Analysis on Conventional Chevron Braced Frame And Diagrid Frame With Plan Irregularity

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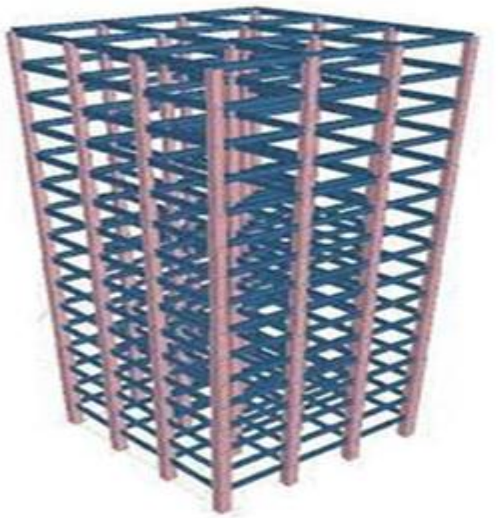
Abstract- *Mention the abstract for the article. An abstract is a brief summary of a research article, thesis, review, conference proceeding or any in-depth analysis of a particular subject or discipline, and is often used to help the reader quickly ascerta in the paper's purpose. When used, an abstract always appears at the beginning of a manuscript, acting as the point-of-entry for any given scientific paper or patent application.*

I. INTRODUCTION

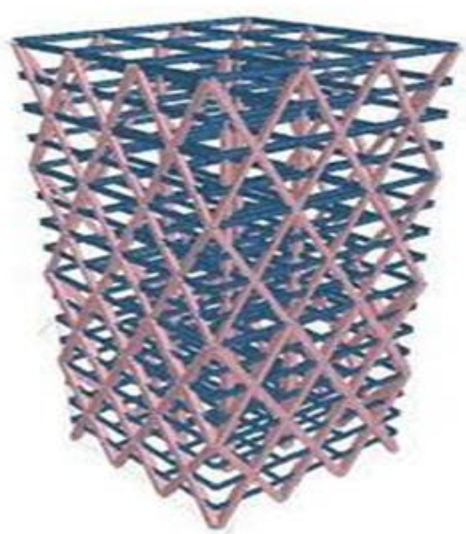
General In today's trend, the rate of growth of population is increased day by day. Due to these increasing population rate the space required for land is insufficient. So, civil engineer construct a building in sufficient space and in sufficient plan. Due to sufficient space, height of building is kept to be maximum for accommodation. In old days these tall buildings only use for commercial purpose but now it is for commercial as well as residential purpose. There are many cases of damage of building from past earthquake all over the world. Due to their structural simplicity, buildings are particularly vulnerable to damage and can collapse when subjected to earthquake motion. In simple or conventional building, when height of building increases the lateral load resisting system (includes earthquake load and wind loads) becomes more important than the structural system that resists gravitational load. The simple buildings as its height increases due to intensity earthquake it experiences or it starts deforming its shape in the form buckling. And it causes the collapse of building Therefore the response of structures to seismic activity has attracted the attention of engineers due to consequences that accompany the earthquakes. The introduction and improvement of computer technology gave lots of scope for researches and practicing engineers to study the use of earthquake resisting frame technology to reduce the damage caused to these structures. Fig 1.1 shows the pictures of the collapse of the building due to earthquake in past.

