COMPARATIVE STUDY ON SEISMIC ANALYSIS OF CONVENTIONAL SLAB AND FLAT SLAB STRUCTURE WITH AND WITHOUT SHEAR WALL USING ETABS

Pooja B K[1], Naveen Kumar S[2]

[1]*M-tech student, Dept. of Civil Engineering, P.E.S College of Engineering, Mandya, Karnataka, India*
[2]*Assistant Professor, Dept. of Civil Engineering, P.E.S College of Engineering, Mandya, Karnataka, India*

---***---

Abstract - *In recent construction activity, Flat slab building has many privilege over conventional slab building in terms of Architectural flexibility, Easier formwork, use of space, less construction time and Better quality control. But, flat slab structures are significantly more flexible than the conventional slab structures, thus becoming more vulnerable to seismic loading. Therefore in order to upgrade the performance, flat slab are usually provided with drops. The flat slab has less stiffness and less shear strength with more flexibility feature than the conventional slab. In the present work a G+12 commercial multistoried building having conventional slab and flat slab having drop with and without shear wall. The buildings are modeled and Analyzed by using ETABS software. The seismic analysis is done as per IS 1893(Par 1). The behavior of Conventional slab and Flat slab structure with and without shear wall in seismic zone II, III, IV and V with type II (medium) soil are taken for all instances. Analysis of buildings is done by Equivalent static method and Response spectrum method. The seismic evaluation result can be done based on the parameters like Storey displacement, Storey drift, Storey stiffness and Natural time period.*

Key Words: Conventional slab, Flat slab, Shear wall, Storey displacement, Storey drift, Storey stiffness, Natural time period

1. INTRODUCTION

These days, the structures are being built quickly because of the expansion in population. At present India is the quickest developing country in economy this leads to demand in infrastructure facilities along with the growth of population. The demand for high rise building in urban areas is increasing day by day than the past decades. Due to urbanization, the desires of the people have been upgraded with respect to less construction time, flexibility in the room layout, aesthetic appearance, better quality control, fire resistant, better diffusion of light and so on. To meet the demand of people different type of construction technique has been adopted these days. Among these flat slab (i.e., beam less slab) is one.

Generally, the multistory structures are constructed with the conventional reinforced concrete slab which proves it to have high storey stiffness and strength. But, due to the several advantages of beamless slab the old style construction i.e., conventional slab are being slowly replaced by flat slabs.

The flat slab directly rest on the column and transfer the loads to the columns without beams. Flat slab buildings are prominent floor construction systems in commercial buildings, residential buildings and other multi storey buildings. Flat slab structures are favored by both architecture and client. In the conventional slab structures the slab is resting on the beams, the slab load is transferred to beams and then beams to columns. But in flat slab structure load is transferred from slab to columns directly.

1.1 Conventional slab system

Conventional slab system is routine method of construction consists of columns, beams and slab. This system utilised in the development of private structures and compact construction. Here all the four edges of the slab are supported on beams where the loads are transferred from slab to beams and then to columns. Hence weight of the structure increases and formwork is also costly compared to flat slab. In this type, the thickness of slab is small whereas the depth of beam is large. It requires more formwork compared with the flat slab.

1.2 Flat slab system

Flat slab usually does not have beams is supported directly by the reinforced columns. It is also called as beamless slab. The projection below the slab i.e., the thickened portion is called as Drop. Flat slab is preferred by both architect and client because of its aesthetic view and economic advantages. The drawback of beamless slab is their lack of resistance to lateral loads.

1.3 Shear wall

Shear wall is a vertical structural element designed to resist the lateral loads in high rise buildings. It provides the stability against lateral force due to its lateral strength and stiffness which can be used to resist the wind loads and seismic loads. The position of the Shear walls is usually provided at corners or middle of the structures. The shear wall forms an efficient lateral force resisting system when it is situated at advantageous positions of the structure.

