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# Structural Analysis of Diagrid Structure for High Rise Buildings with Having Different Portions

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**ABSTRACT:** In India the enormous loss of life and property perceived in the last couple of decades, attributable to failure of structures instigated by earthquakes. Responsiveness is now being given to the assessment of the sufficiency of strength in framed RCC structures to resist solid ground motions. The seismic reaction of RCC building frame in terms of performance point and the earthquake forces on Reinforced building frame with the help of pushover analysis is carried out in this project. In this method of analysis a model of the building is exposed to a lateral load. Pushover analysis can afford a substantial insight into the weak links in seismic concert of a structure and we can know the weak zones in the structure. This study has provided a comprehensive analysis of the structural behavior of conventional buildings and diagrid structures under dynamic loading conditions. for conventional and square diagrid building and similar area consider for G +16 with having Diagrid structure for different portions such as Throughout, Corners, Building faces.

**KEYWORDS:** Diagrid structure, Wind Forces, High-Rise Building, RCC structures, Dynamic Force.

## I. INTRODUCTION

The term earthquake can be used to describe any kind of seismic event which may be either natural or initiated by humans, which generates seismic waves. Earthquakes are caused commonly by rupture of geological faults; but they can also be triggered by other events like volcanic activity, mine blasts, landslides and nuclear tests. There are many buildings that have primary structural system, which do not meet the current seismic requirements and suffer extensive damage during the earthquake. According to the Seismic zoning Map of IS: 1893-2002, India is divided into four zones on the basis of seismic activities. They are zone II, zone III, zone IV and zone V. Some industries usually make full-scale models and execute wide testing, before manufacturing thousands of identical structures that have been analyzed and designed with consideration of test results. Unluckily, this choice isn't available to building industry so that economy of huge scale creation is unfeasible. In India many existing structure design as per Indian standard code 456:2000 but to make building earthquake resistant IS 1893-2002 should be used to avoid future building vulnerable in earthquake.



Fig 1 Diagrid Structure

**Benefits**

The diagrid system has a lot of benefits that can make it more favored by the designer against other systems. Some of those benefits are:

- Mostly free of columns inside and on the outside
- Lots of natural light thanks to fewer interior columns
- Can use about 20% less steel compared to traditional frames
- Uses simple building methods (though they still need some improvement)
- Makes full use of the strength of the materials
- Has similar construction accuracy to regular steel frame buildings (e.g., columns are made slightly longer to account for settling or compression) — the same applies to diagrids
- Allows for open, flexible, and creative floor layouts
- Visually striking and gives the building a bold, modern look.

**II. AIM AND OBJECTIVES****Aim:**

To study on evaluating the structural behavior, load distribution, and performance efficiency of diagrid structures with different segmentations to optimize design parameters for enhanced stability, strength, and material economy in tall building construction..

**Objectives**

- To study the performance of RC plane frames and Diagrid structure under seismic loads (Earthquake loads).
- To perform Non-Linear Analysis of diagrid structure with conventional structure in ETABS.
- To study the performance of Diagrid structure with respect to different parameters such as story drift, story displacement, base shear.
- To study Diagrid structure for different portions such as Throughout, Corners, Building faces

**IV. PROBLEM STATEMENT**

The structural performance of building frames under seismic loading is critical for ensuring safety and resilience during earthquakes. Reinforced Concrete (RC) plane frames and Diagrid structural systems represent two distinct approaches in modern structural engineering. This study aims to evaluate and compare the seismic performance of RC plane frames and Diagrid structures through detailed non-linear analysis using ETABS software. Key performance parameters such as story drift, story displacement, and base shear will be examined to understand the effectiveness of Diagrid systems compared to conventional frames. Additionally, the investigation will explore the behavior of Diagrid structures in different building portions, including the corners, faces, and throughout the entire structure, to assess their contribution to overall seismic stability. The outcomes of this study will provide valuable insights into optimizing building design for enhanced earthquake resistance.

