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To Study The Effect of Shear Wall at Different Locations by Using Staad. Pro Software in Bare Frame System and In Infilled Frame System

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***Abstract:** The purpose of this study is to find the prime location of shear wall and then investigate the effectiveness of best shear wall in bare frame system and infill frame system. The structure is analyzed for earthquake and wind forces in both the types of structural system i.e. Bare frame system and Infilled frame system. From the past records of earthquake, there is increase in demand to construct the earthquake resisting building which can be done by providing the shear wall systems in the buildings. Shear wall is the best structural element which is used for resisting lateral load in multi-storey reinforced concrete structures. Wall which is mainly designed to resist lateral forces in its own plane is called shear wall according to IS 13920:1993. Shear walls are generally provided in high rise buildings to avoid failure of building under lateral forces. They are provided in multi-storey reinforced concrete structures to improve the response of the structure. Past experiences show that shear wall plays a vital role in increasing the strength and stiffness of the building. Shear walls are mainly flexural members which are specially designed to resist lateral forces which are caused by seismic forces, wind forces and others forces. They provide an efficient bracing system and also offer great resistance to horizontal forces. Shear walls start from the foundation level and should be continuous throughout the height of the building.*

In this project, study of G+10 building at Bhuj is presented with some investigations which are analyzed in both the structural system i.e. Bare frame structure and Infilled frame structure. The building is located in Zone-V according to IS 1893: 2002. Analysis of 3 D building model is done by linear static method and surface messing is done to model shear wall. In this study standard package of STAAD Pro V8i is used. Comparison of these models for different parameters like Lateral displacement in X & Y Direction, storey drift and axial force in columns carried out.

Keywords: Shear wall, lateral load, Bare frame structure, Infilled frame Structure, Static method.

I. INTRODUCTION

During past earthquake, many reinforced concrete buildings have either collapsed or experienced high level of damage. Through facts it was concluded that this was due to inadequate ductility, lateral stiffness and strength. It was fact that a shear wall will surely improve the seismic capacity of the structure. The primary function of all types of structural systems which are used in the building frame is to support gravity loads. Gravity load comprises of dead load, live load and snow load. On the other side, buildings are also subjected to lateral loads which incurred due to earthquake, blasting and wind. Due to these loads high stresses are develop which results in sway movement or may cause vibration.

Shear walls are usually provided between column lines, in stairs wells, lift wells, in shafts. They provide lateral force resistance by transferring horizontal forces i.e. wind or earthquake load to the foundation. They are generally used in bare frame. But still bare frame with shear wall is economically unattractive. If in the structural design properties of non-structural element are considered then it will absolutely give good results. The non-structural element which is already exists in structure but not considered in the structural design as a structural element like masonry wall and also it is called as an infilled wall. If we considered the properties of the infill wall like density and modulus of elasticity of brick masonry then it will help in improving the strength and stiffness of the structure. Generally, in India infill wall is not considered as a structural element due to this, stiffness of infill is not estimated and not considered in the design of the structure.

A. Shear wall Frame System

This system is also known as dual system. In this system, concrete frame interact with reinforced concrete shear walls. This system is generally used now-a-days to build earthquake resisting structures. This system has high efficiency to resist lateral load effectively.

B. *Objective Of The Study*

In my current work I have undergone research study on building with and without shear wall at different locations in Bare frame system and in Infilled frame system by using Staad.Pro. V8i. The objectives of this study are:

1) Shear wall will be provided at different locations and best possible location should be analyzed to reduce the lateral displacement and axial force in the column
2) To verify the best location of shear wall in respect of lateral displacement.
3) To find out the economical structural system from Bare frame shear wall system and Infilled frame shear wall system.

II. SHEAR WALL AND ITS CODAL PROVISIONS

Steel reinforcement is provided in the walls in both directions i.e. horizontal as well as vertical with regular space between them as shown in figure. Horizontal reinforcement in the wall is needed to be anchored at the ends whereas vertical reinforcement is distributed across the cross-section of the wall. The minimum area of reinforcing bar which is provided is 0.0025 times the cross sectional area, in both the horizontal and vertical direction.

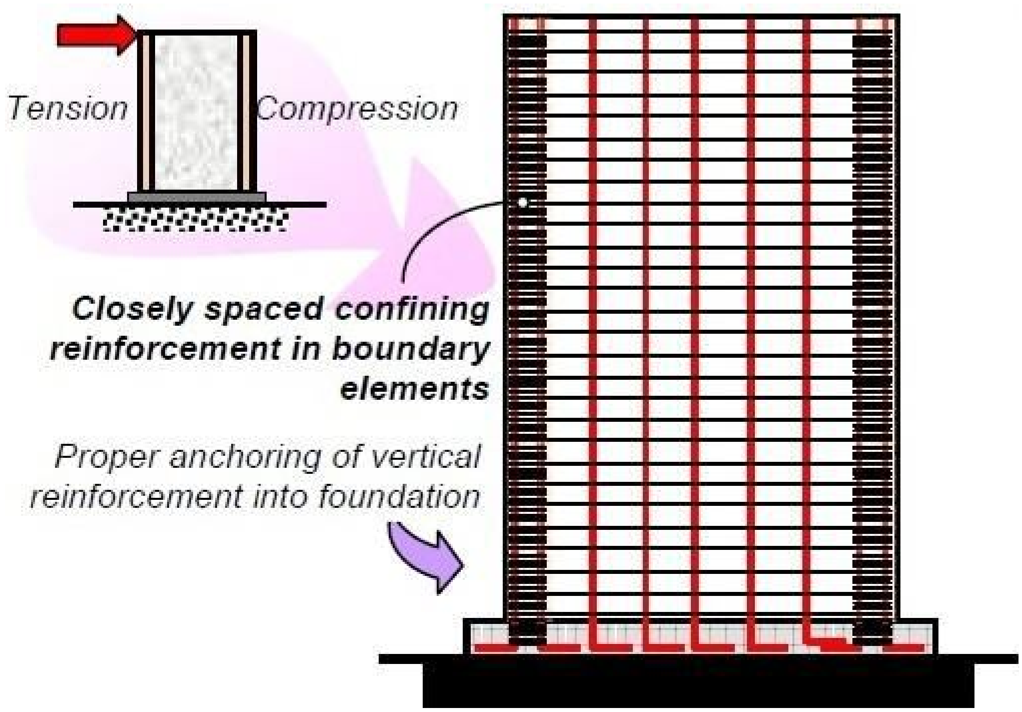

Figure- Layout of main reinforcement in shear walls as per IS: 13920-1993

The following requirements are taken from clause 9.1 of IS 13920:1993. The main purpose of this clause is to highlight the basic requirements.