2. OBJECTIVES OF STUDY

1. To obtain the highly effective structure to resist the horizontal lateral loads.
2. To study the effect of conventional slab and flat slab structure with and without shear wall.
3. Comparative study on various seismic parameters like storey displacement, storey drift, storey stiffness and Time period.
4. The various models thus generated parametrically are compared and suitable conclusions are drawn.

3. METHODOLOGY

The structure considered for an analysis is RC building. A G+12 story building geometry are considered such as Conventional slab structure and Flat slab with and without shear wall. The buildings are modeled and analyzed by using software ETABS for different seismic zones. Models are considered for zone factor II, III, IV and V and soil type is II (medium) as per IS: 1893 (Part 1) code of practice.

4. MODELLING

The models of G+12 storey building are analyzed in both Equivalent static method and Response spectrum method. The analysis results are obtained for seismic zone II, III, IV and V.

4.1 Types of models

1. Conventional slab structure (Zone II, III, IV, V)
2. Flat slab structure without shear wall (Zone II, III, IV and V)
3. Flat slab structure with shear wall at corner (Zone II, III, IV and V)

4.2 Model details

Table-1 Structural and Seismic details of 13 storey conventional and flat slab structure

PARAMETERS	
Plan dimension	36 x 25 m
No. of stories	G+12
Height of the structure	39 m
Bottom storey height	3 m
Grade of concrete	M30
Grade of steel	HYSD 500
Floor to floor height	3 m
Slab thickness	150 mm
Drop size	2 x 2 m
Drop thickness	200 mm
Shear wall size	200 mm
Size of column	(600 x 600)mm
Size of Beam	(300 x 600)mm
Live load on floors	4 kN/m^2
Terrace load	1.5 kN/m^2
Floor finish load	1.5 kN/m^2
Zone considered	II, III, IV and V
Zone factor	0.10, 0.16, 0.24 and 0.36
Importance factor	1.2
Type of soil	II (medium)
Reduction factor (SMRF)	5

