International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 3 ǁ March 2023 ǁ PP. 370-375

Seismic Analysis of Plan Irregular Diagrid Structure

Sumit Modi[1], Lavina Talawale[2]
[1]*PG Research Scholar*
[2]*HOD*
DEPARTMENT OF CIVIL ENGINEERING, SKSITS COLLEGE INDORE

Abstract -
The primary goal of this thesis is to investigate the dynamic behaviour of buildings, specifically diagrid and conventional frames, in seismic zone III. The parameters in both types of buildings are taken the same for comparison under the same seismic zone. The work will be completed by conducting (a) modelling of both building frames. (b) Building frame analysis with seismic parameters (c) Examine the results in terms of moments, stresses, and moments in the slab, forces, drift, deflection, and the economy. The results of the response spectrum analysis provide a more realistic behaviour of the structure response, and the diagrid structure is more effective in lateral load resistance. The following conclusions are drawn from a seismic and wind analysis of a conventional building with different shapes of diagrid building with equivalent plan area in seismic zone III. It was discovered in this study that the diagrid structure is more effective in lateral load resistance due to diagonal columns on the outer edge of the structures. Because of the diagrid shape's advantage, an interior column of smaller size is used for gravity load resistance, and the best small quantity of lateral load is considered for it.
Key Words: *Diagrid Structure, Response Spectrum Method, Peak Factor method, Storey Shear, Node Displacement. Stresses in Slab and beam.*

Date of Submission: 06-03-2023 Date of acceptance: 19-03-2023

I. INTRODUCTION

The diagrid structural system can be defined as a diagonal member shaped as a framework formed by the intersection of various materials used in the construction of buildings and roofs, such as metals, concrete, or wood beams. Steel member diagrid structures are effective in providing a solution in terms of strength and stiffness. However, nowadays, diagrid is widely used in large span and high-rise buildings, particularly when they have complicated geometries and arced shapes. The diagrid structure is made up of inclined columns on the building's exterior. When compared to bending of vertical columns in a framed tube structure, lateral loads are resisted by axial action of the diagonal due to inclined columns. Diagrid structures typically, don't need core because of lateral shear may be carried by the diagonals on the outer boundary of a building.

II. Objective of Study

- 16-story diagrid building with a plan measuring 18 m by 18 m is analysed and designed. The modelling and analysis of structural members are performed using the Staad professional software system. All structural members are created in accordance with IS 456:2000 taking into account all load combinations. When analysing and designing the structure, seismic load and wind load in accordance with IS 1893-2002 and IS 875-part 3 were taken into account.
- Additionally, a 16-story building's diagrid load distribution is examined. Analyses and designs of diagrid buildings with circular and triangular plan shapes are also made, and they are compared to traditional buildings. For seismic zone III, analysis values are compared in terms of Moment, Shear Force, Axial Force, Displacement, and Drift, as well as the Economic Aspect. Investigating the dynamic behaviour of buildings, specifically diagrid and conventional frames, in seismic zone III is the primary goal of this thesis. The parameter is the same for both types of buildings in order to compare these structures that are located in the same seismic zone.

III. Methodology

Different Model of building considered is given below:

Model-1 Conventional Building
Model-2: Square Diagrid Building
Model-3: Circular Diagrid Building
Model-4: Triangular Diagrid Building
Design parameters used for Study-

Model: G+16
Seismic Zones: III
Floor height :3.6 m
The configuration of both the models: Square, Circular and triangular
Angle of diagrid-67.4°
Plan size 18X18
Size of columns: 500mmX500mm
Size of beams :300mmX500mm
Thickness of slab:120mm
Size of Diagonals: 300X500

