Seismic Analysis of Flat Slab Structure with Shear Wall at Different Locations

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Abstract - *The flat slab is now a days widely used in construction. The flat slab structure are the structures in which the beams are absent and the slabs are directly rested on the columns of the structure. It permits the free clear space with the low building height, easier formwork and requires less construction time. The shear walls are the reinforced walls which when combined with structure, increases the lateral resisting capacity of structure. The present work includes analysis of structures with shear wall at different locations and its effect on structure is studied. For this 10 storied flat slab structure are modelled on Etabs software and response spectrum analysis and pushover analysis is performed. Seismic parameters like story displacement, storey drift, base shear and time period are considered.*

***Key Words*: Flat slab, Shear wall, response spectrum, pushover analysis, Etab**

1. INTRODUCTION

The problem of availability of space in urban areas has increased the vertical development consisting of the low rise, high rise and tall buildings. In general the framed structures are used for construction of such buildings. The framed structure are subjected to vertical as well as lateral loads. Thus the buildings which are designed for vertical loads may not stand for the lateral loads and may fail during an earthquake. In many earthquake prone areas the buildings have been failed which are not designed for earthquake loads. Thus all this condition made the seismic analysis of structure of great importance. The flat slab construction technique is nowadays is having boost in India. Due many advantages such as the ease of construction, time required for construction and more clear floor to floor height due to absence of beams have increased the use of the flat slab structure. As the beams are absent in the flat slab structure, these structure are more flexible than the conventional framed structures. The lack of the framed action in the flat slab structure lead to the instability in the structures in the seismic zones. Thus such structures are more vulnerable to earthquake loads. So there is a need to perform the seismic analysis of the flat slab structure. By combining the flat slab structure with some structural elements can give the good results. The structural addition such as shear wall can be used with the structure. The shear wall are the thin reinforced walls which can be combined with the structures. The structure combined with the shear wall increases the resistance of the structure. This increases the structural integrity of the structure.The shear walls are the structural walls which carry the gravity as well as earthquake loads effectively. By using such lateral load resisting system the performance of the flat slab structure can be improved.

2. METHODOLOGY

In this analysis the G+10 flat slab with drop structure is analyzed on the ETABS software. The analysis is performed to study the effect of the location of shear wall on the performance of the structure and the probable best location for the shear wall is found out for which the building performs well. The shear wall with same thickness was assigned at four different location on each of four different models. The location as L shape shear wall at corner, C shape shear wall at core of structure, and shear wall at end bay and central bay are assigned to the structure. The response spectrum analysis and the pushover analysis is performed on the structures. The results for each structure are obtained and are compared with each other to find out the structure with best shear wall location among the analyzed models.

3. MODELLING

Table -1: Sample Table format

Preliminary data	
No. of stories	G+10
Floor to floor height	3.5m
Slab thickness	180mm
Wall thickness	200mm
Column size	600 X 600 mm
Live load	4 KN/m2
Floor finish	1 KN/m2
Seismic data	
Zone	V
Zone Factor	0.36
Type of soil	Medium
Importance Factor	1
Response Reduction Factor	5

Model A = L shape shear wall at corners.

Model B = C shape shear wall at core.

Model C = shear wall at central bays.

Model D = shear wall at end bays.