A. *Boundary Elements*

As we know, horizontal earthquake forces are the most destructive forces and they cause large overturning effect due to which the edges of the shear walls experience very high compressive and tensile stresses. For ensuring shear wall ductile behaviour, the concrete in the end region of wall must be reinforced in a special manner to sustain these loads without losing the strength as shown in figure above.

The end regions of the wall with increased confinement are called boundary elements. Sometimes to increase the strength of the walls, the thickness is also increased in these boundary elements. Reinforced concrete walls with boundary elements have considerably high bending strength and horizontal shear force carrying capacity. Boundary elements are less susceptible to earthquake damage as compared to walls without boundary elements.

III. NUMERICAL STUDY

It is aimed to understand the behaviour of bare frame and infilled frame with different locations of shear wall. In this project shear wall are being modelled by surface meshing.
In this project, shear wall is provided at five different locations and then best location is determined in respect of lateral displacement and axial force in columns. Comparison has also been made of bare frame without shear wall with bare frame with best shear wall location, infill frame without shear wall and infill with best shear wall location. The earthquake loads and wind loads assigned to the buildings are determined with respect to provisions given in IS 1893 (Part-1) and IS 875 (Part-3) respectively. Equivalent static method is used for the analysis. Modelling assumptions, parameters and their ranges considered in the analysis phases are presented. Finally the results are given.

A. Description of the Building

For the present study, a Reinforced Concrete Structure is selected. The same layout has adopted in construction of Alaknanda Appartement at Bhuj, Gujarat. It has symmetrical layout and consists of eleven stories with each storey height of 3 m. Floor plan of all stories is rectangular with length of 25 m in x-direction and length of 15 m in y-direction. The number of bays in x-direction is 5 and number of bays in y-direction is 3. The width of each bay is 5 m in both x-direction and y-direction. All the columns of the building are located at the axes intersections.
Building details are as follows:

1) Building is located in Seismic Zone V.
2) Spacing between bays is 5 m in both x and y-directions.
3) Number of bays in x and y-directions are 5 and 3 respectively.
4) Grade of concrete used is M 25 and grade of steel used is Fe 415.
5) Floor to floor height is 3 m.
6) Parapet wall height is 1 m.
7) Parapet wall thickness is 230 mm.
8) Slab depth is 150 mm.
9) of external wall is 230 mm and thickness of internal wall is 115 mm.
10) Size of columns is 500 mm × 500 mm.
11) Size of beams is 300 mm × 450 mm.
12) Live load on floors is 3 KN/m2.
13) Live roof load is 1.5 KN/m2.
14) Floor finish load is 1 KN/m2.
15) Roof finish load is 1.5 KN/m2.
16) Building is resting on medium soil.
17) Importance factor is taken as 1.
18) Unit weight of RCC is 25 KN/m3.
19) Unit weight of masonry wall is taken as 20 KN/m3.
20) Thickness of Shear walls is 230 mm.
21) Elastic modulus of brick masonry wall is 22360 MPa.
22) modulus of concrete is 25000 MPa.
23) . Size of all infill walls which is equivalent to diagonal strut is 610 ×230 mm.
24) Spectra is taken as per IS 1893 (Part-1): 2002.
25) Damping of structure is taken as 5 percent.

Models of different locations of shear wall are shown in figure

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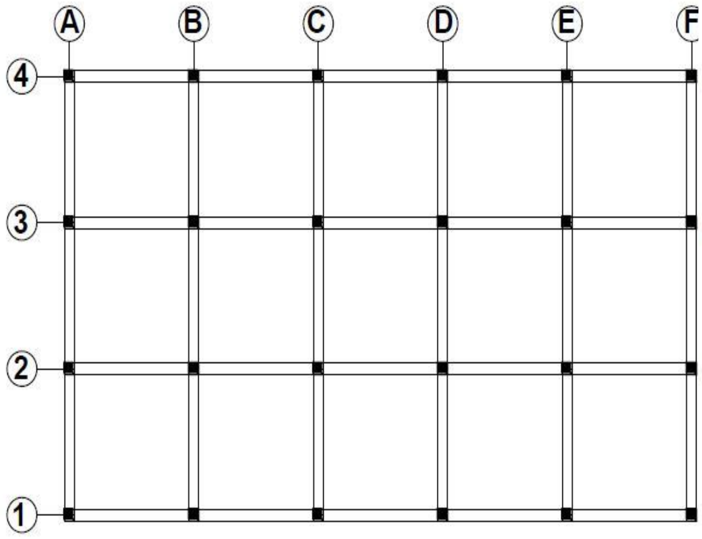
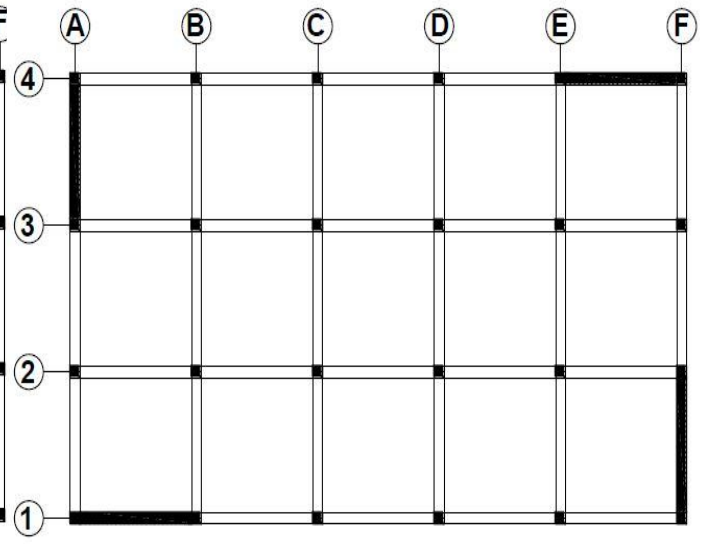
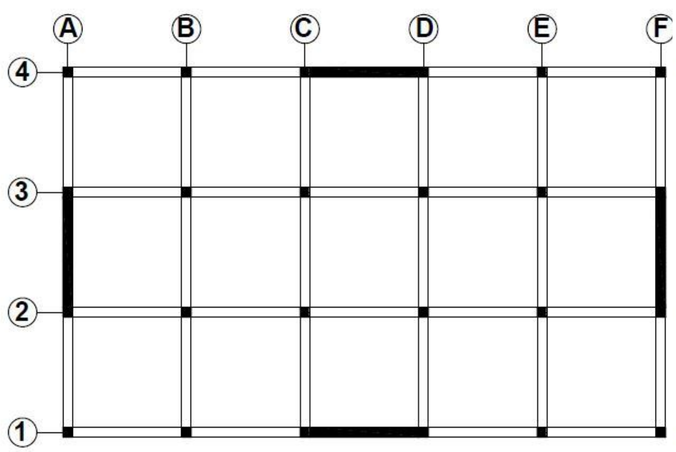


