SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 11 | November 2024 - Peer Reviewed Journal

EXAMINATION OF MULTI-STOREY STRUCTURES USING A HYBRID STEEL BRACING SYSTEM AND SHEAR WALL

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ABSTARCT
The seismic performance of hybrid steel structures that use steel bracings and concrete shear walls as lateral force-resisting elements is examined in this research. The study looks at the displacement, responses, and plate stresses that the structural models under earthquake loading undergo, with a particular focus on seismic Zone-V, which stands for areas with the greatest seismic activity. The findings demonstrate the substantial influence of seismic forces in these areas by showing that structures in Zone-V show the greatest displacement and reactivity. Furthermore, plate stresses increase in proportion to the seismic zone's intensity, highlighting the increased strain on building components. Notwithstanding these difficulties, the hybrid bracing and shear wall system is remarkably successful in reducing seismic stresses, guaranteeing structural stability and resilience in the event of an earthquake. This study emphasizes how crucial it is to choose structural systems that are suitable for seismic risks, especially in high seismic zones, and how effective hybrid systems are in improving seismic performance.
KEYWORDS: *shear walls, bracing systems, multistorey buildings, lateral forces, structural stability*

1. INTRODUCTION

Multi-storey structures are essential elements of urban environments, addressing the growing needs for residential, commercial, and institutional areas. As population densities increase and land availability decreases in metropolitan regions, the development of high-rise structures becomes essential for optimal land use. The structural design and engineering of these structures have distinct problems, notably in maintaining structural integrity, stability, and resilience under diverse loads, including gravitational, lateral, and environmental influences such as wind and seismic activity. One of the primary factors in the design of multi-storey buildings is the choice of a suitable structural system that can endure loads while upholding performance and safety criteria. Conventional structural solutions, including reinforced concrete (RC) shear walls and steel moment frames, have been widely used in the construction of tall buildings, each presenting distinct benefits and drawbacks.

Recently, there has been an increasing interest in hybrid structural systems that integrate the advantages of several materials and building methods to enhance performance and efficiency. A notable hybrid system gaining importance is the integration of shear walls with steel bracing components. This system combines the benefits of increased lateral stiffness and strength from shear walls with the ductility and energy dissipation properties of steel bracing systems. This introduction establishes the framework for analyzing multi-storey structures using a hybrid shear wall-steel bracing structural system. The subsequent sections will examine the structural behavior, design considerations, and performance assessment of this hybrid system, with the objective of elucidating its efficacy and appropriateness for tall building construction under diverse environmental and loading situations. This work aims to provide new ideas for the safe and resilient design of multi-storey buildings via a thorough analysis of this hybrid structural system.

2. REVIEW OF LITERATURE

Thejaswini R.M. et al [1] found that in the modelling, material is considered as an isotropic material. The 3d building model generated in is shown in STADD Pro. A simplified probabilistic risk analysis (PRA) procedure is presented forthe seismic reliability of G+7 storey RCC building by considering effect of with and without floating column in the modelling. Thomsen IV, J. H. et al [2] observed that the moment about X and moment about Z are compared by equivalent static analysis method. The above building models are generated using the software STAAD Pro 8Vi and areanalyzed using equivalent static method.

Vijay Kumara Gowada et al [3] found that in this paper modern construction technology, floating column is becoming a typical feature for multistory buildings in urban India. Such practices are highly undesirable in buildings built in seismically active areas. Due to this floating column the moments in columns, storey drifts, storey shears and other factors tends to increase which leads to strength reduction in structures.

Nanduri, PMB Raj Kiran, et al [4] found that this study emphasizes about recognizing the presence of floating column in multistoried buildings and how to reduce the risk factor of earthquake effects by strengthening the floating columns building with Bracings. In

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this present study four models are used namely, 'Model 1 (G+9 Normal RC Building)', 'Model2 (G+9 RC Floating column Building)', 'Model 3 (G+9 RC Floating column Building with Bracings at corner)', 'Model4 (G+9 RC Floating column Building with Bracings at centre)'.

Chung, Kwangryang, et al [5] observed that seismic analysis is carried out on all four models using Equivalent static method and Response spectrum method in two zones (III, V) respectively. Comparison of results Storey shears, Storey Drifts, Maximum Displacement, Time period and Base shear for all four models are executed. As the Model 4 throw inbetter results compared to other Models, its performance is reviewed using pushover analysis and the performance levelsare discussed by comparing Model 4 with Model 3. This seismic assessment is executed using ETABS software as perthe code book IS:1893-2002.