Fig 1.1: Collapse of building due to earthquake

General Approach To Control Seismic Damage To Building Using Lateral Load Resisting System Buildings are subjected to two types of loads i.e. lateral load due to wind and earthquake and vertical load due to gravity. The structural system of the building cater for both the types of loads. The structural system of building may also be consisting of two components systems such as Horizontal framing system consisting of slab and beams which is primarily responsible for transfer of vertical load to the vertical framing system and Vertical frame system of structure consisting of beams and columns, which is primarily responsible for transfer of lateral load to beam to column, column to foundation. However, the two components work in conjunction with each other. So, for increasing the stability of interior and exterior structural system the civil engineer construct a building with lateral load resisting frame system. 1.3 Diagrid Frame System The wordy meaning of diagrid is dia means many and grids regard those intersecting triangular members or beams. Diagrid frame system is a particular form of space truss. Diagrid system consists of perimeter grid made up of a series of triangulated truss system. Diagrid frame of the building is formed by intersecting the diagonal and horizontal components it has good appearance and it is easily recognized. The configuration and efficiency of a diagrid structural system reduce the number of structural element required on the façade of the building frames, therefore less obstruction to the outside view. The structural efficiency of diagrid frame system also helps in removing interior and corner columns, therefore allowing significant flexibility with the floor plan. The diagonal members in diagrid frame structural systems can carry gravity loads and lateral forces due to their triangulated configuration. Diagrid structural frame system are more effective in minimizing shear deformation because they carry lateral shear by axial action of diagonal members. Diagrid structures generally do not need require high rigidity because lateral shear force can be carried by the diagonal members located on the periphery. Fig 1.2: Various examples of diagrid building structure.



(a)Conventional model



(b) Diagrid model

Fig :Comparison between diagrid frame and conventional frame

1. Advantages derived from Diagrid Structural System Taller and safe Structure:

Diagrid structure provide a safety against collapse. Diagrid frame provides higher strength to the building. Hence building with large height easily constructed.

Go for Super-tall Structures:

On more reason for opting super-multistorey structures is the maximum pressure on the available land. In urban areas of developed countries, there is no land available for single storey house. Previously the structural engineers were using systems like that of shear wall, braced frame, dome section etc. to achieve more of a column free span between the building. But the diagrid construction is more outstanding than other structures.

No periphery Columns:

The diagrid frame system has recently been evolved in parallel to the typical moment frame or brace frame structure. In this type of frame structural system, the periphery columns of building are replaced with a triangulated diagonal beams.

2. Limitations of Diagrid structure:

Despite of many advantages of diagrid frame structural system, still there is more need to explore new tricks and configurations in the structure. The limits of diagrid structure given as follows.

1. The complex design of the diagrid frame system can present challenges in the computation, analyses and construction process.
2. Because of the design variables like the diagonal angle and the bending to shear flexibility ratio, it is not predicated the response in advance, which approach will govern, either global stiffness demand or member strength demand.
3. There is a limitation of height of structure. For diagrid constructed of steel 100 storey is maximum height and 60 stories for diagrid constructed of concrete.
4. Concrete diagrid system is very complex in design. Thus, diagrid structure requires a large amount of form work, which eventually leads to higher construction cost.
5. Similarly, steel members of structure are pre-fabricated due to their complexity. This also increases the construction cost of structure.

1.4 Chevron Braced Frame System

The chevron braced system supports two braces framing into a beam from opposite directions. Chevron brace resisting frame are common configuration for providing lateral load resistance in steel framed building or concrete building. Chevron bracing is of inverted V-type of Shape. frames involves two members meet at the middle point on the upper horizontal beam of building. Chevron structural members are designed for both tension and compression load member. chevron bracing allows the maximum space for doorways or corridors through the bracing opening.

Fig 1.4: Chevron Braced frame model

Advantages of Chevron Braced Frame Structure:

1. Due to bracing, lateral story displacement, story drift, axial force and bending moment in columns reduces to a notable level.
2. The braced frames resist the wind and seismic forces more than the non-braced buildings.
3. It is cost-effective, easy to erect and flexible to design to get required strength and stiffness.

Disadvantages of Chevron Braced Frame Structure:

1. Altitude-dependent changes in seismic region.
2. The length of the span is usually restricted to 40 feet when reinforced.
3. Construction of these frames requires skilled labor.

1.5 Thesis Aims and Objective :

The objectives of this thesis can be summarized as follows:

1. To study the C-Type and T-Type irregular structure.
2. To study the chevron braced frame and diagrid frame action in high rise building for C- Type and T-Type irregular structure.
3. To compare the performance of the building with diagrid structural system, chevron braced frame and conventional frame system under seismic loading for C-T Type and T-Type plan separately using STAAD Software.
4. To obtain the response in terms of parameter such as storey displacement, storey drift shear.
5. To determine the best and the appropriate structural system for the different type of high- rise buildings.

