Analytical Design for Optimization of Shear Wall for Flat Slab

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Abstract - *The Structural engineers in the seismic regions across the world often face the pressure to design high rise buildings with stiffness irregularities, even though they know these buildings are vulnerable under seismic loading. The floor system carries vertical loads and, acting as a diaphragm, lateral loads to the walls for transfer to the foundation. Lateral forces of wind and earthquake are usually resisted by shear walls which are parallel to the direction of lateral load. The aim of this project is to determine the solution for shear wall Location in multi-storey building. For this purpose four different models six Storeys building each has been considered i.e. one model without shear wall And other three with shear walls in same zones. Models are studied in the Zone-III for comparing lateral displacement and load transfer to various Structural elements with different positioning of shear wall. Earthquake load is Calculated as per is: 1893-2002 (part-1), the various parameters like Response Reduction factor, Importance factor, Zone factor are taken from is: 1893-2002(part-1).The buildings are model using software Etabs nonlinear v 16.1 Providing shear walls at adequate locations substantially reduce the Displacements due to earthquake. Hence accounting shear wall in a building will Form an efficient lateral force resisting system. The optimization techniques which are used in this project are firstly considered the size of shear wall is same throughout the building and then analysis is done from the result the failed shear wall dimensions are increased to resist the whole structure, in this way the optimization was done for number of time till the whole structure comes to stable to resist the forces.*

Key Words: *Shear wall, flat slab, earthquake load, response spectrum analysis storey displacement, storey drift, storey shear, storey stiffness, Etabs*

1. Introduction

Looking to the past records of earthquake there is increase in the demand of earthquake resisting building which can be fulfilled by providing the shear wall systems in the building. Also due to the major earthquakes in the recent part the codal provisions revised and implementing more weight age on earthquake design of structure. The decision regarding provision of shear wall to resist lateral forces plays an important role in choosing the appropriate structural system for given project. Generally structures are subjected to two types of loads i.e. Static and dynamic. Static loads are constant while dynamic loads are varying with time. In majority civil structures only static loads are considered while dynamic loads are not calculated because the calculations are more complicated. This may cause disaster particularly during earthquake due to seismic waves. By providing shear wall in multi-storied building we can resist seismic waves of earthquake. For slender walls where the bending deformation is more Shear wall resists the loads due to cantilever action and for short walls where the shear deformation is more it resists the loads due to Truss Action. These walls are more important in seismically active zones because during earthquakes shear forces on the structure increases. Shear walls should have more strength and stiffness. When a building has a story without shear walls, or with poorly placed shear walls, it is known as a soft story building. Shear walls provide adequate strength and stiffness to control lateral displacements. Concrete Shear wall buildings are usually regular in plan and in elevation. Horizontal and vertical distributed reinforcement (ratio 0.25%) is required for all shear walls. Consequently, this paper has been depicted to focus the correct area of shear walls focused around its versatile and Elastro-plastic behaviours.

1.1 objectives of work

- To study the performance of RC shear wall under lateral loads (earthquake loads).
- To study the response of RC shear wall using Response Spectrum analysis.
- To study the variation of Response Spectrum Analysis for a G+5 storey structure without shear wall and structure with shears walls.

1.2 Need for the Study

- In flat slab concept, the lateral load carrying capacity will be less. Therefore shear wall is to be provided in the core and corners of the building.
- Shear walls are designed with economical and as well as structurally reliable.

2. Methodology

In this paper, a G+5-story building with 3.5 meters height for every story is chosen for the analysis. These structures were composed in understanding with the Indian code. The buildings were assumed to be fixed at the base and the floors acts as rigid diaphragms. The areas of structural components are square and rectangular and their measurements are steady for all the models. The buildings were modeled using the software Etabs v16.1.Four models were constructed with diverse introduction of shear walls in a building. Models were studied in zone III, comparing parameters such as storey shear, lateral displacement, story drift and storey stiffness for all models.