- Model: G+16
- Seismic Zones: III
- Floor height: 3.6 m
- The configuration of both the models: Square 3 x 3 grid
- Angle of diagrid- 67.4°
- Plan size 18X18

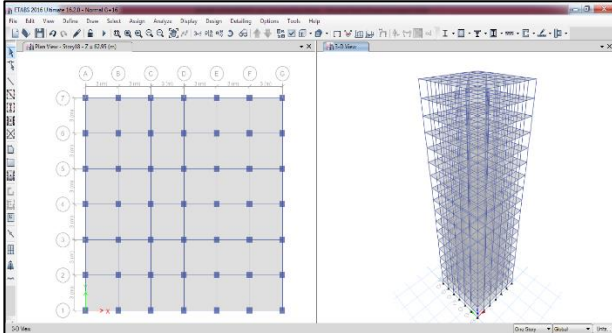


Fig 2 Normal Building G+16

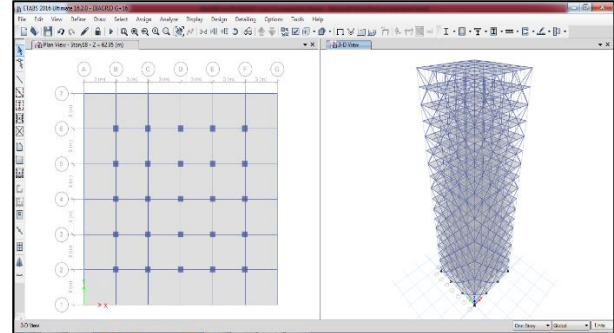


Fig 3 Diagrid Building – Throughout

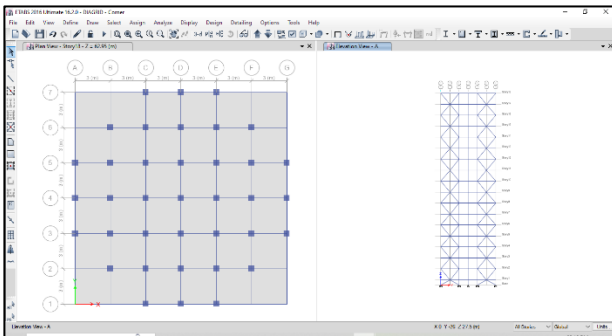


Fig 4 Diagrid Building- Corners

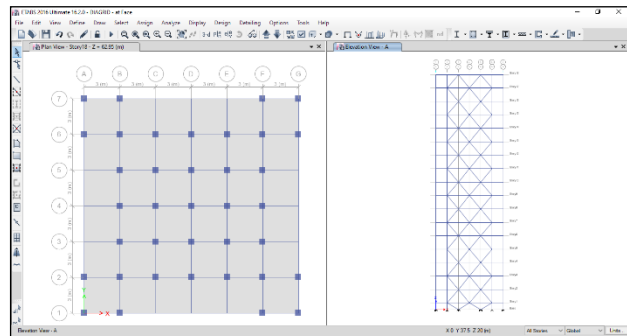
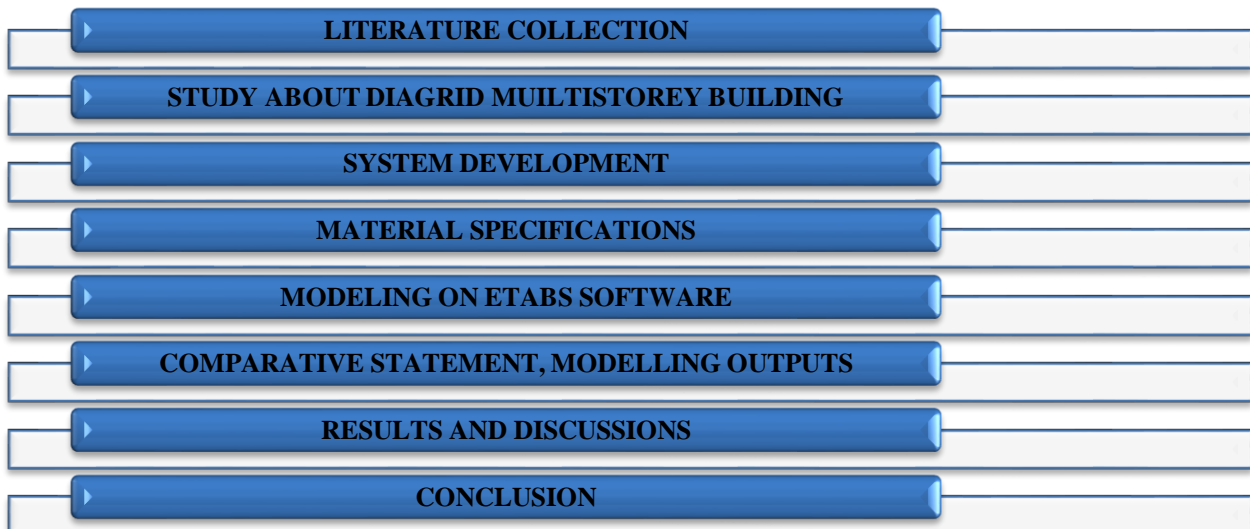


