Impact Factor (SJIF): 3.632

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 3, Issue 4, April-2016

Comparative study of seismic behaviour of conventional slab structure and flat slab structure with and without shear wall

Bhudiya Bharat[1], Vadher Narendrasinh[2]

[1]*ME Civil (Structure) Student, HJD Institute of Technical Education and Research*
[2]*Assinstance professor, civil Engineering Department, HJD ITER, Kera-Kutch*

Abstract - The object of the paper is to analyze conventional RC frame structure and flat slab structure for 5 storey, 8 storey and 11 storey and comparison of both structure for with and without shear wall in Zone V and Zone IV. For present study irregular building is consider. Study is conducted on Plan irregularity (irregular floor plan) as per IS 1893-2002. To study the effect of shear wall on both structure, linear dynamic analysis (Response spectrum analysis) in software ETABs is carried out. In each analysis, the behavior of conventional slab structure and flat slab structure with and without shear wall was investigated and Top storey displacement, storey shear, Maximum storey drift and time period were observed. Comparison of analysis results for both structure is done in terms of time period, storey displacement, storey drift and storey shear.

Keywords – Conventional slab structure, Flat slab structure, Shear wall, storey displacement, storey shear, storey Drift and time period and storey Drift, ETABS

I. INTRODUCTION

In present era, conventional RC Frame buildings are commonly used for the construction. The use of flat slab building provides many advantages over conventional RC Frame building in terms of architectural flexibility, use of space, easier formwork and shorter construction time. Recently there has been a considerable increase in the number of tall buildings, both residential and commercial, and modern trend is towards taller structures. Flat slab is most widely used systems in reinforced concrete construction in offices, residential and industrial buildings in many parts of the world. This system having advantages that it reduces cost of form work and construction time, easy installation and requires the least story height. The flat slab system, in which columns directly support floor slabs without beams. Shear walls are relatively thin, vertically deep reinforced column used in structure which provide stability to structures from lateral loads like wind, seismic loads.

In present study, Column size for both structure and for different height is taken as per design done in Etabs software. Various parameter like time period, storey displacement, storey drift and storey shear of both structure with and without shear wall is presented. In this study for analyzing of structure response spectrum analysis is used using ETABS. Twelve models are prepared in Zone V for different storey for 5 storey, 8 storey and 11 storey and height of structure is 17m, 26m and 35m respectively. Charts & tables for various parameters of both structure with and without shear wall are presented.

II. DATA OF MODELS AND MODELLING OF STRUCTURES

A. Geometrical Data

Plan Dimension	: 20m x 20m
Typical Storey Height	: 3m
Bottom Storey Height	: 3m
Plinth level above GL	: 2m
Height of structure	: 17m, 26m, 35m, 41m
Number of storey	: 5, 8, 11 and 14 storey

B. Material Data

Material	Weight (KN/m3)	Modulus Of Elasticity (E) Mpa	Shear Modulus (G) Mpa	Poisson's Ratio	Coeffi. Of Thermal Expansion 1/C
Concrete (M20)	25	22360.68	9316.95	0.2	0.0000055

C. Loading Data

Live load	: 3 KN/m^2
Floor Finish	: 1 KN/m^2
Zone factor (Z)	: V and IV
Importance Factor (I)	: 1
Response reduction factor (R)	: 5
Soil type	: II (Medium soil)
Damping	: 0.05

D. Member sizes

Slab thickness	: 150mm for Conventional Slab
	: 200mm for Flat Slab
Beam Size	: 230mm X 600mm
Column Size (Conventional structure)	: 400mm X 400mm (5 and 8 storey)
	: 500mm X 500mm (11 storey)
Column Size (Flat slab structure)	: 500mm X 500mm (5 storey)
	: 600mm X 600mm (8 storey)
	: 700mm X 700mm (11 storey)
Shear wall Thickness for conventional structure	: 150 mm (5 and 8 storey)
	: 200 mm (11 storey)
Shear wall Thickness for Flat slab structure	: 150 mm (5 storey)
	: 200 mm (8 storey)
	: 250 mm (11 storey)

