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COMPUTATIONAL ASSESSMENT FOR SEISMOLOGICAL PERFORMANCE OF MULTI-STOREY FLAT SLAB STRUCTURES WITH (AT SPECIFIC POSITIONS) AND WITHOUT SHEAR WALLS

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***Abstract*- In present era, there is a huge scarcity of vacant land led to the development of the high rise structures. For the construction of high rise buildings, normal R.C.C. system is not suitable. These problems can overcome by using flat slab system along with shear wall arrangements. It is very essential that the shear wall position should be appropriate in structure so as to achieve the lateral stiffness and solid structure against lateral loads. In this work, two main factors i.e. with drop panels and without drop panels have been considered for 12 storey structures. In each factor 5 models of various locations of shear wall is taken for consideration. For stabilization of variable parameters such as storey displacement, storey stiffness and storey shear etc the seismic investigation & design of structures had carried out in software ETABS.**

After performing seismic investigation & design of all the structures, result shows that if we provide shear wall at incorrect or inappropriate locations then it will only increase the dead load and cost of the structure. So the final outcomes we have achieved is to provide shear walls at desired position where lateral loads are more predominantly acting on the structures.

Keywords-- **Shear Wall, Lateral Loads, Drop Panels, ETABS**

I. INTRODUCTION

One of the serious issues in the latest development world is the issue of empty space. This shortage in metropolitan regions has prompted the vertical development of low-height, medium-height, tall structures & even high rise structures (more than 50 meters tall). These constructions fundamentally utilized framed system presented to the vertical similarly as lateral loads. Horizontal loads can foster more stresses, induced sway movement or results vibration. Accordingly, it is vital for the design to have adequate strength to oppose vertical loads along with satisfactory solidness (Stiffness) to oppose horizontal loads. These factors may be then again comparative with each other as the construction which is intended for supporting vertical loads probably won't maintain or goes against as mentioned lateral loads.

In high rise structures horizontal loads are most important which will increase quickly with increments in tallness. The design deals with the necessities of strength, rigidity & stability. For structures riser than 15 stories to 20 stories, unadulterated inflexible edge system isn't acceptable considering the way that it doesn't give the desired horizontal solidness & causes extreme bending of the structure. These prerequisites are fulfilled by 2 unique methods. First is by expanding the member size over the prerequisite of strength yet this technique has its restrictions & second is by modifying the primary design into all the high consistent & unbending to limit the bending.

In everyday act of plan and improvement, the slabs are upheld by beams and beams are upheld by pillars. This kind of advancement is known as Beam Slab construction. The accessible net rooftop stature is diminished taking into account the beams. Thus workplaces, stockrooms, public corridors and tall structures are a portion of the time arranged with no beams and slabs are clearly laid on pillars. This system of no beam - slab improvement termed as "Flat Slab" in which slab upheld clearly by pillars having no radiates (Beams). For designers, flat slab improvement gives diminished floor tallness and for architectures, it give aesthetically & great appearance.

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There are generally 4 kinds of flat slab as follows.

1.1 Flat slab without drops panel and column without column heads (Flat plate).
1.2 Flat slab with drop panels and column without column heads.
1.3 Flat slab without drop panels and column with column heads.
1.4 Flat slab with drop panels and column with column heads.

OBJECTIVES

Followings are the objectives assumed for this research.

1. Analysis of multi-storey flat slab building with shear wall (at different location) & without shear wall along with drop panels.
2. Design of multi-storey flat slab building with shear wall (at different location) & without shear wall along with drop panels.
3. Analysis of multi-storey flat slab building with shear wall (at different location) & without shear wall along with no drop panels.
4. Design of multi-storey flat slab building with shear wall (at different location) & without shear wall along with no drop panels.
5. Comparative analysis of both above cases i.e. with drop panels and without drop panels structure.
6. To know the best suitable location of shear wall in above flat slab cases.

II. MODELING

In this research, 12 Storey Flat Slab structures are assumed. In multi-storey structures to minimize column shear & storey drift, Shear wall is introduced at some specific positions & here principal motive is to analyze the structural conduct of the structural configuration with respect to interaction of shear wall & flat slab.

