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Seismic Response of Multi-storeyed Reinforced Concrete Dual System with and without Shear Walls

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Abstract -Performance of structures under frequently occurring earth quake ground motions resulting in structural damages as well as failures have repeatedly demonstrated the seismic vulnerability of existing buildings, due to their design based on gravity loads only or inadequate levels of lateral forces. This necessitates the need for design based on seismic responses by suitable methods to ensure strength and stability of structures. Shear wall systems are one of the most commonly used lateral load resisting systems in high rise buildings.

The use of shear wall in high rise structure is more effective than use in low rise building. The size, configuration and position of shear wall affects the behaviour of the building. Shear walls away from centre of gravity increases most of the member forces.The studies on shear wall have been concentrated on symmetric buildings while asymmetric structures and its nonlinear behaviour have not been researched on yet. The objective is to have a detailed study of the behaviour of buildings with and without shear wall using nonlinear static analysis.

This study aims at comparing various parameters such as storey drift, storey shear, deflection, hinges formation, performance point, and time period etc. of a building under lateral loads based on different position and orientation of shear walls.

Based on linear and nonlinear analysis procedures adopted, the effect of shear wall location on various parameters are to be compared .Pushover analysis is used to evaluate the expected performance of the structure by estimating its strength and deformation demands in design earthquakes by means of static inelastic analysis, and comparing these demands to available capacities at the performance levels of interest. The capacity spectrum method is used to obtain the overall performance level of a structure. The software used is ETAB.

***Key Words*:Static analysis, shear wall, Pushover analysis, lateral loads, storey drift, displacement, ETAB 2009.**

I. INTRODUCTION

Shear wall are one of the excellent means of providing earthquake resistance to multi-storeyed reinforced concrete building**.** The structure is still damaged due to some or the other reason during earthquakes. Behaviour of structure during earthquake motion depends on distribution of weight, stiffness and strength in both horizontal and planes of building. To reduce the effect of earthquake reinforced concrete shear walls are used in thebuilding. These can be used for improving seismic response of buildings. Structural design of buildings for seismic loading is primarily concerned with structural safety during major

Earthquakes, in tall buildings, it is very important to ensure adequate lateral stiffness to resist lateral load. The provision of shear wall in building to achieve rigidity has been found effective and economical. When buildings are tall, beam, column sizes are quite heavy and steel required is large. So there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these place and displacement is quite heavy. Shear walls are usually used in tall building to avoid collapse of buildings. When shear wall are situated in advantageous positions in the building, they can form an efficient lateral force resisting system.

Six different types of models are been designed in ETABS 2009 and its general graphical and tabular analysis is the henceforth part of this paper work.

II. BUILDING MODELLING

For this Study a G+15 and G+20 story building with 3.2 meters height for each storey, regular in plan is modelled. The models were analysed in compliance to Indian Code of practice for Seismic Resistant Design of Building. The models are assumed to be fixed at the base and the floors act as rigid diaphragm. The sections of structural elements are rectangular and their dimensions are changed for different group of storeys. The structures are modelled using software ETABS 2009. Six different models were studied with different positioning of shear wall in building. Models are studied in type zone III comparing displacement, storey drift, Base shear, Time period,Performance point etc. for all models. The dimensions of sections were calculated using plastic theories. The dimensions along the grade of concrete were decided according to the imposed loads or moments upon the section.

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Table 1:- Preliminary data

No of storey	(G+ 15) and(G+ 20)
Floor to Floor height	3.2m
Beam size	300x600 mm
Thickness of slab	200 mm
Column size Ground to 5th floor 6th to 10th floor 11th to 15th floor	 800 X 800 mm 700 X 700 mm 600 X 600 mm
Thickness of wall	300mm
Grade of Concrete	M30
Grade of Steel	Fe500

The plans of building model are given below.
Model 1:- Bare frame structure
Model 2:- Dual frame system with shear wall at exterior.
Model3:- Frame having only shear walls with interior walls placed in y-direction
Model 4:- Frame having only shear walls with interior walls placed in x-direction.
Model 5:- Dual frame having columns at exterior and walls placed in interior in y-direction
Model 6:- Dual frame having columns at exterior and walls placed in interior in x-direction