E. Plan Data

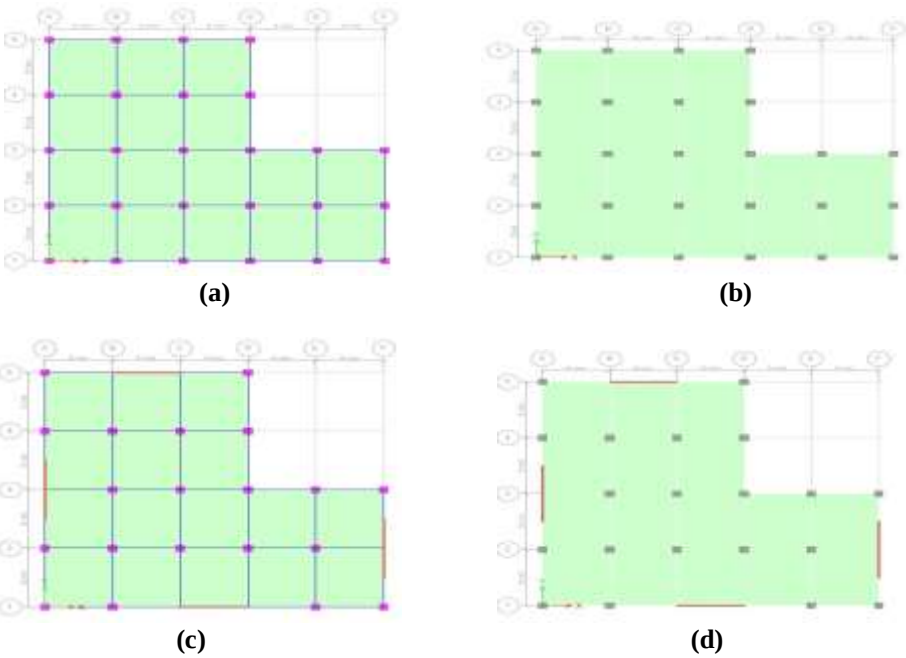
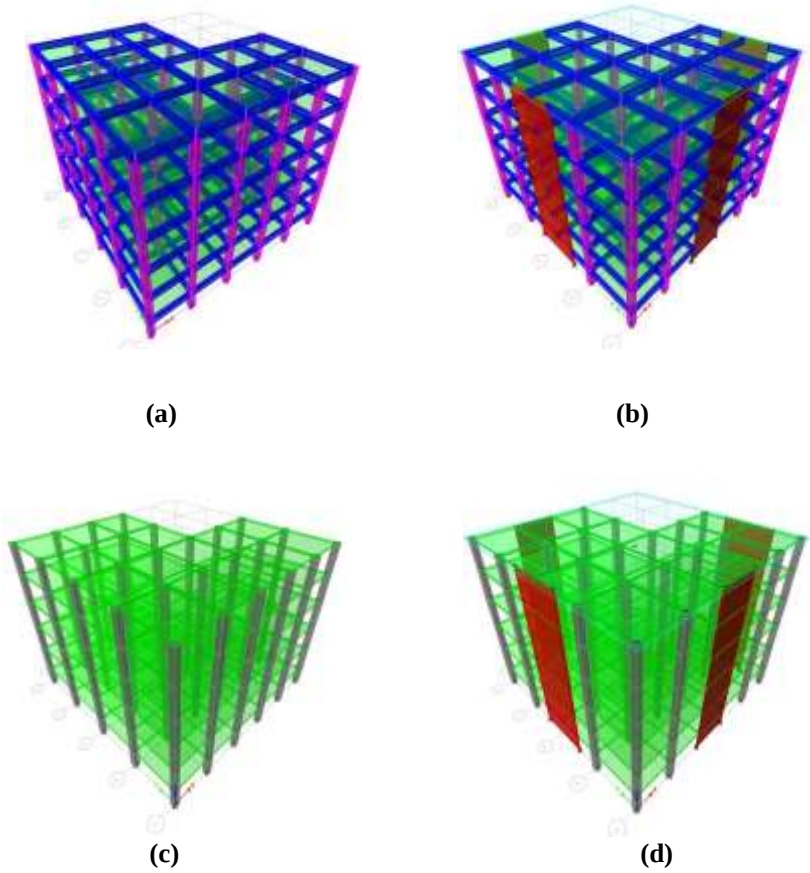