2.1 Structural Data Used

Table -1 Preliminary assumed data

Sr. No.	Content	Description
01	Type of Structure	Flat Slab with shear wall
02	Seismic Zone	II
03	Zone Factor	0.1
04	No. of storey	G + 12
05	Storey height	3 m
06	Bottom storey Height	2 m
07	Size of column & Edge beam	600 X 450 & 450 X 250
08	Thickness of Flat Slab	250 mm
09	Type of soil	Medium Soil Type II
10	Grades of Concrete and Steel	M-30 & HYSD-500
11	Response Spectra	As per IS 1893: 2016 for 5 % Damping Ratio
12	Importance Factor	1.5
13	Response Reduction Factor	5 (SMRF)

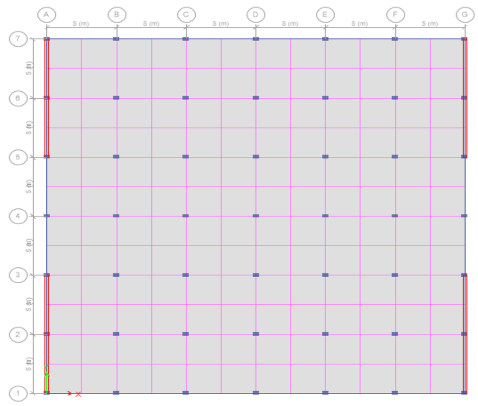

Fig.1. SW along Periphery

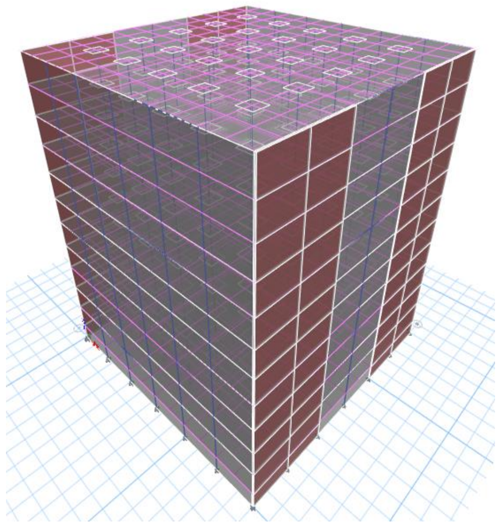

Fig.2. 3D View of SW along Periphery

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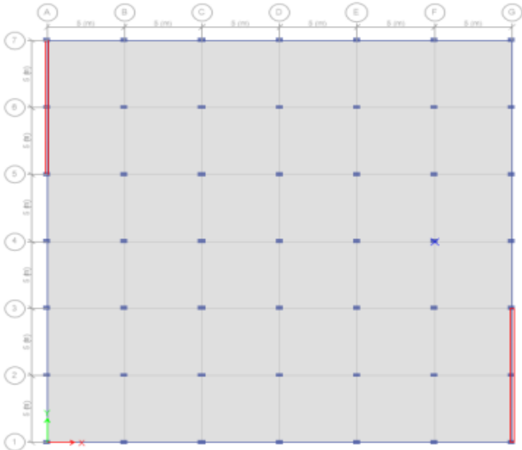

