International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 07 | July 2018 www.irjet.net p-ISSN: 2395-0072

Parametric Study on the Behavior of Diagrid Structures Subjected to Dynamic Loading

Mr. Nithin M[1], Mrs. Parna S Galer[2]

[1]*M-tech Structural Engineering Student, BIET College Davangere, Karnataka, India*
[2]*Assistant Professor, BIET College Davangere, Karnataka, India*

Abstract - *The high cost of land and the rapid growths of urban population and to avoid a continuous urban sprawl, and the need to preserve important agricultural production have all contributed to drive residential buildings upward. Diagrid is a particular form of space truss. It consists of perimeter grid made up of a series of triangulated truss system. Study has been carried out for Steel tubular structure provided with diagrid with 60^0 angles. Modeling and analysis is carried out in ETABS using dynamic time history analysis is carried by Bhuj data. Comparison is carried on tubular steel building and tubular diagrid building with respect to base shear, displacement, drift are found. It was concluded that tubular diagrid structures are economical when storey height is more. The study gives a clear view that diagrid structures are much effective in reducing the response of the structure.*

Key Words: **Diagrid1, Steel tubular structure2, Diagrid with 60^0 angle3, Time history analysis4, Bhuj data5**

1. INTRODUCTION

As the height of building increase, the lateral load resisting system becomes more important than the structural system that resists the gravitational loads. The lateral load resisting systems that are widely used are: rigid frame, shear wall, wall-frame, braced tube system, outrigger system and tubular system. Recently, the diagrid – Diagonal Grid – structural system is widely used for tall steel buildings due to its structural efficiency and aesthetic potential provided by the unique geometric configuration of the system.

Diagrid is a particular form of space truss. It consists of perimeter grid made up of a series of triangulated truss system. Diagrid is formed by intersecting the diagonal and horizontal components. Diagrid has good appearance and it is easily recognized. The configuration and efficiency of a diagrid system reduce the number of structural element required on the facade of the buildings, therefore less obstruction to the outside view.

The diagonal members in diagrid structural systems can carry gravity loads as well as lateral forces due to their triangulated configuration. Diagrid structures are more effective in minimizing shear deformation because they carry lateral shear by axial action of diagonal members.

2. Objectives

- Understand the behavior of tubular steel structures with angled diagrid in comparison with tubular steel structure.
- Study has been carried out for Steel tubular structure provided with diagrid with 60^0 angles.
- Modelling and analysis is carried out in ETABS dynamic time history analysis with high seismic zone.
- Efficiency of tubular steel buildings with respect to base shear, displacement, drift are found out for the respective geometric configurations.
- The behavior of the building on implementation of diagrids to tubular buildings is summarized based on the results so obtained.

3. Methodology

- Carry out literature review, and to establish the purpose of the study.
- Etabs is used to model and analyses of high rise steel buildings.
- Desirable steel sections are used for modelling.
- Two models with steel moment resisting frames will be considered and analysis is done for tubular steel structures with diagrids and structures without diagrids.
- Time history method is used for analyzing and the response Quantities like displacements, base shear, drift and time period are noted.

3.1 Modelling

Table-1: Model Description

Number of Storeys	G+25
Building Type	Tubular Steel Structure
Building Dimension	40mX40m
Typical Storey Height	3 m
Seismic Zone	Zone V
Soil Type	Type 2
Response Reduction Factor	5
Importance Factor	1

Table-2: Loads Applied

Slab Live Load	4 kN/m^2
Floor Finish	1.5 kN/m^2
Glazing Load	1 kN/m^2

Table-3: Earthquake Data

Seismic Zone	V
Z	0.36
Soil Type	II
Importance Factor	1
Response Reduction Factor	5
Code	IS 1893-2002

