Comparative Study of Structure With or Without Diagrids Under Lateral Conditions

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Abstract- *Construction of high – rise buildings is rapidly increasing day by day. There are huge advance changes in structural systems, materials, analysis & design software which are completely focused in growth of these high – rise buildings. Today's tall building concepts are leading in architectural features of building geometry with strength resisting stable structure and stiffness, etc. Hence, there very good enhancing structural systems are coming up from all over the world & diagrid structural system is one these inventions which are made in Civil Engineering world. In present work, a hexagonal structure ofG + 25 is compared with or without diagrid structural system. Due to inclined columns, lateral loads are sustained by steel diagonal members which are provided as a steel diagrid structural system. The size of building is 75 x 63.25m of total 25 stories located in Zone III and analyzed by ETABS. Parametric study & detailed comparison of diagrid structural system w.r.t conventional structure. Various parameters like maximum displacement, mass participation ratio, mass participating direction factors, fundamental time period, maximum base shear, etc.*

Keywords- High – rise building, diagrid, Civil Engineering, Etabs, hexagonal, etc.

I. INTRODUCTION

Tall buildings are increasing day by day & also the cost of construction and land cost are also increasing & in thought of building an iconic unique structure, architectures are looking for good architectural aesthetic elevation. Due to these complex geometries of building it is very difficult to design a structure with strength stability, etc. Hence, engineers are inventing new structural systems for betterment of high – rise structure. Diagrid structural system is one these inventions which gives a more strength than the conventional structural system. Diagrid helps to resist the lateral loads coming on structure which are earthquake and wind loads. There are many structural framings like moment resisting frame system, Braced frame system, Shear wall system, Advanced structural forms tubular system. In these the tubular system is found to be the most efficient concept for both lateral loads & self – weight resistance. Diagrids are made up of strong exterior diagonal bracing support which eliminated the exterior column that are placed at the periphery of the structure. The exterior bracings are the strengthening members for structure.

Diagrid structures are the advancement of the braced tube structures. The major difference between a braced tube buildings and diagrid buildings is there are no vertical columns placed at the periphery of buildings in braced tube there are vertical column present at the periphery. Diagrid has good appearance and easily recognized.

The term "Diagrid" is the combination of two words i.e., "Diagonal" & the other is "Grid". Most of the researches has shown that diagrid gives more strength and stability to the structure than that of the conventional.

II. AIM OF STUDY

To compare the structure with or without diagrid and interpret the difference of result among the both structure

III. OBJECTIVE

1. To compare the lateral loading difference between with and without diagrid structure.
2. To study the concept of diagrid structural system.
3. To Interpret the result and showing the best preferable structure for high – rise buildings.
4. To compare wind results in with or without diagrid for just as an area of interest.
5. To differentiate analytical fundamental time periods.

IV. DIAGRID STRUCTURAL SYSTEM

- What is Diagrid?

"DIAGRID" (a portmanteau of diagonal grid) it is a design for constructing high – rise buildings with steel diagonal members which can be mostly of triangle shape or diamond shapes. It can also be of triangulated beam system which may be curved or straight, and also it consists

horizontal beams. The main principal of diagrid structure is that the diagrid framework offers few focal points notwithstanding disposing of veneer sections. Most quiet itupgrades each basic component. Ordinarily, segments are utilized to convey vertical burdens, and diagonals give steadiness and imperviousness to substantial strengths, for example, wind and seismic burdens. Yet, Rahimian [structural architect for the Hearst Tower] says that diagonals and props "need" to convey vertical burden and the segments need to convey sidelong load under perfect presumptions in an average tall structure. In a DIAGRID auxiliary framework, the two capacities are hitched, he says. 'The sections, diagonals and bracings all are one.'-"Milestone Reinvented" by Brian Fortner.