Fig.3. SW Placing I

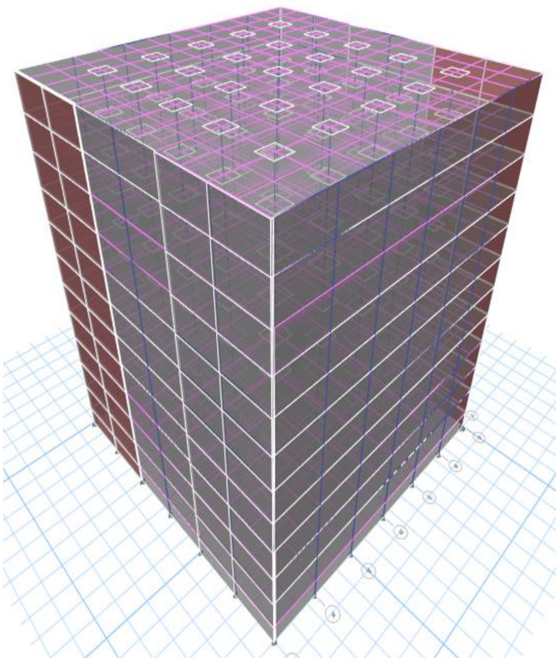

Fig.4. 3D View of SW Placing I

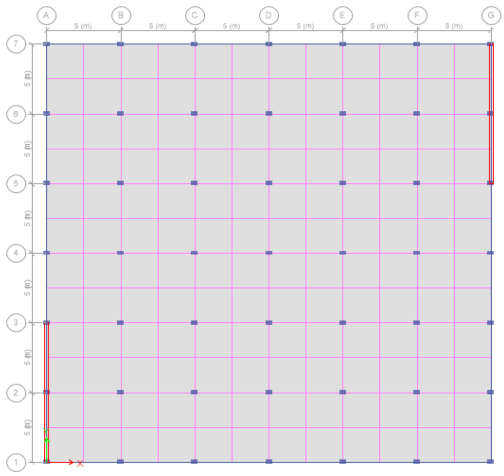

Fig.5. SW Placing II

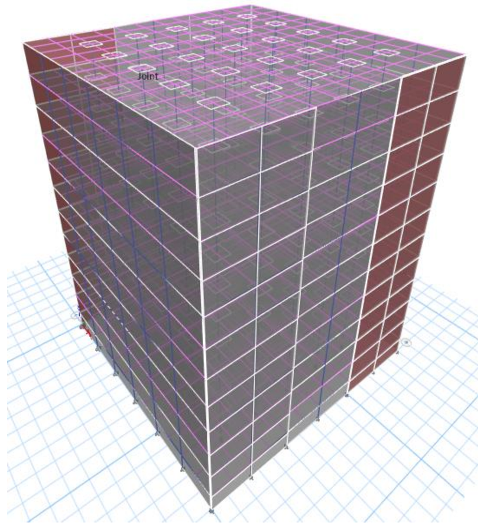

Fig.6. 3D View of SW Placing II

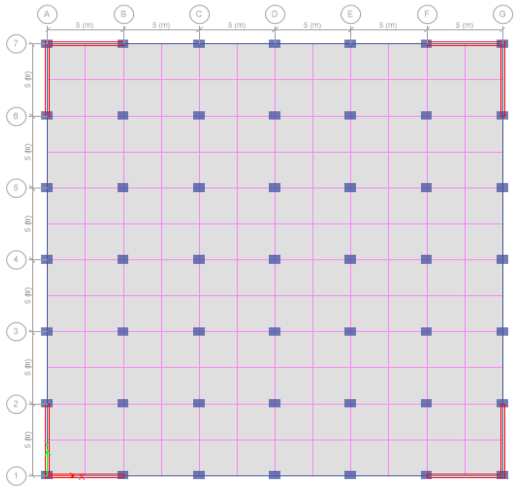

Fig.7. SW at Corners

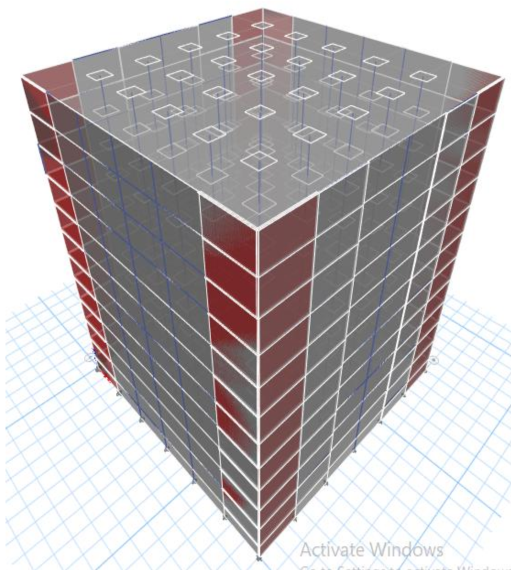

Fig.8. 3D View of SW at Corners

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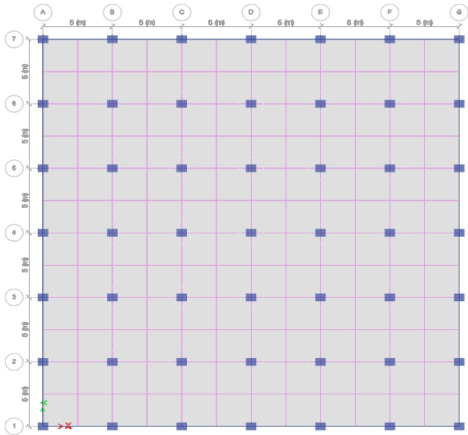

Fig.9. without Shear Wall

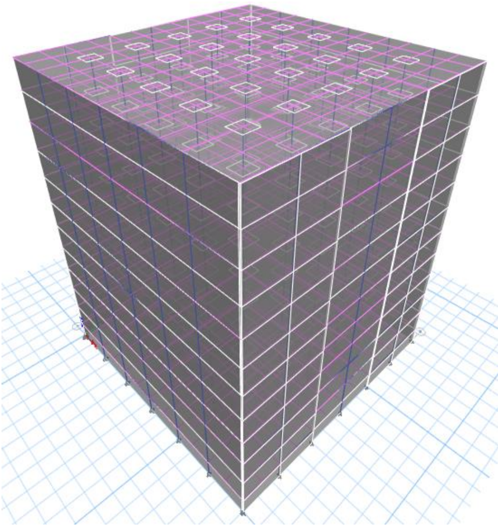

Fig.10. 3D View of SW at Corners

III. RESULTS AND DISCUSSION

In this chapter, we will discuss about the various aspects of results of all the above mentioned models. We will see the result on the basis of the following aspects i.e. Storey Displacement, Storey Shear, Overturning Moments etc. for the structures with and without drop panels.

