

# COMPARATIVE STUDY ON CFST AND STEEL DIAGRID STRUCTURAL SYSTEM FOR HIGH RISE BUILDING

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**Abstract** - In this paper, G+ 42 storeys and G+30 storey building have been analyzed for steel and CFST material in different seismic zones with medium soil. Here, the usage of software program ETABS. 12 cases were modeled and analyzed for comparison on steel and CFST. On the quit concluded that steel diagrid found to perform better compare to CFST diagrid and it was also observed that diagrid shape is likewise able to reducing the impact of dynamic loading on constructing.

**Key Words:** Composite structure, seismic zones, diagrid, dynamic loading, ETABS etc

## 1. INTRODUCTION

Fast development of city population and subsequent stress on restricted space have, drastically encouraged the development of the metropolis. There are various elements which made the cities to grow upward one of the main reason is the free of the land within the towns. Advances in construction enterprises and invention of high electricity substances made it less expensive to construct skyscrapers in preference to making an investment cash to buy huge place of land. Skyscraper enables in optimization the gap, also increase in aesthetic of the city. Diagrid systems are regarded to be keen powerful in structuring an extensive range of constructing kinds. Diagrid structures provides guide to maximum of the house that are of form curved shape and in case of angular house additionally in case of non-rectilinear form. Growth within the top of the constructing makes the structure less stable to lateral masses compared to gravity masses. For this reason the layout for lateral load will become more essential than for the gravity load. There are many structures evolved for countering the lateral load coming on to the structure. Thus providing diagrid helps to interlock the lateral load acting on the structure.

## 2. METHODOLOGY

1. Structure is modeled with diagrid for Steel and CFST material in ETABS for a given plan area.
2. Assigning seismic forces as per Indian standard 1893-part-1 is applied on the structures.

3. Assigning wind load as per Indian standard Is 875-part-3 is applied on the structures.
4. In the next, both the structures compared to determine the use of implementation of diagrid.
5. Using MS excel plotted the result in the form of graph.

## 2.1 GEOMETRY

**Table -1:** geometry and load consideration

Type of structure	Public building (G+42) &(G+30)
Plan dimension	56 m X 56 m
Total height of building	176 m
Height of each storey	4.2 m
Diagrid section	Steel section
Angle of Diagrid	66°
Seismic zone	II, III, IV
Wind load	IS 875-part-3
Dead load	IS 875-part-1
Live load	IS 875-part-2
Seismic code	IS 1893-2002

## 2.2 STRUCTURAL PLAN DETAILS

In fig no. 1 there is structural plan view of all the models having plan of 56m x 56m. The structure is considered as a commercial building. Live load on the building is 3 KN/m<sup>2</sup>. A member load of 11 KN/m is considered on all the beams for the wall loading. The end condition for diagrid is assumed as fixed. The support conditions are assumed as fixed. The angle of diagrid used here is 66 degree. The design of member is carried out on the basis of IS-456-2000. Wind load is computed on the basis of IS 875 Part3. The design earthquake load is computed on the bases of IS 1893-2016 having zone factor 0.1, 0.16, 0.24 soil type medium soil, importance factor 1.2, Response Reduction 5.

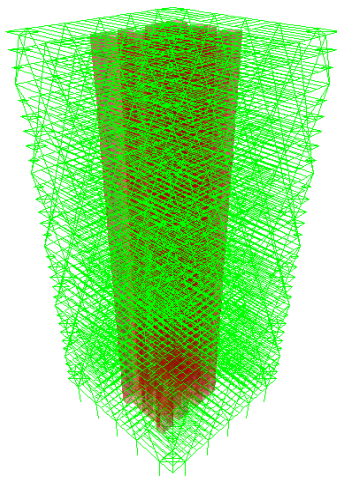


Fig -2: 3D Elevation

### 3. RESULTS & ANALYSIS

Discussion are made based on following parameters

1. Base Shear
2. Storey Displacement
3. Storey Drift
4. Storey Stiffness

#### 3.1. Base Shear

The Shear force at the base of the structure so obtained is been plotted for all cases in X and Y direction.