Plan and 3D view

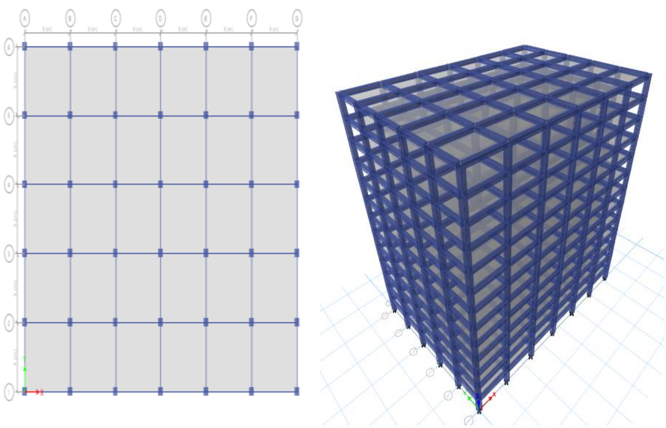

Fig-1: Conventional slab structure

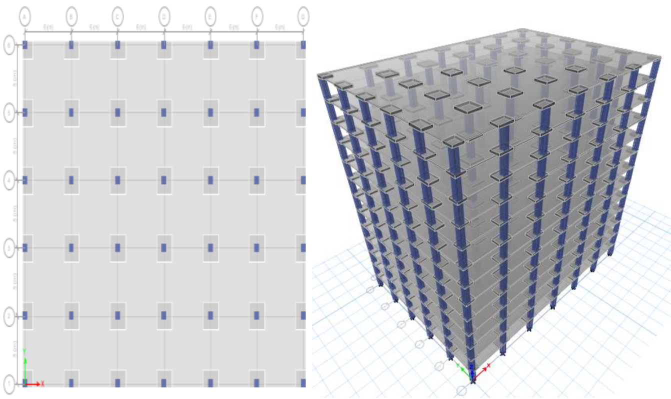

Fig-2: Flat slab structure without shear wall

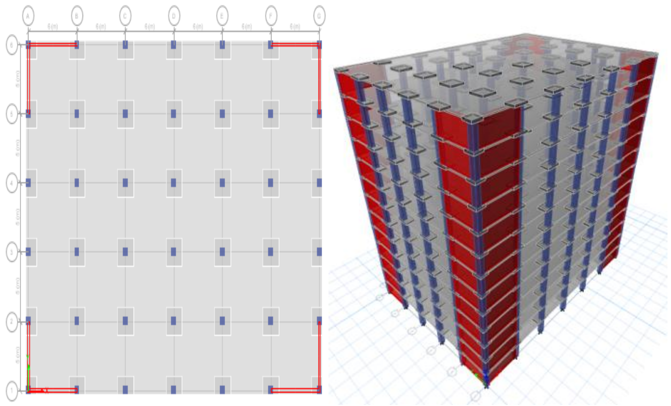

Fig -3: Flat slab structure with shear wall at corner

5. RESULTS AND DISCUSSIONS

The results of each building model are presented in this chapter. The analysis is carried out by Equivalent static method and Response spectrum method. The results are obtained for 13 storey building for the zone factor II, III, IV and V for the parameters Story Displacement, Story Drift, Story Stiffness and Natural time period.

