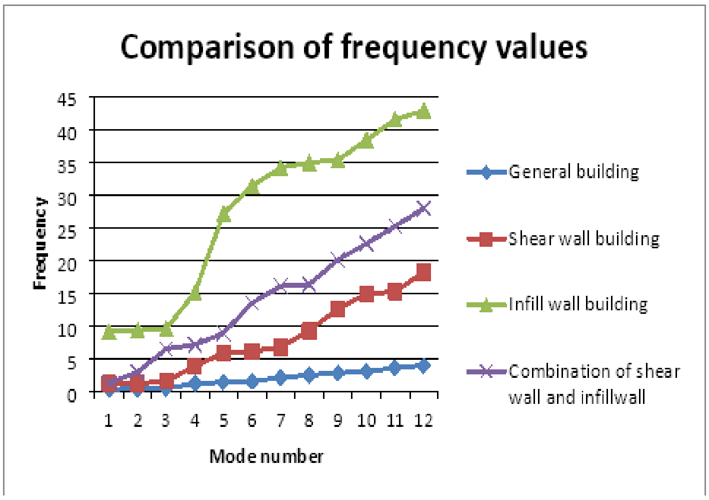
Comparison of bending value in "Y" direction

Shear value in "Y' direction

Comparison of time period in "Y' direction



Comparison of frequency value in "Y'direction



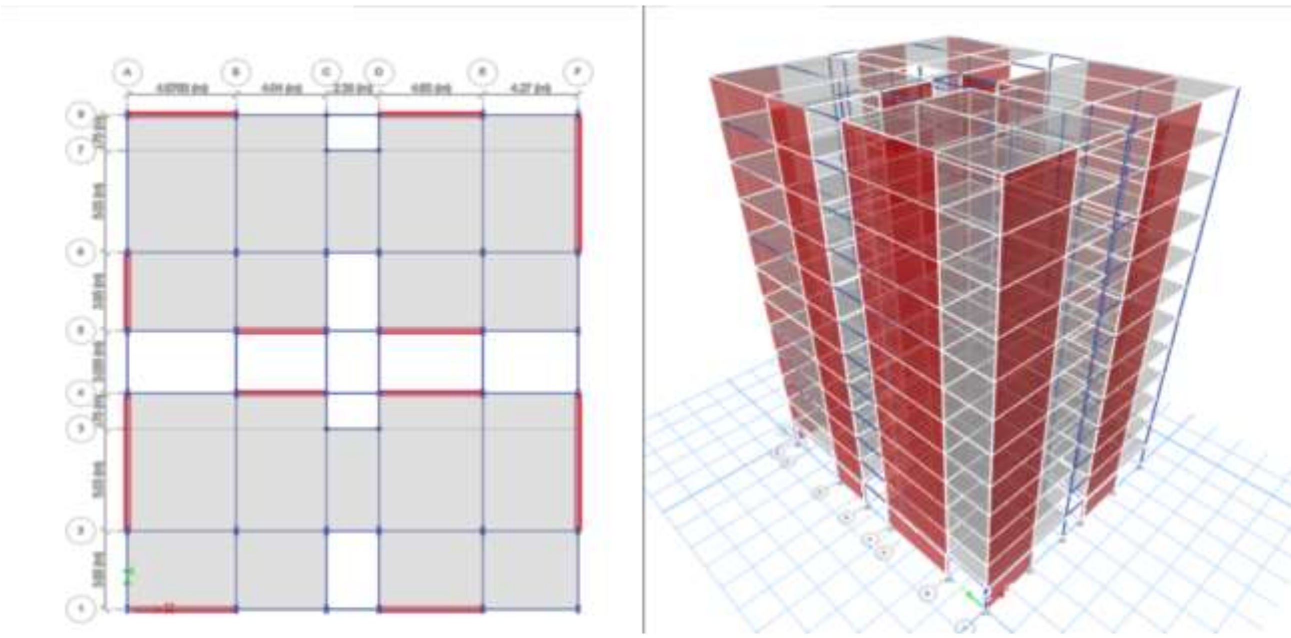


Figure 6 Plan and 3D view of Model

CONCLUSIONS

In this study, Response spectrum analysis was performed for G+12 RC building with shear wall and masonry infill wall. Some of main conclusion as follows

1. Steel shear walls can be used as an alternative to the other strengthen or retrofitting techniques available as the total weight on the existing building will not change significantly.
2. The location of shear-wall members has significant effect on the seismic response of the shear-wall frame and braced frame respectively. The central locations of shear-wall and brace member are favorable as they are effective in reducing actions induced in frame with less horizontal deflection and drift.
3. The infill wall predominantly changes the behaviour of the structure and it is essential to consider infill walls for seismic analysis of structure.

4. The values of storey drift in both Zone II and Zone IV has less values for the building models made with infill wall when we compared with other models like general building, shear wall building and both the combination of shear wall and infill wall.
5. As per the shear, bending and torsion the building model made with shear wall obtained less values when we compared with general building, infill wall and combination of both shear wall and infill wall in both zone II and zone V seismic zones.
6. The storey acceleration decreases from storey 12 to storey 1 in both zone II and zone V.
7. Time period values are decreasing from mode 1 to mode 12 in all the models and frequency values are increasing from mode 1 to mode 12 in all the models.
8. So from this results we can conclude that model made with infill wall will give better results than other building models.

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