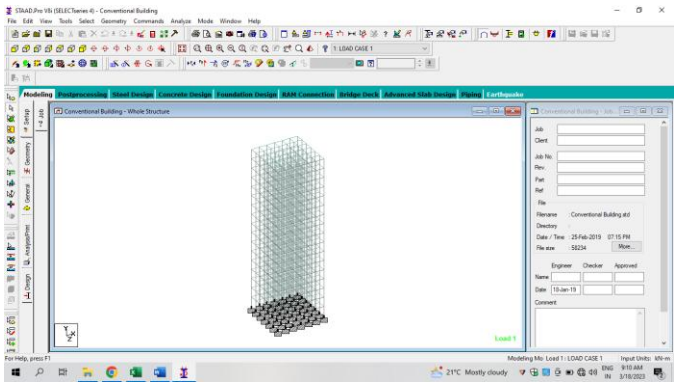


Fig -1: Conventional Building

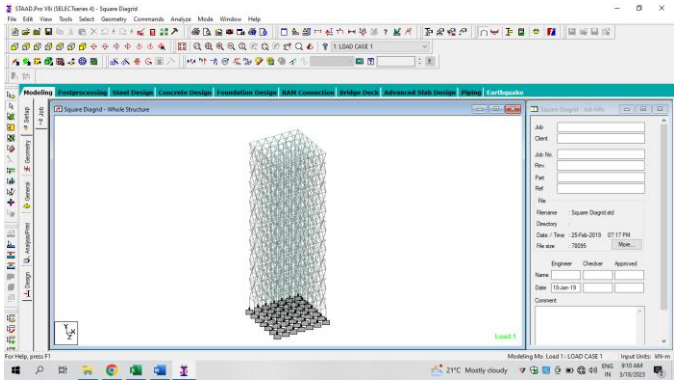


Fig -2: Square diagrid Building

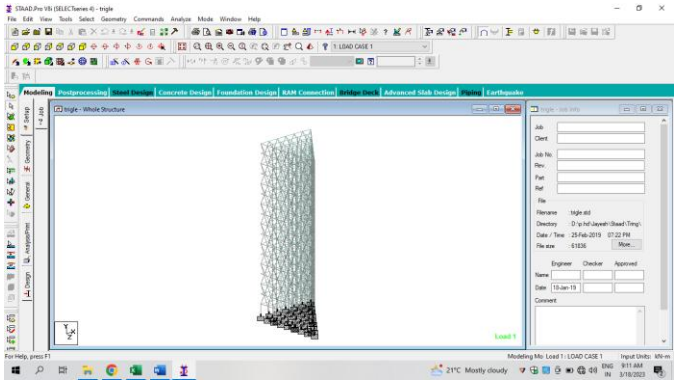
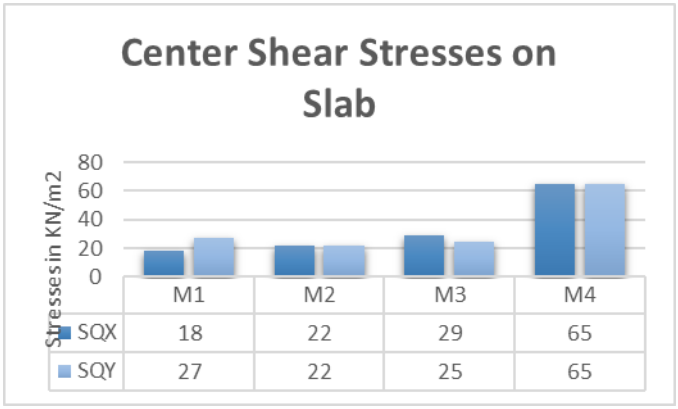
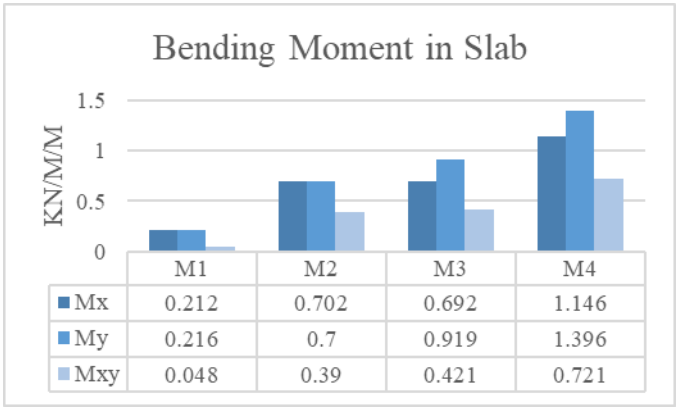


