A COMPARATIVE STUDY ON DIAGRID OVER CONVENTIONAL STRUCTURES USING STEEL AND CONCRETE DIAGRIDS

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ABSTRACT: An exterior inclined element to withstand lateral loads is termed as diagrid. Various shape structures are present in the world but mostly rectangular is considered over all, in this study an attempt is made to make an octagonal shape structure with and without diagrids. In this study a typical model of Octagonal shape and having 12 Storey is made on STAAD PRO. Software and analysis of reinforced concrete framed structure is done with linear static analysis methods as per the IS 1893:2016. The results are then compared for the parameters such as Maximum resultant displacement, Maximum Base Reactions and Maximum Base shear amongst all the structures.

KEYWORDS: Octagonal structure, Diagrid structure, STTAD PRO, octagonal, Static analysis.

I. INTRODUCTION:

Diagrid is an outside basic framework wherein all border vertical sections are killed and comprise of just and just slanted individuals on the substance of the structure. Shear and Overturning minutes are opposed by pivotal activity of these corner to corner individuals when contrasted with bowing in vertical individuals. Late pattern shows that diagrid structure is a creative methodology and getting more well known in tall structures because of inalienable basic and building focal points. In such muddled structures, the type of the structure, notwithstanding the compositional idea, altogether impacts the basic effectiveness and constructability of the entire venture. Lately, the diagrid basic framework has become increasingly intriguing for planning tall structures, due to its basic productivity and tasteful potential, emerging from the special mathematical arrangement of the framework.

OBJECTIVE OF THE STUDY:

Following are some parameters on which the study is going to be carried out-

1. To identify the Maximum resultant displacement, Maximum Base Reactions of all structures.
2. To perceive the behaviour of diagrid structures in different seismic zones of India.
3. To analyse the Diagrid structure over Traditional structure.
4. To compare steel diagrid over concrete diagrid.

II. LITERATURE SURVEY:

- **Huzaifa Nakhwa, Prof. D. N. Kakade (2020)** carried out a literature research on Diagrid and Hexagrid systems. Storey drift and storey shear of the diagrid, Hexagrid and conventional systems and found Hexagrid to be outperforming the other two systems. Hexagrid system was also found by some researchers to be more economical than other systems.
- **Ashwini. D, Abdul Quddus Suhaib (2020)** carried out a study on ETABS software in which ordinary moment resisting building of G+10 stories located over a medium soil. Zone V is considered for the study.

They found out that diagrid structures give more aesthetic look and gives more interior space due to less columns and facade of the building can also be planned more efficiently and diagrids are giving more member stiffness than the conventional braced structures

- **Shubhangi V. Pawar, M. S. Kakamare (2017)** investigated Steel Diagrid Structure with various shapes in plan. Quake and wind powers were considered in the examination, ETABS 2015 basic investigation programming is utilized to dissect structures under the impact of wind and tremor powers in zone III. Equivalent territory of 1296 m2. Shapes considered in the exploration work were Circular, Square, Rectangular plans. Seismic and Wind examination done by Linear Static Analysis. The conduct of building parts was inspected and analyzed based on relocation, story float, and base shear. Their investigation came out with the results that Square and Circular Diagrid Buildings have lower Maximum Story Displacement and Story Drift esteems contrasted with Rectangular Diagrid building. C and has high base shear esteems than other two shapes. D. Square Diagrid structures perform better than Circular Diagrid Building and Rectangular Diagrid building.

- **U. A. Nawale and D. N. Kakade (2017)** investigation of 32-story digrid basic framework without vertical segment around fringe building is introduced here. The examination of investigation of result as far as story dislodging, story floats were done. They saw that Lateral Displacement is higher for the situation of dynamic investigation than static examination. It is seen that breeze investigation is lower coming about than Dynamic Response Spectrum examination yet higher than static investigation. Diagrid building shows less sidelong removal and float in contrast with ordinary structure. Diagrid shows better protection from horizontal burdens and because of this, inward sections get loose and convey just gravity loads. While in customary structure both inward and external section are intended for both gravity and sidelong loads.

- **Mohammed Abdul Rafey and M. A. Azeem (2018)** researches models of diagrid structures and customary supported casing structures with various symmetric and hilter kilter plan calculations. With the end goal of investigation, two symmetric and two unbalanced structures were displayed and examined utilizing straight static strategy for every one of the two basic sorts. Empty mellow steel pipes were considered as outside diagrids though ISA edge areas were considered for outside propping. It was seen that the diagrid structures' exhibition against the sidelong loads was far superior to that of the regular supported casing structure and that the part solidness in diagrid structures' components were of a lot more prominent size than the customary propped structure notwithstanding the way that all fringe vertical sections are dispensed with from the diagrid structure. The popular narrative relocations in the diagrid models are less contrasted with the traditional propped outline models. The story shear for diagrid models is substantially less than that of regular propped outline models which is on the grounds that the seismic loads of diagrid structures are not exactly the seismic loads of the customary supported edge structures. The diagrid components give adequate effectiveness to horizontal burdens considering the way that all the fringe vertical segments from the diagrid structures have been disposed of. In this manner, without the presence of the fringe sections, the diagrids can take a continuous number of horizontal burdens. We can likewise infer that diagrids give more protection from parallel relocations when contrasted with ordinary supported casing structures. By watching these outcomes, we can likewise say something that the diagrids are giving more part firmness than the ordinary propped structures. At long last, a diagrid structure give more stylish look and gives more inside space because of less segments and exterior of the structure can likewise be arranged all the more productively.