5.1 EQUIVALENT STATIC METHOD

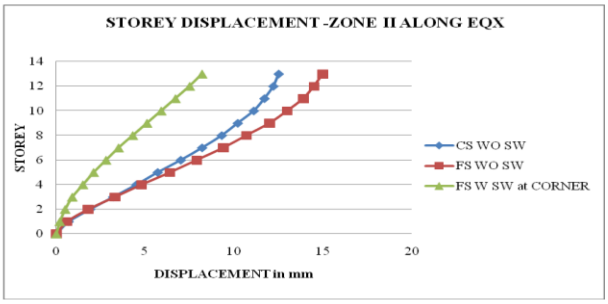

Chart-1: Storey displacement of building for Zone II

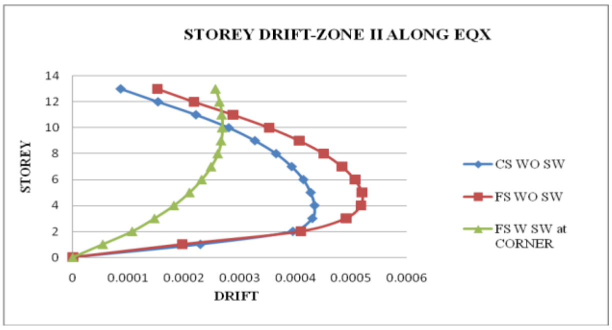

Chart-2: Storey drift of building for Zone II

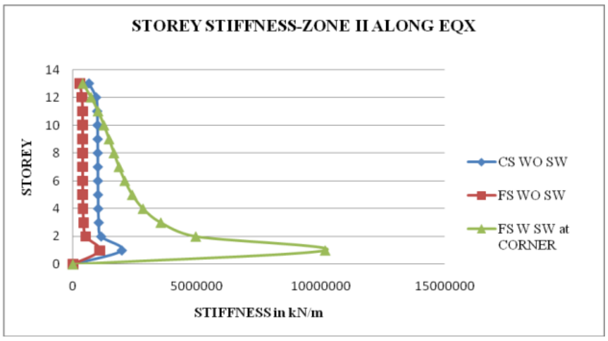

Chart-3: Storey stiffness of building for Zone II

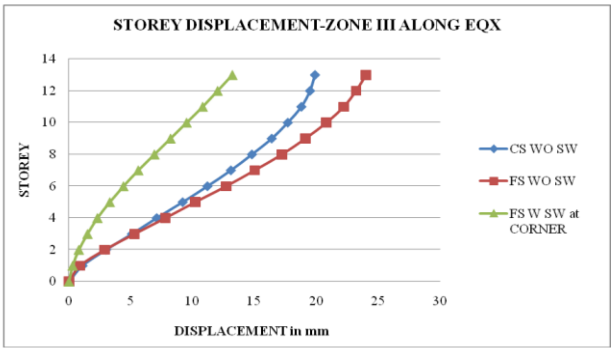

Chart-4: Storey displacement of building for Zone III

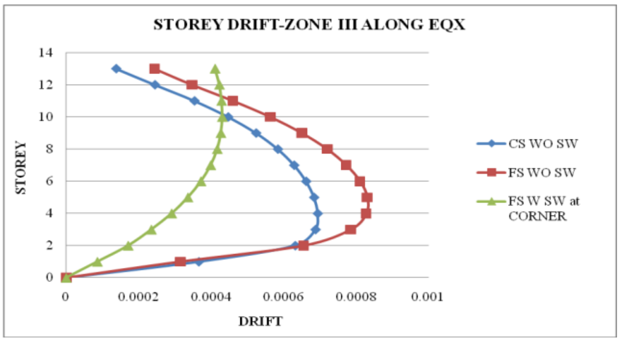

Chart-5: Storey drift of building for Zone III

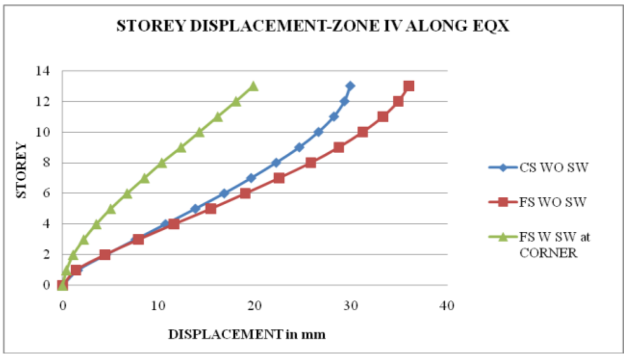

Chart-6: Storey displacement of building for Zone IV

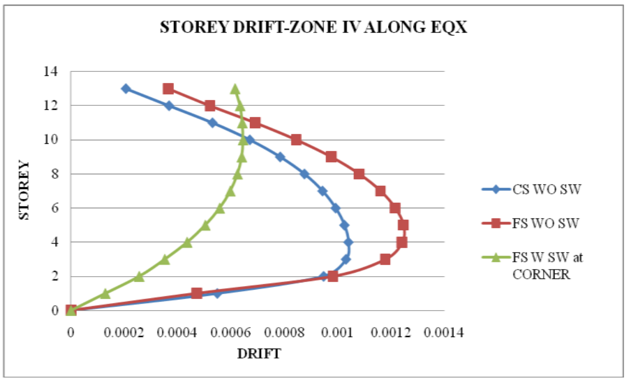

Chart-7: Storey drift of building for Zone IV

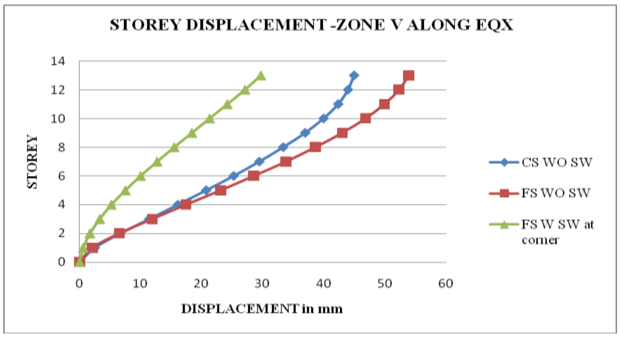

Chart-8: Storey displacement of building for Zone V

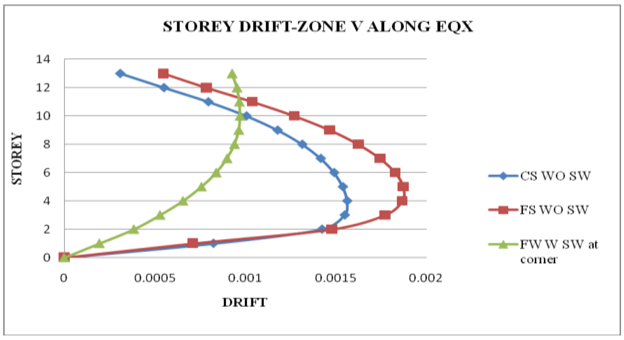

Chart-9: Storey drift of building for Zone V

5.2 RESPONSE SPECTRUM METHOD

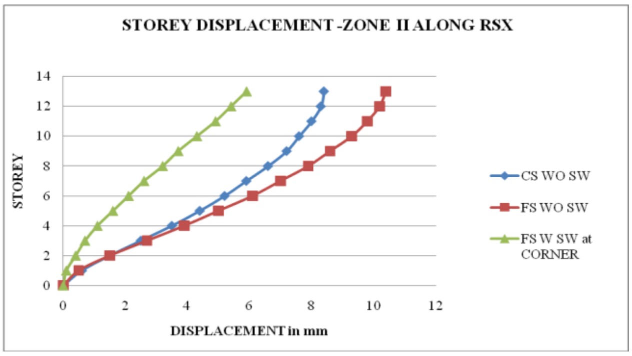

Chart-10: Storey displacement of building for Zone II

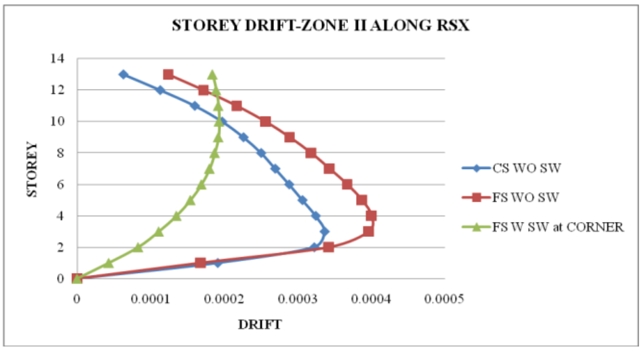