Fig -3: Triangular diagrid Building

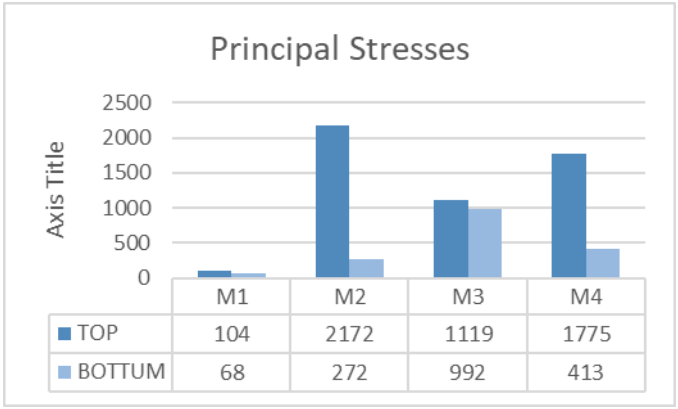
IV. Results



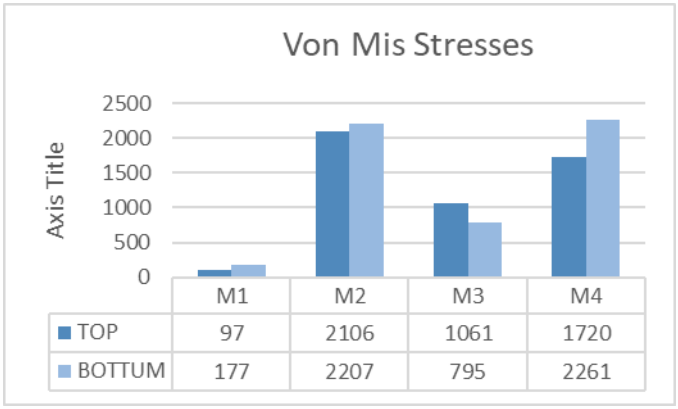
Graph 1Center Shear Stresses Vs Different types of building for Seismic Analysis



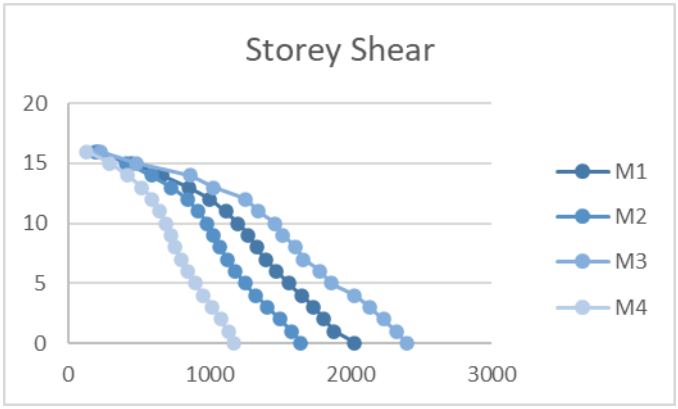
Graph 2 Bending Moment in Slab Vs Different type of building for Seismic Analysis



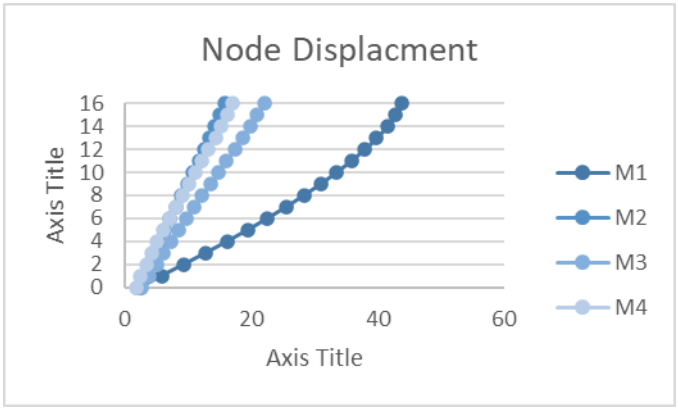
Graph 3 Principal Stresses Vs Different types of Building for Seismic Analysis



