International Journal of Scientific Research in Civil Engineering
© 2019 IJSRCE | Volume 3 | Issue 2 | ISSN : 2456-6667

Analysis of a Tall Structure Considering Lateral Load Resisting Members using Advance Analysis Tools

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ABSTRACT

Nowadays using modern structural systems with specific capabilities, like Diagrid, is emerging around the world. In this Study a new resisting system, a combination of both Diagrid axial behavior and proper seismic performance of regular moment frames in tall buildings, named "Hybrid Diagrid" is presented. The scaled specimen of the suggested Hybrid system was built and tested using *I.S. 1893-I:2002*. The natural frequency and structural responses of the analytical model was updated with the real experimental results of 3-dimensional building frame. In order to compare its performance in comparison with the traditional Diagrid and moment frame systems, Dynamic analysis was carried out. Extensive analysis shows the efficient seismic responses and economical behavior of Hybrid Diagrid structure with respect to the other two systems using Analysis tool Staad.pro.

Keywords: Dynamic analysis, tall structure, Staad, Diagrid, Lateral load, high rise structure.

I. INTRODUCTION

High rise building improvement includes different complex factors, for example, financial aspects, feel look, innovation, city directions, and legislative issues. The Diagrid is a framework of diagonally intersecting metal, concrete or beams that is used in the construction of buildings and high rise structures. Among these, financial aspects have been the essential representing factor. For tall structure, the auxiliary plan is by and largely administered by its parallel firmness. Diagrid structure consists of inclined columns on the exterior surface of building. Inclined columns present lateral loads are resisted due to axial action of the diagonal compared to bending of vertical columns in framed tube structure. diagrid structures generally do not require core because lateral shear can be carried by the diagonals on the periphery of building. A diagrid structure gives awesome basic effectiveness without vertical segments have additionally opened the new tasteful potential for tall building engineering. Diagrid has a decent appearance and it is easily apperceived.

Significant seismic loads can be imposed on a structure during an earthquake. They are likely to be relatively instantaneous loads compared to wind loads. Buildings in areas of seismic activity need to be carefully designed to ensure they do not fail if an earthquake should occur. Lateral loads such as wind load, water and earth pressure have the potential to become an uplift force (an upward pressure applied to a structure that has the potential to raise it relative to its surroundings). Structures should be designed carefully with likely lateral loads in mind. A structural element that is typically used to resist lateral loads is a resisting members. In simple terms, lateral forces could push over parallel structural panels of a building were it not for perpendicular resisting members keeping them upright. The quake has dependably been a danger to human progress from the day of its reality, crushing human lives, property, and man-made structures. The extremely late quake that we looked at our neighboring nation Nepal has again demonstrated nature's fierceness.

Diagrid structural system is a type of exterior structure which is a framework of diagonally intersecting metal, concrete or wooden beams that is used in the buildings. Recently diagrid structural system is adopted in tall buildings due to its structural efficiency and flexibility in architectural planning. The previous earthquakes in India show that not only non-engineered structures but engineered structures need to be designed in such a way that they perform well under seismic loading. To increase the structural performance to lateral loading and to perform well under seismic loading diagrid can be provided. diagrids allow the system to obtain a great increase in lateral stiffness and they increase the natural frequency and usually reduces the lateral drift.

II. LITERATURE SURVEY

Shreepad desai et. al. (2018) Seismic analysis of structural systems has been a necessary in the recent past. The diagrids have favourable circumstances like light weight structure, compelling against gravity stack, resistance against seismic and wind loads, excess, possible for contorted and other complex structures, reasonable. The diagrid structures utilized 33% less steel than common structures with same basic execution. Modelling of the structures with three distinct arrangements for the three diverse story statures independently. To increment the auxiliary execution of the structures by outside segments with the inclining diagrid module for each one of the models. To study and analyze the horizontal relocations and sidelong floats of the all the diagrid models for seismic stacking. To look at the base shear qualities of the models with diagrid individuals. To analyze the above parameters of both diagrid structures

Hanna and Golsz (2017) In the architecture of high-rise buildings there are a multitude of architectural forms, such as twisted, tilted, tapered and free forms. The article describes the characteristics of the diagrid system and its applicability in the construction of tall buildings in relation to other modern construction systems: braced-tube and outrigger. The authors attempt to evaluate the effectiveness of this system for various geometric forms. The characteristics of buildings with very complex geometry and that use the diagrid system are presented.