Chart-11: Storey drift of building for Zone II

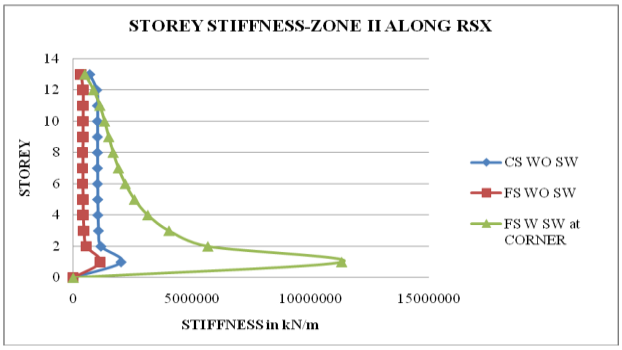

Chart-12: Storey stiffness of building for Zone II

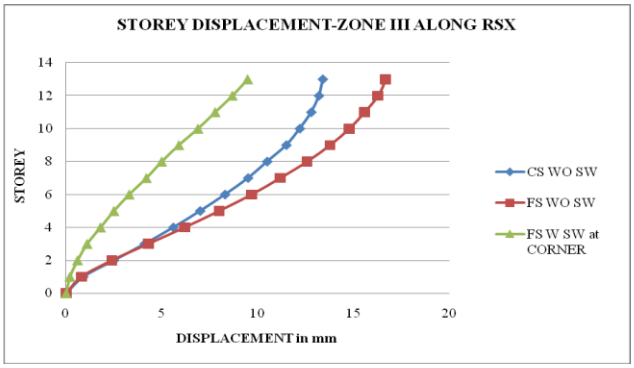

Chart-13: Storey displacement of building for Zone III

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

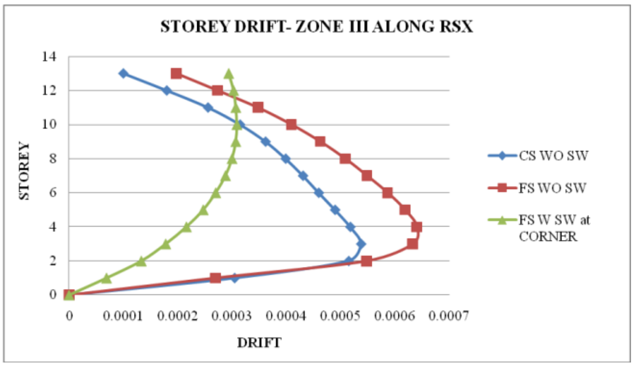

Chart-14: Storey drift of building for Zone III

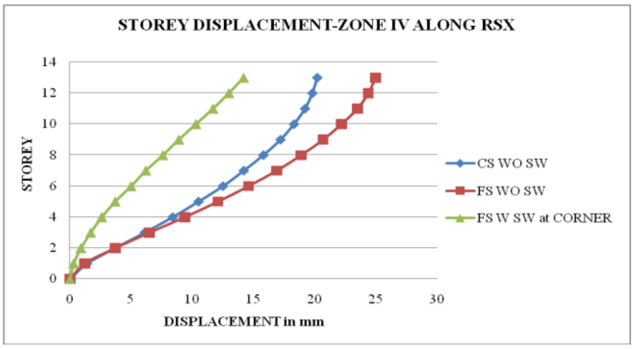

Chart-15: Storey displacement of building for Zone IV

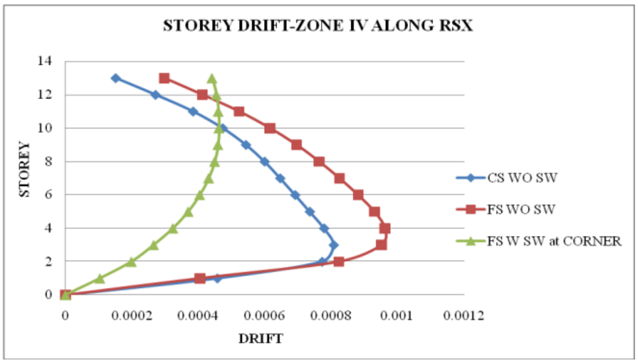

Chart-16: Storey drift of building for Zone IV

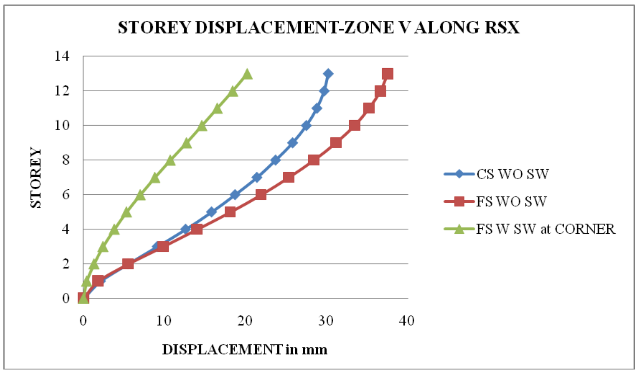

Chart-17: Storey displacement of building for Zone V

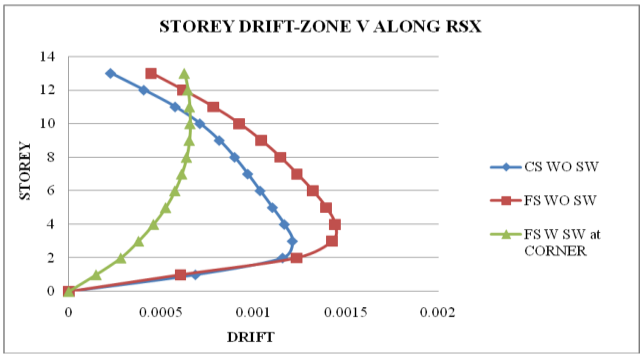

Chart-18: Storey drift of building for Zone V

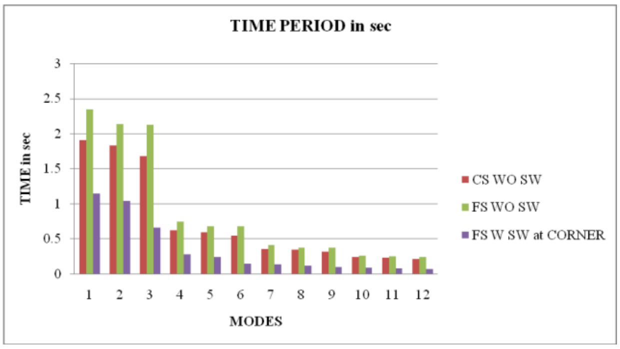

Chart-19: Natural Time period of building

5.3 COMPARISION OF STRUCTURES FOR DIFFERENT SEISMIC ZONES BY EQUIVALENT STATIC ANALYSIS

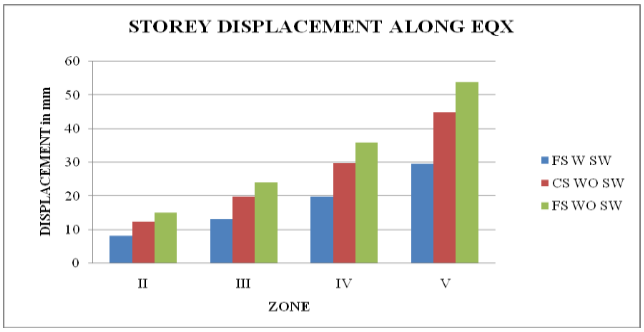

Chart-20: Displacement vs Zone for structures