3.1 Storey Displacement:

❖ **With Drop Panels**

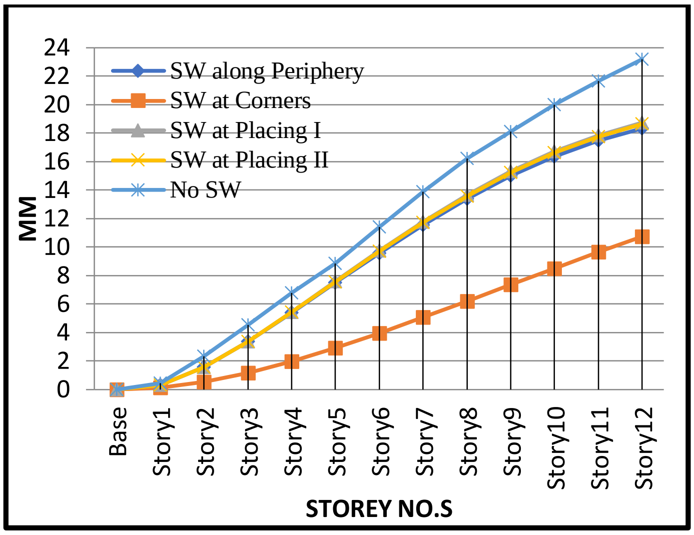

Fig.11. Storey Displacement

The above graph shows the maximum displacement occurs for the structure having no shear wall because the rigidity or the strength against lateral forces in less if we compare this structure to the structures having shear wall. The maximum displacement for without shear wall structure is for the storey 12 i.e. 23.188 mm which is the highest among the all displacements. The lowest displacement is observed for the structure having shear wall at the corners of the buildings. The value for the displacement at storey 12 is 10.719 mm which is the lowest value at all.