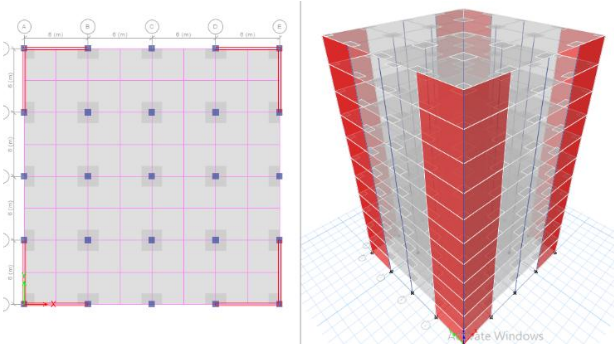


Fig -1: Plan and 3D view of Model A

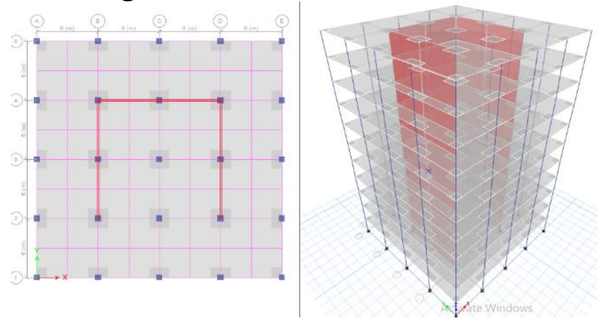


Fig -2: Plan and 3D view of Model B

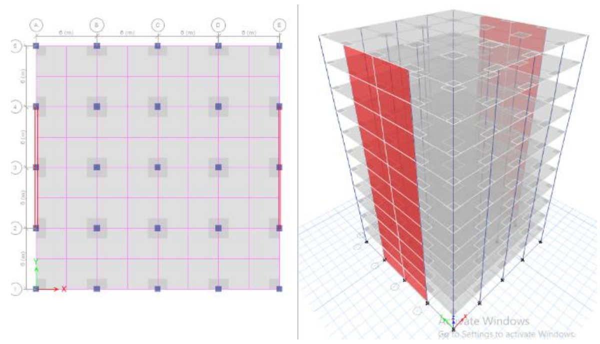


Fig -3: Plan and 3D view of Model C

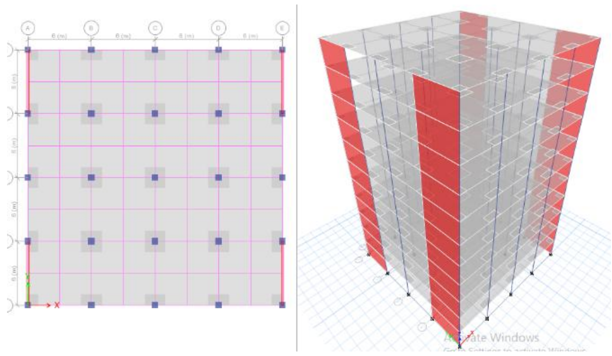


Fig -4: Plan and 3D view of Model D

4. RESULTS AND DISCUSSION

4.1 Modal Time Period

Mode No	Model A (sec)	Model B (sec)	Model C (sec)	Model D (sec)
1	0.844	1.336	3.043	3.043
2	0.514	0.564	0.928	1.017
3	0.463	0.564	0.674	0.928
4	0.179	0.314	0.579	0.901
5	0.143	0.146	0.483	0.483

The time period for all four structures are mentioned in table and above. The minimum period is obtained for model A and maximum time period is obtained for model D. Time period goes on increasing from model A to model D.

4.2 Results from response spectrum analysis

4.2.1 Storey Displacement

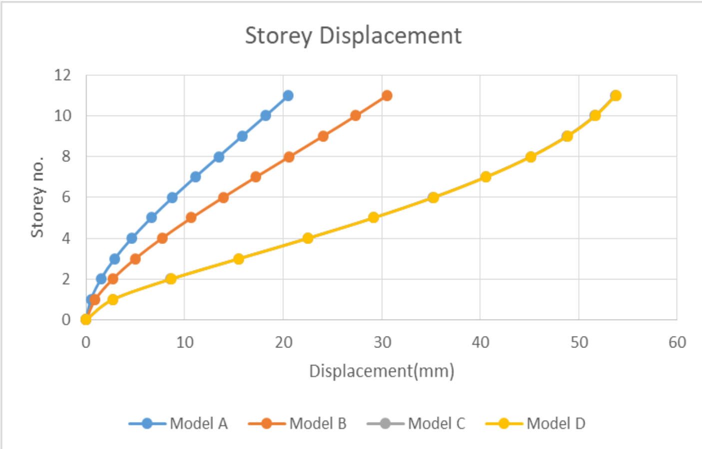


Fig -5: Storey Displacement

On comparison it is observed that the minimum displacement is for the model A and it goes on increasing and the maximum displacement is for the model D. The model with core shear wall gives the moderate displacement values.