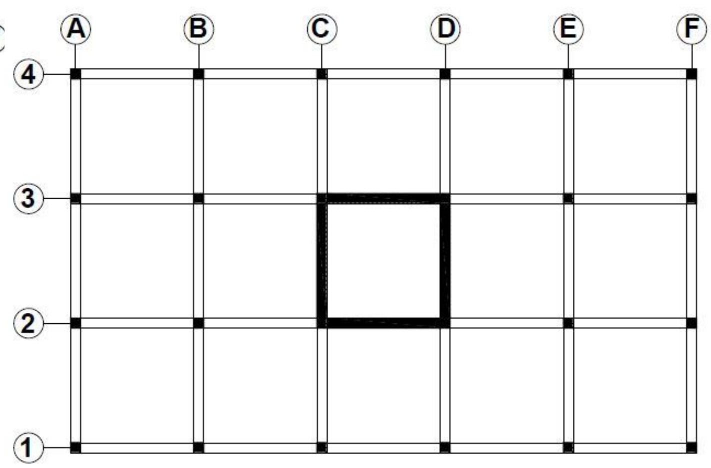
Model -1 (Without Shear Wall)



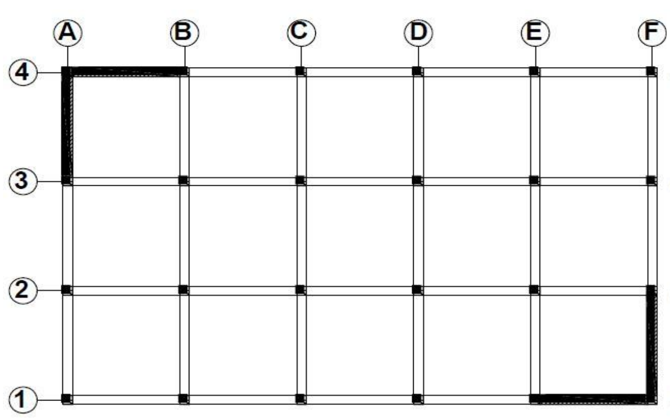
Model-2 (one shear wall at each side diagonally opposite to each other)



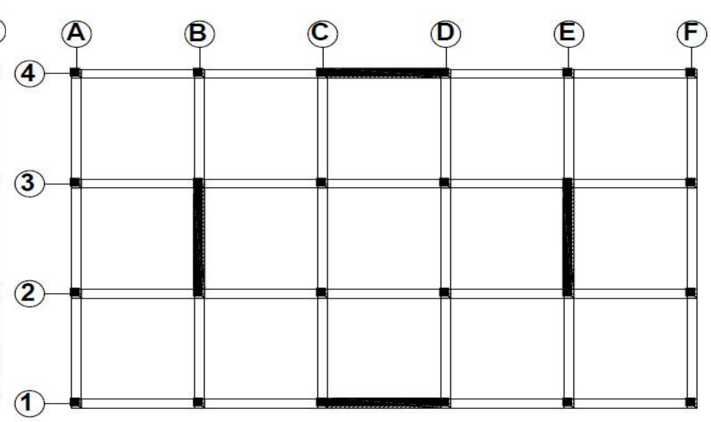
Model -3 (One shear wall at each side at middle)



Model -4 (Core Shear wall)



Model -5 (Corner Shear wall diagonally opposite to each other)



Model -6 (Exterior + Internal Shear wall)

B. Modelling Assumptions

All the models that are developed to determine the best location of shear wall on lateral load performance of the building was created in STAAD.Pro V8i. While creating 3-D models, some basic assumptions were taking into consideration to decrease the complexity of the program and analysis run time. Also, it is known that there are lots of parameters that affect the behaviour of the building system under loading, especially lateral loading. Material properties of the concrete and masonry are fixed for all the cases. Following load combinations are used in this thesis are per IS 1893 (Part-1): 2002.