❖ **Without Drop Panels**

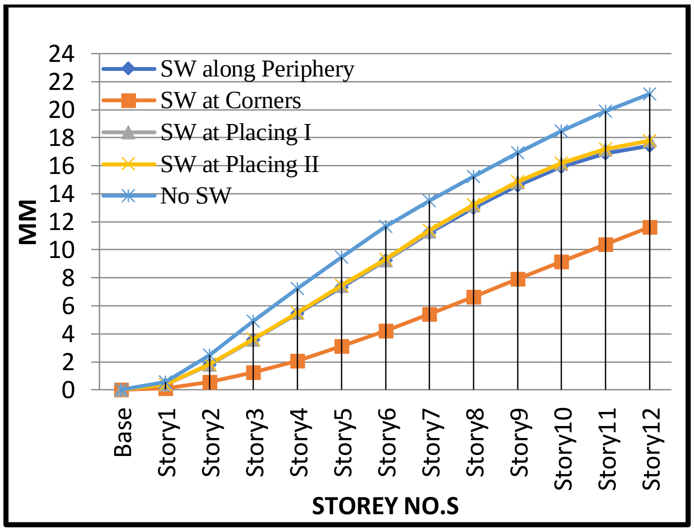

Fig.12. Storey Displacement

From the above graph, the maximum displacement for without shear wall structure is for the storey 12 i.e. 21.105 mm which is the highest among the all displacements. The lowest displacement is observed for the structure having shear wall at the corners of the buildings whose value for the displacement at storey 12 is 10.529 mm.

3.2 Storey Stiffness:

❖ **With Drop Panels**

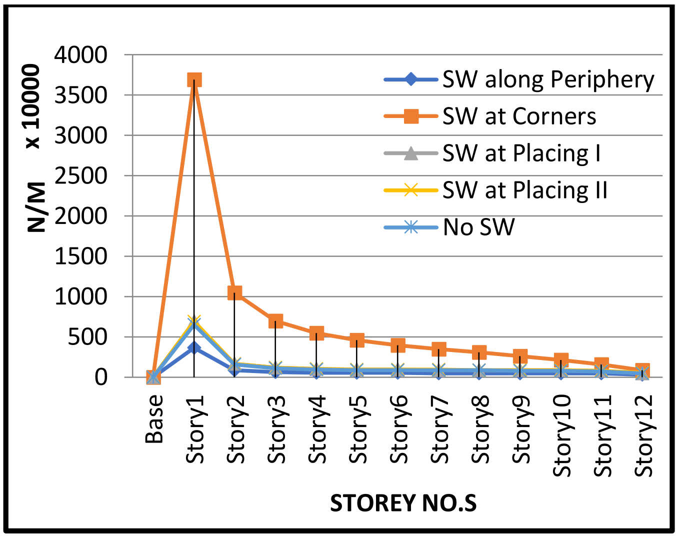

Fig.13. Storey Stiffness

Above graph shows the maximum stiffness of the structure which is having no shear wall is for storey 1 i.e. 6480008.62 N/M but if we see the stiffness for the structure having shear wall at corners of the building then we can say that it is having the maximum stiffness from all the structures. The maximum stiffness for this structure is also for storey 1 which is 3621928.67 N/M and this is because of the storey height of the structures, the first storey height we have assumed is 2m i.e. less as compared to upper storey height.

❖ **Without Drop Panels**

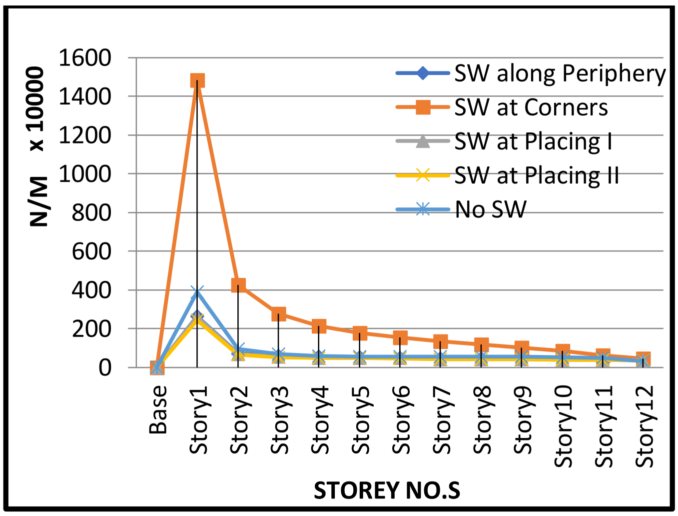

Fig.14. Storey Stiffness

From the above graph, the maximum stiffness is for the structure having shear wall at corners of the building and which observe for the storey 1 i.e. 14820696.75 N/M and the stiffness of the structure which is having no shear wall is very low among all the structures due to less strengthening elements in that structures.