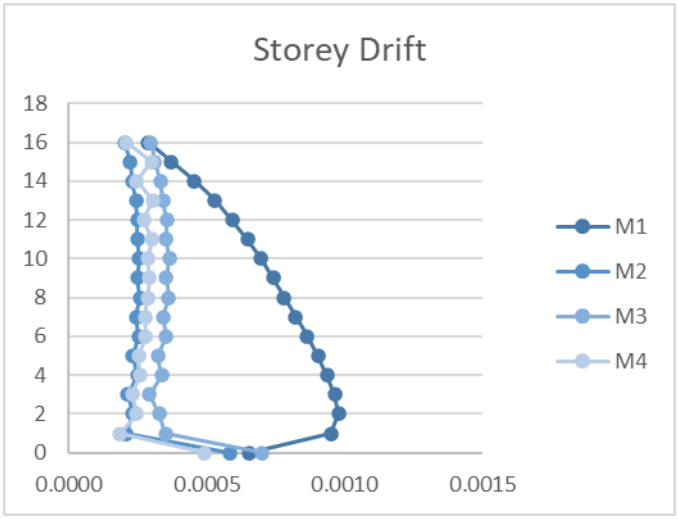
Graph 4 Von mis stresses Vs Different types of Building for Seismic Analysis



Graph 5 Storey vs peak storey shear



Graph 6 Storey vs Displacement for Seismic Analysis



Graph 2 Storey Drift for Seismic Analysis

V. Conclusion

1 Centre shear stresses in slab SQX and SQY are higher in diagrid buildings than in conventional buildings, but these stresses are higher in triangular diagrid buildings than in square and circular buildings.

2 The maximum bending moment in the middle of the slab, i.e. MX, MY, and MXY, grows more in rectangular and triangular shapes of diagrid construction than in standard construction but only slightly in round shape diagrid construction in plan.

3 Similarly, stresses at the top and bottom of the slab increase more in square and triangular shapes (in plan) of diagrid buildings than in conventional buildings, but only slightly in circular shape diagrid buildings.

4 When compared to traditional diagrid construction, total base shear increases in the circular form and decreases in the square and triangular forms for seismic analysis.

5 It concludes that node displacement decreases in all shapes of diagrid buildings when compared to conational buildings.

6 It was discovered in this study that the diagrid structure is more effective in lateral load resistance due to diagonal columns on the outer edge of the structures. Because of the diagrid shape's advantage, an interior column of smaller size is used for gravity load resistance, and the best small quantity of lateral load is considered for it. In the case of conventional body building, each gravity and lateral load is resisted by an exterior as well as an interior column.

REFERENCES

[1]. Irfan Saleem., Dr. Sunil Kumar Tengli (2018). "Parametric Study Parametric Study on Asymmetric Diagrid Structure." International Journal of Applied Engineering Researching 0973-4562 Volume 13, Number 7 (2018) pp. 61-66

[2]. Chetan S.Pattar, Prof. Smt. Varsha Gokak (2018)." Analysis Of Diagrid Structures With Plan Irregularity." International Research Journal of Engineering and Technology, Volume: 05 Issue: 08. e-ISSN: 2395-0056, (435-438)

[3]. Akshat., Gurpreet Singh, (2018). "Dynamic Analysis of Diagrid Structural System In High Rise Steel Buildings." International Journal of Civil Engineering and Technology, Volume 9, Issue 8, August 2018, pp. 71–79, Article ID: IJCIET_09_08_009.

[4]. Trupti A. Kinjawadekar. Amit C. Kinjawadekar., (2015). "Comparative Study Of Seismic Characteristics Of Diagrid Structural Systems In High Rise Construction International Journal of Civil Engineering and Technology, Volume 9, Issue 6, june 2018, pp. 315–323, Article ID: IJCIET_09_08_036.