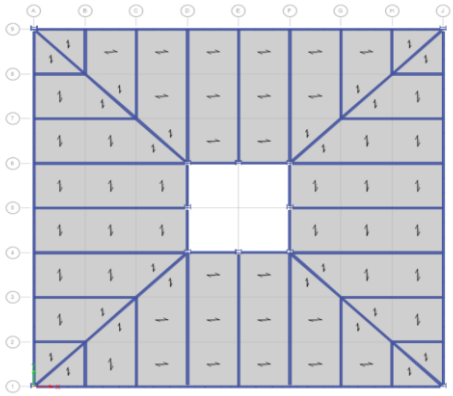

Fig-1: Plan View of Tubular Steel Structure

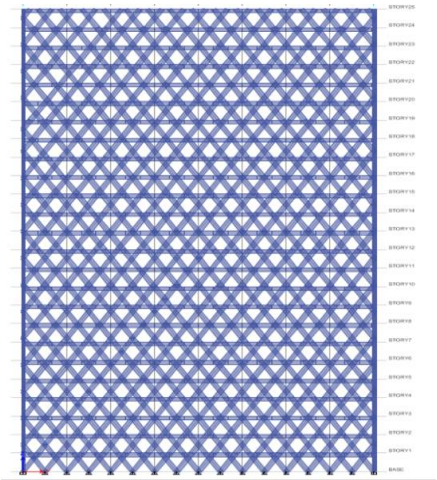

Fig-2: Elevation of Tubular Diagrid Structure with 60° Angle

4. Analysis Results

The nonlinear time history analysis is performed on following models and the obtained results are as follows:

