Static Analysis of A RC Framed 20 Storey Structure Using ETABS

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Abstract – Static analysis of a structure for a four condition such as (i) bared frame (ii)with infill (iii)with core shear wall (iv)with shear wall at the peripheral region, in order to study the behavior of above characteristic with respect to 6” thick wall and 9” thick wall in the zone II and zone V for the critical conditions.

***Key Words*: Static analysis, ETABS, Lateral displacement, Base shear, Story drift.**

1. INTRODUCTION.

Now a day the construction of structural buildings is like fashion and height of the building is important factor then compare to the other structural elements. Tall structures is like a symbol of developed countries and the developing countries wants the high building to empower its commercial and economical growth to stand as a developed nation. A city or an area develops in any state or a country people from the surrounding rural area are motivated to work or wants to get job in that city to develops their family economic due to this reasons the a city is develops gradually the population of the city increases obviously a city wants fashionable tall structures. But the earth-quake zone of the city is a main term considered in the construction of the tall structures because earthquake is a characterized as shaking and vibrating earth surface due to any underground development in inner surface of the earth like core or mantle and this shaking and vibration by earthquake is known as seismic waves. This waves are unexpected in the present days and many of the counties have their own standard code books to construct the tall building in there country (e.g IS 1893:2002) its an Indian code practice for the construction of building in the earthquake zones.

2. LITERATURE REVIEW

2.1 Introduction

After studying different literatures this project deals with the behavior of structure when it is constructed with 6” thick wall and 9” thick wall in the zone II and zone V for the critical condition. This critical condition is obtained by taking importance factor (I = 1.5) and structure is assumed as ordinary RC moment resisting frame (OMRF) with assuming wall load on the beam.

2.2 Literature reviews studied for project:

Sud et al., [2014], haveconsidered 5 models of a 5 storey building located in seismic zone five providing shear walls at different positions (bare frame, core shear wall, shear wall on each side of external bay, and adjacently placed at corners). These models wereanlysed for dynamic loadings, and it was found that the core shear wall reduced the lateral drift by 29% as compared to bare frame. The shear wall on each side of external bay also reduces the floor drift, and they concluded that core shear wall and shear wall on each side of external bay are preferable over bare frame.

Bhat et al., [2015], have compared the different positions of shear wall for a 40 storied structure. The 4 models analyzed are bare frame, shear wall on each side of wall, shear wall at corner and core shear wall of the building. The analysis of the structure by response spectrum method was carried out using STAAD pro software for different earthquake zones. They compared their models with respect to the lateral drift of the structure, and concluded that the core shear wall gives less lateral drift as compared to other models. Also, the cores shear wall decreases the lateral drift by 17.5% as compared to bare frame.

Itware and Kalwane., [2015],have studied the effects due to opening in shear wall on structural seismic response, by considering 6 and 12 storey apartment with typical floor plans (35m × 15m) and floor height of 3m with various opening sizes and locations of shear wall. The structures were modeled using STAAD Pro, the equivalent static analysis for the models was performed as per IS: 1893:2000 and the results were compared. The results showed that when shear wall area opening was less than 20%, the opening decides the stiffness of the system.

3. OBJECTIVES

- To study the four structural systems will be carried out (without infill, with infill, core shear wall, and shear wall at the peripheral region).
- To study and knowing the performance of the four types structural systems against the earthquake lateral load for the critical conditions in zone II and zone V.
- Study about the various parameters like lateral displacement, storey drift, base shear, storey stiffness for the 6” wall and 9”wall.
- To check the percentage of base shear of different zones of India.

4. METHODOLOGY

- For the reference we undergo many of the literature and IS 1893:2000.
- ETABS software was used for building modeling and analysis.
- Structure is analyzed using static method manually and using software, plan as a dimension with six bays in both X and Y direction. Column to column spacing is 4m for each bay. Assumed all the columns are fixed at the base.
- Structure is analyses for compare results with the four structural such as beam column structure (without infill), with infill, core shear wall and shear wall at the peripheral region for 6" wall and 9"wall in the zone II and zone V.
- Grade of concrete used M-20and steel used Fe-500 are considered for analysis of the structure.
- Conclusions are made based on the results we obtained.