Fig. 1: Typical Floor plan (a) Conv. Structure (b) Flat slab structure (c) Conv. Structure with SW (d) Flat slab structure with SW



(a) **(b)**

(c) **(d)**

Fig. 2: 3D View (a) Conv. Structure (b) Flat slab structure (c) Conv. Structure with SW (d) Flat slab structure with SW

The Stepwise Procedure followed for modelling and analysis of structure in Etabs:

- Define Storey data like storey height, no of storey etc.
- Select Code preference from option and then define material properties from define Menu.
- Define Frame Section from Define menu like column, beam, and slab section.
- Prepare the three dimensional structural model as shown in Fig 2.
- Assign the support conditions.
- Assign the section properties to the elements.
- Define Load cases and Load combinations
- Apply the loads to the structure as mentioned in the section II.
- Define Response spectrum function and response spectrum load cases.
- Analyze the Model.
- From analysis results comparison of conventional structural system and Flat Structural system carried out.

III. ANALYSIS RESULS AND DISCUSSSION

A. Comparative analysis output

The comparative analysis results of both conventional and flat slab structure with and without shear wall in terms of time period, Storey shear, Displacement, Inter-storey Drift are presented in this section.

The comparative results for time period of 5 storey conventional structure with and without shear wall and flat slab structures with and without shear wall are shown in Figure 3. It is observed that 1st mode shape time periods for Flat slab structure is higher compared to conventional structure and with shear wall structure time period is less than without shear wall structure.

The comparative results for storey shear, storey displacement and storey drift of 5 storey conventional structure with and without shear wall and flat slab structures with and without shear wall for RSA X load in Zone V are respectively shown in Fig. 3, Fig 4 and Fig 5. It is observed that shear for Flat slab structure is lesser compared to conventional structure and with shear wall structure shear is less than without shear wall structure. Same as top storey displacement for conventional structure is well within in IS code permissible limit whereas flat slab structure top storey displacement is not well within

in limit in Zone V. But by providing a suitable size of shear wall at suitable location in plan top storey displacement of flat slab structure is then well within in permissible limit as per shown in fig 5. Here height of 5 storey structure is 17 m so limit of top storey displacement as per IS 456-2000 is H/500. So here limit is 17000/500 = 34 mm.