Fig 5 Diagrid Building Building face

### V. METHODOLOGY

The research study involved two stages. The primary data was gathered through a Literature survey targeted by web searches and review of eBooks, manuals, codes and journal papers. After reviewing the problem statement is defined and model preparation is taken up for detail study and analysis purposes. This project execution follows the flow chart given below.

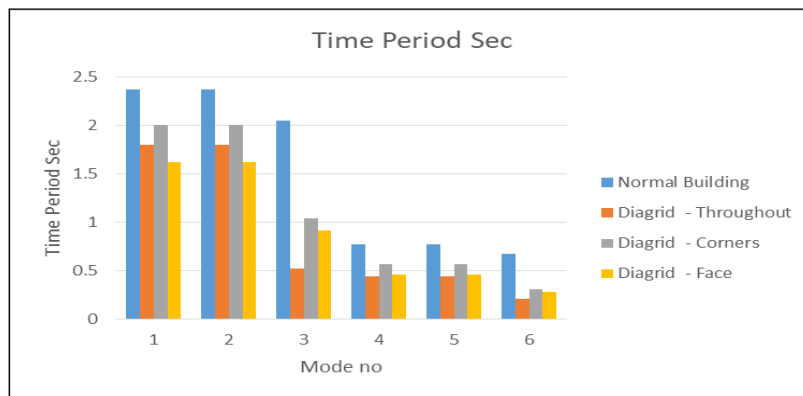


VI. RESULTS AND ANALYSIS

Results for Dynamic Analysis- Time Period Sec

Table 1 Time Period Sec

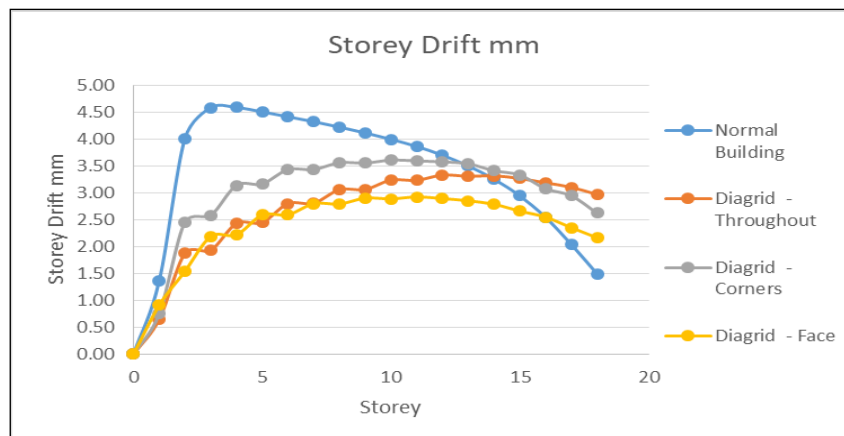
Time Period Sec				
Mode	Normal Building	Diagrid - Throughout	Diagrid - Corners	Diagrid - Face
1	2.366	1.798	2.005	1.616
2	2.366	1.798	2.005	1.616
3	2.048	0.519	1.035	0.914
4	0.769	0.44	0.568	0.46
5	0.769	0.44	0.568	0.46
6	0.677	0.21	0.308	0.284