5. MODELS

5.1 Structural plan:

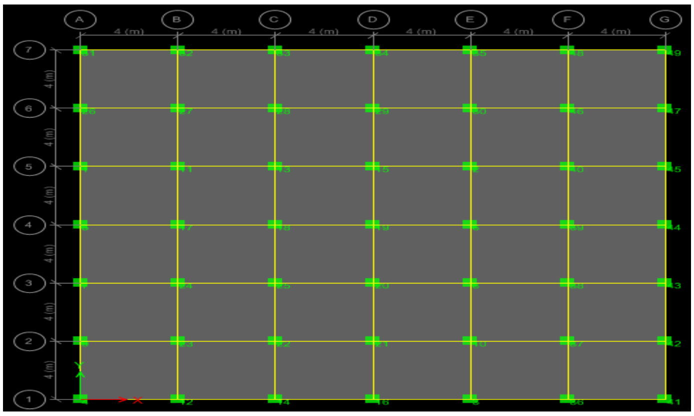

Fig.1: plan without infill

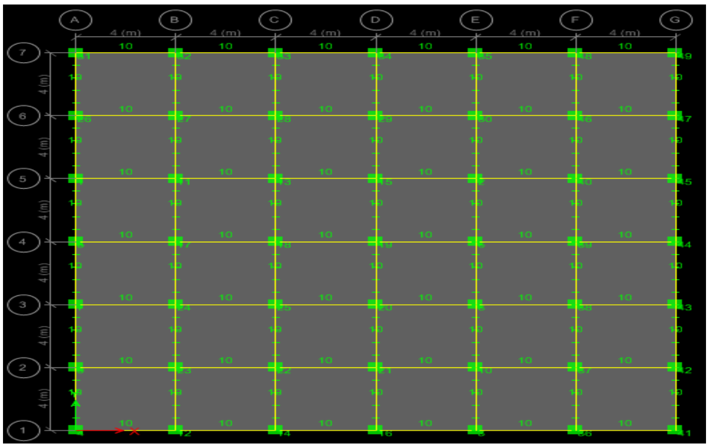

Fig.2: with infill (6"wall)

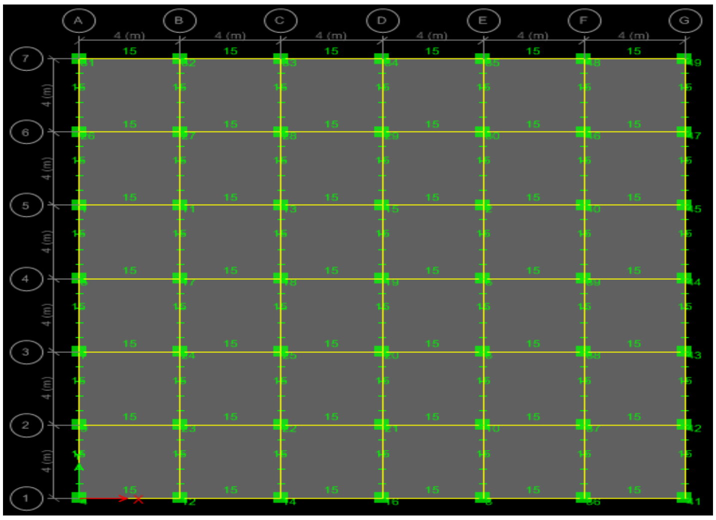

Fig.3: with infill (9"wall)

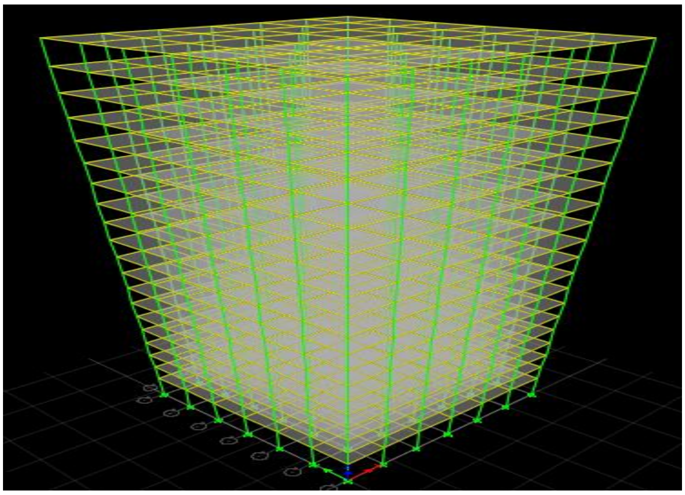

Fig. 4: 3D view.

5.2 Model with core shear wall

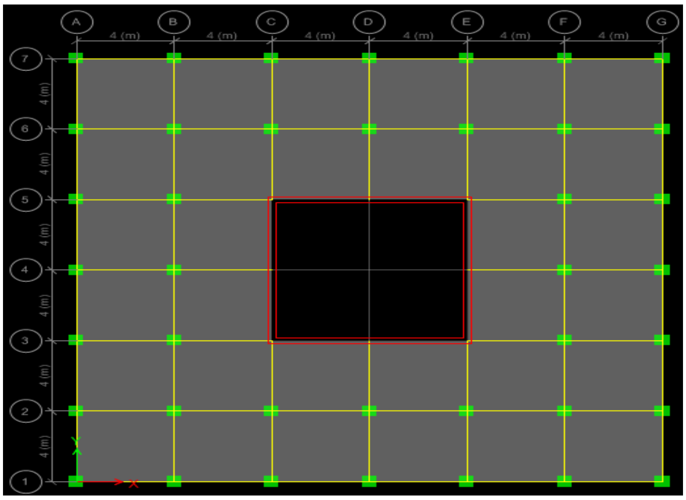

Fig.5: plan with core shear wall.