1.6 Scope of Work

1. Consideration of C-type and L-type of plan.
2. Consideration of chevron braced frame and diagrid frame.
3. Evaluation of the response of different models of building using STAAD Software.
4. Comparison of the response obtained by different parameter for C-Type and L-type of plan separately.

LOADS

The following two types of loadings have been considered for the analysis and design of structures.

1. Gravitational loads 2. Lateral loads

1. Gravitational Loads

Loads acting in the direction of gravity due to gravitational force are called as gravitational loads. Mainly two gravitational loads act on building (a) Dead Load (b) Live Load

(a) Dead Load

Load due to weight of material of structure and components of building is called as dead load. The unit weight of reinforced cement concrete is considered to be 25 kNW. Load due to floor slab is taken as 3.61 kN/m2 all over the plan of model.

b) Live Load All live weight other than weight of building frame components is considered as live load. It is taken as 2.50 kN/m2 on all floor.

2. Lateral Load

Loads which act perpendicularly to gravity or dead load are called as lateral loads. Earthquake load, snow load and wind load are example of lateral load. These three or two loads did not considered together on buildings. Hence designed load for building which is greater of earthquake and wind load has been applied.

(a)EARTHQUAKE LOAD

Earthquake load on tall building is higher compared to wind load in earthquake prone region. Hence earthquake load has been considered for analysis. The dynamic along earthquake loading is computed as per IS: 1893 (part-1) 2002 method**.**

In below image the data for earthquake analysis given for delhi region. The region delhi comes into zone iv. According to zone iv the data for soil factor, zone factor, response factor.

II. METHODOLOGY

Method and analysis which is performed in your research work should be written in this section. A simple strategy to follow is to use keywords from your title in first few sentences.

Subheading

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Subheading

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III. MODELING AND ANALYSIS

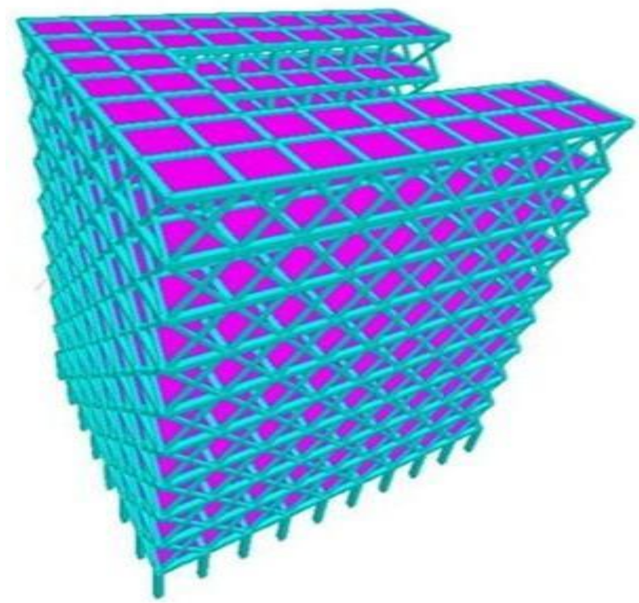


Fig 3.1: 3D Rendering view of C Base plan structures in STAAD Software

For C-TYPE the rendering view of models isshown above. The 3d view of diagrid model, chevron braced model and conventional model shown in below. These 3d view of model obtained from STAAD Software**.**

