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Comparative Investigation of Conventional Frame and Diagrid Frame with Plan Irregularity

Manish S. Ramteke, Kirti R. Padmawar

P.G. Student, Department of Civil Engineering, Ballarpur Institute of Technology, Ballarpur, Maharashtra, India

Assistant Professor, Department of Civil Engineering, Ballarpur Institute of Technology, Ballarpur, Maharashtra, India

ABSTRACT: In such a building risk of failure can be minimized by adopting lateral load resisting system. In this study, we compared two lateral load resisting frames i.e. diagrid frame and conventional frame system. The seismic analysis is done on these two frames. The structures are analysed by linear static method. The building is considered to be irregular in plan. For irregular plan, C-shape plan, L-shape plan considered. The results are obtained after analysis are compared by various parameters like storey displacement, base shear, bending moment, frequency and storey drift. The First Comparison is between diagrid system and conventional frame system for C-Type and L-Plan separately and after that second overall comparison is between C-Plan and L- plan with diagrid frame and conventional frame. The analysis is done on by using STAAD-PRO Software. The result of work showed that diagrid system resists lateral more efficiently than conventional frame system as it yields the least value for absolute displacement, storey drift, bending moment and base shear.

KEYWORDS: Diagrid frame system, conventional frame system, plan Irregularity.

I. INTRODUCTION

In the today's generation, the rate of Population is increased day by day. Due to this space required for land is insufficient. So, civil engineer constructs a building in sufficient space with maximum height with regular and irregular plan. In old days these high-rise buildings only use for a commercial purpose. But, Now-a-days, it is used for both commercial and residential purpose due to lack of space. So, for safety, strength and aesthetical point of view structural engineer and architect construct a high-rise building with some shear wall, wall frame, rigid frame, braced tube system. Recently, for increasing the stability of structure diagrid frame, braced frame with diagonal grid is usually used. Diagrid frame has better appearance in view and it is easily recognized. High rise buildings are more collapse due to earthquake pressure. In this Project we compared two lateral load resisting frames with their plan irregularity that is diagrid frame and conventional frame system. The seismic analysis is done on these two frames. The structures are analyzed by Response Spectrum method in STAAD-PRO software and building is considered to be irregular in plan. In this thesis analysis of a G+11 storey building with two frame and C and L in irregular plans.

The main difference between lateral load resisting diagrid structure model and conventional frame structure is that in diagrid structures almost all exterior conventional vertical columns are eliminated. Because of exterior frame consist of diagonal members which can carry gravity loads as well as lateral loads in diagrid structure because of their triangulated configuration, whereas conventional structure can carry only lateral loads. Diagrid structures are more effective in case of minimizing shear deformation than a conventional structure or other type of structure. One of the drawbacks of diagrid structure is that conventional structure has maximum ductility than it.

II. LITERATURE SURVEY

The concept of image inpainting was first introduced by Manthan I. Shah, snehal v. meveda, Vishal B. patel(2022) "Comparative Study of Conventional Frame and Diagonally Intersecting Metal with Geometric Irregularities" Here in this journal paper it is concluded that 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 and Diagrid structure shows less maximum bending moment value than other two structures for both plans. To analyses the stability of structure in seismic zone according to comparison between bending moment diagram, shear

force variation using Staad pro software. In this thesis, we compared Diagrid frame with chevron braced frame and conventional frame. For irregular plan, C-Plan and T-plan taken for analysis.

Navnit Kumar, m. c. Paliwal, (2017) “Comparative Analysis of Diagrid and Chevron Braced Frame Structure under Dynamic Loading”. This journal paper indicates the simple effective technical for design of diagrid tall steel buildings. The diagrid structural system is adopted these days for tall buildings because of its stiffness and flexibility in the architectural planning. This Dissertation paper represents the study of G+29 stores in which “Diagrid structure is compared with chevron braced frame structure under dynamic loading.” And it’s concluded that Diagrid structure provides more efficiency than chevron braced frame structure. This paper also discusses the concept of tall building strength and optimization diagrid structure system provides more economy in terms of consumption of steel and concrete as compared to chevron braced frame structure.