1. 1.5 (DL + LL)
2. 1.2 (DL+LL ± EL)
3. 1.5 (DL ± EL)
4. 0.9 DL ± 1.5(EL)

Where,
DL= Dead Load
LL= Live Load
EL= Earthquake Load

IV. RESULTS

Table 5.24 – Comparison of Lateral displacement along X-direction in bare frame system and Infill frame system without and with best shear wall location

Storey No.	Lateral displacement in X-direction (mm)			
	Bare Frame without shear wall	Bare Frame with best shear wall location	Infill Frame without shear wall	Infill Frame with best shear wall location
11	50.97	16.41	17.46	7.55
10	49.40	15.57	16.01	6.79
9	46.80	14.33	14.58	5.95
8	43.21	12.74	13.15	5.12
7	38.84	10.97	11.77	4.29
6	33.89	9.14	10.79	3.51
5	28.50	7.33	9.89	3.13
4	22.81	5.60	8.97	2.83
3	16.93	3.98	8.07	2.51
2	11.02	2.49	7.12	2.21
1	5.33	1.17	4.66	1.86

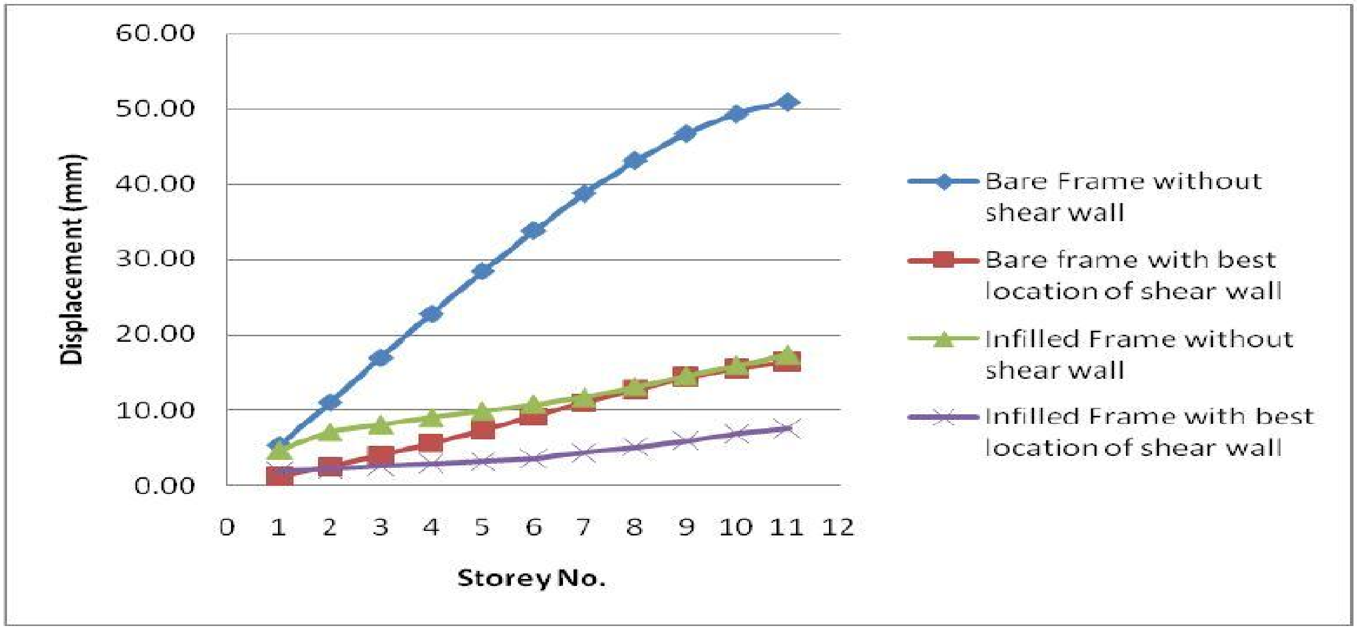


Figure 5.19 – Graph of Lateral Displacement along X-direction in bare frame and Infill frame system without and with best location of shear wall

Table 5.25 - Comparison of Lateral displacement along Y-direction in bare frame system and Infill frame system without and with best shear wall location

Storey No.	Lateral displacement in Y-direction (mm)			
	Bare Frame without shear wall	Bare Frame with best shear wall location	Infill Frame without shear wall	Infill Frame with best shear wall location
11	107.24	44.43	51.08	19.76
10	103.85	42.79	49.16	18.72
9	98.18	40.04	45.88	16.96
8	90.47	36.34	41.55	14.83
7	81.17	32.00	37.46	12.59
6	70.65	27.29	34.48	10.50
5	59.25	22.41	30.75	9.28
4	47.26	17.52	26.19	8.02
3	34.94	12.73	20.74	6.56
2	22.59	8.12	14.40	4.81
1	10.83	3.86	7.41	2.72

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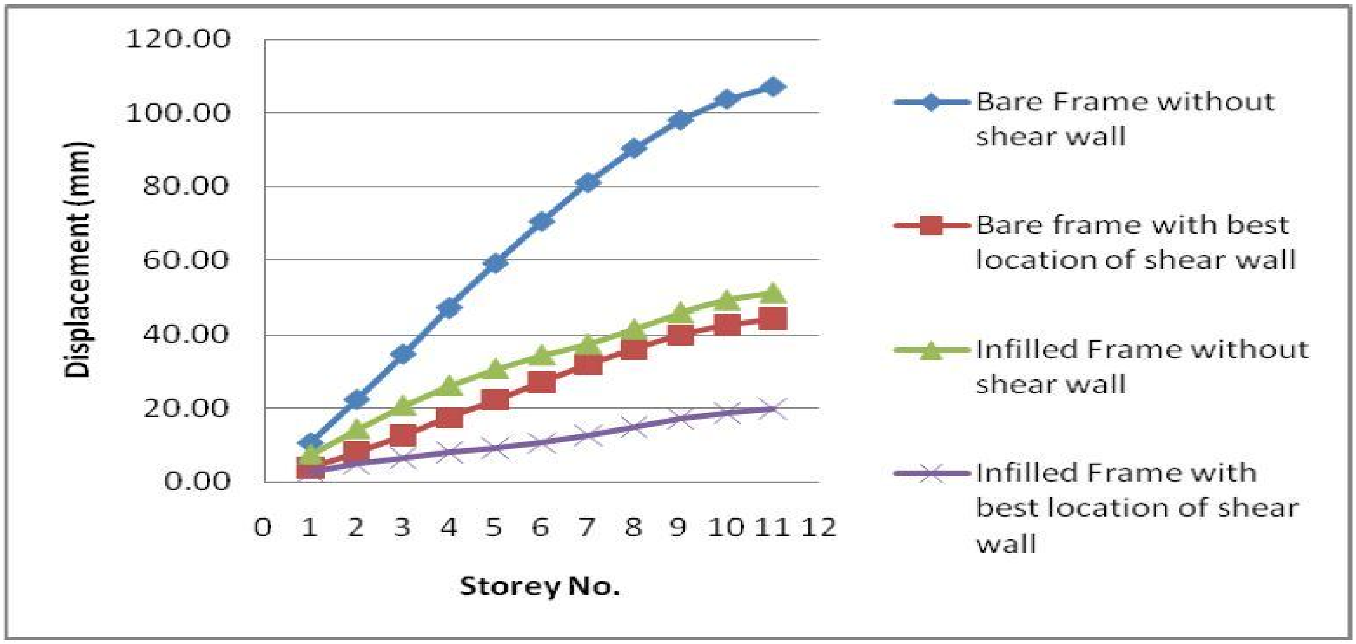