3.3 Overturning Moments:

❖ **With Drop Panels**

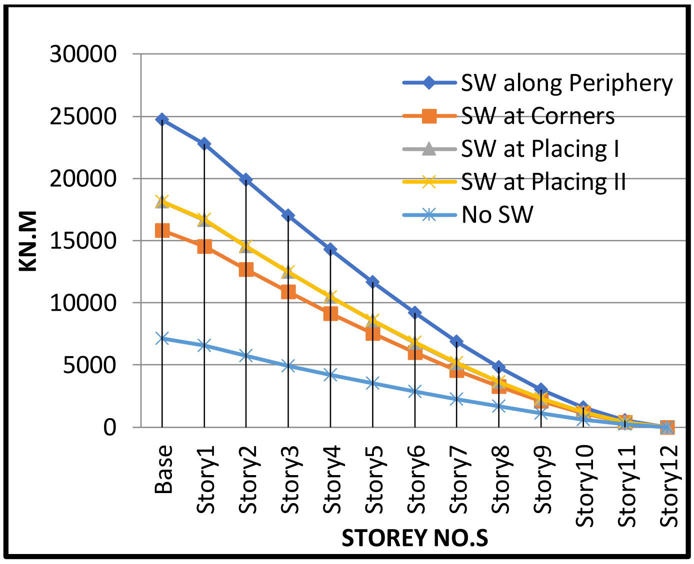

Fig.15. Overturning Moments

In this above graph, the overturning moments in X-direction of structures having drop panels are shown. As we can see that the overturning moments for the structure having no shear wall is much less as compared to shear wall structures but, the structure which is without shear wall is not suitable for lateral forces. If we see the moments in shear wall structures, the lowest moments are in the structures which is having shear wall at corners of the buildings i.e. 15840.76 KN.M.

❖ **Without Drop Panels**

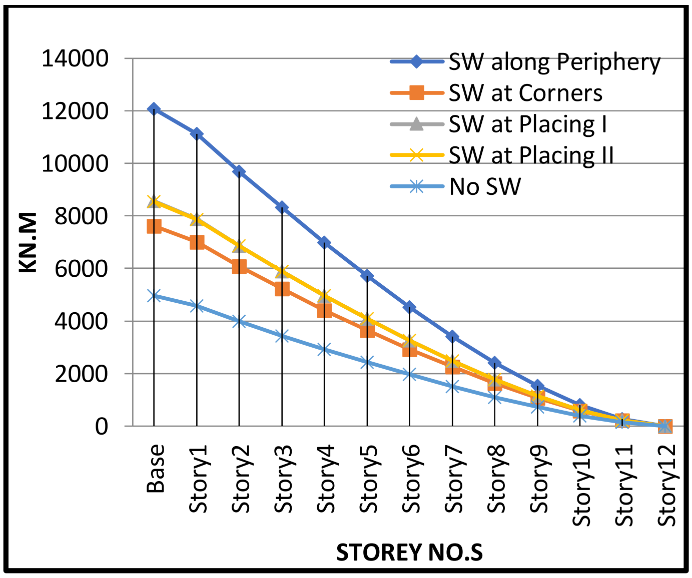

Fig.16. Overturning Moments

Above graph shows the moments in the structures, the lowest moments are in the structures which is having shear wall at corners of the buildings i.e. 7619.40 KN.M and this is because of the shear wall proper location.