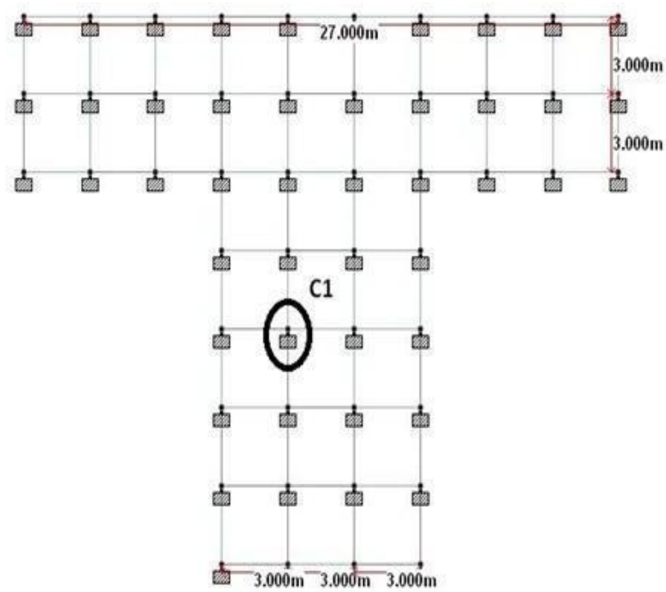


Fig 3.2: T Base plan structures in STAAD Software

IV. RESULTS AND DISCUSSION

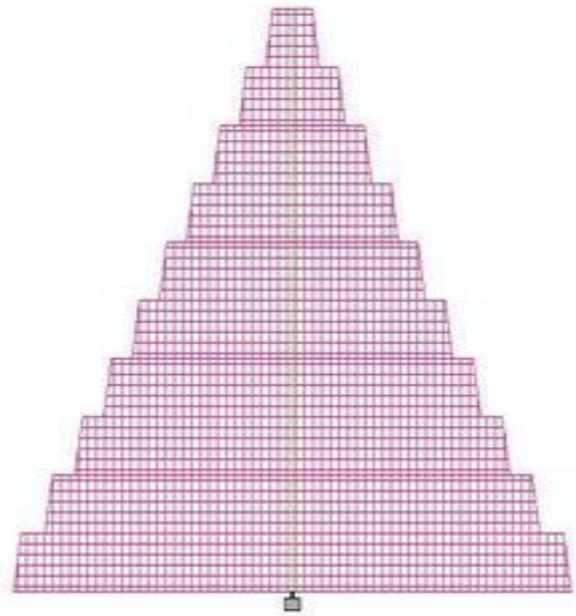
4.1 Overview

All the selected C-type and T-Type building models with different configuration are analysed using STAAD-Pro software. This chapter presents the result analysis and relevant discussions for models. According to the objectives of the present study, the results presented here are focused on Displacement, storey drift, Axial force, Force and Moment of different types of building model. The details of the diagrid system, chevron braced and conventional bare frame are discussed and Modal analysis procedure is explained in Chapter 4. Codal provisions are explained in Chapter 4. Analysis of G+9 storeyed diagrid frame models, chevron braced models and conventional model are done separately for C-Type and T-type using STAAD-Pro software, from the analysis results obtained, diagrid system, chevron braced system and conventional frame system models are compared. In this thesis two types of comparison is observed. The First Comparison is between diagrid system, chevron braced system and conventional frame system for C-Type and second comparison is between diagrid system, chevron braced system and conventional frame system for T-Type. The comparison of these results to find effective lateral load resisting system for C-Plan and T Plan. Also comparison is done here in between C-Type and T-Type irregular structure. For earthquake resistant design of structures IS 1893 (PART-1): 2002 code is used for calculating seismic design force. 1.5(DL+EQ) load combination case taken for analysis.