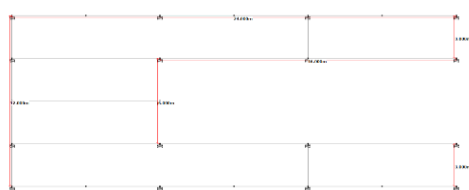
Ashish Gupta, Abhishek Thorat, Rushikesh Elag, Aditya Bhosale, Shubhra Dhamande, (2023) “Review on Analysis and Comparison between Diagrid and Conventional structures using E-tabs”. The aim of this journal paper indicates the result is a highly efficient and visually striking structural system that is often used in tall buildings, bridges, and other large structures. Increase in the load of constructional elements due to complicated shapes and needs obtained from the height of buildings calculated all using E-tabs software. The crisscross pattern of the diagonal members creates an interesting and visually striking facade.

III. METHODOLOGY

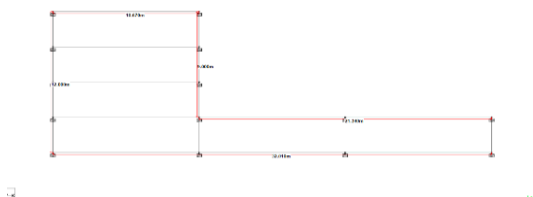
Comparative investigation of conventional frame and diagrid frame with plan irregularity is performed on STAAD-PRO software in accordance with IS 1893-2002 and IS 456-2000. This method used for analyzing the structures is response spectrum analysis method. It is the better and far most technology which has been and it is the better and far most technology which has been utilized from few years ago which supports the results helps in obtaining from the monotonically increasing lateral forces which is varied along with the building height.

Analysis of diagrid structure system and chevron braced system in this study Four models are considered with C-Type plan and L-type plan layout. For C-Type layout, Model is dividing into two part and for L-type, model is also divide into 2 part, in their there are total 4 models named as C-1, C-2, L-1, L-2. The categorization of model is shown in below. The models are analyzed by using STAAD Software.

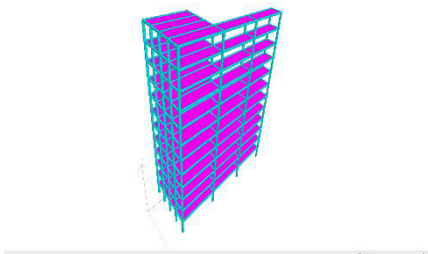
C-1: Diagrid Structure corresponding to an C-Base plan. C-2: Conventional Structure corresponding to an C-Base plan. L-1: Diagrid Structure corresponding to an L-Base plan. L-2: Conventional Structure corresponding to an L-Base plan. For study the effect of different frames following analysis is carried out by considering C-shape base plan building. The analysis is carried out on reinforced cement concrete building. The building with C-base plan having area of 192 m². The building height considers to be 36m with 11 storeys. Each storey height is considered to be 3m and same building consider as a L plan building. The data for seismic analysis taken from IS1893-2002(Part-1). For zone delhi(iv) All building models have same floor plan. Structure type is commercial, G+11, Floor to floor height is 3m, Ground floor height 3m, Thickness of slab is 150 mm, Grade of concrete used for Beams and Slabs is M25 and for columns is M30, Fe550 grade of steel is used, masonry wall load, live load and floor finish are 13.8 kN/m, 4 kN/m² and 1.5 kN/m² respectively, damping ratio 0.05, soil type is III(HARD), seismic zone factor(Z) is 0.36, importance factor is 1.5, (SMRF) Response reduction factor taken as 5. From the above property of building, property of frame, seismic data the model is analyses by linear static analysis. The analysis is done with help of STAAD software.



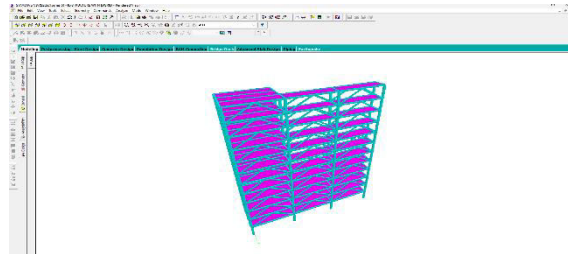
1(a)



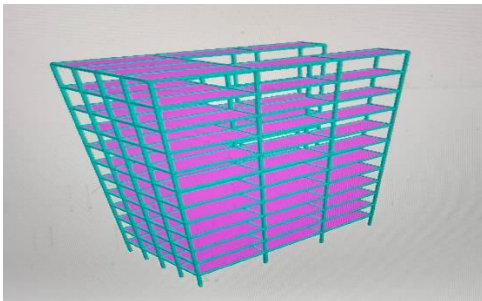
2(a)