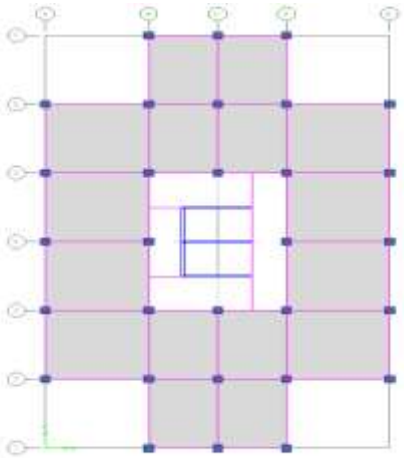

Figure 1:- Model 1

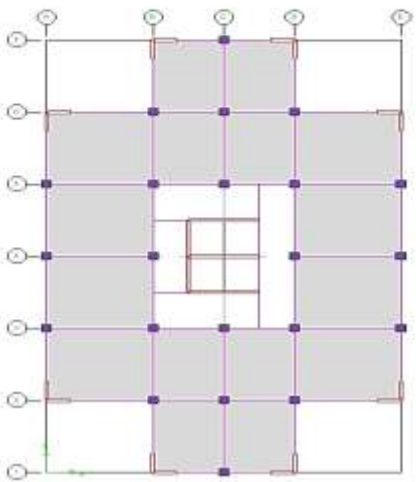

Figure 2:- Model 2

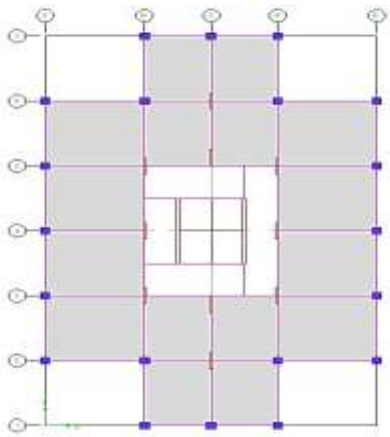

Figure 3 :- Model 3

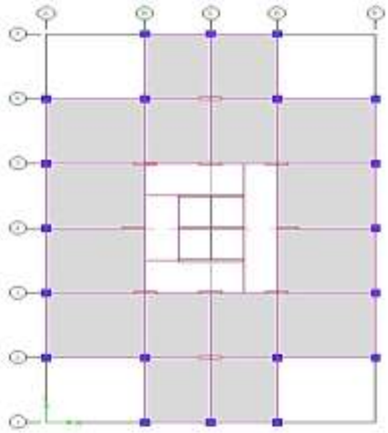

Figure 4:- Model 4

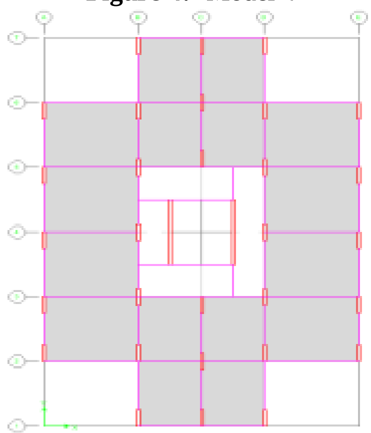

Figure 5:- Model 5

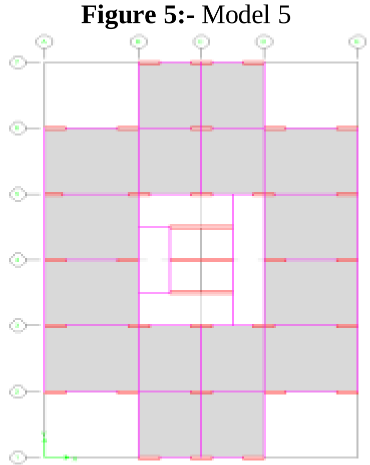

Figure 6:- Model 6

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III. RESULTS AND DISCUSSION

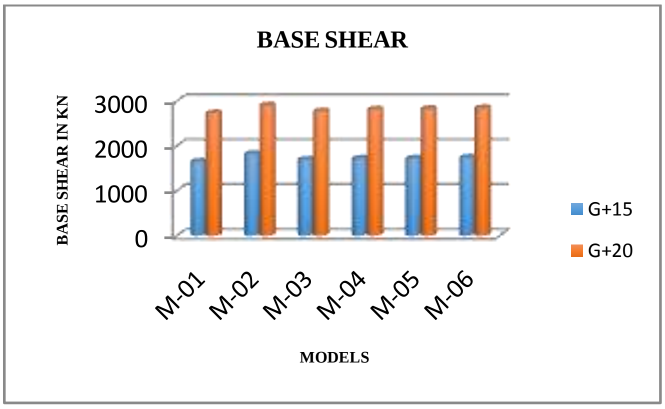

Chart 1:-Base Shear of G+15 & G+20 building stories

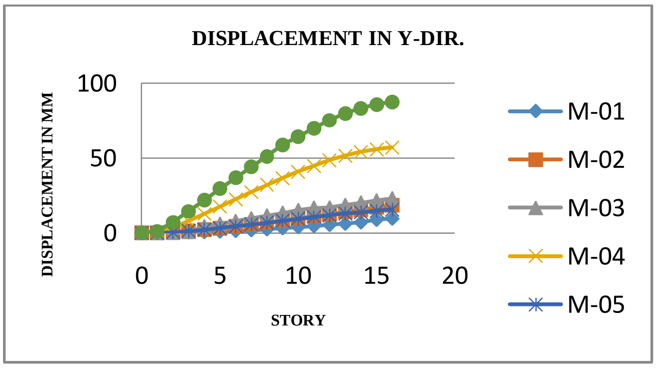

Chart 2:- Displacement for G+ 15 stories

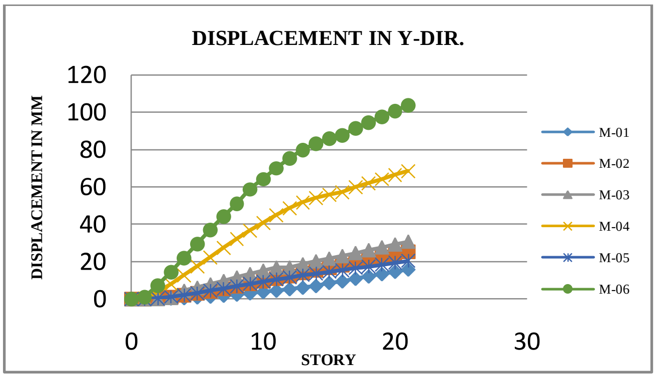

Chart 3:- Displacement for G+ 20 stories

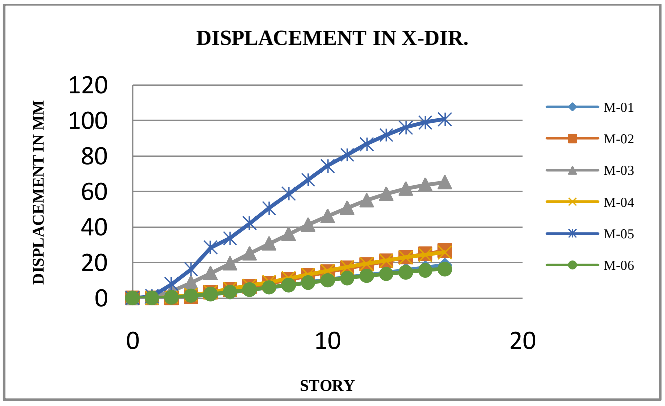

Chart 2:- Displacement for G+ 15 stories