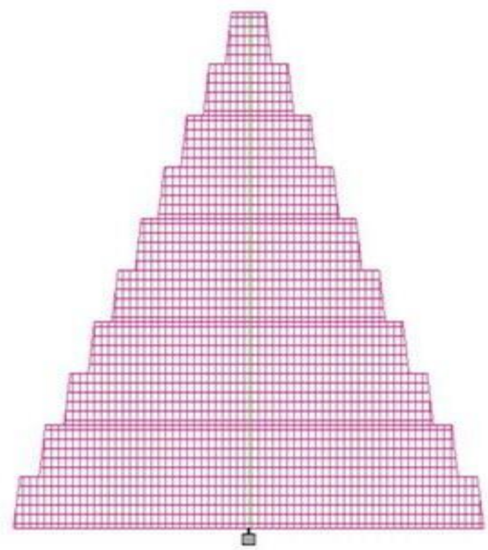
Axial Force In Interior Column:

The comparison of axial force in interior columns between diagrid building, chevron braced building and conventional building for C-type plan and T-type plan are shown in table 5.1and 5.2. The use of diagrid and chevron braced has increased the column axial force in all the column for the considered load cases at location of column. The maximum axial force is found to be 807.86 KN at the bottom column and the minimum is found in top most column to be 79.09 KN in case of conventional building, in case of diagrid building the maximum axial force is found to be 787.90 KN in the bottom column and the minimum is found in top most column to be 76.522 kN whereas , in case of chevron braced building the maximum axial force is found to be 1107.641 KN in the bottom column and the minimum is found in top most column to be 122.296 KN for C-Plan.

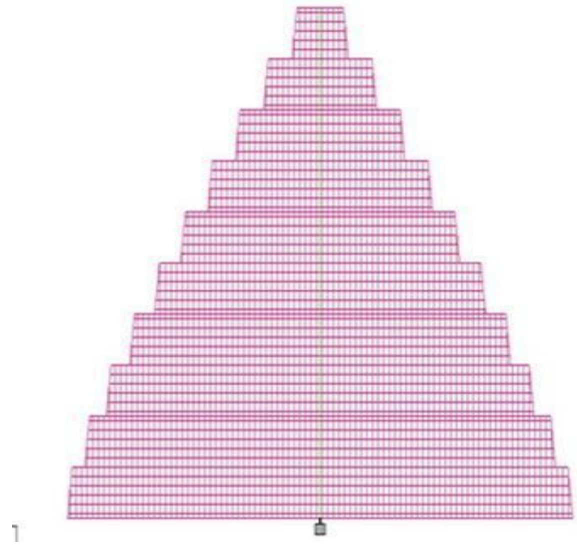
The maximum axial force is found to be 829.58 kN at the bottom column and the minimum is found in top most**,** column to be 80.198 kN in case of conventional building, in case of diagrid building the maximum axial force is found to be 1020.139 kN in the bottom column and the minimum is found in top most column to be 76.522 KN whereas , in case of chevron braced building the maximum axial force is found to be 841.598 kN in the bottom column and the minimum isfound in top most column to be 82.831 kN for T-Plan**.**



Diagrid frame



Chevron braced frame

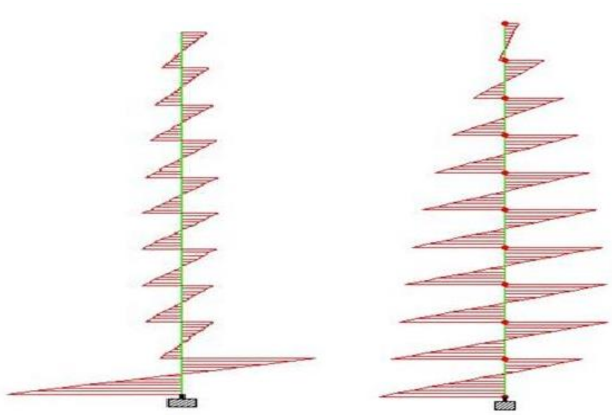


Conventional frame

Fig 4.1: Axial force in interior column for C-Plan

Bending Moment in internal column:

The comparison of bending moment in interior columns between diagrid building, chevron braced building and conventional building for C-type plan and T-type plan are shown in table 4.1 and 4.2 Diagrids has effectively reduces the bending moment in interlocation of column. The maximum bending moment is found to be 48.52 kN at the bottom column and the minimum is found in top most column to be 1.254 kN in case of conventional building, in case of diagrid building the maximum bending moment is found to be 32.507 kN in the bottom column and the minimum is found in top most column to be 5.043 kN whereas , in case of chevron braced building the maximum bending moment is found to be 38.586 kN in the bottom column and the minimum is found in top most column to be 0.428 kN for C-Plan.



