Effect of Concrete and Steel Diagrid system on Tall Building

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Abstract- *Tall buildings are more vulnerable in high wind and earthquake regions. The risk of failure in such buildings can be minimize by adopting lateral load resisting systems. Diagrid buildings are emerging as structurally efficient as well as architecturally significant assemblies for tall buildings. In present work effect of concrete and steel diagrid on lateral performance of 10 stroreyd building is studied and comparison is made with a building without diagrid system. It was observed that, Steel diagrid performs better than concrete diagrid.*

Keywords- Diagrid, Base Shear, Displacement.

I. INTRODUCTION

In today's world tall buildings are becoming more and more slender, which leads to possibility of more sway comparing to older tall buildings. The selection and arrangement of the structural system will efficiently resist more vertical and lateral load. Dia-grid structure is a particular form of space truss. It consists of perimeter grid made up of a series of triangulated truss system. Architecturally the absence of columns in the corners of the building enables great panoramic views and extends the useful space from the interior. The Diagrid structures have mostly free exterior/interior column, hence free and clear, unique floor plans are Possible. Dia-grid system reduce the number of structural element required on the facade of the buildings. The dia-grid members can carry gravity loads as well as lateral forces due to triangulated configuration. Dia-grid structures are more effective in minimizing shear deformation because they carry lateral shear by axial action of dia-grid member.

In present work, G+9 Reinforced Concrete Building (RCC) is analysed embedding concrete and steel diagrid system and compare the performance for high wind and earthquake region.

II. METHODOLOGY

In this study comparison of diagrid and conventional structure under seismic forces and wind load is done. Here G+9 storey is taken and same loading is applied in both the buildings for its behaviour and comparison.

1. Structural Modelling

A regular floor plan of 14m x 14m is considered in both buildings. Storey height is 3m and the total height is 30m. The angle of inclined column(59.740) is kept constant throughout the height. The design dead load and live load are 4.375 kN/m2 and 3 kN/m2 respectively. Both the building frames are analyzed for seismic zone IV and wind forces. Seismic parameters are taken as per Indian code IS 1893(Part 1) : 2002 and wind forces calculated as per Indian code IS875 (Part 3) – 1987. The properties of structure, materials and loading condition are given in Table 1.

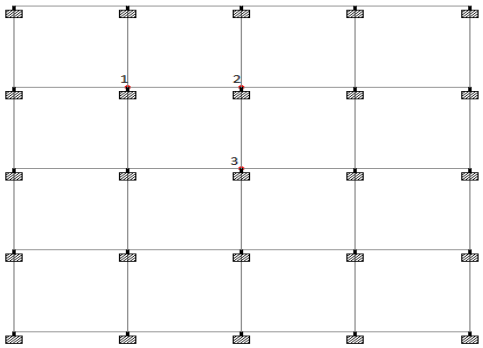

Figure 1. Plan of Building

III. ANALYSIS

A G+9 storeyd buildings with and without diagrid system are analysed in STAAD Pro V8i SS6 for Earthquake zone IV and wind speed 47 m/s as per the guidelines of IS 1893-2002 and 875-1984.Equivalent static analysis is done for all three models without diagrid and with concrete and steel diagrid shown in Fig2.

Two load combinations were consider for all three models for Earthquake and wind load.

