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Study On High Rise (G+40) Story Building With Diagrid, Hexagrid And Shear Wall Against Earthquake

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Abstract - The structural system of a high-rise building is designed to cope with vertical gravity loads as well as lateral loads caused by wind or seismic activity. The structural system consists only of the members designed to carry the loads, and all other members are referred to as non-structural. The present investigation involves the study of this research is to model multistoried building with combination of Diagrid, hexagrid and shear wall System in ETABS-2016. To analyses and compare results of multistoried building for the G+40, To get the best Stability of structure by providing Diagrid, Hexagrid and shear wall. To analyses and compare the seismic parameters like base shear, lateral drift and displacement, etc.

Key Words: Diagrid, Hexagrid shear wall structure, IS-1893, ETABS-2016.

1. INTRODUCTION

Structural demands in high seismic zones require the use of strong lateral framing systems. Lateral load resistance of structure is provided by interior structural system or exterior structural system. The structure must have adequate strength and stiffness to resist smaller, frequent earthquakes with limited damage, but must also be able to sustain large inelastic cyclic deformations to economically assure safety and stability during large, infrequent earthquakes. Hexagrid and diagrid structural system consists of Hexagrid perimeter which is made up of a network of multi-story tall hex-angulated truss system. Hexagrid is formed by intersecting the diagonal and horizontal components. A diagrid and hexagrid (a portmanteau of diagonal grid) is a framework of diagonally intersecting metal, concrete, or wooden beams that is used in the construction of buildings and roofs. It requires less structural steel than a conventional steel frame. A shear wall is a structural component provided to multistoried or tall buildings or ordinary buildings in high wind velocity areas. These walls usually begin from the foundation level, along the length and width of buildings. Their thickness can be above 150 mm or below 400 mm in tall buildings; they are like vertical-oriented wide beams that carry the earthquake load towards the foundation.

2. PRELIMINARY DATA CONSIDERED FOR THE ANALYSIS:

Model

- Length in X direction=42m
- Length in Y direction= 30m
- Typical storey height=3m
- No. of storey =40,
- Diagrid and hexagrid height = 4 storey

Load Calculation

DEAD LOAD

- Self-weight of the member
- Super imposed dead load- 2kn/m2

LIVE LOAD- 2kN/m2

SEISMIC LOADING

- Z=0.36 (for zone V IS1893:2016)
- I=1.0 (importance factor)
- Soil Type II
- R=5(Response Reduction Factor)

Codes used for analysis of the structure:-

- R.C.C. design : IS 456: 2000
- Earthquake design: IS1893: 2016
- Code for Dead load: IS875: Part 1
- Code for Live load: IS875: Part 2
- Code for wind load: IS875: Part 2

The basic parameters considered for the analysis and design:-

- Slab depth: 125 mm thick :Assumed
- Live load in floor area: 3 kN/sq m
- Live load in Balcony area:2 kN/sq m
- Live load in passage area : 2 kN/sq m
- Live load in urinals : 2 kN/sq m
- Floor finish load : 1.5 kN/ sq m
- Wall thickness : 600 mm thick wall
- Stair case loading : 3 kN/sq m

