Design Optimization and Earthquake Analysis of Shear Wall in High Rise Building

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Abstract- The shear wall is a structural element which is used to resist earthquake forces. These wall will consumptives shear forces & will prevent changing location of construction & consequently destruction. On other hand, shear wall arrangement must be absolutely accurate, if not, we will find negative effect instead. For example if the shear walls not construct, we cannot expect a good tensional behavior from the structure. The bending moment, shear force, torsion, axial force contribution by rest of the structural element and the ultimate design of all the structural components also affected by that. A study has carried out to determine the optimum Structural configuration of a multistory building by changing the shear wall thickness value. Three different cases of shear wall thickness for a 15 storey residential Tower have analyze and design as a space frame system by computer application software, subjected to lateral and gravity loading in accordance with IS provisions

Keywords – Shear wall, ETABS, shear strength, flexure strength, shear force

I.INTRODUCTION

Shear walls are vertical elements of a force resisting system which is horizontal. They are constructed to act against the effects of lateral loads that are acting on the structure. In residential construction, shear walls are straight external walls that form a box which provides the lateral support of the building. Lateral supports are caused by wind, earthquake, weight of structure and occupants. These loads can tear or shear a building apart. Reinforcing a frame by attaching a rigid wall inside it maintains the shape of the frame and prevents rotation at the joints. Especially in high rise buildings which are subjected to seismic forces and lateral wind forces. Shear wall buildings are for residential purposes to accommodate 100-500 inhabitants per building

II.METHODOLOGY

In high rise buildings we should concern about all the forces that act on a building. If we will do so much calculation for a high rise building manually then it will take more time as well as human errors can be occurred. So the use of any software example, ETABS will make it easier. Shear walls are vertical elements of the horizontal force resisting system. Shear walls are constructed to counter the effects of lateral load acting on a structure. In the last two decades, shear walls became an important part of mid and high-rise residential buildings. When shear walls are designed and constructed properly, they will have the strength and stiffness to resist the horizontal forces. To achieve this figure the speed of construction should be good enough. To avail the rapid construction, the most effective way is to provide shear walls instead of masonry walls. The main focus of this work is to analyze a R.C. building frame with R.C. shear walls at different locations of a building to know its the most efficient location. Shear wall is a specially designed structural walls incorporated in building to resist lateral forces that are produced in the plane of the wall due to seismic, wind and other forces. In this work, a 6 storey R.C. building frame has been analyzed for seismic zone-III using ETABS package. Special moment resisting frame (SMRF) and hard rock types are used in this work. There are some parameters considered such as node displacement, Maximum reactions and total weight of reinforcement to compare the results for different models. It has been judged that the model-IV is most efficient than other models. Hence, this paper has been described to determine the proper location of shear wall. An RCC medium rise building of 6 stories subjected to an earthquake loading in Zone has been considered.

III.SOFTWARE DESCRIPTION

Creation of models has never been easier - intuitive drawing commands allow for the rapid generation of floor and elevation framing. CAD drawings can be converted directly into ETABS models or used as templates onto which ETABS objects may be overlaid. The state-of-the-art SAPFire 64-bit solver allows extremely large and complex models to be rapidly analyzed, and supports nonlinear modeling techniques such as construction sequencing and time effects (e.g., creep and shrinkage).The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings.

