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STUDY ON DIAGRID STRUCTURE OF MULTISTOREY BUILDING

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Abstract : Multistory building construction is quickly growing across the world. The diagrid structural system has recently become popular for tall structures due to the structural efficiency and aesthetic possibilities given by the system's distinctive geometric layout. The most recent technological development in diagrid buildings is growing these days. Diagrid structures are buildings having diagonal grids at the peripheral at a certain angle and in modules over the building's height. The diagrid construction employs triangulated grids in place of vertical columns in the perimeter. As a result, technologies that are more effective in achieving stiffness against lateral stresses are regarded preferable solutions for tall structure design. This work describes a stiffness-based design process for estimating preliminary member sizes in r.c.c. diagrid structures for tall buildings. A G+24, G+36, G+48, G+60 story RCC structure with a plan dimension of 18 m 18 m located in Surat is being examined for wind and seismic study. STAAD. Pro programme is used for structural member modelling and analysis. All structural components are developed in accordance with IS 456:2000, and seismic force load combinations are taken into account in accordance with IS 1893(Part 1): 2002. Analysis findings are compared in terms of beam displacement, Storey Drift, and Bending Moment. This results in a more cost-effective diagrid structure design as compared to a traditional structure.

IndexTerms **- Diagrid building, Diagrid Angel, STAAD.Pro, Displacement, Storey Drift, Bending Moment**

I. INTRODUCTION

The creation and expansion of tall structures in crowded cities throughout the world is expanding on a daily basis. It is owing to the ongoing urban development, the availability of additional rental places with less environmental impact, the necessity for cost-effective building, and the need to conserve agricultural land. Diagrid - Diagonalised grid structures – is an emerging revolutionary idea for tall skyscraper architecture. Diagrid not only increases rigidity but also resists lateral forces (from wind and seismic activity) and gravity load via axial action. It is a type of space truss that consists of a perimeter grid made up of triangular structural structure. Diagrid- a term made up of the words "diagonal" and "grid"- identified Diagrid as a completely new trend.

Diagrid is a type of space truss that consists of a perimeter grid made up of a succession of triangular modules. This module can alternatively be fashioned like a diamond. The most significant aspect of a diagrid structure system is the material used for the construction.

The materials available for the construction of diagrid are:-

1. Steel
2. Concrete
3. Timber

1.1 Diagrid System

A diagrid structure is a type of structural system consisting of diagonal grids connected through horizontal rings which create an elegant and redundant structure that is especially efficient for high-rise buildings. A diagrid structure is different from braced frame systems, since diagonals as main structural elements participate in carrying gravity load in addition to carrying lateral load due to their triangulated configuration, which eliminates the need for vertical columns. The column free structure of a diagrid system offers several advantages such as high architectural flexibility and

elegancy, and enormous day lighting due to its large free surface.

1.2 Diagrid Angel

The structural design of diagrid structure is greatly influenced by the angle of diagonals. With the deviation of angle of diagonals from optimum condition, not only the required amount of steel increases significantly but also storey drift of structure, storey shear and top storey displacement changes. Therefore, it is very necessary for an Engineer to obtain the optimum angle of diagonals in diagrid structure in order to obtain a safe structural design of diagrid. For maximum bending rigidity, the angle made by column should be 900 and for maximum shear rigidity, it is 350. It is expected that optimum angle of diagrid falls in this

range. bending beams whereas short buildings with low aspect ratio behave like shear beams. Thus, it is expected that, increase in building height increases the optimal angle of diagonals.

1.3 Objectives

- The Main objective of this study is to understand the concept of diagrid structural system.
- The objective of this study is to understand the analysis and design methodology of diagrid structure using
- STAAD.Pro v8i ss5 software.
- To determine the various optimum angle and various storey for diagrid system.
- Analysis of building wind analysis.
- Analysis of building frames considering seismic analysis.
- Comparison between conventional building and diagrid building.