4.2.2 Storey Drift

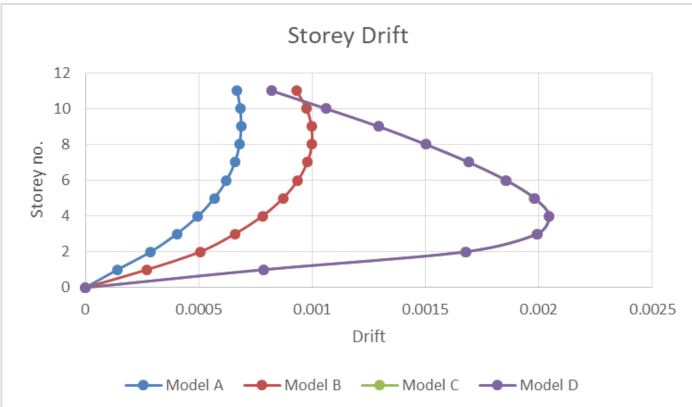


Fig -6: Storey drift

From the graph above the maximum drift value are for the model D and the minimum drift value are for the model A. The moderate drift values are obtained for other two structures. Thus it is seen that the model A performs well with minimum drift value.

4.3 Results from pushover analysis

4.3.1 Storey Displacement

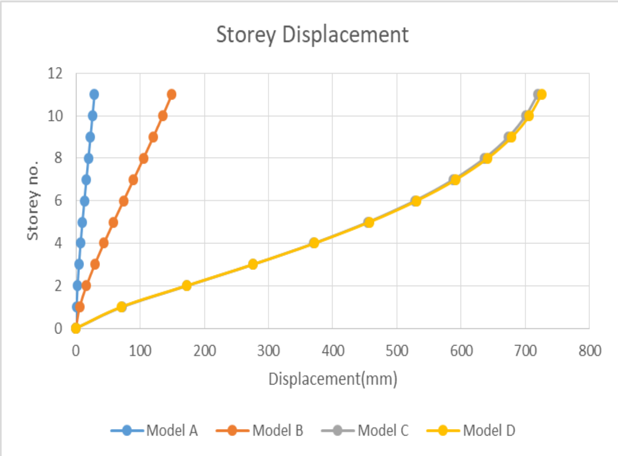


Fig -7: Storey displacement

The above graph shows the displacement values for the structures with the shear wall at different location. The results shows that the minimum displacement values are obtained for the model A which is structure with L shape wall. The maximum values are obtained for the model D. The slight difference is observed in the values of model C and model D.

4.3.2 Storey Drift

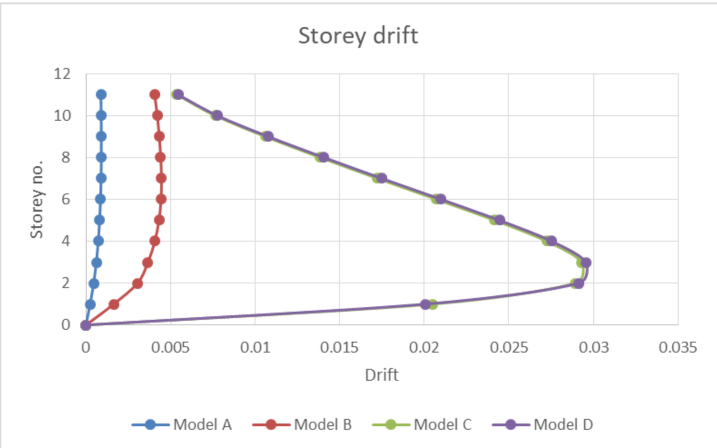
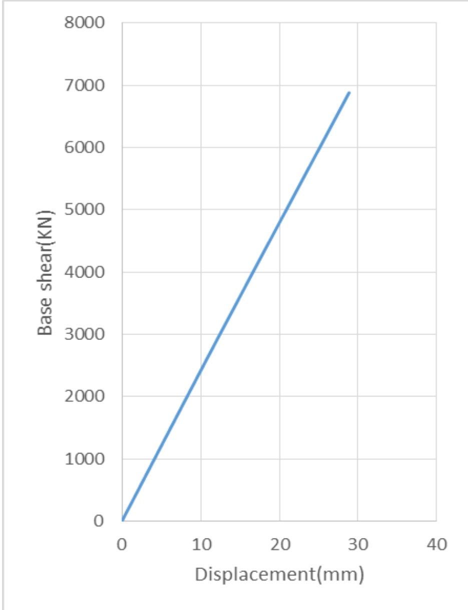