Figure 5.20 – Graph of Lateral Displacement along Y-direction in bare frame and Infill frame system without and with best location of shear wall

Table 5.26 - Comparison of Maximum Axial Force in column with storey in bare frame system and Infill frame system without and with best shear wall location

Storey No.	Maximum Axial Force (kN)			
	Bare Frame without shear wall	**Bare Frame with best shear wall location**	**Infill Frame without shear wall**	**Infill Frame with best shear wall location**
11	359.81	303.51	355.85	295.20
10	820.07	704.63	810.94	686.82
9	1280.84	1108.76	1266.74	1081.68
8	1742.52	1515.79	1723.66	1479.77
7	2205.20	1926.90	2181.85	1882.40
6	2669.17	2343.25	2641.67	2290.89
5	3134.70	2766.03	3103.48	2706.61
4	3602.07	3196.50	3567.63	3130.97
3	4071.55	3635.96	4034.46	3565.40
2	4543.44	4085.79	4504.35	4011.46
1	5017.88	4547.22	4977.58	4470.54

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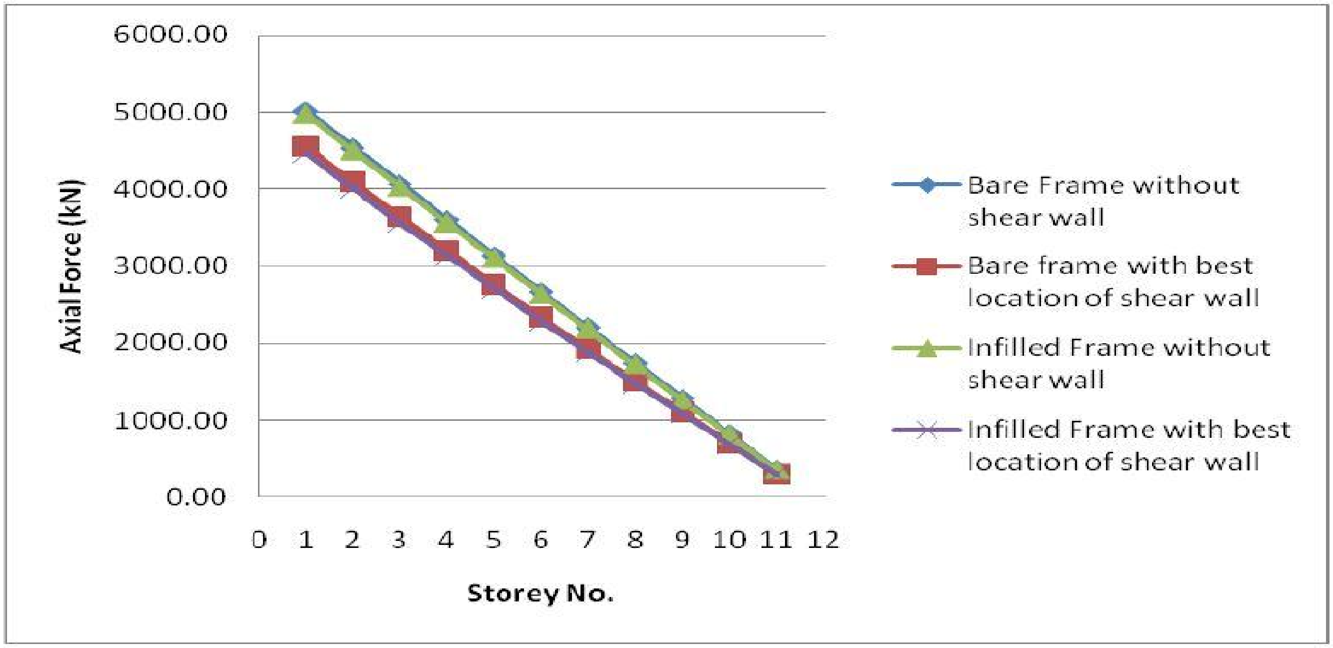

Figure 5.21 – Graph of Maximum Axial force in bare frame and Infill frame system without and with best location of shear wall

Table 5.27 - Comparison of Inter-storey drifts along X-direction in bare frame system and Infill frame system without and with best shear wall location

Storey No.	Inter-storey drifts along X-direction			
	Bare Frame without shear wall	Bare Frame with best shear wall location	Infill Frame without shear wall	Infill Frame with best shear wall location
11	0.52	0.28	0.48	0.25
10	0.87	0.41	0.48	0.28
9	1.20	0.53	0.48	0.28
8	1.45	0.59	0.46	0.28
7	1.65	0.61	0.33	0.26
6	1.80	0.60	0.30	0.13
5	1.90	0.58	0.31	0.10
4	1.96	0.54	0.30	0.11
3	1.97	0.49	0.32	0.10
2	1.90	0.44	0.82	0.12
1	1.78	0.39	1.55	0.62