3.4 Storey Shear:

❖ **With Drop Panels**

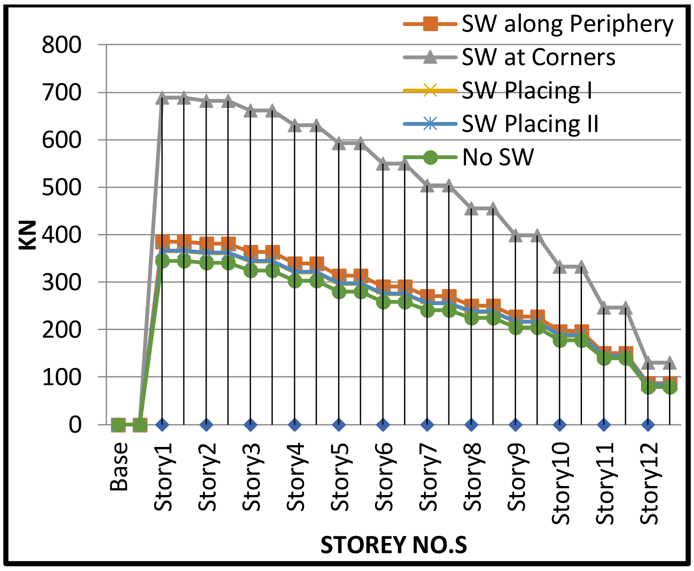

Fig.17. Storey Shear

Above graph shows the storey shear for the structures with drop panels, the storey shear decreases as building height increases. In this above graph, the maximum storey shear is for the structure having shear wall at corners of the building. The storey shear is inversely proportion to the height of the structure.

❖ **Without Drop Panels**

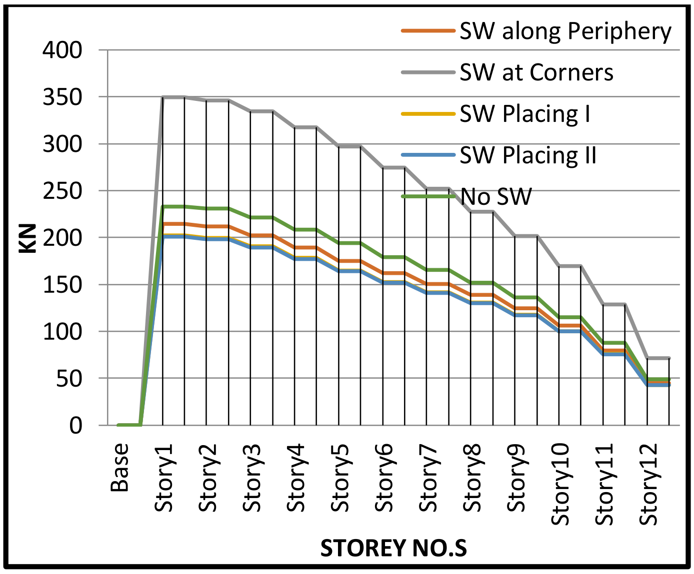

Fig.18. Storey Shear

Graph shows the storey shear for the structures without drop panels, the storey shear for the structure having shear wall at corners of the building is more as we compared to other structures.

IV. CONCLUSION

Followings are the conclusions derived as a result of this study performed throughout works; as per discussion of result, we conclude that there is a marginal reduction in displacement and increasing the stiffness of the structures by introducing the shear wall at proper locations.

1. As per IS875 (Part I) maximum displacement should not exceeds H/500, our project results are within the limitations of IS. So the input data used for this project is accurate for this design.
2. A flat slab building without shear wall shows poor seismic response as compared to other building structures because of less lateral stiffness.
3. Shear wall position affects the seismic responses of structure i.e. the structures having shear wall along periphery shows more displacement as compared to the structure having shear wall at corners of the building.
4. Base shear of the structures with drop panels observes to be more values that the structures without drop panels.

4.1 Future scope

For future study, we may go for the points which I have suggested below.

1. We may use the composite type of materials for the construction of shear walls.
2. We may go for the light weight concrete for the construction of shear wall.
3. For further study we can go for the different shapes of the shear walls i.e. irregular shapes for the construction so as to the aesthetic view as well.

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Standard Codes:

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2) BIS, IS1893: 2002 (Part I), - Criteria for Earthquake resistant design of structures, Bureau of Indian standards, Fifth Revision.

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