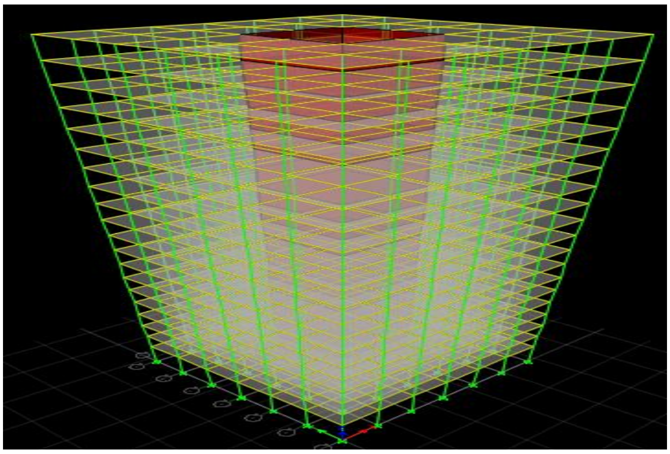

Fig.6: 3-D view of core shear wall.

5.3 Model with peripheral shear wall

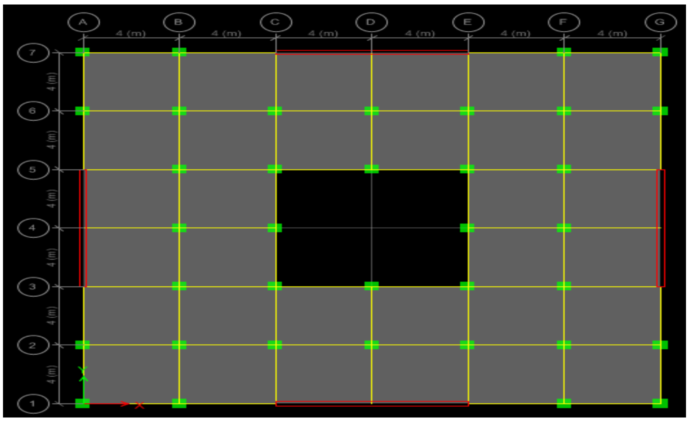

Fig.7: plan of shear wall at peripheral region.

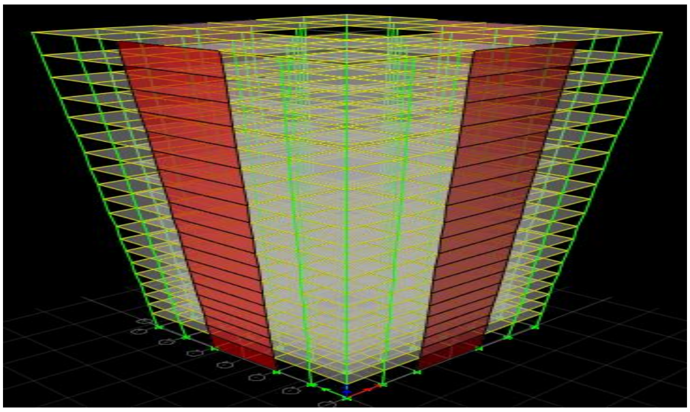

Fig.8: 3-D view of shear wall at peripheral region.

6. Results

6.1Lateral displacement

Lateral displacement of the 6” wall thickness building and 9”wall thickness building for the four various structural system in the seismic zone II.

Table - 1 Max lateral displacement of 6”wall and 9”wall in the seismic zone II.

Models	Lateral displacement (mm)	
	6”wall thickness	9”wall thickness
Without infill	138.4	138.4
With infill	315.4	370
Core shear wall	79.3	90.65
Peripheral shear wall	144.6	168.2

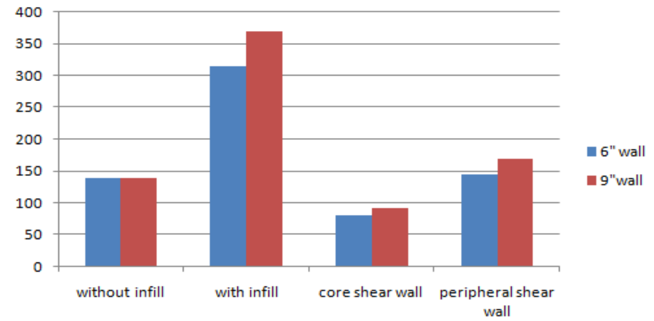

Fig.9: Max lateral displacement of 6”wall and 9”wall in the seismic zone II.