a. 1.2(DL+LL+WL) – for wind analysis
b. 1.5(DL+EQ) – for earthquake analysis

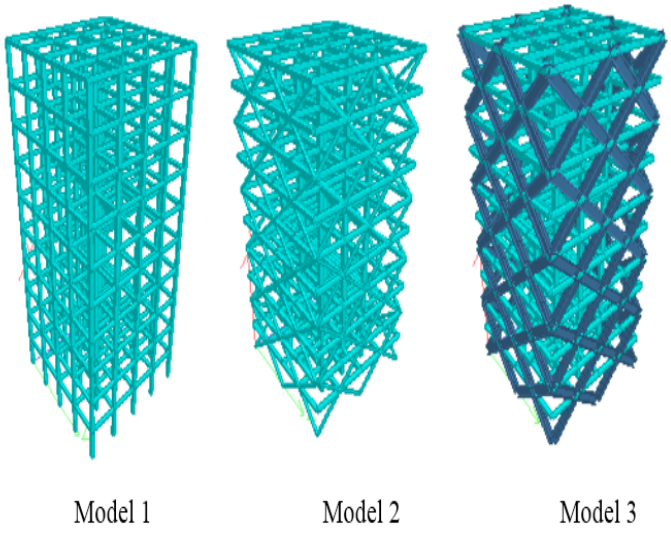

Figure 2. Building with and without Diagrid

Table 1. Structural Properties and loading

Types of Structure	OMRF
No. Of stories	G+9
Storey Height	3 m
Material property	
Grade of concrete	M25
Grade of Steel	Fe 415
Member Properties	
Thickness of slab	0.120 m
Beam Size	
Model 1	300×300mm
Model 2	380×380mm
Model 3	380×380mm
Column Size	
Model 1	350×350mm
Model 2	480×480mm
Model 3	450×450mm
Diagrid Size	
Model 2	230×230mm
Model 3	I80012B50012
Load Intensities	
Seismic Zone	IV
Location	DELHI
Height of building	30 m
Live load	3 KN/M2
Dead load	4.375 KN/M2

IV. RESULTS AND DISCUSSION

All three models with and without diagrid system were analysed in STAAD Pro V8i SS6 and results of base shear and storey displacement of internal column 1, column 2 and column 3 as shown in Fig.1 for each case is compared with each other.

Table 2 and Fig. 3 shows the values of base shear, the maximum value of base shear is observed in steel diagrid building also from Fig. 4, Fig.5 and Fig 6 shows the absolute displacement for wind loading and Fig.7, Fig.8 and Fig. 9 shows the absolute displacement for earthquake loading. In both the load cases, the steel diagrid system shows minimu storey displacement as compaired to concrete diagrid and building without diagrid.

