Analysis of Diagrid Structural System using Push over Analysis

Chava Venkatesh*, Chereddy Sonali Sri Durga, Komma Hemanth Kumar Reddy, Polu Sathish*, Muddineni Naresh.

Abstract: ***The present paper majorly focuses on the modern high raised buildings. Construction of high raised buildings is big asset to the developed and developing countries. Diagrid structures are very efficient as a point structural capability as well as aesthetic appearance. It is combination of couple of straight beams and triangulated beams and this entire system is tied with circular horizontal rings. In the present work G+10 storey building is modeled and analyzed with ETABS software with aspect ratio range of 2.67 to 4.26 and also adopted bracing angles are 78 º and 71º. In present study all the conditions are analyzed by pushover analysis.***

Index Terms: - Aspect ratio, Diagrid structures, High raised buildings, Pushover analysis, Triangulated beams

I. INTRODUCTION

Construction of high raised buildings is big asset to the developed and developing countries. Because, in present days population is increasing rapidly but the earth surface area is constant, also the cost of the land is rapidly increasing day by day. Based on the above reasons many high raised buildings are came to reality [1-3].

When the height of the building is increases then the lateral forces (wind forces and earth quake forces) are drastically act on the buildings [4-5]. Diagrid structures offer more resistant to lateral loads as compared to conventional high raised buildings [6-7]. Diagrid structure is a combination of couple of straight beams and triangulated beams and this entire system is tied with circular horizontal rings [1]. Many studies are conducted on diagrid structures [8-10]. Kim et al.2010[11] modeled a G+36 storey building with 36m width and 36m height and also pushover analysis conducted it. Finally study reported that increasing the bracing angle decreasing the resistance of lateral strength of structure and study mention that the optimum bracing angle range is 60º to 70º. Krawinkler and seneviratna[12] reported that the non linear static analysis grape the intensity of lateral loads like earth quake and works according to the loading. Inel and ozmen[13] conducted a study on push over analysis by using exploitation of SAP2000 and study compared both user defined hing properties and default hinge properties. Finally study reported that user defined hinge properties are very accurate as compared to the default hinge properties. Moon et al[] reported that , the axial action of diagrid structural members can able to minimize the deformation of lateral shear. Panchal et al,[14], modeled and analyzed 20 story conventional framed structure as well as diagrid structure and reported the diagrid structures shown lesser top displacement when compared to conventional frame structures. In the present study diagrid structure analyzed with pushover analysis and G+10 story diagrid structure is modeled in ETABS software with aspect ratio of 2.67 to 4.2 and bracing angle of 71º and 78º.

II. MODELING DETAILS

In the present paper, modeled a G+10 storey square diagrid structure with area of 144m^2 and height of every floor is 3.2m as shown in fig 1. The size of beams is 300mm width and 450mm height. Square columns were used with size of the columns 300mm height and 300mm width. In case of braces, 150mm diameter and 10mm thickness steel tubes were used. The thickness of slab used in present paper was 150mm and the adopted steel and concrete densities are 25kN/m^3 and 78.5kN/m^3. The entire structure design is within limits of IS800:2007. The lateral displacement and base shear is controlled by push over analysis by using ETABS software.

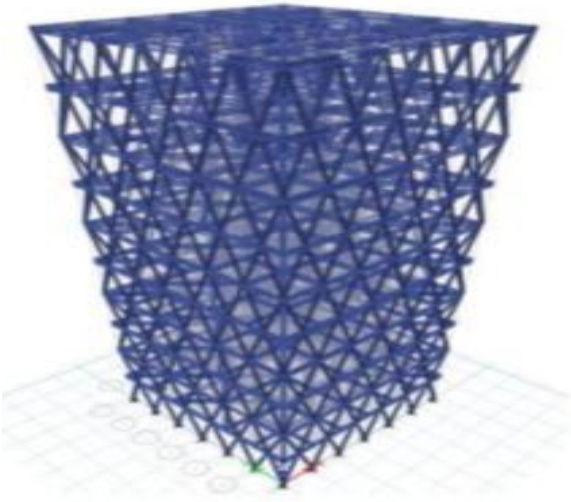

Fig 1. G+10 story of diagrid structure

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III. RESULTS AND DISCUSSION

In the Fig 2. Shown that the influence of base shear and aspect ratio of a diagrid structure with 71º and 78 ºbracing angles. As increasing the aspect ratio base shear is decreasing as in case of 78º of bracing. But in case of 71º of bracing shown, higher base shear resistance when compared to 78º and aspect ratio of 3.73 shown optimum resistance of base shear in 71º.