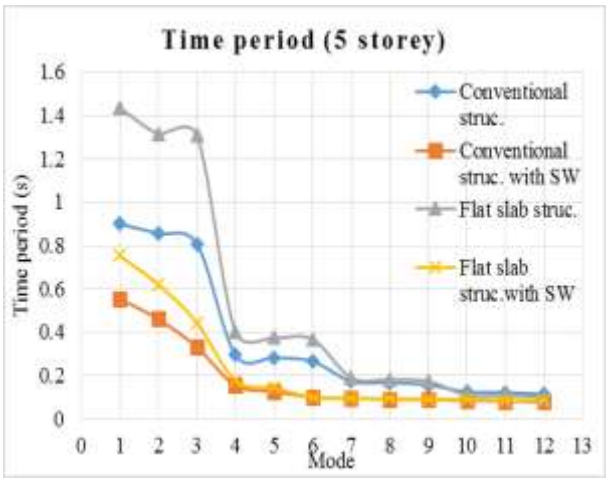


Fig. 3 Comparative Time Period of 5 storey structure

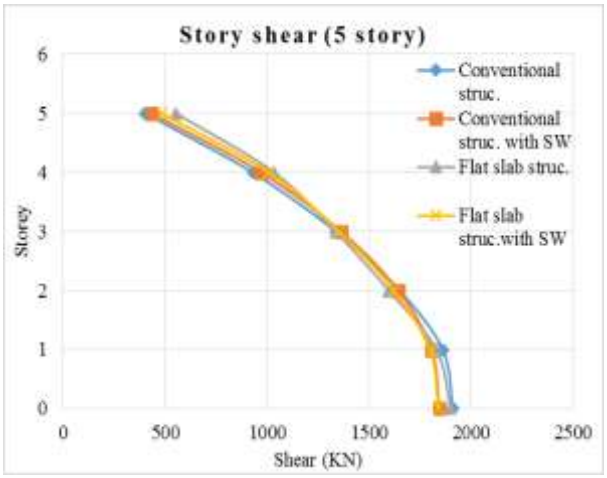


Fig. 4 Comparative shear of 5 storey structure

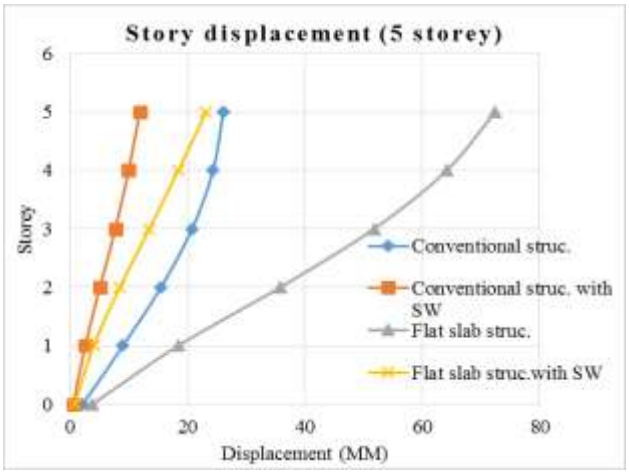


Fig. 5 Comparative displacement of 5 storey structure

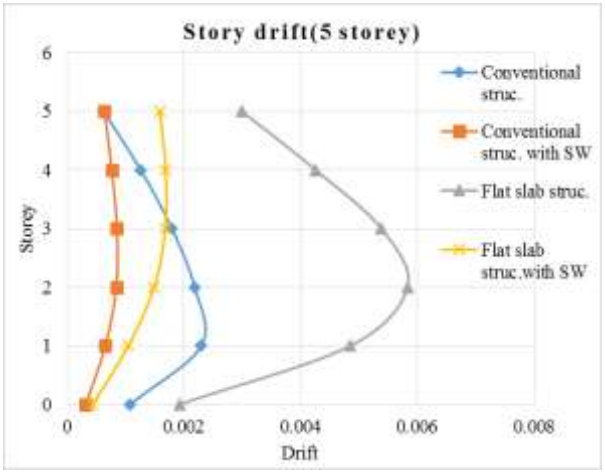


Fig. 6 Comparative drift of 5 storey structure

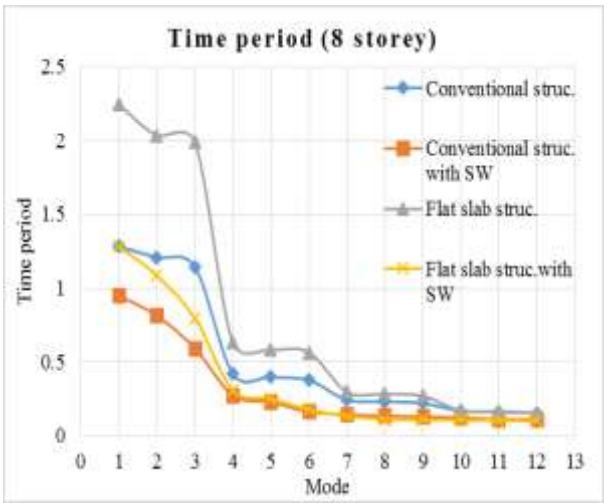


Fig. 7 Comparative Time Period of 8 storey structure