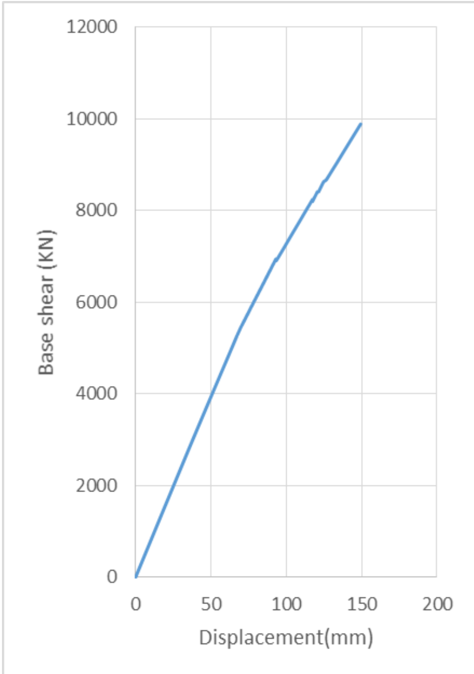
Fig -8: Storey drift

The above graph shows the values of the drift for all structures. It is observed that the maximum drift value are obtained for the model D and the minimum drift values are obtained for the model A. The slight difference is observed in the values of drift for the model C and model D. Thus the model A performs well with the minimum drift values.

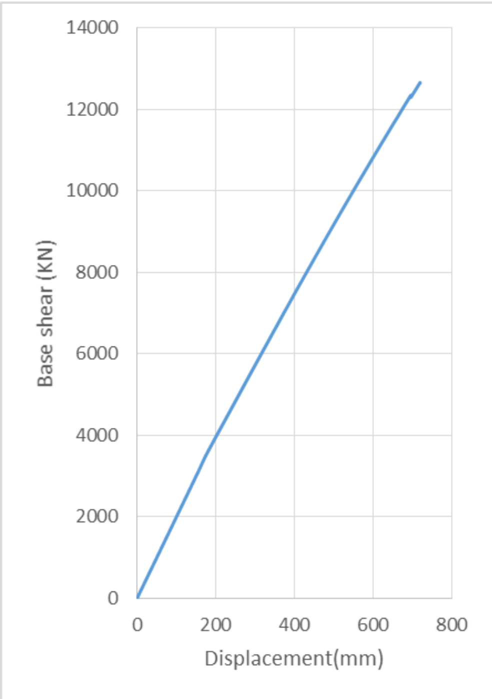
4.3.3 Pushover curves



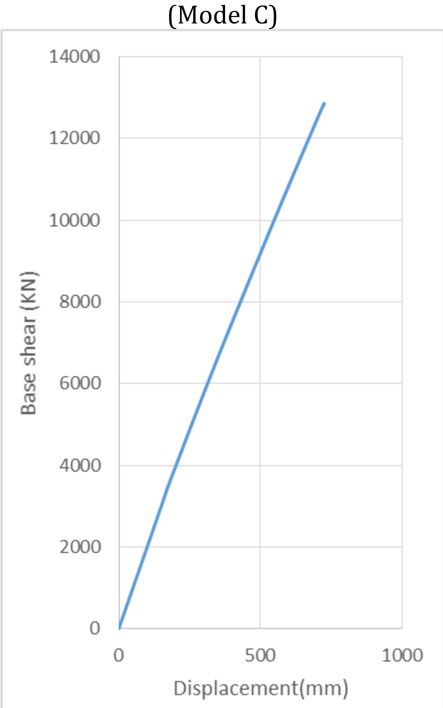
(Model A)



(Model B)



(Model C)



(Model D)

Fig -9: Pushover curves

The pushover curves above describes the values of base shear of all four structures. The minimum base shear is for the model A and the maximum base shear is obtained for model D. The base shear values of model B and C are 26.05% and 1.48% less than the maximum base shear. The maximum ultimate displacement is for the model D and goes on decreasing towards model A. The minimum displacement value is of model A.

5. CONCLUSIONS

The response spectrum analysis and pushover analysis is performed. The results are drawn and compared with each other. From comparison we can conclude that,

- The time period of the model A is minimum and maximum for the model D. Time period goes on increasing from model A to D.
- The storey displacement of the model A is minimum than all others structures. The value increases from model A to D and is maximum for model D. Thus the model A performs well than other structures.
- The model A has minimum drift values and goes on increasing towards model D. The maximum value is for model D.
- From all the above discussion, it is observed that the model A i.e. structure with L shape shear at corner gives good results than the structure with shear wall at other locations.
- Thus the L shape shear wall at corner is the optimum location of wall were structure gives good performance under seismic conditions.

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