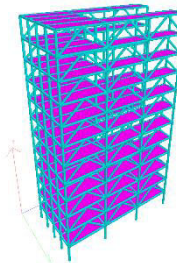
1 (b)



1 (c)



2(b)

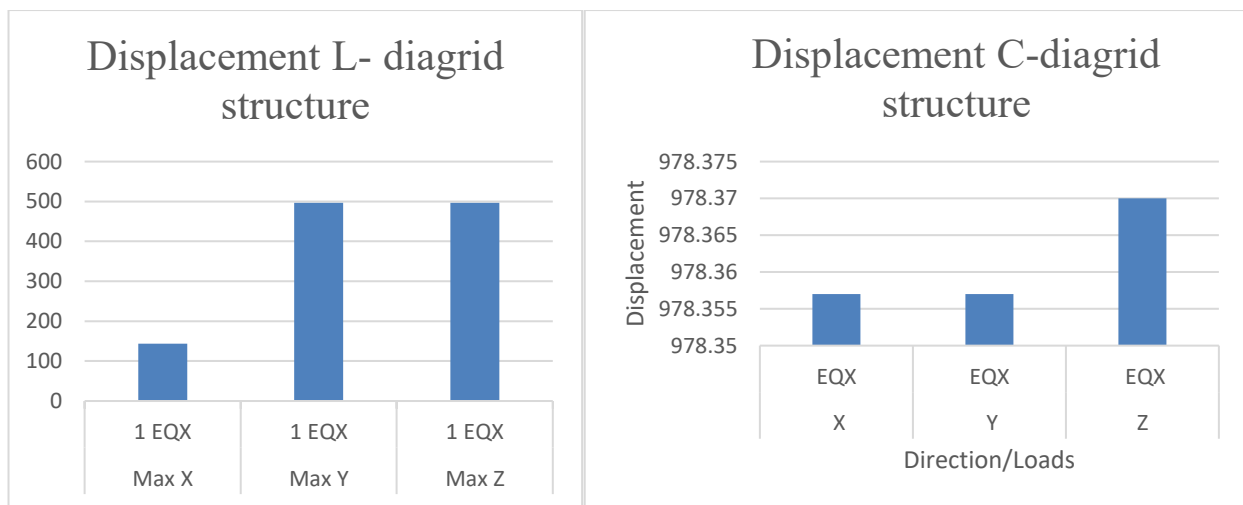


2 (c)

Fig. 1. (a). L floor plan, (b) L conventional frame (c) with diagrid L frame
Fig. 2. (a). C floor plan, (b) C conventional frame (c) with diagrid C frame

IV. EXPERIMENTAL RESULTS

Resultant Displacement

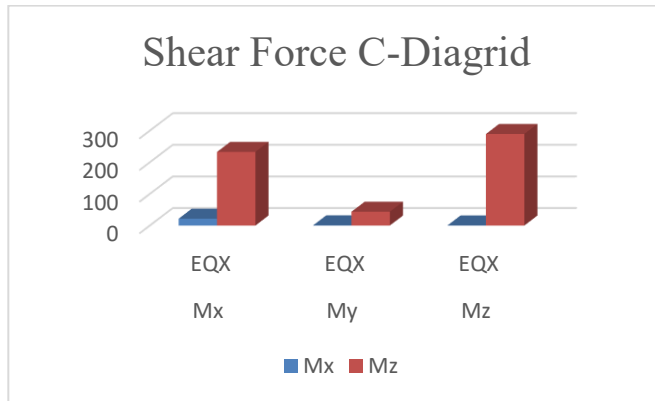


3(a)

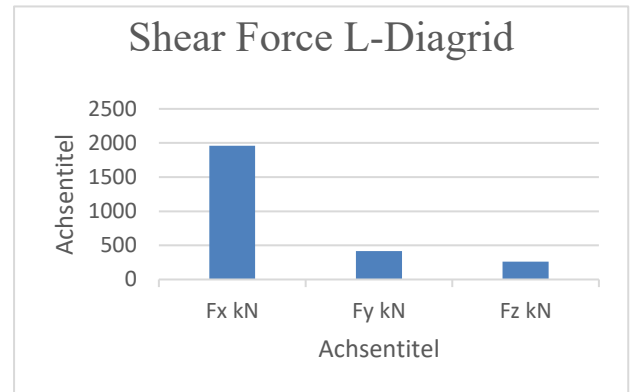
3(b)

Fig 3. Graph Maximum resultant displacement (a) Variation of story Displacement in the X direction in L diagrid structure of all the four model. (b) Variation of storey Displacement in X direction of C- diagrid structure.