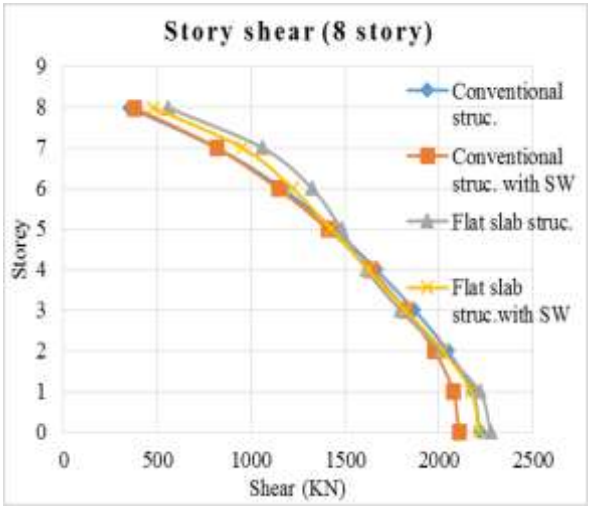


Fig. 8 Comparative shear of 8 storey structure

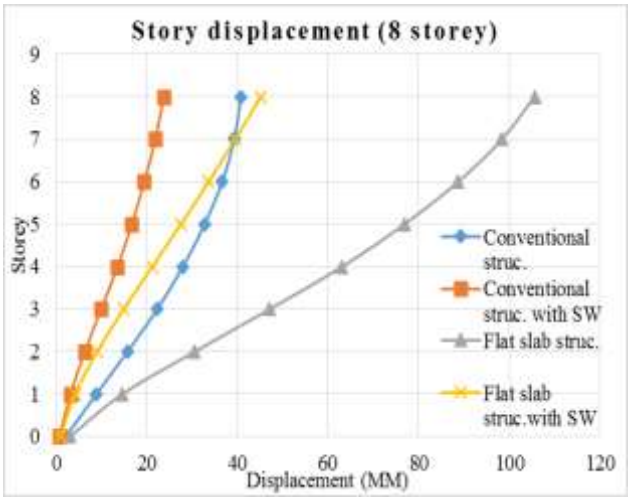


Fig. 9 Comparative displacement of 8 storey structure

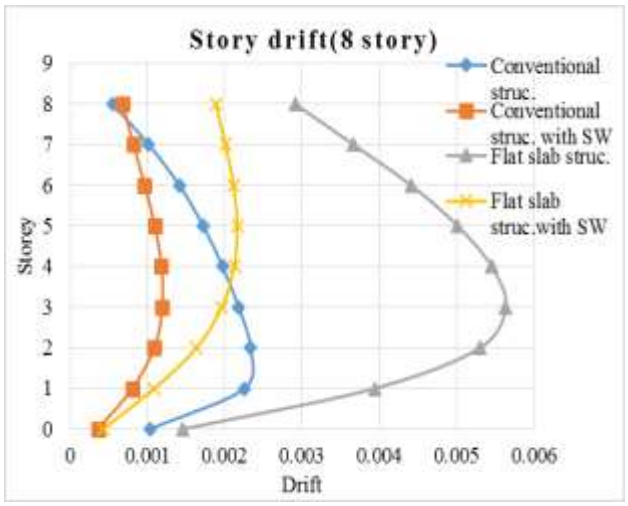


Fig. 10 Comparative drift of 8 storey structure

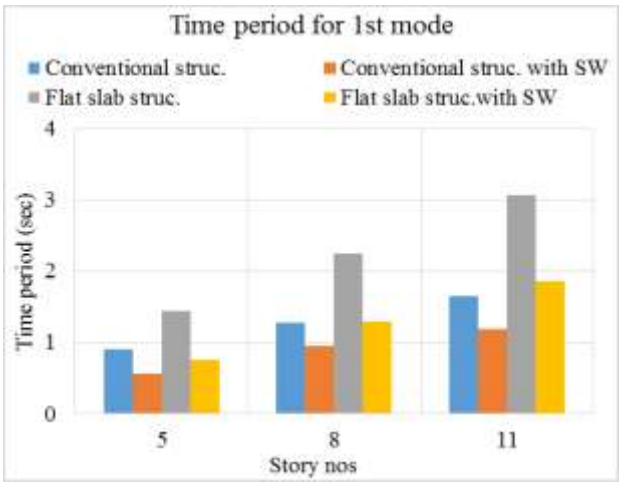


Fig. 11 Comparative Time period for all stories

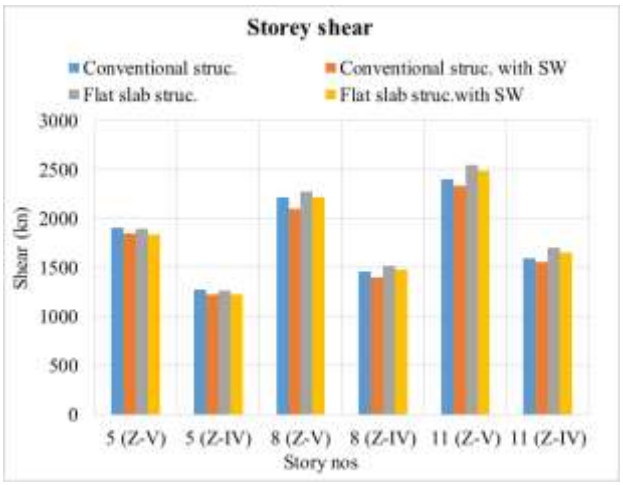


Fig. 12 Comparative Storey shear for all stories