[5]. Avnish Kumar Rai & Rashmi Sakalle (2017). "Comparative Analysis of A High Rise Building Frame With And Without Diagrid Effects Under Seismic Zones Iii & V." International Journal Of Engineering Sciences & Research Technology, DOI: 10.5281/zenodo.886723

[6]. Ravi Sorathiya ,Asst. Prof. Pradeep Pandey (2017). "Study on Diagrid Structure Of Multistorey Building." International Journal of Advance Engineering and Research Development Volume 4, Issue 4, April -2017. Pp-512-524

[7]. Deep Bajoria, Gaurav Banwat, Avishekh Jaiswal, Saurabh Agarwal.,(2017). "Dia-Grid Structures." International Research Journal of Engineering and Technology. Volume: 04 Issue: 09 | Sep -2017,pp-1341-1345.

[8]. N. Snehal S. Mali., Roshni John., D. M. Joshi (2017) "Response of High Rise Building with Different Diagrid Structural System" International Journal of Science Technology & Engineering,4(5), 1030-1040.

[9]. Shubhangi V. Pawar1, M. S. Kakamare (2017) "Earthquake and Wind Analysis of Diagrid Structure International Journal for Research in Applied Science & Engineering Technology. Volume 5 Issue VII, July 2017, pp-1729-1739.

[10]. Ravish Khan, Sangeeta Shinde (2016) "Analysis of Diagrids Using Symmetric and Asymmetric Plan Geometry" International Journal of Recent Advances in Engineering & Technology (IJRAET). 4(3), 2347 - 2812.

[11]. Kiran Kamath, Sachin H, ,Jose Camilo Karl Barbosa Noronha (2016) "An Analytical Study on Performance of a Diagrid Structure Using Nonlinear static Pushover Analysis" Perspectives in Science (2016), http://dx.doi.org/10.1016/j.pisc.2016.04.004

[12]. Manthan I. Shah, Snehal V. Mevada, Vishal B. Patel (2016) "Comparative Study of Diagrid Structures with Conventional Frame Structures" Int. Journal of Engineering Research and Applications. Vol. 6, Issue 5, (Part - 2) May 2016, pp. 22-29

[13]. Arpitha L M, Sahana T S, Siddu Karthik C S (2016) "Comparative Study of Diagrid Structures over Braced tube Structures International Journal of Innovative Research in Science, Engineering and Technology, 5(7) 13652-13660.
[14]. R. Bharath Reddy, S. Sai Gopi Nihal, A. S. Taneja and J. S. Kalyana Rama (2015)" Comparative Study on the Lateral Load Resistance of Multi-Storied Structure with Bracing Systems" Indian Journal of Science and Technology, 8(36) 2-9.
[15]. Prashant T G, Shrithi S Badami, Avinash Gornale (2015)"comparison of symmetric and asymmetric steel diagrid structures by non-linear static analysis" International Journal of Research in Engineering and Technology 4(5) 486-492.
[16]. Deepa Varkey and Manju George (2015). "Dynamic Analysis Of Diagrid System With Complex Shape" International Journal of Innovative Science, Engineering & Technology, 3(8) 484-487.
[17]. Andre R. Barbosa, and Garlan Ramadhan.(2014) "Seismic Performance of a Tall Diagrid Steel Building with Tuned Mass Dampers" International Journal of Innovations in Materials Science and Engineering. 1(2) 244-252.
[18]. Rohit Kumar Singh, Dr. Vivek Garg, Dr. Abhay Sharma (2014) "Analysis and design of concrete diagrid building and its comparison with conventional frame building." international journal of science, engineering and technology, 2(6) 1331-1337.
[19]. Ravi K Revankar, R.G.Talasadar (2014) "Pushover Analysis of Diagrid Structure" International Journal of Engineering and Innovative Technology." 4(3), 168-173.
[20]. Khushbu Jani , Paresh V. Patel (2013)." Analysis and Design of Diagrid Structural System for High Rise Steel Buildings" Elsevier, Procedia Engineering 51 (2013) 92 – 100, doi: 10.1016/j.proeng.2013.01.015