A Review of Study About Design And Analysis Diagrid Building Structure With Medium Rise Building

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Abstract- *The modern high rise building is generally based on a different new structural concept by using high strength material and method of construction relevant more stiffness and lightness. This becomes structure lighter and stiffer than compare to other conventional. To become stand the building under forces, it is more essential to dissipate the intensity of vibration of lateral load. Most of tall building design for the lateral load due to earthquake and wind load. For the resistance of lateral load of earthquake or wind the effective structural system which fulfil the all requirement. Present diagrid structural system more popular in use having efficient and flexibility in architectural planning. Diagrid system composed of closely spaced vertical column frame at interior and inclined column at exterior of the building structure. The main purposes of this exterior inclined column to resist the lateral load of structure in axially form. In this study many literature concepts are listed and further these works are presented for different types of diagrid structure.*

Keywords- Tall building, diagrid structure, earthquake load, wind load, stiffness and lateral load, interior and exterior column.

I. INTRODUCTION

In 19th century tall building were built in development country. According to researcher studies before 1980's the most of tall building are constructed in only American country, now recently studies shows that number of high rise buildings and construction process is more in Asian countries. Generally these tall buildings are developed and used for residential apartments and commercial offices building. They are trends due to growth of urban population and limited spaced to development of city. They made attempt by structural systems which is superior as compare to conventional building become more resisting against lateral load than compare to gravitation forces.

The stages of planning a whole team including architect, designer should collaborate to agree on a structure to satisfy their requirements of serviceability, durability and safety functions. The use of structural system in all tall building used to fulfil architectural requirement for free space arrangement and aesthetic view of structure.

A Diagonal Grid or Diagrid Structure is a framework of diagonally intersecting section (steel section used in this paper) that is used in the construction of skyscrapers buildings and rooftops. These structures offer unique supremacy to high risers because of structural efficiency and pleasant aesthetics. It conveniently eliminates the dependence on column of a structure and also requires comparatively lesser structural steel and thus optimize the cost. The Steel Diagrid Structure are more popular than other conventional materials such as wooden beams and concrete as they are quickly erected. These buildings are energy efficient, environmentally sensitive and a clear winner in the run for what future sustainable buildings may look like.

II. STRUCTURAL SYSTEMS FOR TALL BUILDING

The term structural form systems in structural engineering refer to lateral load-resisting system of a structure. The structural forms employed in the high-rise structures transfers loads through structural components which are connected with each other in an efficient manner. The commonly used structural forms can be classified into different categories, depending on the type of stresses that may arise in the structural members due to the application of loads. Sometimes two or more of the basic structural forms may be combined in a single structural form system to form a hybrid system in order to meet the structures operational requirements. The structural system of a tall building is designed to deal with vertical gravity loads and mainly the lateral loads caused by wind and seismic activity. The structural system consists of only the members designed to carry the loads, all other members which does not participate in carrying loads are referred as non-structural members. From the point of view of structural engineer, the determination of the structural system for tall building structures would ideally involve the selection and arrangement of the major structural elements to resist most efficiently the various combinations of gravity and lateral loading. A major consideration affecting the structural system is the intended function of the building

which a building is going to serve. The following structural syste are used for tall building strucuture.

- Moment-Resisting frame (MRF)
- Shear Wall
- Diagrid system
- Bundled Tube
- Braced Tube
- Space Trusses
- Framed Tube System
- Tube-In-Tube
- Outrigger structure