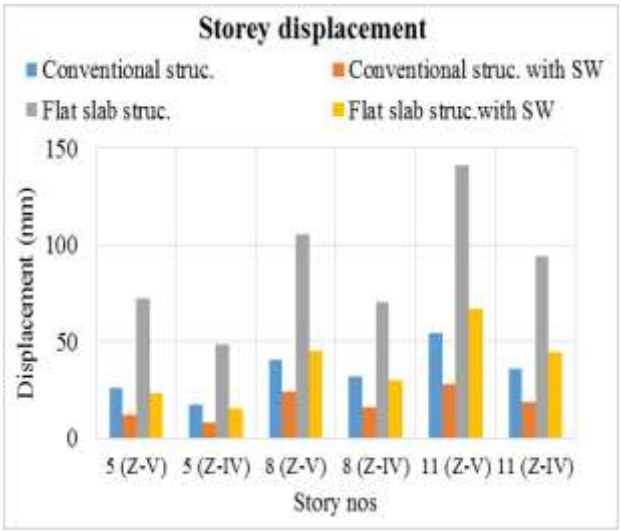


Fig. 13 Comparative storey displacement for all stories

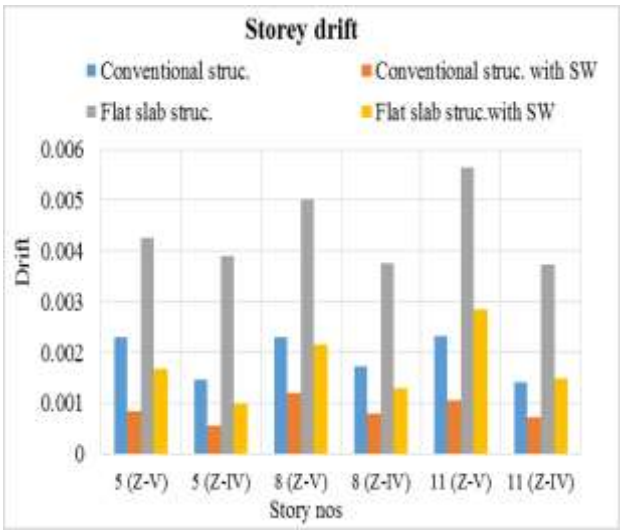


Fig. 14 Comparative Storey drift for all stories

IV. CONCLUSION

Analysis of 5 stories, 8 storey and 11 storey RCC conventional slab structure and flat slab structure building with and without shear wall is carried out by using response spectrum method. The following conclusions are drawn from the study.