Table 2. Base Shear

MODELS	BASE SHEAR IN KN
MODEL 1	815.00
MODEL 2	898.83
MODEL 3	944.42

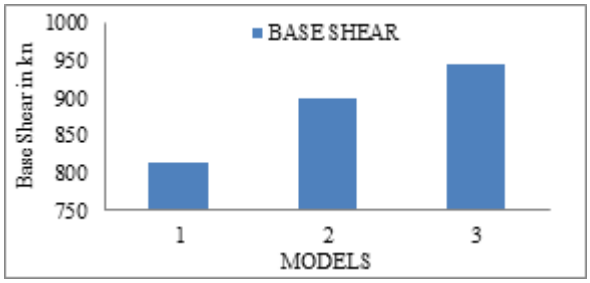

Figure 3. Variation in Base Shear

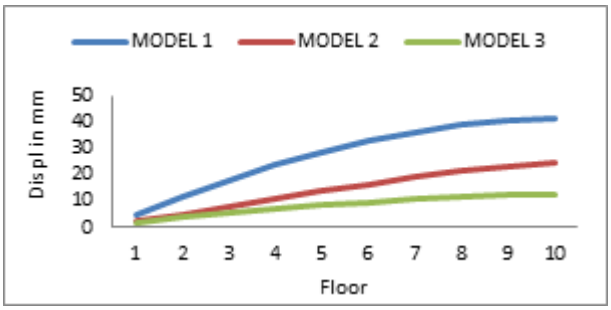

Figure 4. Displacement in internal column 1 for wind load

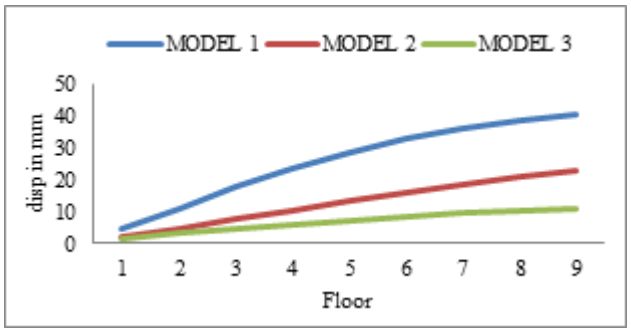

Figure 5. Displacement in internal column 2 for wind load

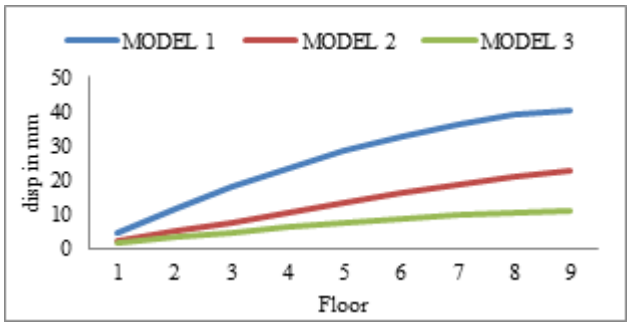

Figure 6. Displacement in internal column 3 for wind load

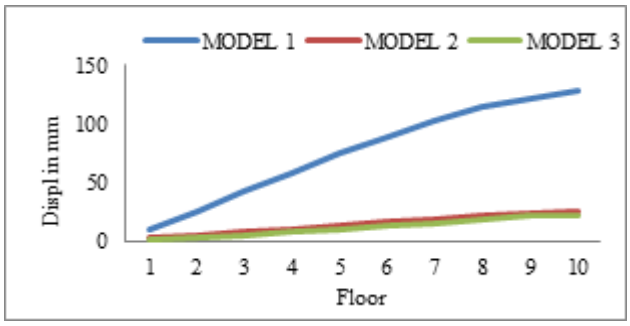

Figure 7. Displacement in internal column 1 for Earthquake load

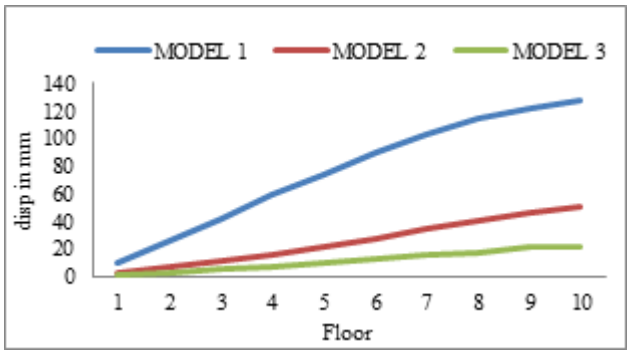

Figure 8. Displacement in internal column 2 for Earthquake load

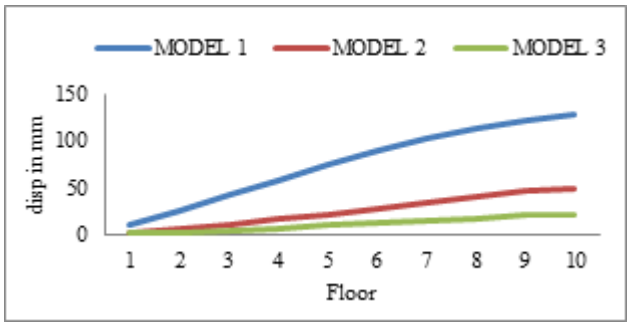

Figure 9. Displacement in internal column 3 for Earthquake load

V. CONCLUSION

Base shear characteristics of building increases after introducing diagrid in the modelling. However, Maximum value of base shear is observed in steel diagrid building.

Similarly, Storey displacement reduced in diagrid building and minimum displacement is found in steel diagrid building compared to concrete diagrid building.

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