A. 2D AND 3D MODEL G+40 Structure-

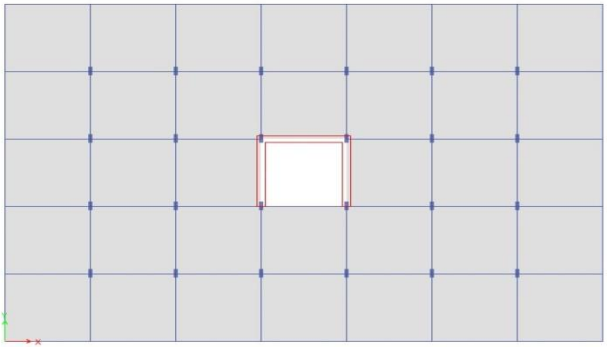


Fig 01- Show the building plan for hexagrid and diagrid building

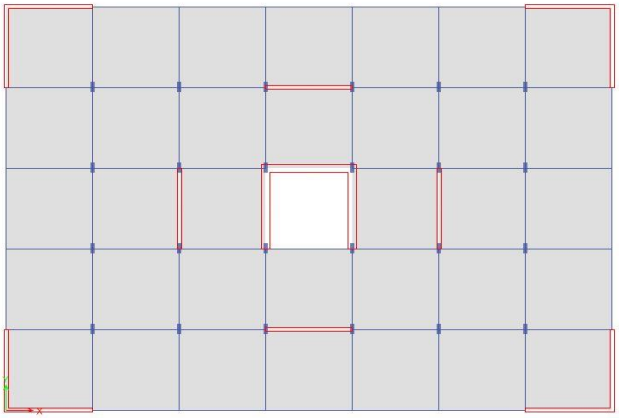
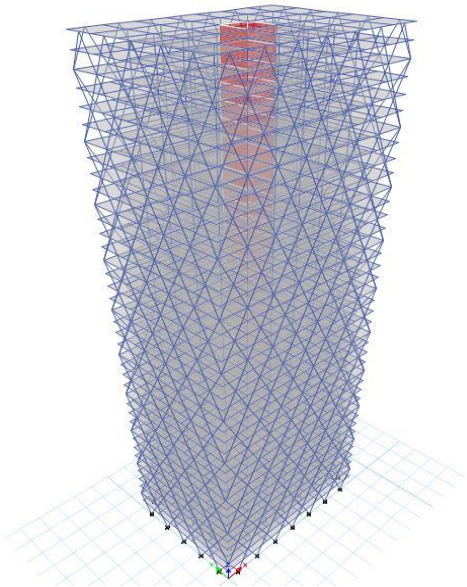
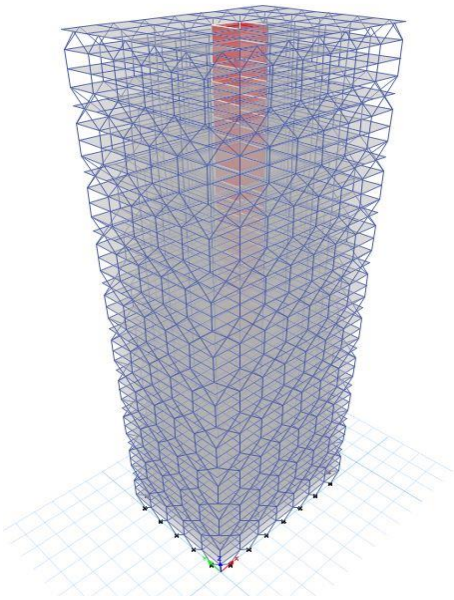


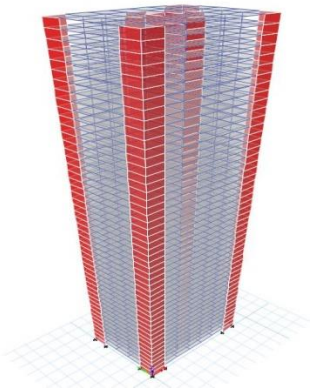
Fig 02- Show the building plan for shear wall building



a) Diagrid frame



b) Hexagrid frame



c) Shear wall frame

Fig.03 shows the Various grid pattern of the structure with diagrid, hexagrid and shear wall

3. Results And Discussion:

3.1.1 Modal Time Period-

Table 01 - Modal Time Period For Mode-1, 2 and 3 for all type of structure

Mode	Diagrid	Hexagrid	Shear wall
Mode-1	4.911	5.9	4.241
Mode-2	3.922	4.998	4.053
Mode-3	1.878	4.323	3.208

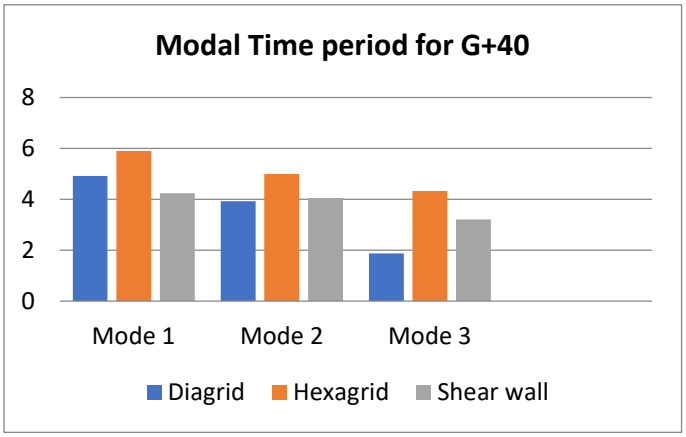


Fig. 04 Fig. 06 Modal time period for G+40 with all structure

3.1.2 Base Shear Details:-

Table 02 – Base Shear Details for Static AND Dynamic load Condition in X and Y Direction-

Base Shear	Diagrid	Hexagrid	Shear wall
Static Ex	5282.37	5032.66	4265.4
Static Ey	5178.96	5032.66	4265.45
DynamicEx	30620.75	24001.0	24065.4
DynamicEy	30034.66	26378.78	24429.18