1) Time period is less, lesser is mass of structure and more is the stiffness of structure. There is 50% to 60 % Reduction in time period of conventional structural system compared Flat slab structural system, indicates that conventional structural systems has higher Stiffness compared to flat slab structural system.
2) There is 50% to 60 % Reduction in time period for with shear wall structure to without shear wall structure indicates that with shear wall structure has higher stiffness compare to without shear wall structure.
3) The maximum top storey displacement should not exceed H/500, where H=total height of the building, the permissible limit. It can be seen that when the height of the building is increase, the top storey displacement is also increase. From graph it can be seen that in Zone V structure has higher displacement than zone IV structure so as seismic zone level increase displacement is also increase. Top storey displacement for conventional structure is well within in IS code permissible limit whereas flat slab structure top storey displacement is not well within in limit in Zone V. But by providing a suitable size of shear wall at suitable location in plan top storey displacement of flat slab structure with shear wall is then well within in permissible limit.
4) There is 35% to 40 % Reduction in storey displacement of conventional structural system compared flat slab structural system and 30% to 50% in reduction in storey displacement of with shear wall structure to without shear wall structure.
5) For earthquake load, as per code IS: 1893-2002, clause: 7.11.1, page no: 27, the storey drift in any storey due to minimum specified lateral force with partial load factor of 1.0 should not exceed 0.004 times storey height. From graph it can be seen that in Zone V structure has higher drift than zone IV structure so as seismic zone level increase drift is also increase.it also seen that as storey height increase drift is also increase. There is 30% to 40 % Reduction in storey drift of conventional structural system compared flat slab structural system and 40% to 50% in reduction in storey drift of with shear wall structure to without shear wall structure.
6) From graph it is observed for 5 storey structure there is minor difference in storey shear of conventional structural to flat slab structure but as height of structure increase storey shear of flat slab structure is also increase and same as seismic zone level is increase shear is also increase.
7) It is also observed that as height of flat slab structure is increase a required thickness of shear wall to limit a top storey displacement of flat slab structure is also increase.
8) So Building with shear wall is preferred because of considerable difference in storey displacement, time period, base shear and storey drift.

REFERENCES

1) Vakas K. Rahman, Prof. A. R. Mundhada “Comparative Study of RCC and Prestressed Concrete Flat Slabs”, International Journal of Modern Engineering Research (IJMER) ISSN: 2249-6645
2) Dr. Uttamasha Gupta, Shruti Ratnaparkhe, Padma Gome, “Seismic Behaviour of Buildings Having Flat Slabs with Drops” International Journal of Emerging Technology and Advanced Engineering (IJETAE) ISSN 2250-2459
3) Prof .K.S.Sable, Er.V.A.Ghodechor, Prof.S.B.Kandekar “Comparative Study of Seismic Behaviour of Multi-storey Flat Slab and Conventional Reinforced Concrete Framed Structures” International Journal of Computer Technology and Electronics Engineering (IJCTEE) ISSN 2249-6343 Volume 2, Issue 3, June 2012.
4) Mohana H.S, Kavan M.R, “Comparative Study of Flat Slab and Conventional Slab Structure Using ETABS for Different Earthquake Zones of India”, International Journal of Engineering Research & Technology (IJERT) ISSN: 2395-0056 Vol. 2 Issue 3, June – 2015.
5) Rajib Kumar Biswas, Dr. Md. Mahmudur Rahman “Dynamic Analysis of High Rise Flat Plate Building with Different Retrofitting Systems” European academic research vol.I, Issue11, February 2014.
6) Sumit Pawah, Vivek Tiwari, Madhavi Prajapati “Analytical Approach to Study Effect of Shear Wall on Flat Slab And Two Way Slab” International Journal of Emerging Technology and Advanced Engineering ISSN 2250-2459, Volume 4, Issue 7, July 2014
7) Shyam Bhat M, N.A.Premanand Shenoy, Asha U Rao “Earthquake Behaviour of Buildings with and without Shear alls” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X
8) Uttamasha Gupta, Shruti Ratnaparkhe, Padma Gome “ Seismic Behaviour Of Buildings Having Flat Slabs With Drops” International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 2, Issue 10, October 2012
9) IS1893-2002: Indian Standard Code of Practice for Criteria for Earthquake Resistance Design of Structures.
10) N KRISHNA RAJU Book of advanced reinforced concrete design”.
11) Plain & Reinforced Concrete Code of Practice” Fourth Revision IS: 456:2000.
12) P.C Varghese a book of advanced reinforced concrete design”
13) Bhavikatti S.S, “Advance R.C.C. Design” , New Age International (p) Limited, Publishers, New Delhi, India