Maximum storey shear



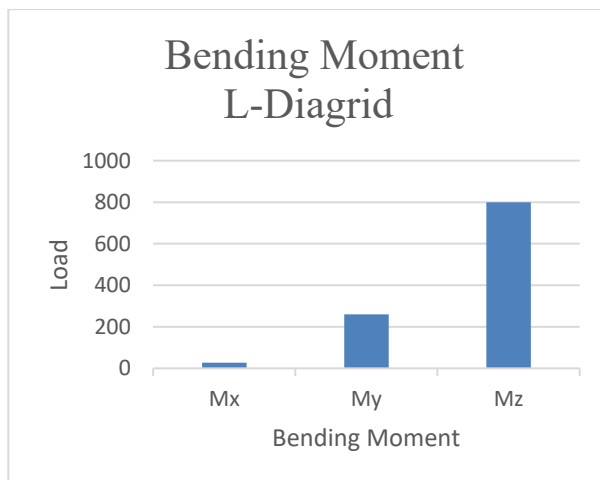
4(a)



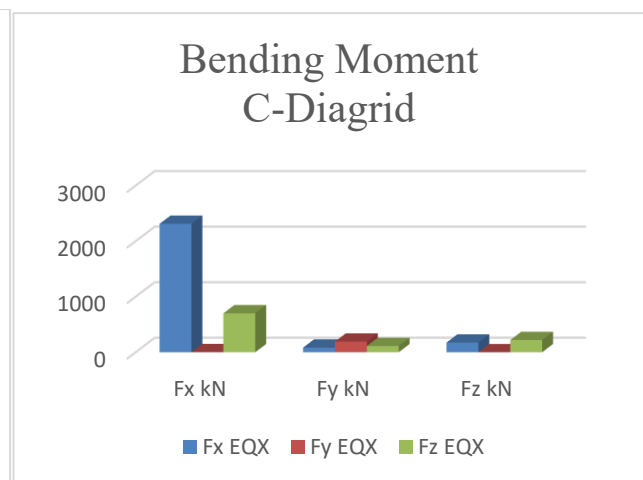
4(b)

Fig. 4. Graph of maximum storey shear (a) shear force C diagrid more in Mz direction
(b) shear force L diagrid more in Fx direction

Bending moment



5(a)



5(b)

Fig 5. Graph of Bending moment (a) Show the graph bending moment more in Mz direction.
(b) show the graph bending moment more in Fx direction.

V. CONCLUSION

In this study the seismic analysis performed on building by using STAAD Software. Initially, the comparison between diagrid model and conventional model for C-Type and L-Type done separately by using various parameter like shear force, bending moment, displacement, frequency and storey drift.

The following observations are drawn from the results obtained through analyses. According to analysis results it is observed that

[1] In C-plan structure, For base shear, diagrid structure is 17.75% effective than conventional frame structure.

- [2] In C-plan structure, displacements structure in diagrid are observed to be less 17.38% in diagrid structure as compared to simple conventional frame system.
- [3] For bending moment, diagrid structure is 1.25% better than conventional frame structure for C-Plan.
- [4] In C-Plan, considering storey drift frame is 97.06% diagrid structure is less as compared to conventional frame.
- [5] In L-Plan, considering base shear, diagrid frame is 80.58% effective than conventional frame system.
- [6] In L-Plan, considering displacement, diagrid structure 74.49% less than conventional frame structure.
- [7] For Frequency, diagrid structure is 13.81% better than conventional frame structure in L-Plan.
- [8] A significant decrease of bending moment, shear force, displacement, frequency diagrid building is found in comparison to conventional building.

After that, overall performance between C-plan and L-plan studied here. These two plan are compared by various parameter like base shear, displacement, bending moment.

1. Considering base shear L-Type building frame is best suited.
2. Considering storey shear C-Type building frame is better choice.
3. Considering storey displacement, C-Type building frame is more efficient.

[9] Finally, can conclude that the diagrid structure system is the better choice than the conventional frame building in aesthetic appearance, architectural purposes and structural efficiency.

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