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# A Review on Comparative Study on Seismic Behaviour of RC Structure with diagrid and X- steel bracing for Different Stories

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**Abstract- The seismic behavior of reinforced concrete (RC) structures with diagrid structures and x-bracing structures for various stories is compared in this work. This study uses the structural ETABS software to assess how well these structural systems perform when subjected to seismic and wind loads. These findings have the conclusion that the diagrid construction might be a good substitute for tall structures in seismic areas. The primary findings and suggestions of this study are that the diagrid structure should be designed with sufficient stiffness and strength to prevent excessive deformation and failure, and that additional research is required to examine the effects of various factors, including soil-structure interaction, material properties, and loading patterns on the seismic behavior of these structures. Buildings with varied stories (36-story, 40-story, 50-story, and 60-story) and an area of 1296m2 (36m x 36m) were used for the analysis. The evaluation of both lateral load resisting systems' story displacements. structural analysis utilizing the Response Spectrum Method. The findings demonstrate that, in terms of displacement, drift ratio, base shear, and structural ductility, the diagrid construction outperforms the x-bracing structure in terms of seismic resistance.**

**Keywords: seismic response spectrum, diagrid structure, X-steel bracing structure, lateral load resistance, and ETAB.**

## INTRODUCTION

Politics, economics, technology, and aesthetic concerns all contribute to the complexity of tall building development. Economic factors have been the primary influencing factor in these. However, without supporting technology, the growth of the current highrise construction trend would not have been possible. The primary structural framework of a highrise building can be thought of as a vertical cantilever beam with its base rooted in the earth. In addition to vertical gravity forces, the structure must withstand lateral wind and seismic loads. Gravity loads are primarily caused by dead and live loads. The building frequently topples under lateral stresses. There, the structure needs to be able to handle vertical loads while also having shear and bending resistance. Tall constructions are more dependent on the design of their perimeter than any other building form because of their exceptional height and resulting heightened susceptibility to lateral pressure. It is highly desirable to concentrate as many lateral load resisting system components as possible on a tall building's perimeter in order to enhance the structural depth of those structures and, consequently, their resistance to lateral loads. When examining the history of diagrid and X-braced systems in highrise buildings, it is evident that these systems may be applied to a wide range of architectural geometries, supporting both the strength and the aesthetics of the structure. The diagrid and X-braced structure's main objective is to withstand the lateral and gravitational loads applied to the building.

### 1.1. Diagrid System

A "diagrid," a combination of the words "diagonal" and "grids," is a structural system that is single thickness in nature and obtains its structural integrity through the application of triangulation. Diagrid systems can be planar, crystalline, or adopt different curvatures; they commonly use curvature to become stiffer. The perimeter diagrids that support the floor margins normally take care of the lateral and gravitational strains placed on the two structures. Shear and moment are both communicated by the diagrids diagonal element. Therefore, the best angle for positioning the diagonal is determined by building height. In a typical RCC building, a diagonal's optimal angle for maximizing shear rigidity is 35 degrees, whereas a column's best angle for maximizing bending stiffness is 90 degrees. The ideal diagrid angle is thought to be halfway between the two, or 60 to 70 degrees, which is the typical adoption rate. The optimal angle increases in line with the height of the building. The height of the diagrid is dependent on how many layers are stacked within a single module. A module of a diagrid typically has 2 to 6 floors stacked on top of each other.

Figure 1.0 : BASE OF 30 ST MARY AXE, LONDON, UK. 3

1.2. X-bracing Structure

Cross bracing typically consists of two diagonal supports placed in an X configuration. Under lateral stress (such as wind or seismic activity), one brace will be in tension while the other will be in compression. A structure can support more weight thanks to this kind of mechanism. It is widely employed while constructing earthquake-resistant buildings. Cross bracing can be used in any rectangular frame structure.

Figure 1.1 : X-bracing (cross bracing) system

LITERATURE REVIEW

The following part reviews and presents the study articles that numerous researchers have published in various journals:

U. A. Nawale and D. N. Kakade (2017) "Analysis of Diagrid Structural System by E-Tab" This essay presents a study of a 32-story digrid structural system without a vertical column surrounding the building. Here is a comparison of the results of the analysis in terms of storey displacement and storey drifts.

Khushbu Jania , Paresh V. Patel (2013) "Analysis and Design of the Diagrid Structural System for High Rise Steel Buildings" A 36-story diagrid steel building's analysis and design are given. A standard floor layout measuring 36 m 36 m is taken into account. For modeling and analysis of structural members, ETABS software is employed. According to IS 800:2007, all structural components are created taking into account all load combinations. For the structure's study and design, both dynamic along wind and across wind are taken into account. For a 36 story building, the load distribution in the diagrid system is also investigated. Similar research and design work is done on 50, 60, 70, and 80 storey diagrid structures. This study compares the findings of the analysis in terms of time, top storey displacement, and inter-storey drift.