III. METHODOLOGY:

Table 1: Building Configuration

Building Configuration and its Shape	Details of Building and its configurations	Description of Story Height	Story heights	Type of loads
Octagonal Configuration	**30 m x 30 m** Exterior panel with Diagrid Material of Diagrid: a) Steel b) RCC	Foundation Depth: **1.5 m**	Typical storey height of diagrid structure is **3.5 m**	**Seismic Loads** [as per the standards of IS: 1893: 2002 / 05]

In the above study octagonal shape structures with and without diagrids of steel and concrete diagrids are compared with angle of diagrids as 35^0. Foundation depth is kept as 1.5 m below ground level.

Table 2: Specification of the Structure

Specifications	Data
Typical Storey Height	3.5 m
No. of Bays along X-Direction	6
No. of Bays along Y-Direction	12
Bay Length along X-Direction	5 m
Bay Length along Y-Direction	3.5 m
Concrete Grade	M 25
Density of R.C.C.	25 KN/m^3
Density of Masonry	20 KN/m^3
Columns	400 mm x 400 mm
Beams	350 mm x 350 mm
Slab Thickness	150 mm
Steel Diagrids	ISA 100 x 100 x 10
Concrete Diagrids	300 mm

In the above study specifications of the structure are shown as follows:
Number of bays along X and Y direction as 6 and 12, Concrete grade is kept as M 25 and density of R.C.C. and Masonry is taken as 25 kN/m^3 and 20kN/m^3, Dimensions of beam and columns are taken as 350 x350 mm and 400 x 400 mm respectively. Slab thickness is kept as 150 mm and for steel diagrid angle section is taken as ISA 100 x 100 x 10 mm and for concrete diagrid 300 mm RCC section is used.

CASES CONSIDERED IN THE STUDY:

1. Conventional Structures - Seismic loading (considering seismic zone II, III, IV & V):

   a) 12 Story Octagonal Structure (40m x 30m) in seismic zone II- **12OSZ2**
   b) 12 Story Octagonal Structure (40m x 30m) in seismic zone III- **12OSZ3**
   c) 12 Story Octagonal Structure (40m x 30m) in seismic zone IV- **12OSZ4**
   d) 12 Story Octagonal Structure (40m x 30m) in seismic zone V- **12OSZ5**

2. Diagrid Structures - Seismic loading (considering seismic zone II, III, IV & V):

   a) 12 Story Octagonal Steel Diagrid Structure (40m x 30m) in seismic zone II- **12ODZ2**
   b) 12 Story Octagonal Steel Diagrid Structure (40m x 30m) in seismic zone III- **12ODZ3**
   c) 12 Story Octagonal Steel Diagrid Structure (40m x 30m) in seismic zone IV- **12ODZ4**
   d) 12 Story Octagonal Steel Diagrid Structure (40m x 30m) in seismic zone V- **12ODZ5**
   e) 12 Story Octagonal Concrete Diagrid Structure (40m x 30m) in seismic zone II- **12ODZ2**
   f) 12 Story Octagonal Concrete Diagrid Structure (40m x 30m) in seismic zone III- **12ODZ3**
   g) 12 Story Octagonal Concrete Diagrid Structure (40m x 30m) in seismic zone IV- **12ODZ4**
   h) 12 Story Octagonal Concrete Diagrid Structure (40m x 30m) in seismic zone V- **12ODZ5**