IV.SOFTWARE ANALYSIS

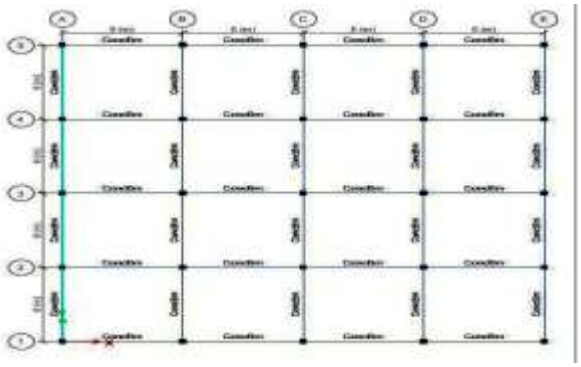


Fig.1 Plan

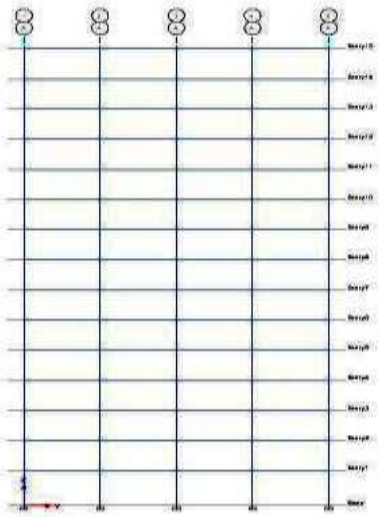
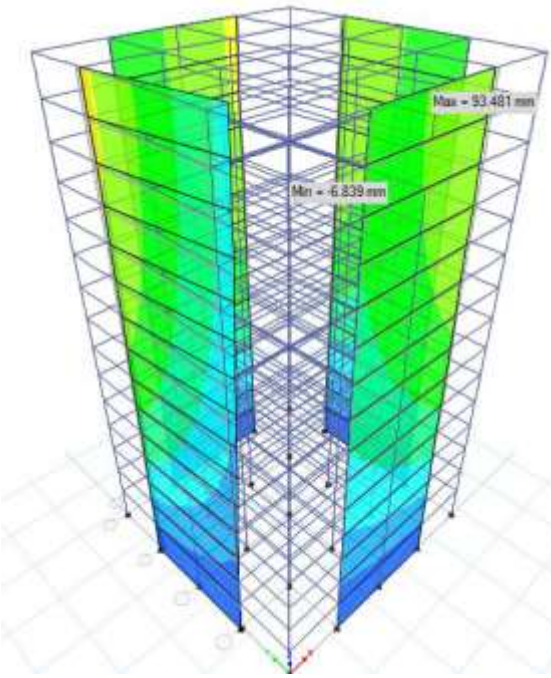


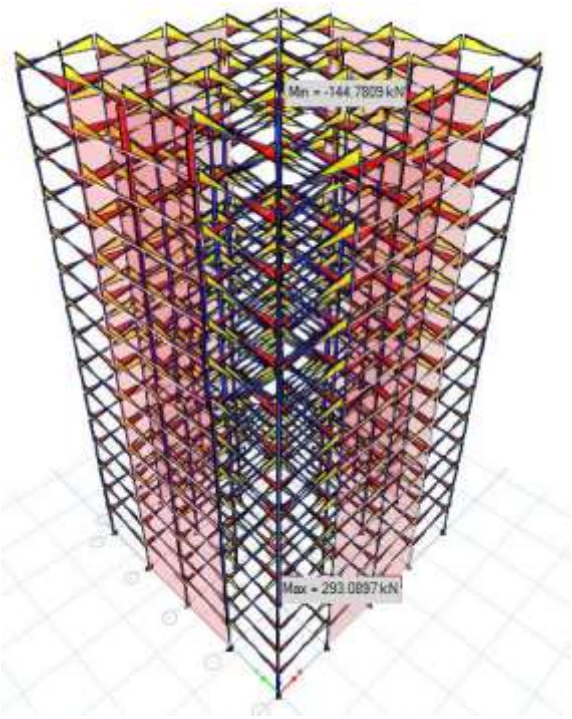
Fig.2 Elevation of building

Table 1-Storey Data

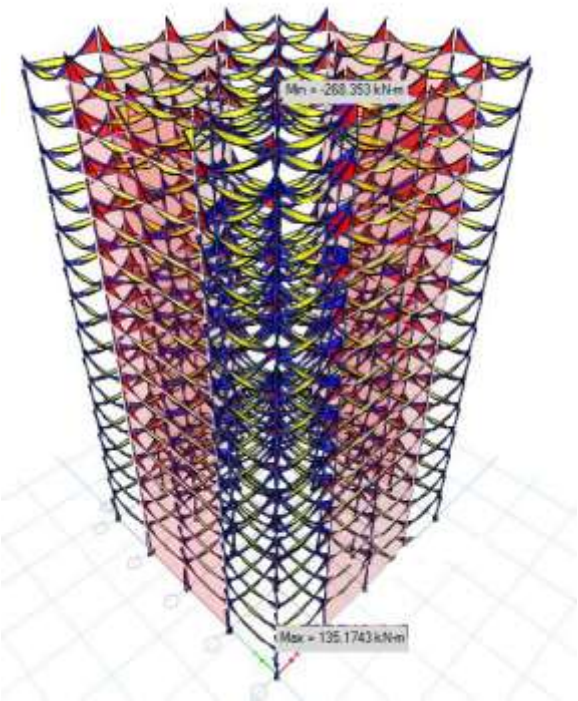
Name	Height mm	Elevation mm
Story15	3000	45500
Story14	3000	42500
Story13	3000	39500
Story12	3000	36500
Story11	3000	33500
Story10	3000	30500
Story9	3000	27500
Story8	3000	24500
Story7	3000	21500
Story6	3000	18500
Story5	3000	15500
Story4	3000	12500
Story3	3000	9500
Story2	3000	6500
Story1	3500	3500
Base	0	0