- Model 1- Tubular steel Structure
- Model 2- Diagrid Structure with 60 degree

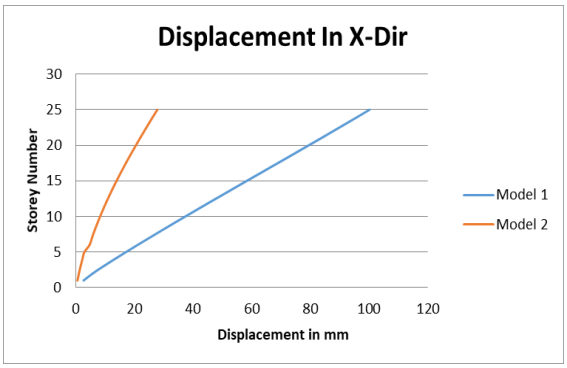

Chart-1: Displacement in X-Direction

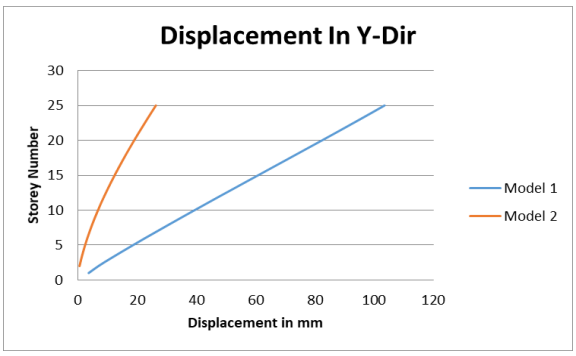

Chart-2: Displacement in Y-Direction

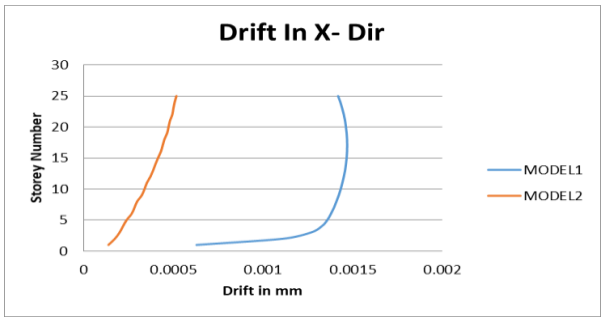

Chart-3: Drift in X-Direction

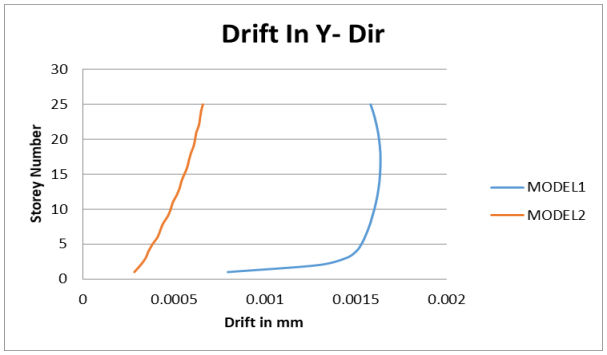

Chart-4: Drift in Y-Direction

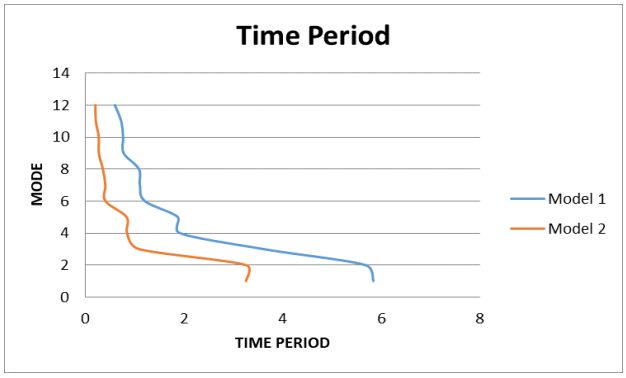

Chart-5: Time Period

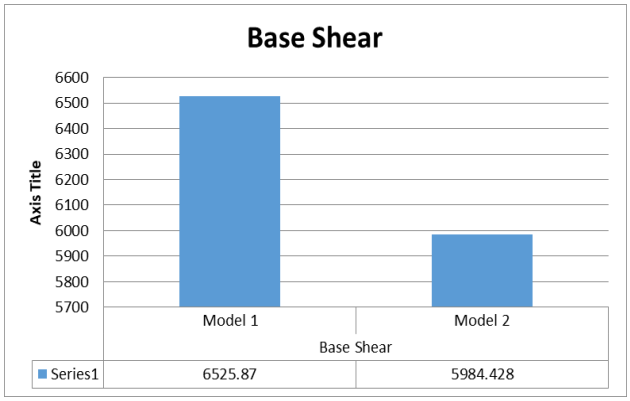

Chart-6: Base Shear

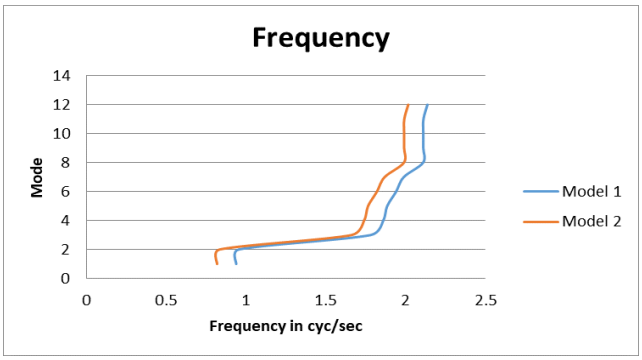

Chart-7: Frequency

5. CONCLUSIONS

Dynamic analysis of tubular structures with Diagrid is studied to evaluate their performance and to know the behavior of the structure with diagrid system. For the results obtained graphs are plotted above, it is concluded that;

1. The diagrids provide proper stiffness to structure that in turn result in decreasing the storey displacement.
2. As time period decreases, lesser will be mass of structure and more is the stiffness in members.
3. In terms of utilization of steel and concrete, the diagrid structure with an angle of 60^0 is more economical.
4. Also, tubular diagrid structures are economical when storey height is more.
5. The comparative study on tubular steel structure and tubular diagrid steel structure give a clear view that diagrid structures are much effective in reducing the response of the structure and is compatible.

REFERENCES

1. Nishith B. Panchal, Dr. V. R. Patel, Dr. I. I. Pandya, "Optimum Angle of Diagrid Structural System", International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869, Volume-2, Issue-6, June 2014.
2. Deepa Varkey, Manju George, "Dynamic Analysis Of Diagrid System With Complex Shape", IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 8, August 2016.
3. Sree Harsha J, K Raghu, G Narayana, "Analysis of Tall Building for Desired Angle of Diagrids",

International Journal of Research in Engineering and Technology.

4. Saket Yadav, Dr. Vivek Garg, "Advantage of Steel Diagrid Building Over Conventional Building", International Journal of Civil and Structural Engineering Research Vol. 3, Issue 1, pp: (394-406), Month: April 2015 - September 2015.

5. Giovanni Maria Montuori, Elena Mele, Giuseppe Brandonisio, Antonello De Luca, "Geometrical patterns for diagrid buildings: Exploring alternative design strategies from the structural point of view"- Published By Elsevier.

6. Deepika R, Shivanand C.G, Dr. Amarnath K," Performance Study of High Rise Buildings with Diagrid and Hexagrid Systems under Dynamic Loading", Volume 6 Issue No. 4.

7. Khushbu Jani, Paresh V. Patel, "Analysis and Design of Diagrid Structural System for High Rise Steel Buildings"- Published By Elsevier.

8. Jatin B Tank, Ashwin G Hansora," Analysis of Varying Angle Diagrid Structural System for High-Rise Steel Building".

9. Kyoung Sun Moon, "Sustainable Design of Diagrid Structural Systems for Tall Buildings", International Journal of Sustainable Building Technology and Urban Development / March 2011.

10. Khalid K Shadhan,"Optimal Diagrid Angle to Minimize Drift in High-Rise Steel Buildings Subjected to Wind Loads".

AUTHORS:

Mr. Nithin M.
PG Student,
Department of Civil Engineering,
BIET College, Davangere.

Mrs. Parna S Galer
Assistant Professor,
Department of Civil Engineering,
BIET College, Davangere.