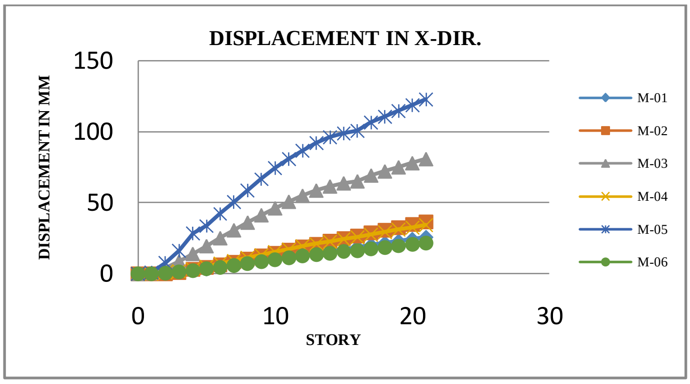

Chart 3:- Displacement for G+ 20 stories

Storey Drift

Storey drift of all models are as shown are

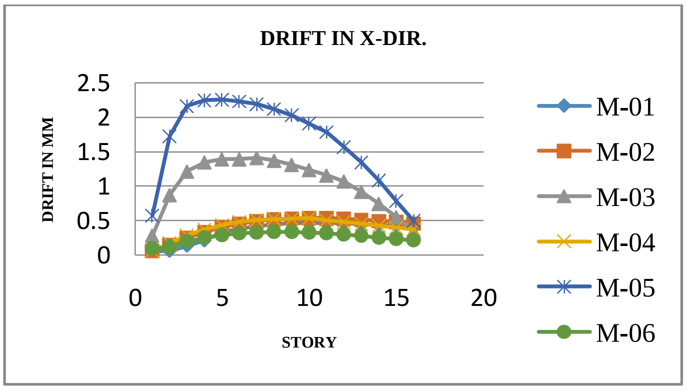

Chart 4:- Storey drift in x- direction for G+ 15 stories

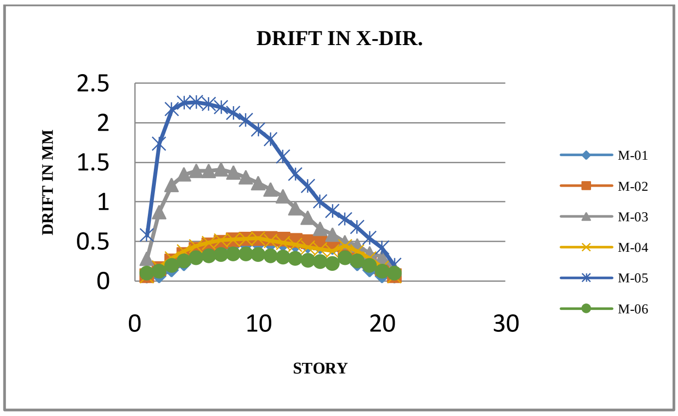

Chart 4:- Storey drift in x- direction for G+ 20 stories

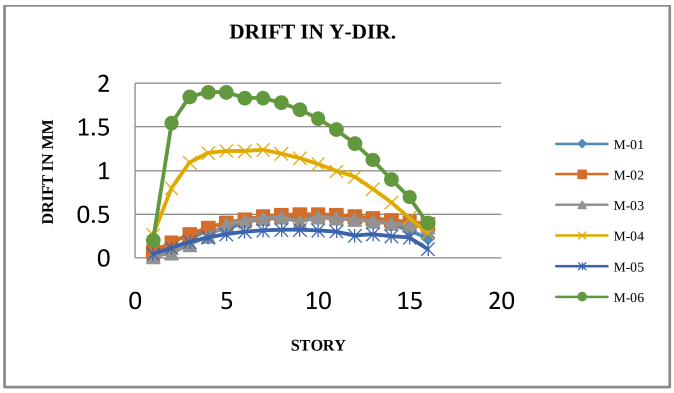

Chart 3:- Storey drift in y- direction for G+ 15 stories

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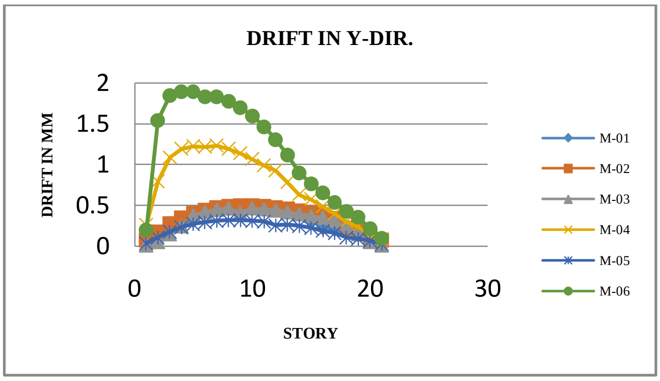
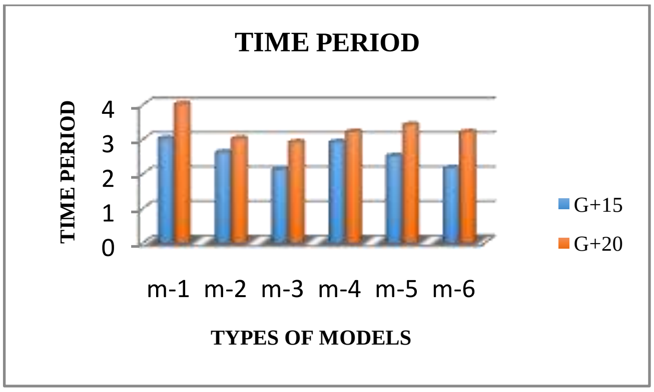


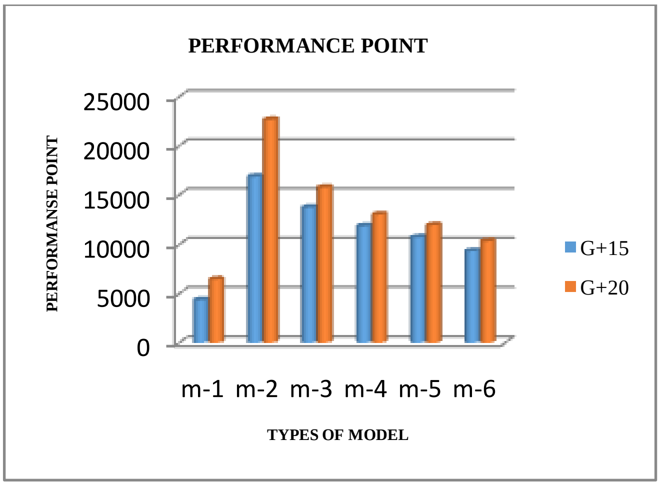
Chart 3:- Storey drift in y- direction for G+ 20 stories

Time period for all models are tabulated and graphically presented as follow



Graph 6: Time Period for G+15& G+20 Story

Performance point for all models are tabulated and graphically presented as follow



Graph 11: Performance Points for G+15 and G+20 Story

IV. CONCLUSION

It can be concluded from the above graphs that implementation of shear walls adds stability to structure. The above graphs shows that a bare frame structure and the structure having walls column at exterior and shear walls at interior are unstable than the model having only column and the models having shear walls at corner and interior filled with columns. However by displacement graphs it can be seen that Model no. 2 is better. Hence it can be concluded that the Structure with shear wall only is more stable during seismic activities.

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