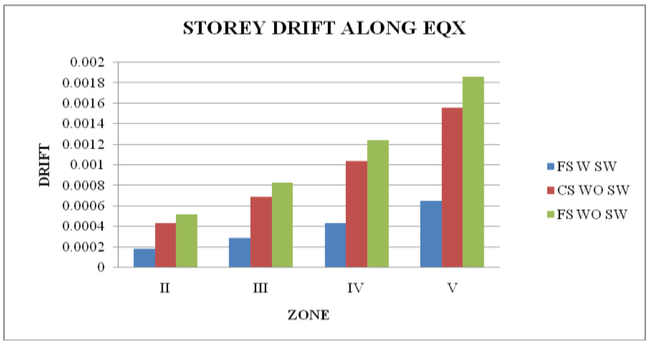

Chart-21: Drift vs Zone for structures

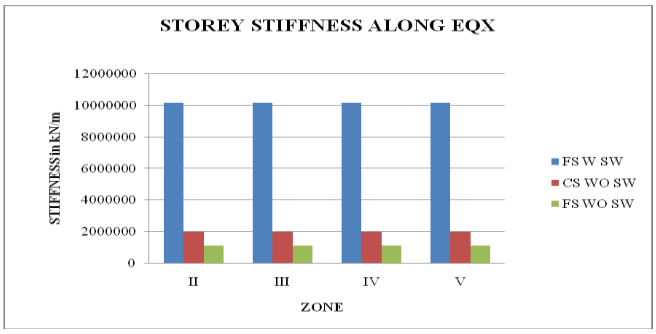

Chart-22: stiffness vs Zone for structures

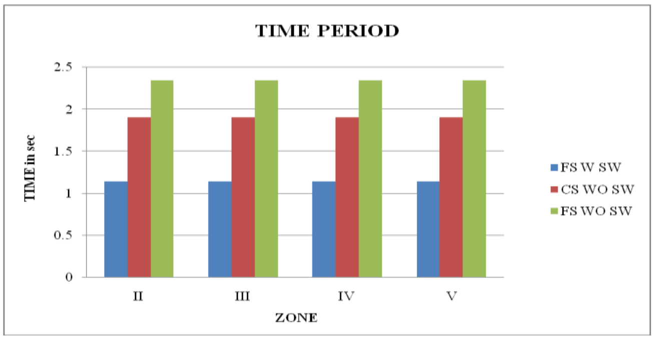

Chart-23: Time vs Zone for structures

5.4 COMPARISION OF STRUCTURES FOR DIFFERENT SEISMIC ZONES BY RESPONSE SPECTRUM ANALYSIS

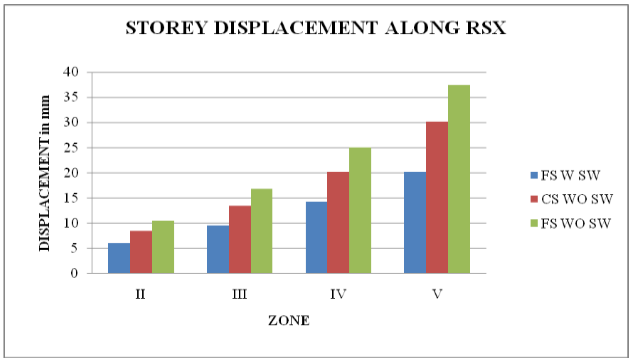

Chart-24: Displacement vs Zone for structures

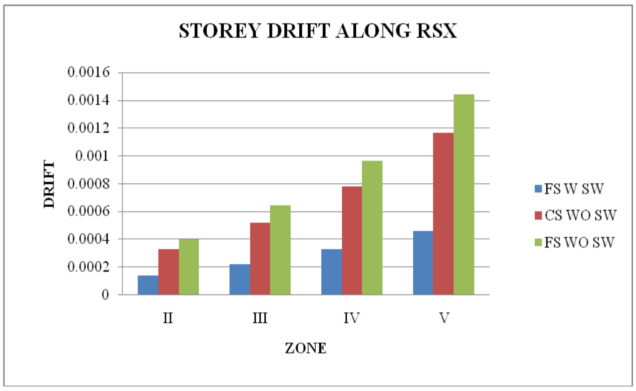

Chart-25: Drift vs Zone for structures

Chart-26: stiffness vs Zone for structures

6. CONCLUSIONS

1. The storey displacement is high at the top storey and less at the base. With the increase in the height of the structure the displacement goes on increases. Storey displacement of flat slab structure without shear wall shows maximum value.

2. The storey drift follows a parabolic path along the storey height. Storey drift of flat slab structure without shear wall is maximum.