Displacement Diagram



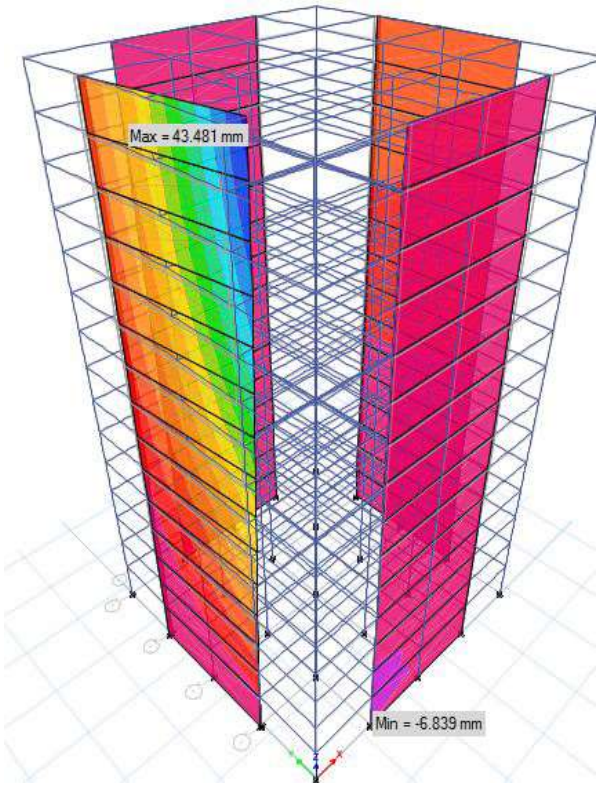
Shear Force Diagram



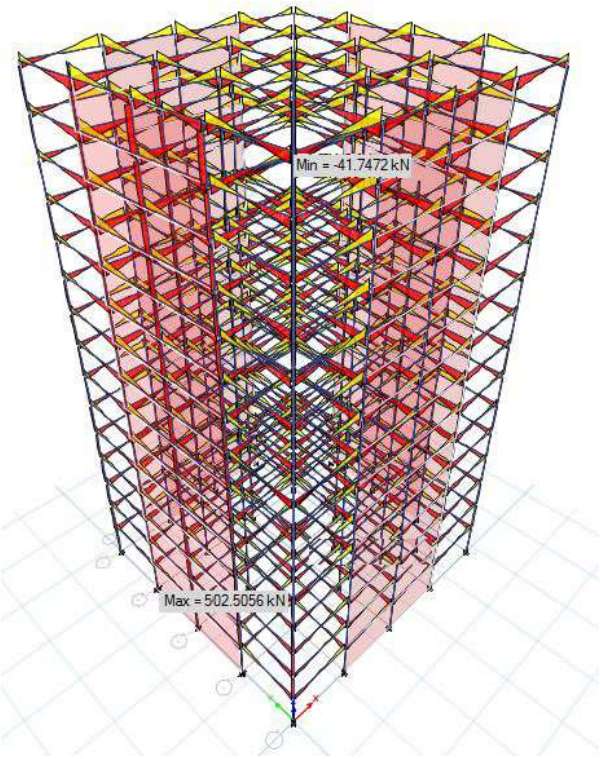
Bending Force Diagram

Fig 3 Analysis of Shear wall

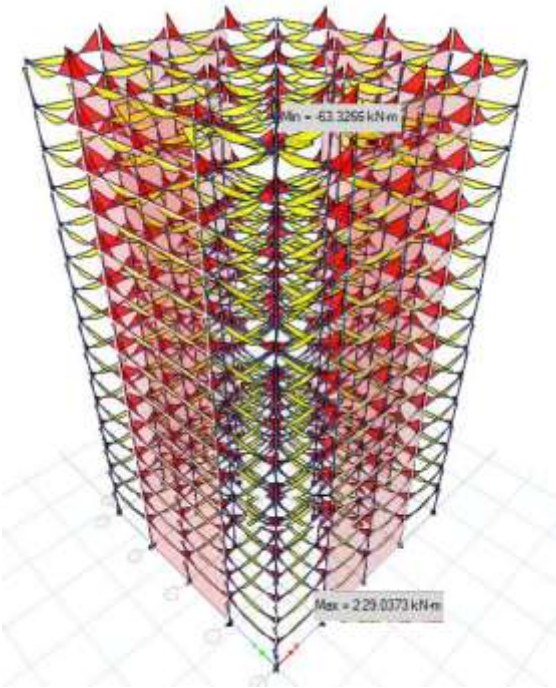
Steel Plate Shear Wall



Displacement Diagram



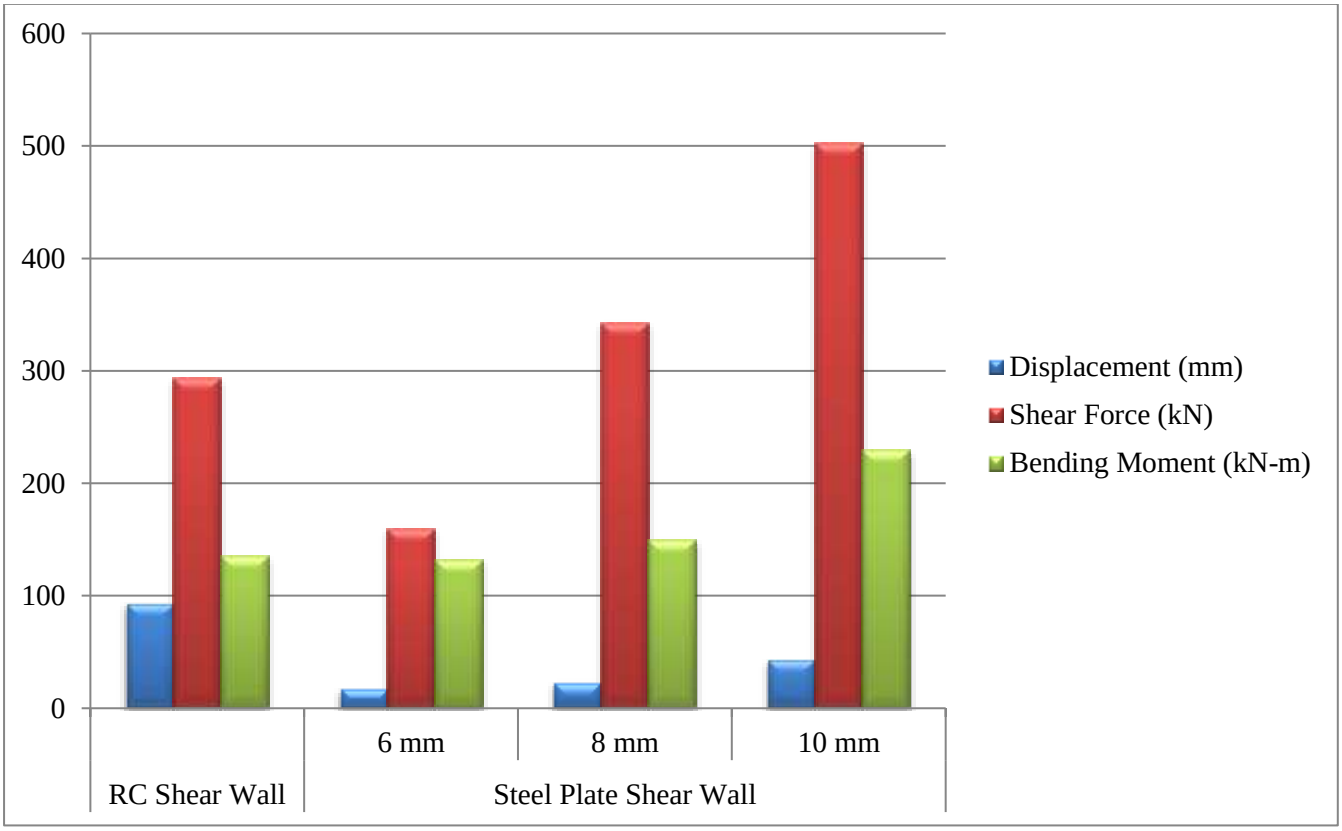
Shear Force Diagram



Bending Force Diagram

Fig 4 Analysis of plate shear wall

Table 2-Comparison Results



V. CONCLUSION

Dynamic linear analysis using response spectrum method is performed and lateral load analysis is done for structure with RC shear wall and Steel plate shear wall. Results are compared for the earthquake forces and bending moment of both the cases. It is also observed that lateral forces are reducing when the shear walls are added at the appropriate locations of frames having minimum lateral forces. Therefore, it is inferred that Steel plate shear walls (t=6 mm) are more resistant to lateral loads in an irregular structure. Also they can be used to reduce the effects of torsion. Results indicate that steel plate shear walls have a large effect on the behaviour of frames under earthquake excitation. In general, steel plate increase stiffness of the structure. Deflection in case of without SPSW is very large & in case of with SPSW deflection is very less. With the use of steel shear walls in the buildings, the bending moments in the column are reduce. Due to presence of SPSW total weight of steel in building is reduced than building without SPSWs. From above result it is observed that, due to use of SPSW in building there is considerable decrease in value of bending moment, shear force, deflection and axial force for some columns and also quantity of steel is reduced. Hence steel building with SPSWs is economical compare to without SPSWs. Due to relatively small thickness of SPSW compared to reinforced concrete shear walls, from architectural point of view, steel shear wall occupy much less space than equivalent reinforced concrete shear wall .

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