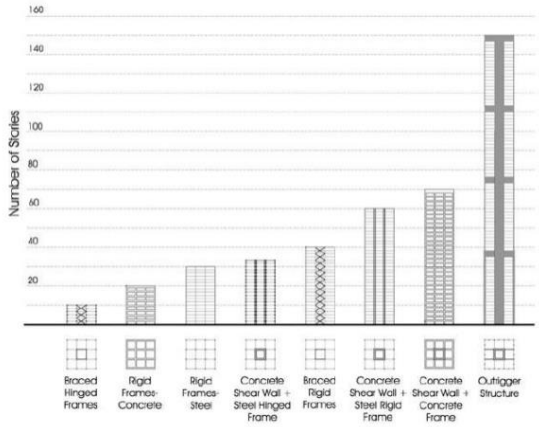

Figure 1. Structural Forms

III. LITERATURE REVIEW

ayesh Akhand et. al. (2019) Analysed and designed of 16 storey diagrids building with plan of 18 m × 18 m size is considered. Staad professional software system is employed for modelling and analysis of structural members. All structural members are designed as per IS 456:2000 considering all load combinations. Seismic load as Dynamic load as per IS1893-2002 and Wind load as IS 875-part 3 considered for analysis and design of the structure. Load distribution in diagrid system is also studied for 16 storey building. Response spectrum analysis results provides a more realistic behaviour of structure response and diagrid structure is more effective in lateral load resistance Seismic and wind analysis of conventional building with different shapes of diagrid building with equivalent plan area at seismic zone III is carried out.

Pattan Venkatesh et. al. (2018) This study presented the structural behaviour of three models of 60 storey buildings viz., Conventional rigid framed building with rectangular plan having plan dimensions of 24mx24m, diagrid building with rectangular plan having plan dimensions of 24mx24m and diagrid building with circular plan having a plan diameter of 24m. Modelling and Analysis for all the above buildings is done for gravity, earthquake and wind loads using ETABS software. IS 800:2007 is used for the design of the structural members. All the three models are analysed and compared using the parameters such as base shear, storey displacement, time periods, structural weight and storey drifts.

Yogeesh et. al. (2018) A Comparative study of 8 storey bare frame building and a diagrid building is presented. A 'C' shaped floor plan of 16 m × 16 m size was considered. ETABS was used in modelling and analysis of structural members. All structural members were designed as per IS 456:2000, load combinations such as dead load, live load and design earthquake loads were considered for analysis and design of the structure. Later both bare frame and diagrid structural systems were compared; the comparative study of diagrid structural system shows an increase in the responses like storey shear, storey stiffness and decrease in the responses like storey displacement and storey drift. The Storey displacement and story drift is maximum for RC bare frame and minimum for RC frame with diagrid.

Snehal et. Al (2017) has been different diagrid structures of (G+30) storey are carried out to obtain optimized position of diagrid. And response of this diagrid building is compared with conventional building by providing same parameters to both the buildings. The analysis of the building is carried out by using ETABS software. Diagrid structural system has emerged as a better solution for lateral load resisting system in terms of lateral displacement.

Moon et. al (2016) different diagrid structures of (G+30) storey are carried out to obtain optimized position of diagrid. And response of this diagrid building is compared with conventional building by providing same parameters to both the buildings. The analysis of the building is carried out by using ETABS software.

Shah et. al (2016) had done a comparative study of diagrid structure with conventional frame structure. The main objectives of this study were to review tall building in India, to compare the performance, to study the critical effect of lateral forces and to obtain the response in terms of parameter. In this study they had designed 7 buildings (4, 8, 12, 16, 20, 28, 40 storey) in ETABSsoftware. Analysis and design were carried out for dead load, live load, lateral earthquake load and lateral wind load. For earthquake loads, both static and response spectrum analysis was done. To consider extreme conditions of lateral loads, the buildings are considered to be located in Zone V. Various parameters like fundamental time period, maximum top storey lateral displacement, maximum base

shear, steel weight, percentage differences in change of steel weight, maximum storey displacement and maximum storey drift are considered in this study. It was observed that in diagrid system earthquake forces were predominant up to 16 storey and in conventional frame up to 12 storey. This means wind forces were predominant after 16 storey in diagrid system and 12.

Varsani et. al (2015) had done the comparative analysis of diagonal structural system and conventional structural system for high rise steel building. In this study, Analysis of diagrid structural system and conventional structural system for 24 storey building was carried out. A regular floor plan of 36 m x 36 m size was considered for both structures. Also analysis of 36, 48, 60 storey diagrid structure was done and then comparison of these buildings with conventional structural system was held in terms of storey displacement, storey drift, time period. ETABS software was used for modelling and analysis of structural members. All structural members were considered as per IS 800:2007 considering all load combinations. He also concluded that the diagonal columns resisted lateral loads of the structure and structure is more flexible in terms of architectural planning. Top storey displacement is very less. Maximum displacement for conventional building was 172.7mm whereas in diagrid structure it was 31.6mm only.