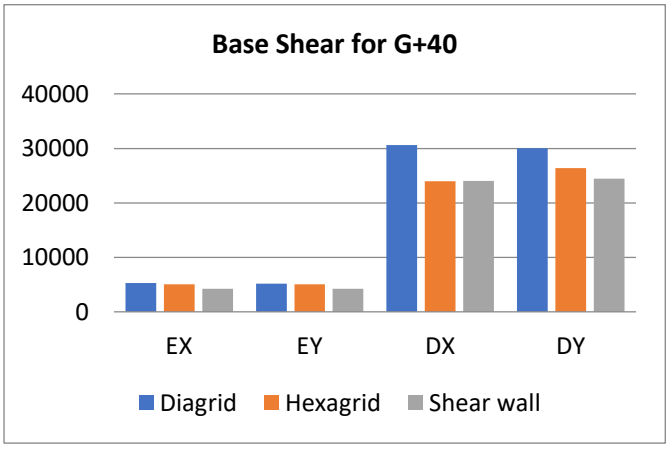


Fig. 05 Base shear for G+40 with all structure

3.1.3 Displacement Details: –

Table 03 (A) – Displacement Details in X and Y Direction for Seismic Condition- :-

Displacement	Diagrid	Hexagrid	Shear wall
Static Ex	0.113	0.179	0.138
Static Ey	0.181	0.271	0.121
Dynamic Ex	0.578	0.881	0.732
Dynamic Ey	0.934	1.51	0.619
Wind WX	0.104	0.188	0.161
Wind WY	0.227	0.329	0.197

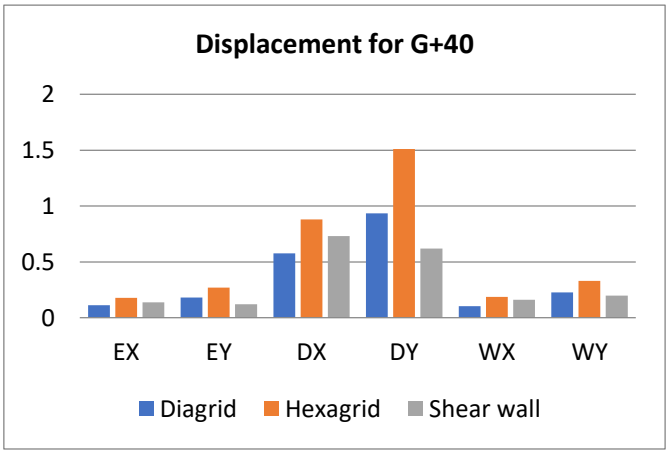


Fig. 6 Displacement detail for G+40 with all structure

3.1.4 . Drift Details: -

Table 04- Drift Details in X and Y Direction for Seismic Condition-A-For Regular building

Drift	Diagrid	Hexagrid	Shear wall
Static Ex	0.00105	0.00233	0.00135
Static Ey	0.00175	0.00344	0.0011
Dynamic Ex	0.00533	0.02374	0.00598
Dynamic Ey	0.00904	0.0278	0.00598

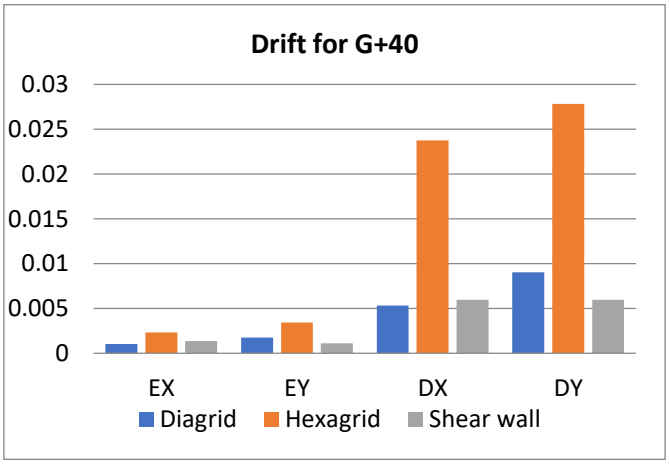


Fig. 7 Drift for G+40 with all structure

5. CONCLUSIONS: - Following are the conclusion we have obtained from above analysis results are: -

1. Time period
   When comparing hexagrid structure with shear wall structure and diagrid, hexagrid show more modal time period then the other both structure in all considerable direction.

2. Base shear
   In case of comparing all structure diagrid structure show more base shear as compared to hexagrid structure and shear wall structure in all considerable direction.

3. Drift
   Drift are getting less in case of Diagrid structure and higher in hexagrid structure in all considerable direction.

4. Displacement
   Displacement is increasing as the structure pattern is changing as shown in table. The hexagrid structure is having higher Displacements value when compared with diagrid structure and shear wall structure.

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