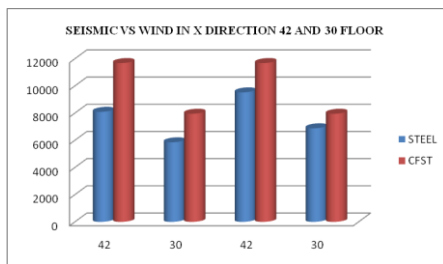


Chart 1: Base shear in x direction seismic zone II with medium soil condition

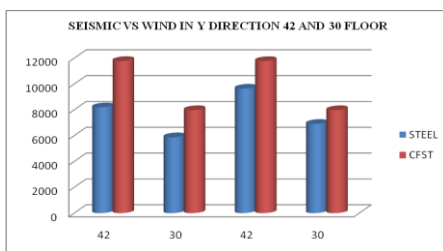


Chart 2: Base shear in y direction seismic zone II with medium soil condition

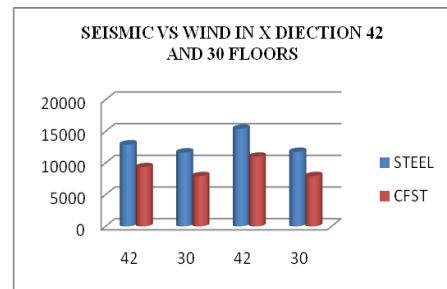


Chart 3: Base shear in x direction seismic zone IV with medium soil condition

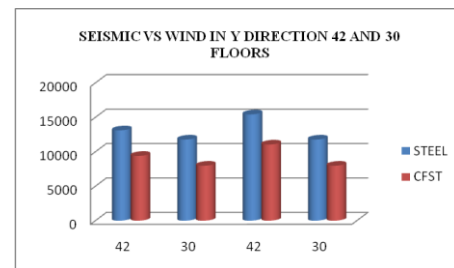


Chart 4: Base shear in y direction seismic zone IV with medium soil condition

#### 3.2. Storey Displacement

Analyses of the frames are done having consideration of different zones (II, III & IV) and keeping the soil conditions medium. The sections are provided in frames are the minimum requirement of the frames to maintain the stability of the structures. From the analyses, it is evident that the CFST having huge storey displacement compared to Steel system for high rise building. The different displacement results are shown in below figures.

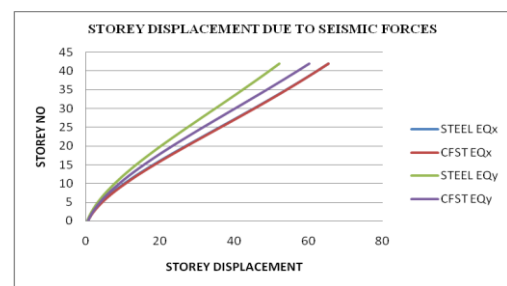


Chart 5:- Storey displacement in seismic zone IV with medium soil condition 42 storey



Chart 7:- Storey displacement in seismic zone IV with medium soil condition 30 storey

### 3.3. Storey Drift

The floor level versus drift graph is been plotted for both models in X and Y direction.

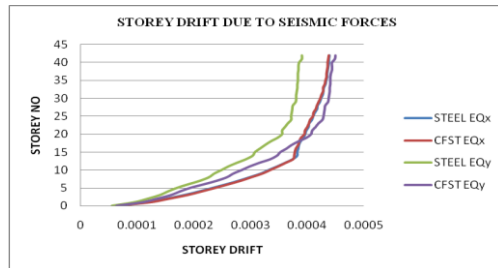


Chart 6:- Storey drift in seismic zone IV with medium soil condition 42 storey

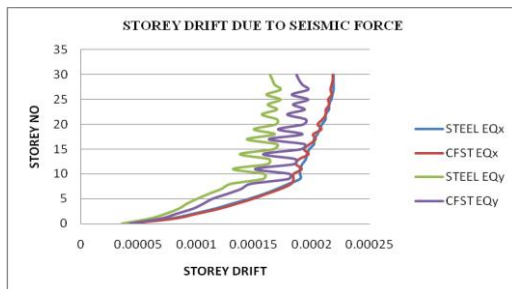


Chart 8:- Storey drift in seismic zone IV with medium soil condition 30 storey

### 4. Conclusions

Maximum storey displacements are maximum for CFST diagrid compared to steel diagrid structures for a given angle of variation.

Consequences of impact of diagrid perspective variation confirmed that Diagrid angle inclination appreciably influences the structural parameters of the structure. Most beneficial perspective of diagrid inclination (size of module) is for this reason important for the design of diagrid.

Maximum storey drift are maximum for CFST diagrid compared to steel diagrid structures for a given angle of variation.

However, the diagrid being erected / set up from ground has better benefits in terms of constructability, procurement lead time and parallel creation time. It also accentuates the architectural motive.

But, conventional diagrid with ductile shear wall and with special second resistant body has been found to be functionally performing better to counter the ductility necessities as advised in the codes.

### REFERENCES

- [1]. Mele E, Toreno M, Brandonisio G and Luca A D 2014 Diagrid structures for tall buildings: case studies and design considerations *Struct. Design Tall Spec. Build.* **23** 124-45.
- [2]. Khan, F.R., & Sbarounis, J. (1964). Interaction O Shear Walls and Frames In Concrete Structures Under Lateral Loads. *Structural Journal of the American Society of Civil Engineers*, 90(St3), 285335.
- [3]. Khan, F.R. (1969). Recent Structural Systems In Steel For High Rise Buildings. In *Proceedings of The British Constructional Steelwork Association Conference on Steel In Architecture*. London: British Constructional Steelwork Association.
- [4]. A. G. Davenport, "The Response of Six Building Shapes to Turbulent Wind", *Seria A, Mathematical and Physical Sciences*. Vol. 269, No. 1199, A Discussion on Architectural Aerodynamics, 1971, Pp. 385394.
- [5]. Khan, F.R. (1973). Evolution of Structural Systems For High Rise Buildings In Steel And Concrete. In J. Kozak (Ed.), *Tall Buildings In The Middle And East Europe: Proceedings of The 10th Regional Conference On Tall Buildings Planning, Design And Construction*. Bratislava: Czechoslovak Scientific and Technical Association.
- [6]. Popov, E.P. (1982). Seismic Framing Systems for Tall Buildings. *Engineering Journal/American Institute of Steel Construction*, 19(Third Quarter), 141149.
- [7]. Council on Tall Buildings And Urban Habitat. 1995. *Structural Systems for Tall Buildings*. McGrawHill: New York.
- [8]. Aisc. 1998. *Manual of Steel Construction: Load And Resistance Factor Design*. American Institute of Steel Construction: Chicago,