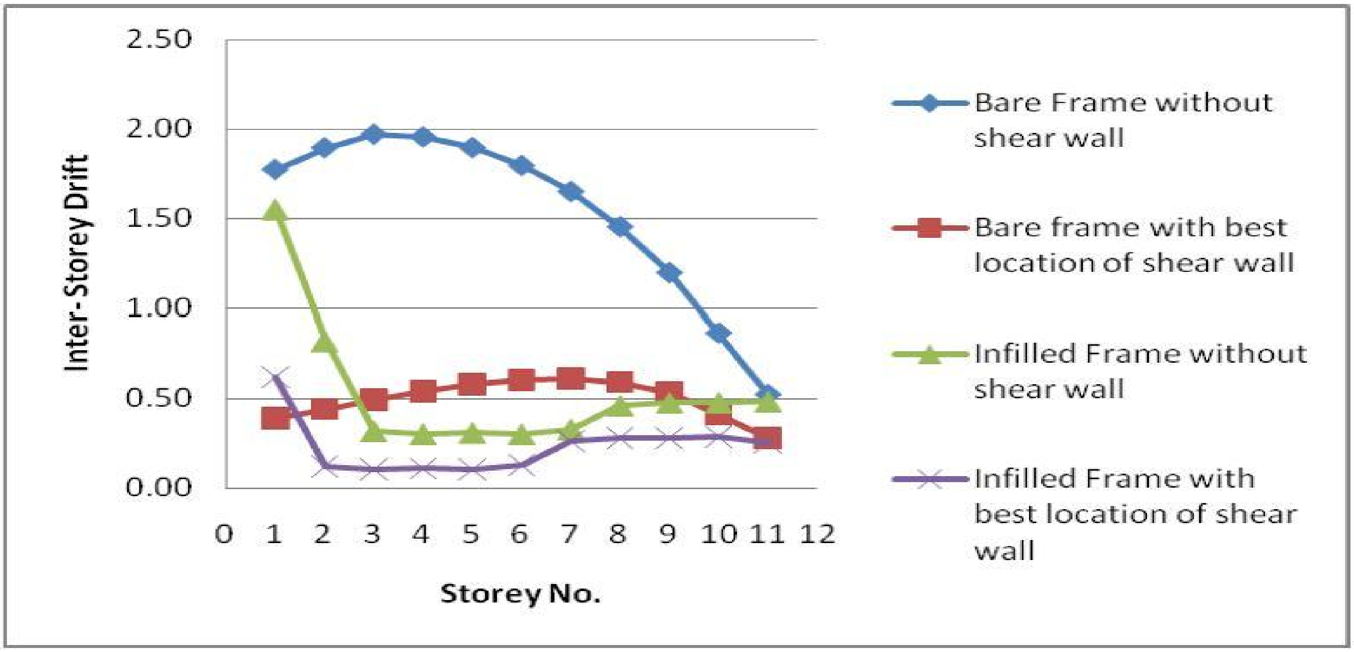

Figure 5.22 – Graph of Inter-storey Drift along X-direction in bare frame and Infill frame system without and with best location of shear wall

Table 5.28 - Comparison of Inter-storey drifts along Y-direction in bare frame system and Infill frame system without and with best shear wall location

Storey No.	Inter-storey drifts along Y-direction			
	Bare Frame without shear wall	Bare Frame with best shear wall location	Infill Frame without shear wall	Infill Frame with best shear wall location
11	1.13	0.55	0.64	0.35
10	1.89	0.92	1.09	0.58
9	2.57	1.23	1.44	0.71
8	3.10	1.45	1.36	0.75
7	3.51	1.57	0.99	0.70
6	3.80	1.63	1.24	0.41
5	4.00	1.63	1.52	0.42
4	4.11	1.60	1.82	0.49
3	4.12	1.54	2.11	0.58
2	3.92	1.42	2.33	0.70
1	3.61	1.29	2.47	0.91

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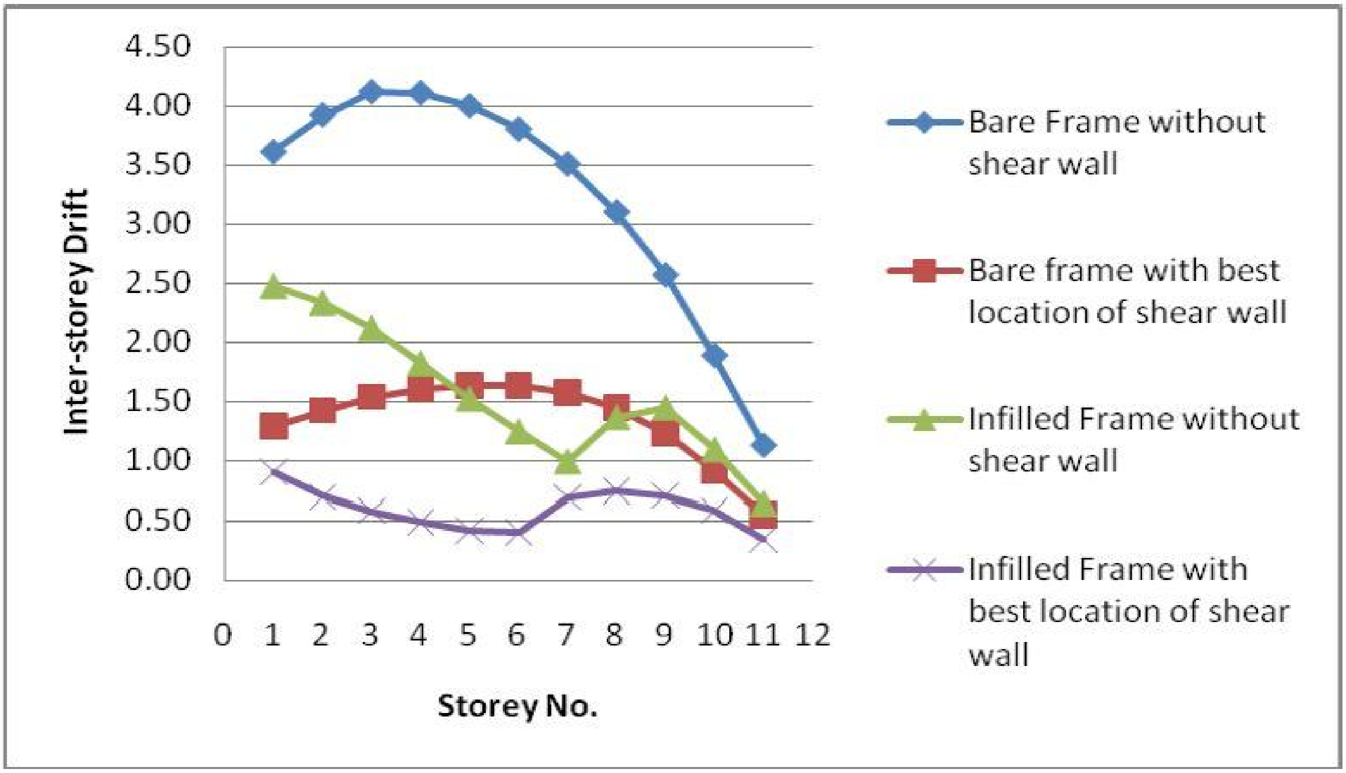