Comparing the result with 6”wall

From the graph lateral displacement is reduce upto 56% when comparing with without infill, about 75% will reduce when using core shear wall, about 54% will reduce when using shear wall at the peripheral region.

Comparing the result with 9”wall

From the graph lateral displacement is reduce upto 63% when comparing with without infill, about 76% will reduce when using core shear wall, about 55% will reduce when using shear wall at the periphery.

6.2Base shear

Base shear for the 6” wall thickness building and 9”wall thickness building for the four various structural system in the seismic zone II.

Models	Base shear (kN)	
	6”wall thickness	9”wall thickness
Without infill	2887	2887
With infill	6615	7794
Core shear wall	4219	5084
Peripheral shear wall	3571	4314

Table - 2 Max base shear of 6”wall and 9”wall in the seismic zone II.

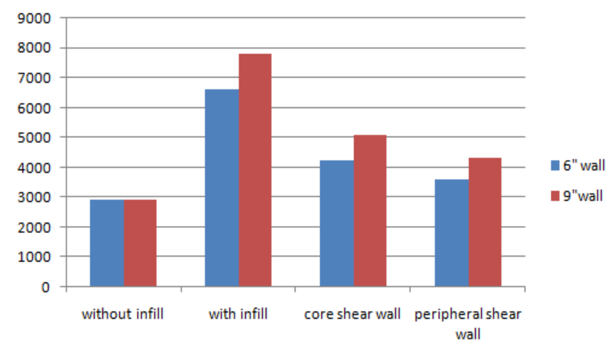

Fig.10: Max base shear of 6”wall and 9”wall in the seismic zone II.

Comparing the result with 6”wall

From the graph base shear is reduce upto 56% when comparing with without infill, about 36% will reduce when using core shear wall, about 46% will reduce when using shear wall at the peripheral region.

Comparing the result with 9”wall

From the graph base shear is reduce upto 63% when comparing with without infill, about 35% will reduce when using core shear wall, about 45% will reduce when using shear wall at the peripheral region.

6.3Story drift

Story drift for the 6” wall thickness building and 9”wall thickness building for the four various structural system in the seismic zone II.

Table - 3 Max story drift of 6”wall and 9”wall in the seismic zone II.

Models	Story drift (mm)	
	6”wall thickness	9”wall thickness
Without infill	0.0030(6)	0.0030(6)
With infill	0.0069(6)	0.0081(5)
Core shear wall	0.0011(14)	0.0019(13)
Peripheral shear wall	0.0032(11)	0.0034(11)

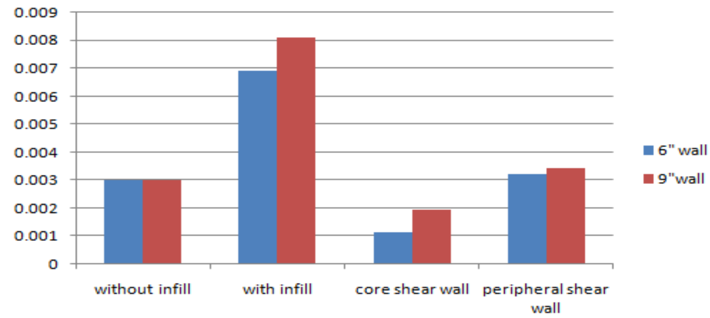

Fig.11: Max story drift of 6”wall and 9”wall in the seismic zone II.

Comparing the result with 6”wall

From the graph story drift is reduce upto 57% when comparing with without infill, about 84% will reduce when using core shear wall, about 54% will reduce when using shear wall at the peripheral region.

Comparing the result with 9”wall

From the graph story drift is reduce upto 63% when comparing with without infill, about 77% will reduce when using core shear wall, about 58% will reduce when using shear wall at the peripheral region.

7. CONCLUSION

- Manually analysis is done for calucualting base shear for all zones
  - (i) Worst condition:- Importance factor (I)=1.5, structure type (OMRF), R=3, soli type= soft soil, with infill. (FOR ALL ZONES).
  - (ii) Better condition:- Importance factors (I)=1.0, structure type (SMRF), R=5, soil type=hard soil, without infill. (FOR ALL ZONES).
- From the analysis we concluded that introducing 6”wall by 9”wall base shear, lateral displacement, story drift will reduce upto 15% to 20%.
- By introducing core shear wall to 6”wall and 9”wall about 30% to 40% of base shear will be reduce, lateral displacement will reduce upto 70% to 75%, storey drift will reduce about 70% to 85%.
- By introducing peripheral shear wall to 6”wall and 9”wall about 45% of base shear will be reduce, lateral displacement will reduce upto 55%, storey drift will reduce about 50% to 60%.

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