2.1 Description of Building Structure

No of bays along X axis	3
No of bays along Y axis	4
Spacing in both directions	8m & 6m Respectively
No of stories	G+5
Storey height	3.5m
Size of column	0.3x0.7m , 0.35x0.75m
Size of beams	0.23x0.19m
Slab	0.19m thick
Drop panel	0.25m thick
Shear wall	0.23m thick

2.2 Load Conditions

- The dead load condition for all the different Models is - Self Weight.
- The dead imposed load for masonry wall is- 16.1 kN/m.
- The live load condition for all the different Models is - 3kN/m
- Lateral load is the earthquake load as per is 1893(part 1):2002 and is applied to the mass center of the building.

2.3 Load Combination

- 1.5D.L+1.5D.I.L+1.5L.L
- 1.2D.L+1.2D.I.L+1.2L.L+1.2EQX
- 1.2D.L+1.2D.I.L+1.2L.L+1.2EQY
- 1.5D.L+1.5D.I.L+1.5EQX
- 1.5D.L+1.5D.I.L+1.5EQY
- 0.9D.L+0.9D.I.L+1.5EQX
- 0.9D.L+0.9D.I.L+1.5EQY

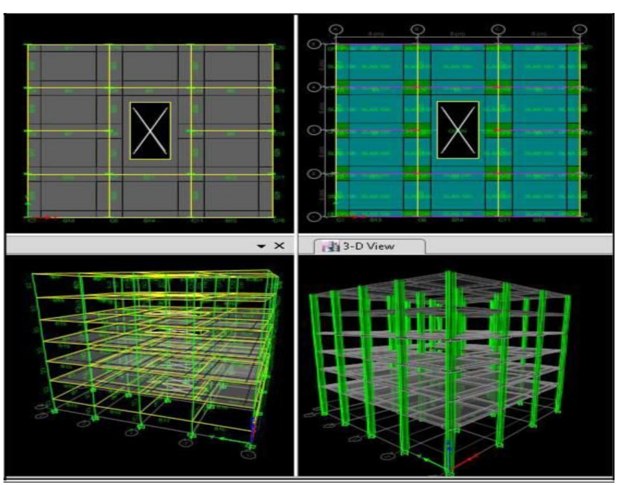

Fig -1: Plan of Normal Building without a Shear Wall.