Figure 5.23 – Graph of Inter-storey Drift along Y-direction in bare frame and Infill frame system without and with best location of shear wall

V. CONCLUSIONS

A. General Remarks

The present study has analyzed bare frame system and infilled frame system without and with shear wall at different locations. Shear wall plays a significant role in increasing the performance of building under the lateral forces. In this study to ensure same cost, the length and thickness of shear walls have been keep same in all the models.

B. Precise Conclusions

The results shows that the presence of shear wall in bare frame structure and infilled frame structure modifies the lateral force behaviour of the RC framed building to a large extend.

From the results presented in previous chapter the following conclusions are drawn –

1) When Bre Frame System without and with shear wall is considered

a) Total displacement of the building decreases considerably when the frame building is provided with shear wall.

b) From the results it has been concluded that the model-4 (when shear walls are placed as a core) shows best location of shear wall since lateral displacement and axial forces are less as compared to other models. (In model 4 lateral displacement is equal to 16.41 mm and 44.43 mm in X and Y direction respectively which are less than the values of other model.)

c) About 67% of the lateral displacement in X direction & 58% of the lateral displacement in Y Direction get reduced when shear wall is incorporated in the Bare Frame System. (Without shear wall lateral displacement is equal to 50.97 mm & 107.24 mm in X and Y direction which get reduced to 16.41 mm and 44.43 mm in X and Y direction respectively when shear wall is placed in bare frame system.)

d) About 15% of the axial force in the column gets reduced when the shear wall is incorporated in the Bare Frame System. (Without shear wall axial force in columns is equal to 359.81kN which get reduced to 303.51kN when shear wall is placed in bare frame system.)

2) When Infilled Frame System without shear wall is considered

When infill wall is treated as structural element about 65% of lateral displacement in X- direction and about 52 % of lateral displacement in Y-direction get reduced when compared with bare frame system without shear wall. (Without shear wall lateral displacement in bare frame is equal to 50.97 mm & 107.24 mm in X and Y direction respectively which get reduced to 17.46 mm and 51.08 mm in X and Y direction respectively in infilled frame system without shear wall.)

3) When Infilled Frame System with best shear wall location is considered

a) About 85% of the lateral displacement in X-direction and 81% of lateral direction in Y-direction get reduced when shear wall in incorporated in infill frame system when compared with bare frame without shear wall. (Without shear wall lateral displacement in bare frame system is equal to 50.97 mm & 107.24 mm in X and Y direction which get reduced to 7.55 mm and 19.76 mm in X and Y direction respectively when shear wall is placed in infilled frame system.)

b) About 27 % of the axial force in the column get reduced when shear wall in incorporated in infill frame system as compared to bare frame system without shear wall. (Without shear wall axial force in columns in bare frame system is equal to 359.81kN which get reduced to 295.19 kN when best shear wall location is placed in infilled frame system.)

4) Combined Effect of Both System (i.e. bare frame and infilled frame system)

a) Considering both system it is concluded that Infilled frame system with shear wall is much more economical as compared to bare frame system because displacement drastically reduced in infilled frame structure.(with beat location of shear wall lateral displacement in bare frame system is equal to 16.41 mm and 44.43 mm in X and Y direction which get reduced to 7.55 mm and 19.76 mm in X and Y direction respectively when best location of shear wall is placed in Infilled frame system.)

b) The axial force in infilled frame system is less as compared to bare frame system this shows that the size of column can be reduced do to which we get more carpet area and cost will also get reduced.

VI. SCOPE OF FUTURE STUDIES

A. Use of bracing for better rigidity in structural member in study can be included.
B. Dynamic modeling can also be included for better understanding of results.
C. Pushover analysis can be done for future course of study.
D. Fly ash bricks or hollow blocks may replace in infill frame walls in modeling.
E. Scope of tube structure for mega tall buildings / ultra-tall building.
F. Study for 30 storey or greater for future researchers due to scarcity of land.
G. Limitation of shear wall for more than 40 storey due to its interaction at various floors.
H. More precise combination models can be studied for limiting displacement and Inter-storey drift.

REFERENCES

[1] Tarun Shrivastava, Prof. Anubhav Rai, Prof. Yogesh Kumar Bajpai "Earthquake Analysis of Multi-Storey Structure with Different Location of Shear Wall with Response Spectrum Method Using Hand Method", International Journal of Emerging Technology and Anvanced Engineering, pp. 309-318, ISSN: 2250-2459, Vol.5, Issue 1, January 2015.

[2] M.S. Aainawala, P.S. Pajgade "Deisgn of Multistoried R.C.C Buildings with and without Shear walls" International Journal of Engineering Sciences & Research Technology, pp.498-510, ISSN-2277-9655, July 2014.

[3] Vikas Govalkar, P.J. Salunke, N.G.Gore "Analysis of Bare Frame and Infilled Frame with different position of Shear Wall" , International Journal of Recent Technology and Engineering, ISSN: 2277-3878, Volume 3 Issue-3, July 2014.

[4] Shahzad Jamil Sardar & Umesh. N. Karadi "Effect of Change in Shear Wall Location on Storey Drift of Multistorey Building Subjected to Lateral Loads" International Journal of Innovative Research in Science Engineering and Technology, pp.4241-4249, ISSN: 2319-8753, Vol.2, Issue 9, September 2013.

[5] P.P. Chandurkar, Dr. P.S. Pajgade "Seismic Analysis of RCC Building with and without Shear Wall", International Journal of Modern Engineering Research, pp.1805-1810, ISSN: 2249-6645, Vol.3, Issue 3, May – June 2013.