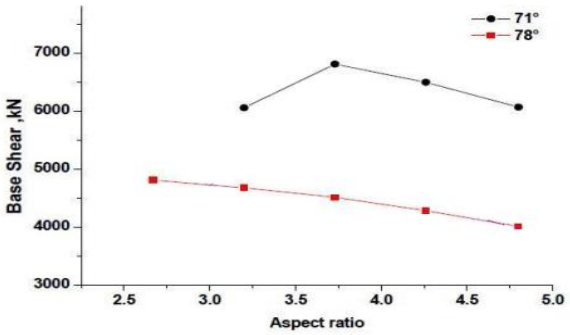

Fig 2. Aspect ratio Vs base shear.

In this paper Fig 3 showed variation of roof displacement and aspect ratio with two different bracing angles (71º and 78º). As the aspect ratio of diagrid structure increases with increasing the roof displacement, increasing.78º bracing angle shown higher roof displacement as compared to the 71º bracing angle.

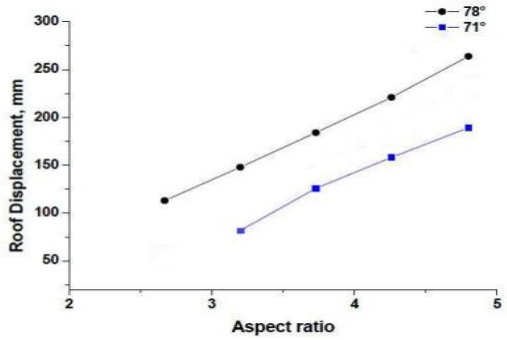

Fig 3. Aspect ratio Vs roof displacement

In this present paper fig 4 shown that the increasing the aspect ratio decreasing the S_a×W and 71º bracing angle offers more resistance against the S_a×W as compared to 78º bracing angle. In case of 71º bracing angle section, shown higher S_a×W at aspect ratio of 3.73.

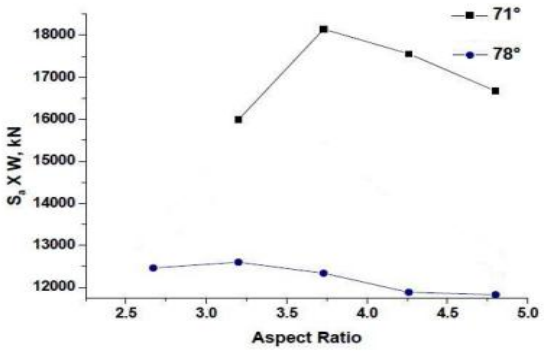

Fig 4. Aspect Ratio Vs Sa×W.

In this paper fig 5 shown that variation between the base shear and roof displacement with different aspect ratios such as 2.67, 3.2, 3.73and 4.26 as shown in fig 5. Lesser the aspect ratio higher the bases shear resistance and lesser the roof displacement.

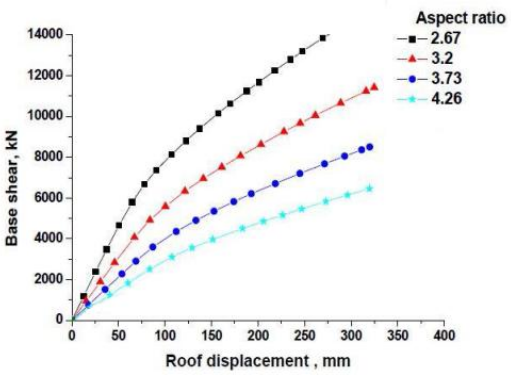

Fig 5. Roof displacement Vs base shear.

IV. CONCLUSION

Based on the modeling and results analysis, following observations were found.

- In case of diagrid structures, 71º bracing angle shown higher resistance to base shear and displacement as compared to 78º bracing angles.
- In the present study increasing aspect ratio, decreasing the resistance of base shear.
- Lesser the aspect ratio higher the bases shear resistance and lesser the roof displacement.

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