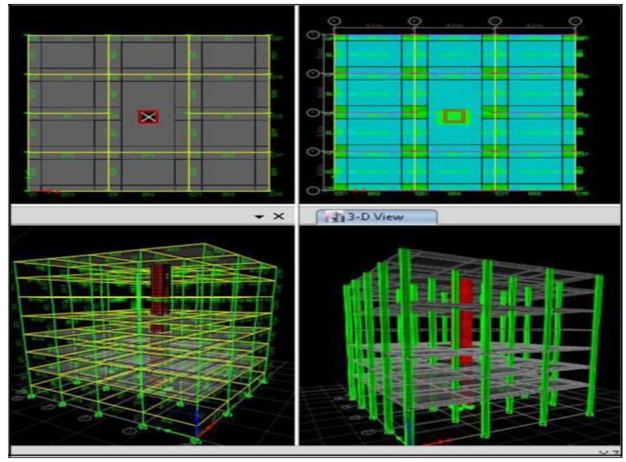

Fig -2: Plan of the Building with Shear Wall at the Center

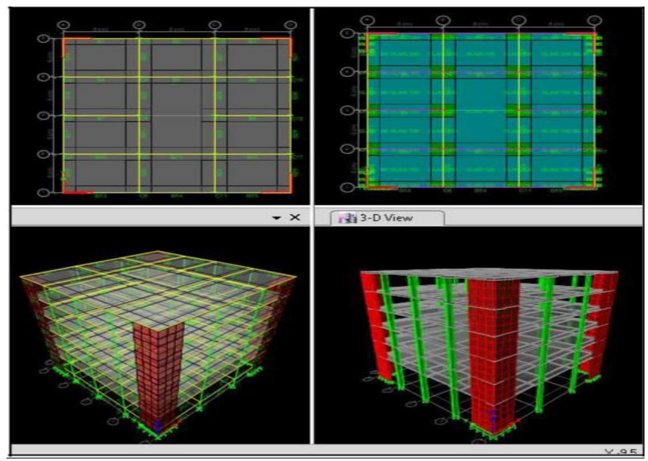

Fig -3: Plan of the Building with L - Shaped Shear Wall

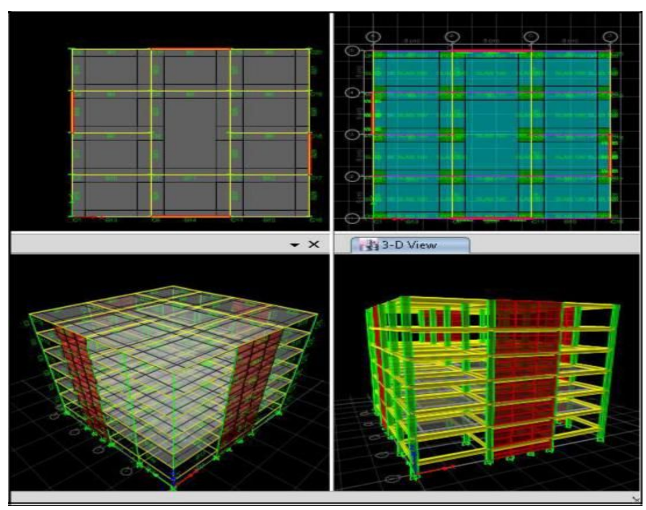

Fig -4: Plan of the Building with Shear Wall at the Edges

3. Result and Discussion

3.1 Maximum Storey Displacement (Response Spectrum –X&Y Direction)

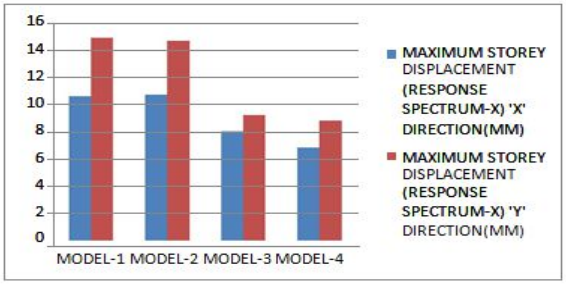

Chart -1: Storey Displacement -X Direction

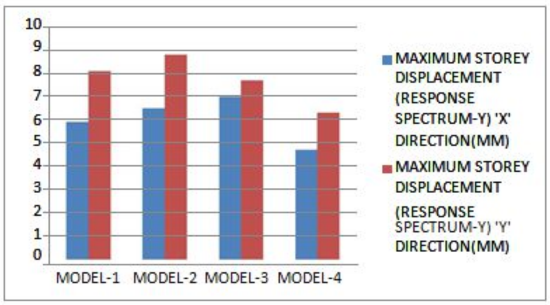

Chart -2: Storey Displacement-y Direction

3.2 Maximum Storey Drift (Response Spectrum –X&Y Direction)

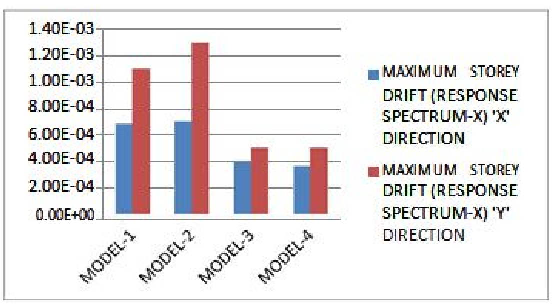

Chart -3: Storey Drift-X Direction

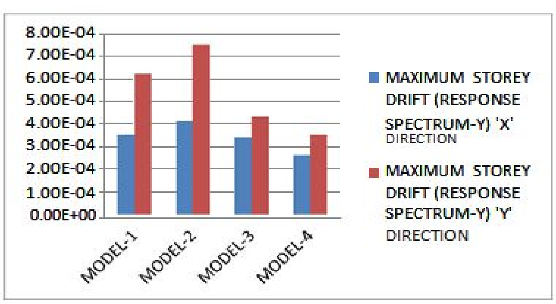

Chart -4: Storey Drift-Y Direction

3.3 Storey shear (Response Spectrum –X&Y Direction)

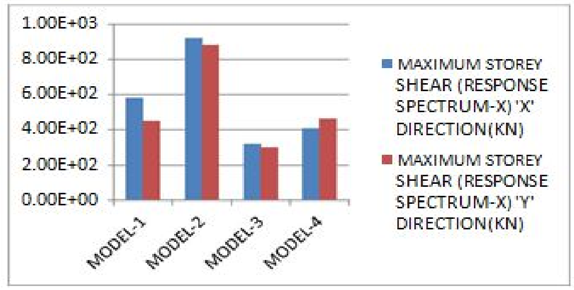

Chart -5: Storey Shear -X Direction

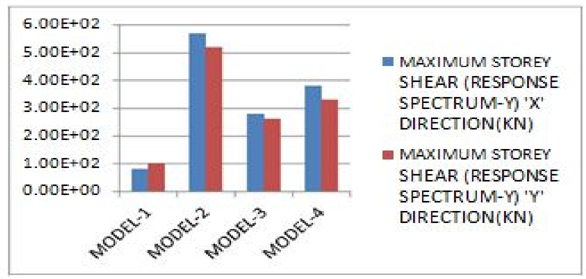

Chart -6: Storey Shear -Y Direction

3.4 Storey Stiffness (Response Spectrum –X&Y Direction)

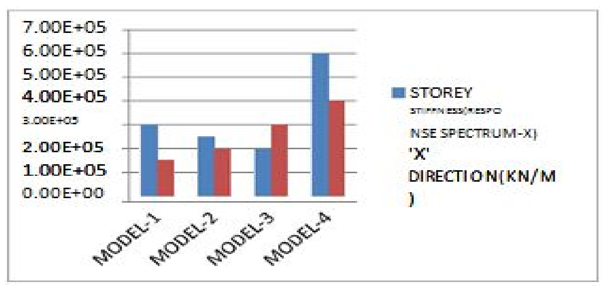