II. METHODOLOGY

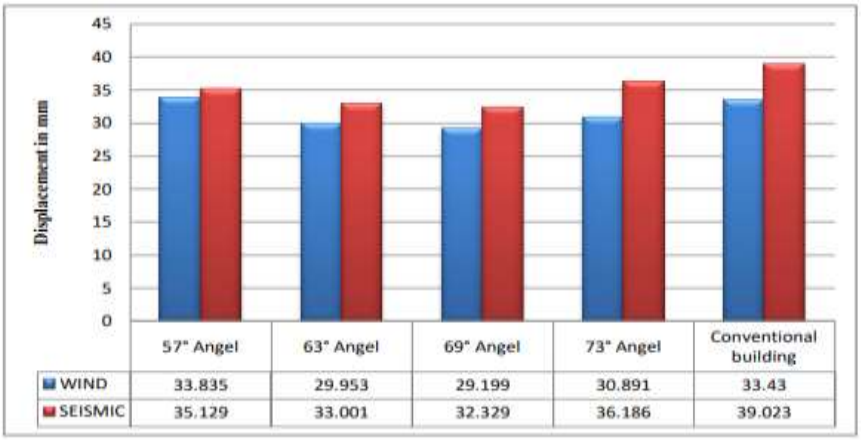
The design methodology is applied to a set of diagrid structures G+24, G+36, G+48 and G+60 stories tall, The diagrid structure of each storey height is designed with diagonals of various uniform angles as well as diagonals of gradually changing angles over the building height in order to determine the optimal grid geometry of the structure within a certain height range. The building's typical plan dimensions are 18x 18 meters with typical storey heights of 3 meters. The structures are assumed to be in Surat.

2.1 Geometry And Structural Data
(1) Plan dimension-18x18 m
(2) Storey height-3 m
(3) Diagrid angel-57º,63º,69º,73º
(4) No. of storey- G+24, G+36, G+48 and G+60
(5) Diagrid storey module-2,3,4 and 6 storey
(6) The dead load taken -8.75 KN/m
Floor finish-2 KN/m²
(7) Live load-floor finish-2.5 KN/m²
(8) Slab thickness-200 mm
(9) Support- Pinned support
(10) Characteristic strength of concrete: 30 N/mm2
(11) Characteristic strength of steel: 415 N/mm2