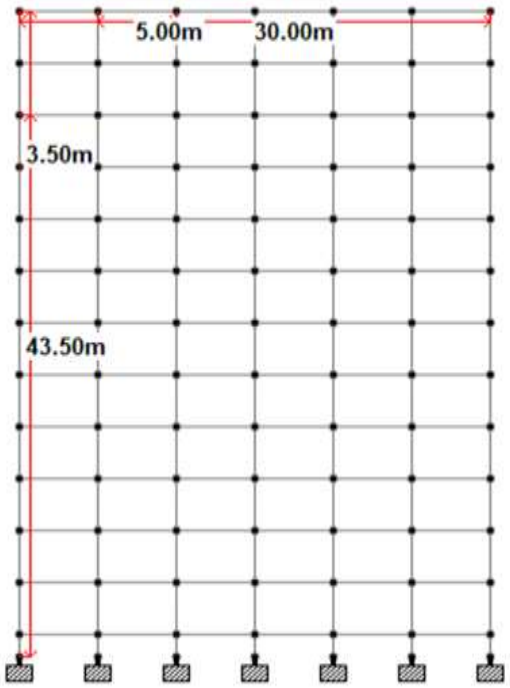

Fig.1: Dimensions of the structure

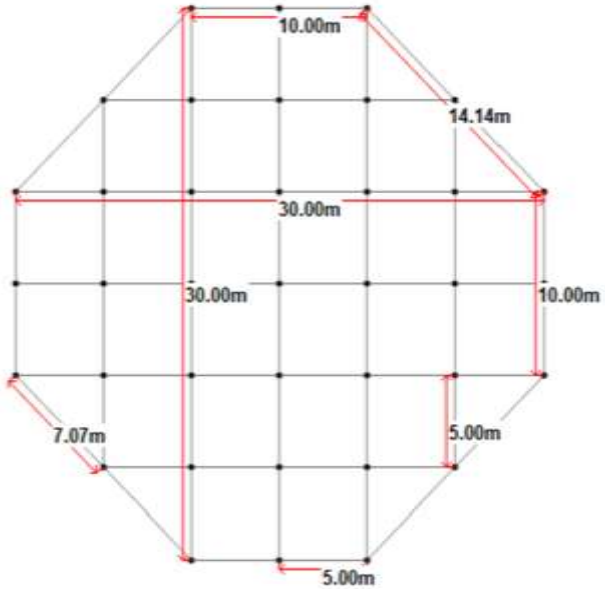

Fig.2: Plan of the structure

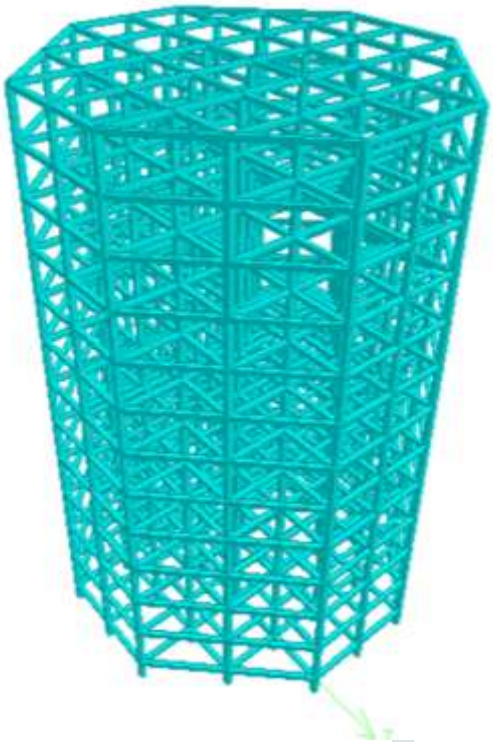

Fig.3: Rendered view of the structure

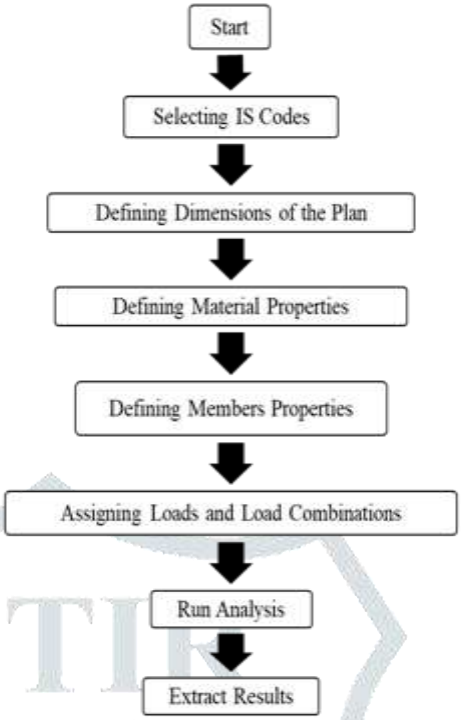

Fig.4: Layout of the study

IV. RESULT AND DISCUSSION:

- It can be concluded from the above results concrete diagrids resist displacement more than steel diagrids by 50 % as they are more effective comparatively.
- It can be concluded from the above results that concrete diagrids have more reaction value than steel diagrids comparatively of about 92%.
- It can be concluded from the above results that base shear value of concrete diagrids is 91 % than steel diagrids because the weight of concrete diagrids is effectively more than steel diagrids.
- Hence Diagrids have proven to be more effective in higher seismic zones of India than conventional structure and concrete diagrids results to be more impressive than steel diagrids.
- It can also be concluded that in less severe seismic zones like zone II steel diagrid can be adopted easily and in adverse severe zone like zone IV and zone V concrete diagrid can be adopted and in seismic zone III selection of material of diagrid will be dependent only on structural design off the structure.

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