Graph 1 Time Period Sec

The findings show that the diagrid structure has a shorter time period at the face and throughout the structure compared to the conventional building. A shorter time period generally indicates a stiffer structure, which is beneficial in dynamic analysis because it means the structure is less likely to resonate with seismic or wind excitations.

Results for Dynamic Analysis- Storey Drift



Graph 2 Storey Drift

The results show that the diagrid structure exhibits lower storey drift at the face and throughout the structure compared to the conventional building. Reduced storey drift is beneficial, as it indicates better lateral stiffness and improved performance under dynamic loads, such as earthquakes and wind.

**Results for Wind Load Analysis- Max Storey Drift**

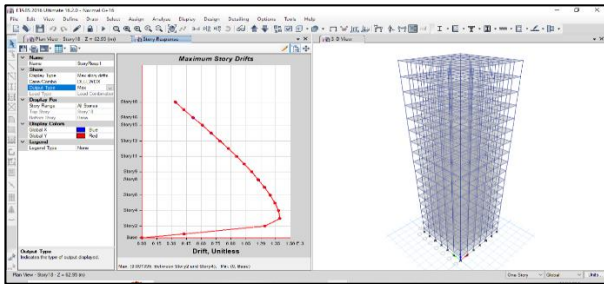


Fig 6 Max Storey Drift Normal Building

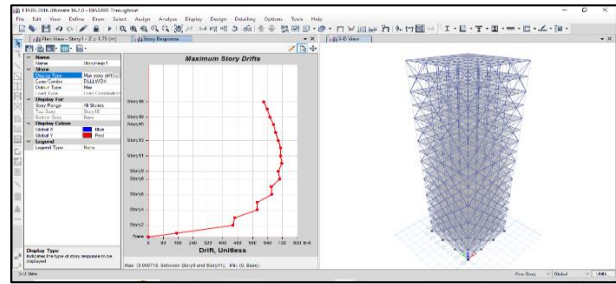


Fig 7 Max Storey Drift Diagrid - Throughout

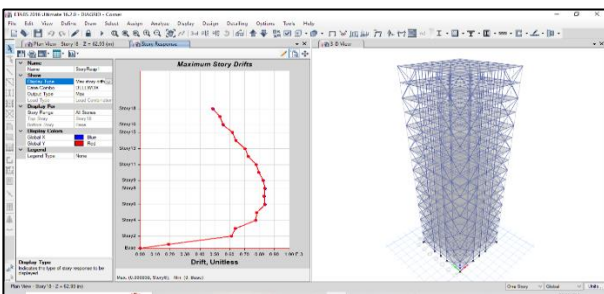


Fig 8 Max Storey Drift Diagrid - Corners

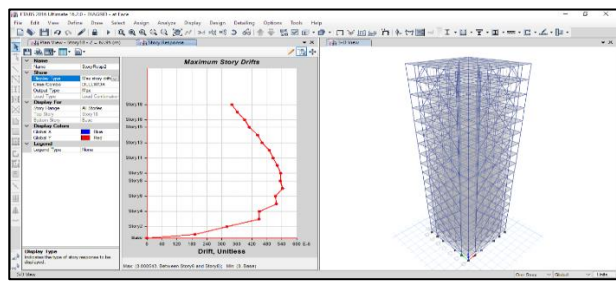
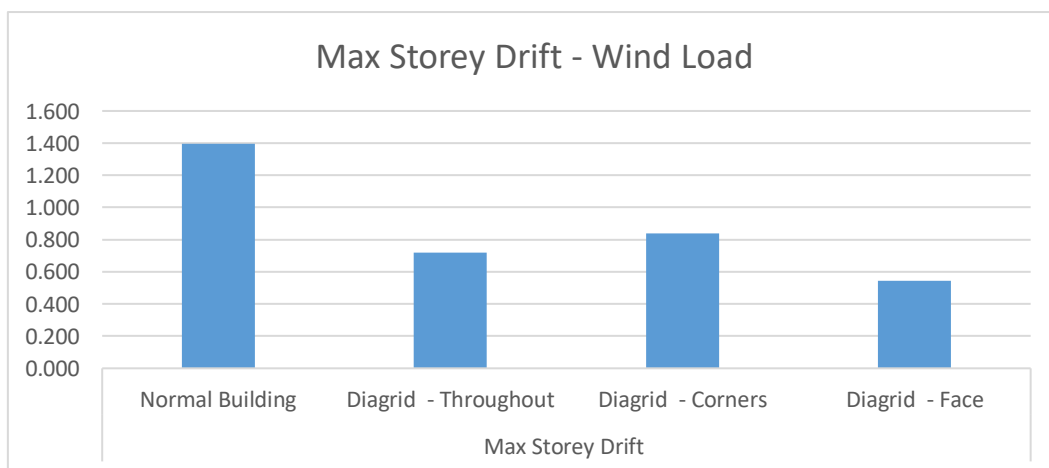


Fig 9 Max Storey Drift Diagrid - Face

Table 2 Max Storey Drift

Max Storey Drift			
Normal Building	Diagrid - Throughout	Diagrid - Corners	Diagrid - Face
1.395	0.718	0.838	0.543



Graph 3 Max Storey Drift

Under wind load, the table shows that diagrid systems significantly reduce maximum storey drift compared to a normal building. The diagrid on building faces performs best with the lowest drift (0.543), followed by diagrid throughout (0.718) and diagrid at corners (0.838), while the normal building shows the highest drift (1.395), indicating the least wind resistance.

## VII. CONCLUSION

This study has provided a comprehensive analysis of the structural behavior of conventional buildings and diagrid structures under dynamic loading conditions. The results from the displacement, time period, storey drift, and lateral force analyses clearly highlight the advantages of the diagrid system in improving structural performance.