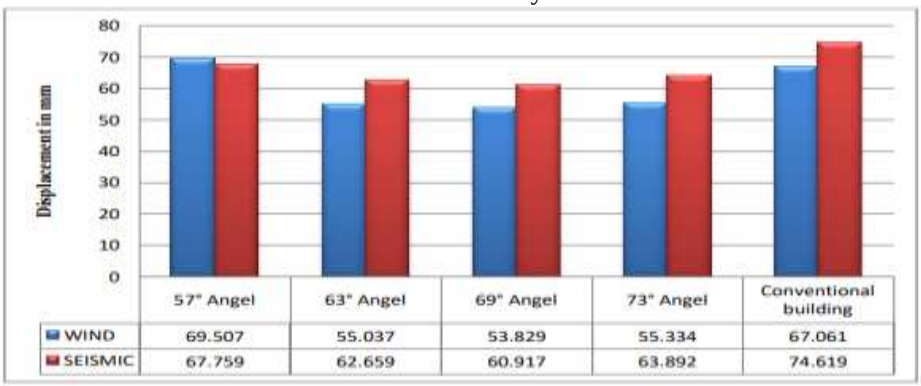
III.RESULTS

3.1 Storey Displacement

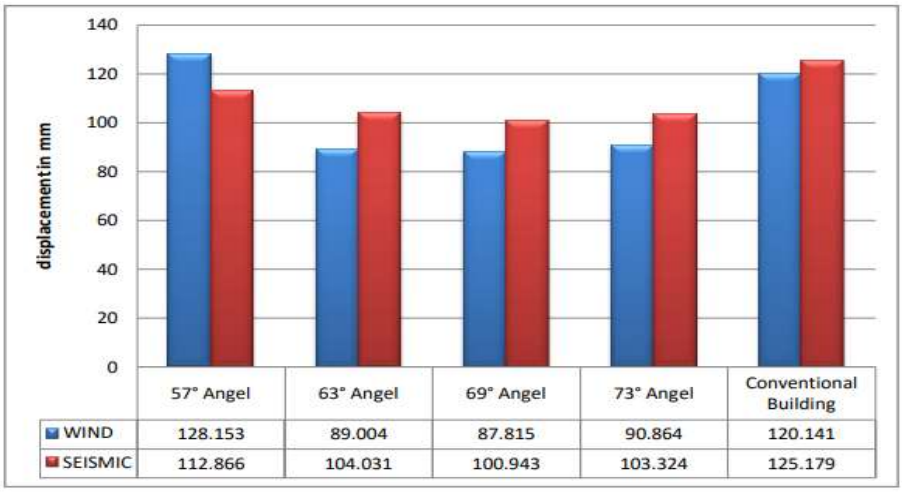
There are G+24,G+36,G+48,G+60 storey wind and seismic analysis max. displacement various diagrid angel and conventional buildingl. As per IS 456-2000 in clauses 23.2 page no. 37 permissible displacement should not exceed span/250.
A G+24 Storey



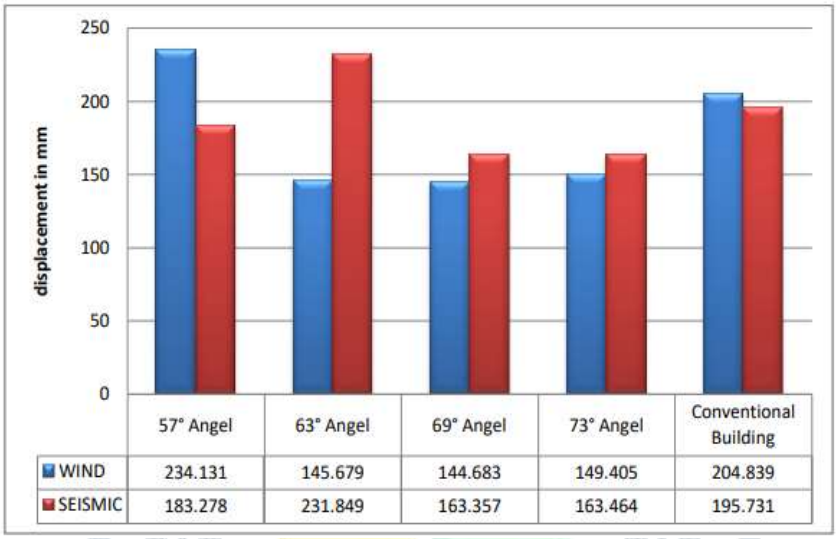
B G+36 Storey



C G+48 Storey



D G+60 Storey



IV. CONCLUSION

The current study is carried out by considering the different angles of diagrid and also different storey module of the varying building height. The proposed plan of 18m x 18m is considered with four different types of angles of diagrid that is 57°, 63°, 69°,and 73° for 2 storey, 3 storey, 4 storey, 6 storey diagrid module for G+24, G+36, G+48 and G+60 storey building. also comparative study diagrid and conventional building is carried out. We conclude from the study that

• For all the 40 models consider for the study storey displacement and storey drift values are within the permissible limit.

• Wind and seismic analysis are all storey diagrid angel 63° and 69° provides more stiffeness to the diagrid structural system which reflect the less storey displacement, less storey drift and less bending moment

• And comparison of diagrid building and conventional building they are shows that diagrid building are less displacement,less story drift and less bending moment in wind and seismic analysis.

• Diagrid structure comparison to conventional building provide more aesthetic look it becomes important for high rise structure

So from result comparison with conventional building, one can adopt diagrid structure for better lateral and gravitational load resistance.

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