Fig 1. Al Dar headquarters building, Abu Dhabi, UAE

V. MODELLING

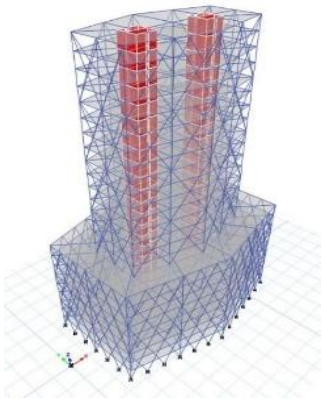

Fig 2. Structure with Diagrid

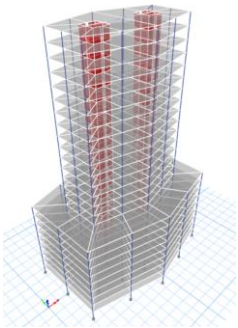

Fig 3. Structure without Diagrid

VI. ANALYSIS REPORT

1. As per IS 1893 -2016 Criteria for Earthquake Resistant Design of Structures:

Formulae for calculating maximum Displacement of structure:
=H/250
= 84000/250
= 336 mm

Table 1. Static Earthquake Results in X –Direction

Static Earthquake Analysis X - Direction		
Direction	**With Diagrid**	**Without Diagrid**
Max Displacement	**37.039 mm**	**225.31 mm**

Table 2. Static Earthquake Results in Y- Direction

Static Earthquake AnalysisY - Direction		
Direction	**With Diagrid**	**Without Diagrid**
Max Displacement	**78.147 mm**	**294.014 mm**

2. As per Indian Codes Wind Analysis (As per IS 875 (Part 3)-2015:

Formulae for calculating maximum Displacement of structure:
=H/500
= 84000/500
= 168 mm

Table 3. Wind Analysis Results in X – Direction

Wind Analysis in X - Direction		
Direction	**With Diagrid**	**Without Diagrid**
Max Displacement	**9.781 mm**	**61.784 mm**

Table 4. Wind Analysis Results in Y – Direction

Wind Analysis in Y - Direction		
Direction	**With Diagrid**	**Without Diagrid**
Max Displacement	**35.486 mm**	**137.810 mm**

Table 5. Base Shear Results in Earthquake X - Direction

Base Shear in Earthquake X - Direction		
Direction	**With Diagrid**	**Without Diagrid**
Base Shear	**35.486 mm**	**137.810 mm**

Table 6. Modal Direction Factor with Diagrids

Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	1	1.929	0	0.999	0	0.001
Modal	2	1.314	0.997	0	0	0.003
Modal	3	0.839	0.003	0.003	0	0.995
Modal	4	0.659	0	0.992	0	0.008
Modal	5	0.504	0.962	0.001	0	0.037
Modal	6	0.41	0.037	0.012	0	0.95
Modal	7	0.287	0	0.988	0	0.012
Modal	8	0.225	0.989	0	0.001	0.009
Modal	9	0.203	0.003	0.002	0.995	0
Modal	10	0.149	0.95	0.027	0.006	0.017
Modal	11	0.136	0.013	0.96	0.023	0.003
Modal	12	0.112	0	0	0.998	0.001

Table 7. Modal Direction Factor without Diagrids

Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	1	3.757	0	0.997	0	0.003
Modal	2	3.223	0.995	0	0	0.005
Modal	3	2.255	0.007	0.006	0	0.988
Modal	4	1.036	0.051	0.678	0	0.271
Modal	5	0.95	0.581	0.231	0	0.188
Modal	6	0.871	0.366	0.088	0	0.546
Modal	7	0.391	0.083	0.834	0	0.082
Modal	8	0.367	0.873	0.112	0	0.016
Modal	9	0.219	0.001	0.002	0.987	0.01
Modal	10	0.192	0.783	0.068	0.019	0.13
Modal	11	0.172	0.032	0.829	0.106	0.034
Modal	12	0.133	0.005	0.005	0.917	0.073

VII. RESULT

1. By comparing Static Earthquake in X & Y direction with diagrid structural system is controlling the displacement at large scale as compare to without diagrid structural system.
2. By comparing wind in X & Y direction with diagrid structural system is controlling the displacement at large scale as compare to without diagrid structural system.
3. Time period in diagrid structural system is less as compared to without diagrid.
4. Overall lateral load resisting as well as the sustaining gravity loading & stability of the structure is good and better in diagrid structural system.

VIII. CONCLUSION

The paper is concluded by that diagrid structural system is good and betterment in the advancement in resistivity of the structure under different loadings & also gives the goof stability to the structure and also the good architectural aesthetical elevation for making the structure unique & iconic also it resists the earthquake loading and also for wind loading.

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