Chart -7: Storey Stiffness -X Direction

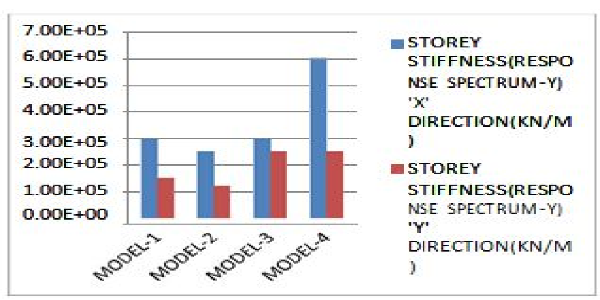

Chart -8 : Storey Stiffness –Y Direction

4. Conclusions

1. The following conclusions are made based on the Analysis and design of multi-storey building with and Without shear walls for gravity loads and lateral. Forces for seismic zone III of India. The different shear Wall types are also taken into account.

2. From the analytical study of storey displacement , it has been Observed that the building with shear wall has less displacement in x, y direction when Compared to building without shear wall.

3. It has also been observed that the shear wall model 2 results more drift when compared to other shear wall models.

4. It is observed that the shear wall model 2 more shear when compared to other shear wall models.

5. From the analytical study the storey stiffness has been observed that building with shear wall model 4 has more stiffness in x & y direction when compared to building without shear wall.

5. References

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