Jaswani et. al (2015) the main aim of the study was to study the diagrid structure of varying angle configurations. From this study they gave the results for varying and uniform angle for different earthquake zones.

Deshpande et. al (2015) had done the analysis and comparison of diagrid and conventional structural system. In this study they have considered 60 storey diagrid steel building with regular floor plan of 24m x 24m. Stiffness based design methodology was used in the analysis in which they had calculated gravitational and lateral loads. All structural members are designed as per IS 800:2007 considering all load combinations. Dynamic along wind and across wind are considered for analysis and design of the structure. For wind load they have done wind load analysis by using IS 875 part III. Based on the analysis and design models are prepared by using ETABS software in which diagonal angles ware taken 720 for 1 to 36 floors and 560 for 26 to 60 floors. After r study they have reached to the conclusion that weight of diagrid structure reduced to greater extent, steel consumption is 28% less. Diagrid performs better across all the criterions of performance evaluation, such as, efficiency, expressiveness and sustainability. Structure has comparatively less deflection. Due to this structure has more resistance to lateral forces Cost effective and Ecofriendly.

Korsavi et. al (2014) examined the evolutionary process of diagrid structure towards architectural, structural and sustainability concepts through case studies. In this they had examined 30 cases of diagrid structure. According to the prevailing properties of these structures, they had significant advantage in terms of height, i.e. for greater height diagrid structural system is more effective to resist the lateral loads.

Panchal et. al (2014) compare the analysis and design of 20-storey diagrid structural system building and simple frame building is presented here. A regular floor plan of 18m x 18m size is considered. ETABS 9.7.4 software is used for modeling and analysis of structure. Analysis results like displacement, story drift, story shear are presented here. Also design of both structures is done and optimum member sizes are decided to satisfy the code criteria. He concluded from the study that, as the lateral loads are resisted by diagonal columns, the top story displacement is very much less in diagrid structure as compared to the simple frame building. And also find that design of both structures are done by using same member size but that member sizes are not satisfied to design criteria in case of simple frame structure and failure occurs with excessive top storey displacement. So the higher sizes of members are selected to prevent the failure criteria.

Jani et. al (2013) analysis and design of 36 storey diagrid steel building is presented in detail. A regular floor plan of 36 m × 36 m size is considered. ETABS software is used for modeling and analysis of structure. All structural members are designed using IS 800:2007 considering all load combinations. Load distribution in diagrid system is also studied for 36 storey building. Also, the analysis and design results of 50, 60, 70 and 80 storey diagrid structures are presented. From the study it is observed that most of the lateral load is resisted by diagrid columns on the periphery, while gravity load is resisted by both the internal columns and peripherial diagonal columns. So, internal columns need to be designed for vertical load only. Due to increase in lever arm of peripherial diagonal columns, diagrid structural system is more effective in lateral load resistance. Lateral and gravity load are resisted by axial force in diagonal members on periphery of structure, which make system more effective. Diagrid structural system provides more flexibility in planning interior space and façade of the building.

Moon et. al (2009) is applied to a set of diagrid structures, 40, 50, 60, 70 and 80 stories tall, with height-to-width aspect ratios ranging from 4.3 to 8.7. The diagrid structure of each story 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 36 x 36 meters with typical story heights of 3.9 meters. The structures are assumed to be in New York. Based on the ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures, the basic wind speed in New York is 110 mph. Member sizes were generated to satisfy the maximum lateral displacement requirement of a five hundredth of the building height. He concluded that structural efficiency of dia-grids for tall buildings can be maximized by configuring them to have optimum grid geometries. Though the construction of a diagrid structure is challenging due to its complicated nodes, its con-structural ability can be enhanced by appropriate prefabrication methods.

IV. CONCLUSION

These study shows that different researcher give idea about effectiveness of diagrid structure. These inclined member outer faces are design in such a way the maximum effect of lateral load carry by diagrid member and remaining lateral load and gravitational load transfer by interior framed structure inn tall building. After this review the author understand the load distribution pattern of diagrid and try to finding optimum size and inclination of diagrid.

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