Objectives:

The main objectives of the present study are as follows:-

1. To study the concept of Hybrid diagrid structural system on a Tall structure.
2. To determine the optimum configuration for buildings using STAAD software.
3. To determine the variation in forces due to diagrid structure under seismic forces.
4. Comparison of results in terms of Max story drift, max story displacement, base shear in seismic case.
5. To determine the variation in forces due to Non-linear P-delta analysis.
6. To prepare cost analysis of hybrid diagrid structure as per S.O.R. 2017.

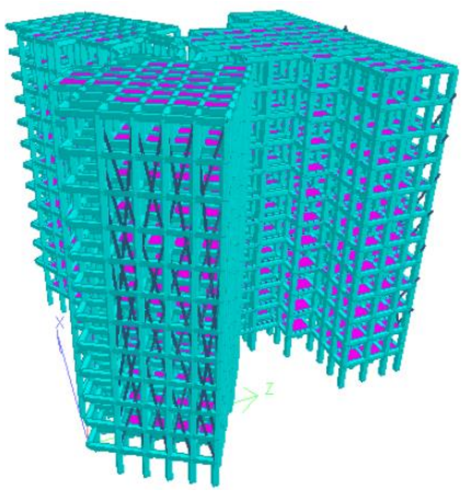


Fig 1: Modelling in analysis tool

III. METHODS AND MATERIAL

- Step-1: First step is collection of data related to Diagrid system considering to software implementation and non linear analysis.
- Step-2: Second step is to decide geometrical structure of the project details and CAD drawings
- Step-3: To assign section data and material properties.
- Step-4: To Assign support conditions.
- Step-5: To assign Nonlinear load as per I.S. 1893-I-2016.
- Step-6: To perform dynamic analysis.
- Step-7: To prepare comparative result in M.S. excel.
- Step-8: To provide conclusion as per results.