Ravi sorathiya, asst. prof. pradeep pandey (2017) "study on the diagrid structure of a multistorey building" In order to estimate the preliminary member sizes of r.c.c. diagrid structures for tall buildings, this research proposes a stiffness-based design methodology. For the analysis, a G+24, G+36, G+48, and G+60 storey RCC building with a plan dimension of 18 m 18 m in Surat is taken into consideration.

Harshita Tripathi, Dr. Sarita Singla(2016) The phrase "Diagrid structural system for R.C.Framed multistory buildings" In order to estimate the preliminary member sizes of r.c.c. diagrid structures for tall buildings, this research proposes a stiffness-based design methodology. To establish the ideal grid configuration of the diagrid structure within a specific height range, the methodology is applied to diagrids of different heights and grid geometries.

G. Milana, P. Olmati, K. Gkoumas, and F. Bontempi,(2015) "Ultimate capacity of diagrid systems for tall buildings in nominal configuration and damaged state," There are two objectives for this study. A diagrid tall structure's optimal structural plan should be assessed first, along with how it compares to a typical outrigger building. Sustainability (the use of structural steel) as well as structural safety and serviceability should be prioritized. This is accomplished by testing and contrasting various diagrid geometries. The second aim (modeled by the deletion of diagonal grids) is to give some light on the residual strength of the diagrid structures, even in their damaged state. Both goals are achieved via FEM nonlinear analysis.

K. S. Moon,(2011) "Diagrid buildings for tall structures with complicated shapes" The structural performance and build ability of diagrid structures used for complex-shaped tall buildings, such as twisted, slanted, and freeform towers, were discussed in this work.

Anes Babu, Dr. Chandan (2017) The "Effect of Steel Bracings on RC Framed Structure" In three sections, a reinforced concrete framed building (G+9) was modeled and investigated in this study. 1) A design devoid of steel bracing or shear walls 2) Model using a different brace 3). model of a shear wall. Shear walls were erected, and the middle bays were reinforced. All of these models were checked for seismic forces in various seismic zones using the E tabs 2015 application.

K. Sangle, K. Bajoria, and V. Mhalungkar,(2012) The study, "Seismic Analysis of High Rise Steel Frame With and Without Bracing," In this work, a linear time history analysis of a high-rise steel building with various bracing systems for the Northridge earthquake is conducted. Natural frequencies, fundamental time period, mode shapes, inter-story drift, and base shear are identified with different bracing system layouts. Further optimization study was carried out to select the suitable type of bracing design while maintaining the inter-story drift, total lateral displacement, and stress level within permissible limits. The goal of the study was to compare and contrast the results of a seismic analysis of a steel high-rise construction.

M. Prasanna Kumar and R. M. Vishnu,(2017) In "A Comparative Study on the Effect of Lateral Loading on Steel Braced Reinforced Concrete Structure of Unsymmetrical Building Plan," In this study, the analytical research is being used to find the ideal location for bracing and bracing system in an asymmetrical building design (T-shape) of G+ 30 storeys by taking into account both the wind and seismic effects. Bracings like the X and the single diagonal are contrasted and supplied at various exterior locations of the building.

S. Gerasimidis, P. Pantidis, B. Knickle, and K. S. Moon, (2016) The article, "Diagrid Structural System for High-Rise Buildings: Applications of a Simple Stiffness-based 49 Optimized Design," This study presents a simple approach for increasing the member sizes for tall steel diagrid constructions. The volume of the diagonal components of a diagrid construction should be minimized throughout the optimization procedure. The constraints of the stiffness-based design prohibit the building's tip from deflecting past generally accepted legal limitations. Additionally, the current work investigates the potential of the diagrid structural system and attempts to open a discussion on the essential topic of optimization and robustness for tall structures.

## CONCLUSION

The following results from the examination of the literature review are made:

- Different tube structures come in different forms. The majority of research is done on tube-in-tube structures to withstand lateral loads. Due to the presence of the inner tube, interior planning is restricted in tubes.
- In this study, diagrid structures are used to analyze high-rise buildings and to withstand lateral loads like earthquake and wind loads. The internal floor design is left relatively open in diagrid buildings, increasing the net useable floor space. The buildings are significantly more economically efficient due to the reduction in material.
- There is plenty of room to look at how RC buildings with diagrid and x-bracing behave under seismic loads for structures with 36, 40, 50, and 60 storeys. the use of ETAB software for structural seismic analysis.

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