3. The storey stiffness is more at base and it decreases as the height of the structure increases. Storey stiffness of flat slab structure with shear wall at corner is maximum.

4. The time period of flat slab structure without shear wall is maximum.

5. It is observed that as the seismic zone increases from zone II to V, the storey displacement and storey drift increases and storey stiffness and time period remains same.

6. Flat slab structure with shear wall at corner gives the best results, because the Time period, Storey displacement, story drift is less and Story stiffness is more than other two structures.

REFERENCES

[1] Sandesh D. Bothara, Dr.Valsson Varghese.(July-August 2012)-"Dynamic analysis of special moment resisting frame building with flat slab and grid slab" , Vol. 2, Issue 4, pp.275-280, ISSN: 2248-9622.

[2] M A Rahman (2012)-"Effects of openings in shear wall on seismic response of structures", Vol 2 ,issue 10 july 2012.

[3] R.S.More, V. S. Sawant, Y. R. Suryawanshi.(2013) –"Analytical study of different types of flat slab subjected to dynamic loading", IJSR, ISSN (Online): 2319-7064.

[4] Sharad P. Desai, Swapnil B. Cholekar (2013) "Seismic performance of reinforced Concrete building with flat slab"; Volume 2, Number 10; April-June, 2013.

[5] Lakshmi K O (2014), "Effect of shear wall location in buildings subjected to seismic loads",ISOI Journal Engineering and Computer Science, Volume 01,December 2014.

[6] Salman I Khan and Ashok R Mundhada. (February 2015)-"Comparative study of seismic performance of multistoried rcc buildings with flat slab and grid slab", Vol. 4, No. 1, , ISSN 2319 – 6009.

[7] N KRISHNA RAJU Book of advanced reinforced concrete design".

[8] Government of Bureau of Indian Standards: IS 875, part 2 (1987), Live Loads on Buildings and Structures, New Delhi, India.

[9] Plain & Reinforced Concrete Code of Practice" Fourth Revision IS: 456:2000.

[10] IS 1893 (Part-I) : Criteria for Earthquake Resistant Design of Structures, Part-I General Provisions and Buildings, Fifth Revision, Bureau of Indian Standards, New Delhi.