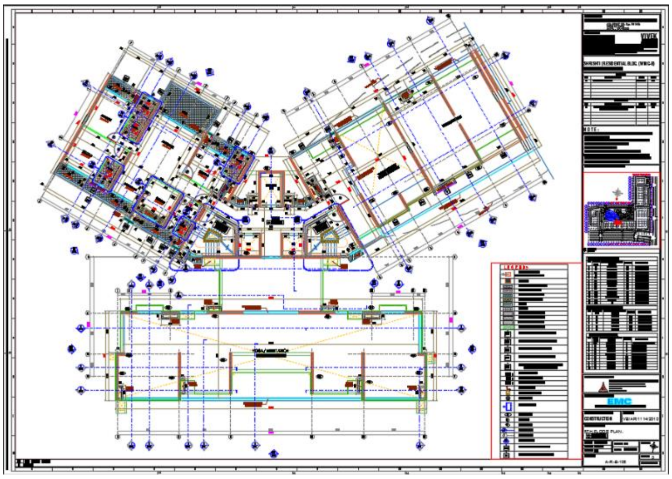


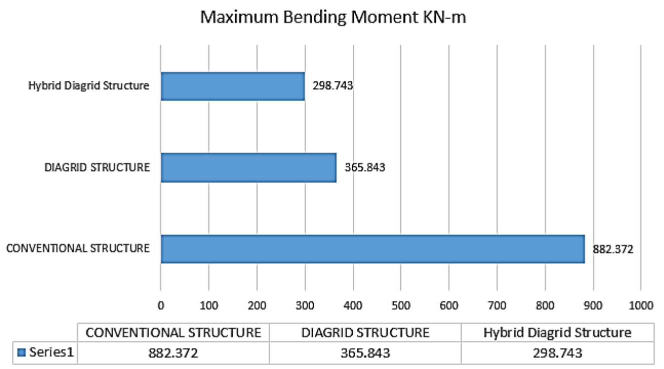
Fig 2: Plan of the work

Table 1: Geometrical data

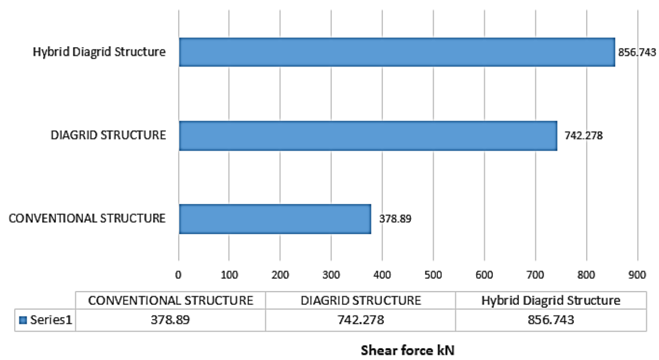
Type of structure	(G+11)
Plan dimensions	54.13 m × 43.72 m
Total height of building	41.5 m
Height of each storey	3.2m
Depth of foundation	2.5m
Bay width in longitudinal direction	54.13 m
Bay width in transverse direction	43.72 m
Size of beams	230 mm X 400 mm
Size of columns	450 mm X 450 mm
Thickness of slab	125 mm
Thickness of walls	115 mm
Seismic zone	V
Soil condition	Soft (type III)
Response reduction factor	5
Importance factor	1.5
Floor finishes	1 kN/m^2
Live load at roof level	1.5 kN/m^2
Live load at all floors	3 kN/m^2
Grade of Concrete	M25
Grade of Steel	Fe 415
Density of Concrete	25 kN/m^3
Density of brick masonry	20 kN/m^3
Design philosophy	Limit state method conforming to IS 456-2000

IV. RESULTS AND DISCUSSION

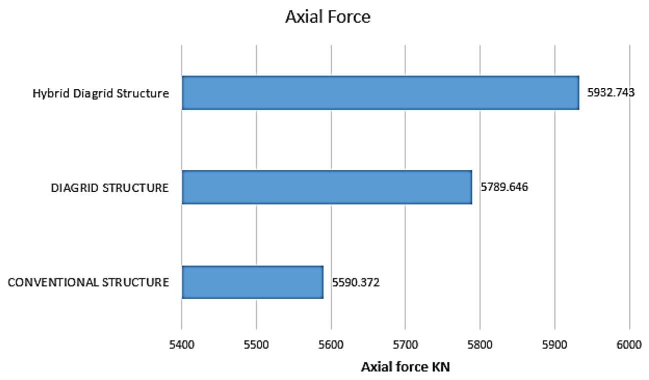
Bending moment:



Shear force:



Axial force:



V. CONCLUSION

From the present study it is concluded that both infill and diagrid structures are resisting lateral forces, but in comparison of both it is observed that diagrid structure is more stable, suitable and economical as compared to Infill structure.

- **Max. Bending Moment (kN-m):** The comparison determined less moment in a hybrid diagrid structure more economical than diagrid structure and conventional structure.
- **Shear Force:** This parameter went vice-verse as Conventional Structure presented less bending moment in comparison to Hybrid Diagrid Structure and Diagrid Structure due to its stiff structure resulting in less unbalanced forces.
- **Axial Force:** these vertical forces are maximum in approximately all the three cases.

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Cite this article as :

Prafull Kumar Yadav, Pratiksha Malviya, "Analysis of a Tall Structure Considering Lateral Load Resisting Members using Advance Analysis Tools", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 3 Issue 2, pp. 61-64, March-April 2019. URL : http://ijsrce.com/IJSRCE193211