[6] Ashish S. Agarwal, S.D. Charkha "Effect of Change in Shear Wall Location on Storey Drift of Multistorey Building Subjected to Lateral Loads", International Journal of Engineering Research and Applications, pp. 1786-1793, ISSN: 2248-9622, Vol.2, Issue 3, May – June 2012.

[7] P.S. Kumbhare, A.C.Saoji "Effectiveness of Changing Reinforced Concrete Shear Wall Location on Multi-storeyed Building", International Journal of Engineering Research and Applications, pp.1072-1076, ISSN: 2248-9622, Vol.2, Issue 5, September- October 2012.

[8] C.R.V. Murty and S.K. Jain (2000), "Beneficial Influence of Masonry Infill Walls on Seismic Performance of Reinforced Concrete Frame Buildings", Proceedings of the 12th World Conference on Earthquake Engineering, New Zealand.

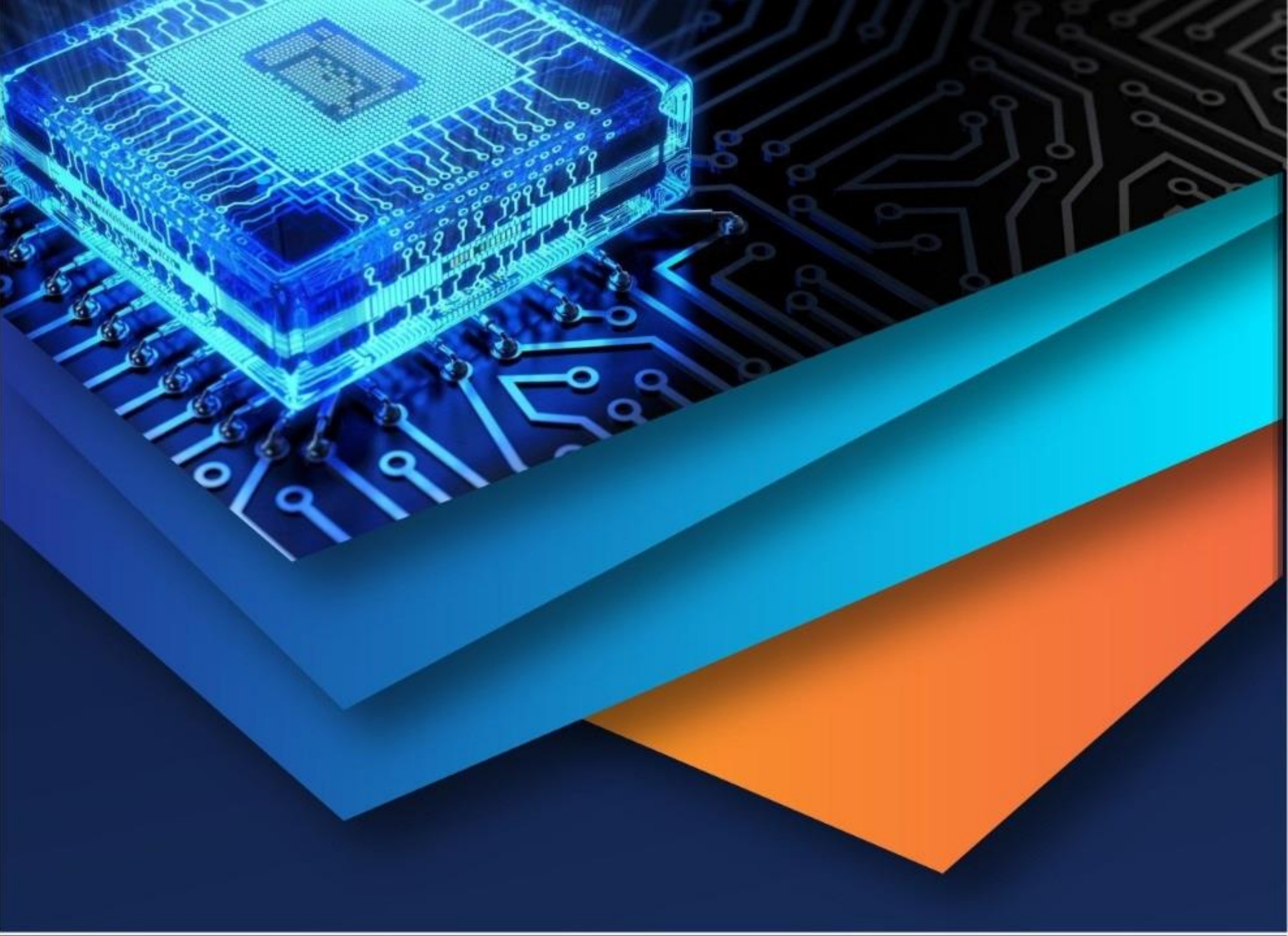
[9] Yogendra Singh and Dipankar Das (2006), "Effect of URM infills on seismic performance of RC frame buildings", 4th International Conference on Earthquake Engineering, Taipei, Taiwan.

[10] S.K Duggal "Earthquake Resistant Design of Structures" Oxford University Press, 2009, ISBN-13 : 9780195688177

[11] Boz. C.T, "Modelling of Building Structures for Lateral Load Analysis", M.S. Thesis, Middle East Technical University, 1987.

[12] "Response of Building to Lateral Forces", ACI Committee Report, SP-91, Detroit, 1985:21-46.

[13] Smith, B.S & Girgis, A , "Simple Analogus Frames for Shear Wall analysis", Journal of Structural Division, ASCE, 110 (11),1984.
[14] T. Paulay, M.J.N. Priestley (1992), "Seismic Design of Reinforced Concrete and Masonary Building", John Wiley & Sons, USA.\
[15] Stafford Smith, B., & Coull A., "Tall Building Structures: Analysis and Design", John Wiley & Sons, 1991.
[16] Bungale S. Taranath, "Reinforced Concrete Design of Tall Building", ISBN-9781439804803, CRC Press.
[17] Dr. Sudhir K Jain "Explanatory Examples on Indian Seismic Code IS 1893", Department of Civil Engineering, Indian



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