- Displacement: The diagrid structure demonstrated lower displacement at both the face and throughout the structure compared to the conventional building. This reduction in displacement is a positive outcome, as it enhances the structural stability and reduces the risk of excessive deflection, particularly under dynamic loads such as earthquakes or wind.
- Time Period: The diagrid system exhibited shorter time periods, indicating higher stiffness and improved resistance to dynamic forces. A shorter time period is desirable, as it reduces the risk of resonance with seismic or wind-induced vibrations, ensuring better safety and performance during such events.
- Storey Drift: The analysis showed that the diagrid system had lower storey drift, especially at the face and throughout the structure. This reduction in storey drift suggests better lateral stiffness and reduced inter-storey displacements, which contributes to greater stability and comfort for building occupants.
- Lateral Force: While the diagrid structure experienced higher lateral forces, this is indicative of its superior ability to resist lateral loads. The increased stiffness and efficient force distribution of the diagrid system allow it to handle seismic and wind forces more effectively, ensuring the building remains structurally sound during extreme events.
- Under wind load, diagrid structural systems significantly improve building performance by reducing storey displacement and drift compared to a normal building. Among the configurations, the diagrid applied on building faces shows the best results in minimizing deformation while effectively resisting lateral forces, demonstrating enhanced structural stiffness and wind resistance.
- The diagrid structural system demonstrated significant advantages in terms of structural performance and dynamic load resistance. It provided superior stability, reduced displacement, and better force distribution compared to the conventional building design. These benefits make the diagrid system an ideal choice for high-rise buildings or structures in areas with high seismic or wind activity, offering enhanced safety, efficiency, and performance.

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