Diagrid frame(b) Chevron braced **Fig 4.2:** Bending moment in interior column for C-Plan

Table 4.1: Maximum Values in different types of frame for C-Plan type and T-Plan type

	Shear Force		Bending Moment	
Frame	C-TYPE PLAN	T-TYPE PLAN	C-TYPE PLAN	T-TYPE PLAN
Diagrid Frame	12.704	15.902	3.5	17.65
Chevron braced frame	7.72	16.802	3.958	18.67
Conventional Frame	7.795	27	4.1	37.589

The results presented in Tables 5.1-5.13 are also shown graphically in Figs 5.1-5.25 for better understanding. The Axial force, Absolute displacement, shear force, Bending moment for different types of building model are plotted against number of stories. Fig. 5.1-5.22 presents the comparison of different types of diagrid system, chevron braced frames and conventional frame separately for C-Plan and T-plan and then comparison between C-Plan and T-plan take place from STAAD–Pro Software. This figure shows that the diagrid model effective than chevron braced model and conventional model for both C-Plan and T-Plan.

V. CONCLUSION

In this study the seismic analysis performed on building by using STAAD Software. Initially, the comparison between diagrid model, chevron braced and conventional model for C-Type and T- Type done separately by using various parameter like shear force, bending moment, axial force, displacement and storey drift. The following observations are drawn from the results obtained through analyses.

1. In c-plan structure, For base shear, diagrid frame system is 7.20% effective than chevron braced frame system and 8.38% effective than conventional frame structure.
2. In c-plan structure, Storey drift and displacements structure on each storey in diagrid are observed to be less indiagrid framestructure as compared to chevron braced system and simple conventional frame system. The value of storey drift is observed to be in limit 0.004xh) where h is storey height.
3. For top storey shear, diagrid frame structure is 15.56% better than chevron braced frame structure and 34.12% better than conventional frame structure for C-Plan.
4. In T-Plan, Considering base shear, diagrid frame is 6.4% effective than a chevron braced frame structure and 9.1% effective than a conventional frame system.

5. In T-Plan, Consideringstorey drift and displacement, diagrid structure shows less value than chevron braced structure and conventional frame structure. The value of storey drift is observed to be in limit 0.004xh) where h is storey height.

6. For top shear value, diagrid structure is 16.42% better than chevron braced structure and 21.80% better than a conventional frame structure in T-Plan**.**

7. A significant decrease of bending moment, shear force and axial force in interior column of diagrid building is found in comparison to conventional building and chevron braced building.

8. Diagrid structure shows less value than other two frames in C-Plan for internal beam. In terms of T-Plan, chevron braced structure shows less value other than two plan.

9. Interior beam of structures for all model shows higher value in terms of shear force, displacement, bending moment than the corner beam.

10. Diagrid structure shows less maximum bending moment value than other two structures for both plan. After that, overall performance between C-plan and T-plan studied here.

These two plan are compared by various parameter like base shear, displacement, storey drift**.**

1. Considering base shear T-Type building frame is best suited.
2. Considering top storey shear C-Type building frame is better choice.
3. Considering top storey displacement, C-Type building frame is more efficient.
4. Considering maximum bending moment and maximum shear force, C-Plan is more efficient.

5. Overall performance of C-Plan is better than T-Plan.

VI. FUTURE SCOPE

1. From earlier research work till now, Various researches have carried out work on diagrid structure with symmetrical plan under different type of loading condition but there are very few scientific research dealing with performance of diagrid system in high rise building especially with vertically unsymmetrical.
2. There are mostly seismic analysis done on diagrid structure and diagrid structure found effective under seismic loading. But there are only studies done for diagrid structure under wind loading.
3. The analysis of model had done in only on grid model or multistorey building. No researches have done by taking actual plan of the building in this country.

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