3. METHODOLOGY

Following models in STAAD-PRO carried out:

1. G-4 Steel Building (without shear wall / bracings)
2. G-4- Steel Building EQ-2
3. G-4- Steel Building EQ-3
4. G-4- Steel Building EQ-4
5. G-4- Steel Building EQ-5
6. G-5 Steel Building (without shear wall / bracings)
7. G-5- Steel Building EQ-2
8. G-5- Steel Building EQ-3
9. G-5- Steel Building EQ-4
10. G-5- Steel Building EQ-5

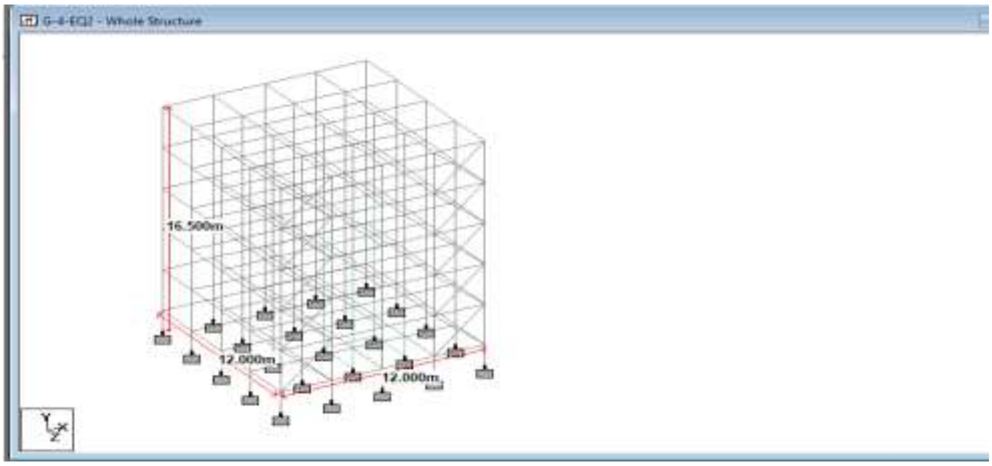

Fig.1: Geometry of G-4 Steel Building

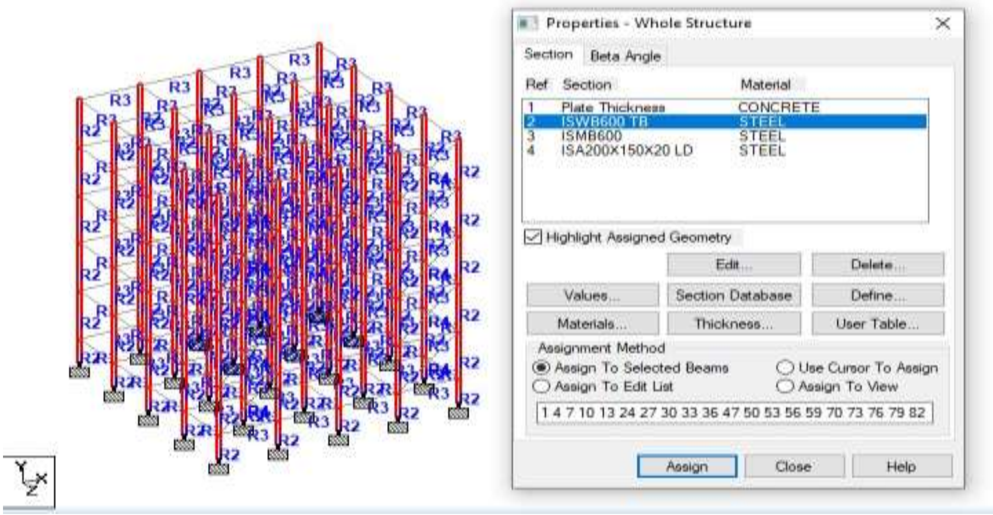

Fig.2 : Properties Assigned to the steel building

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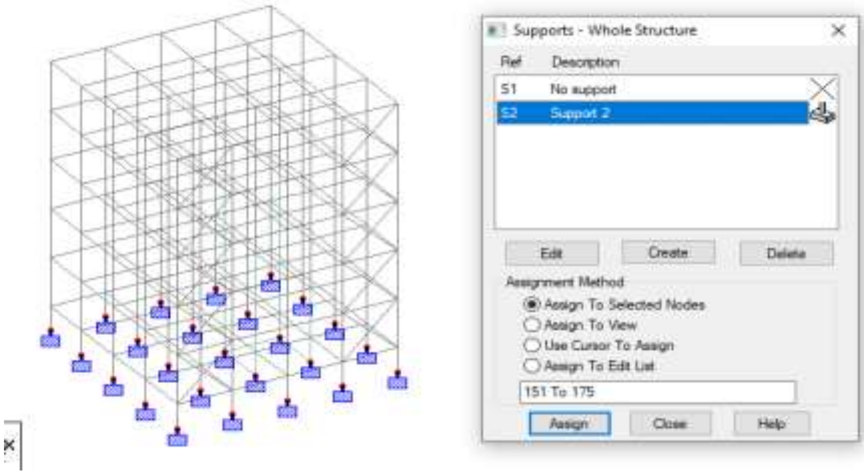

Fig.3 : Supports Assigned to the steel building

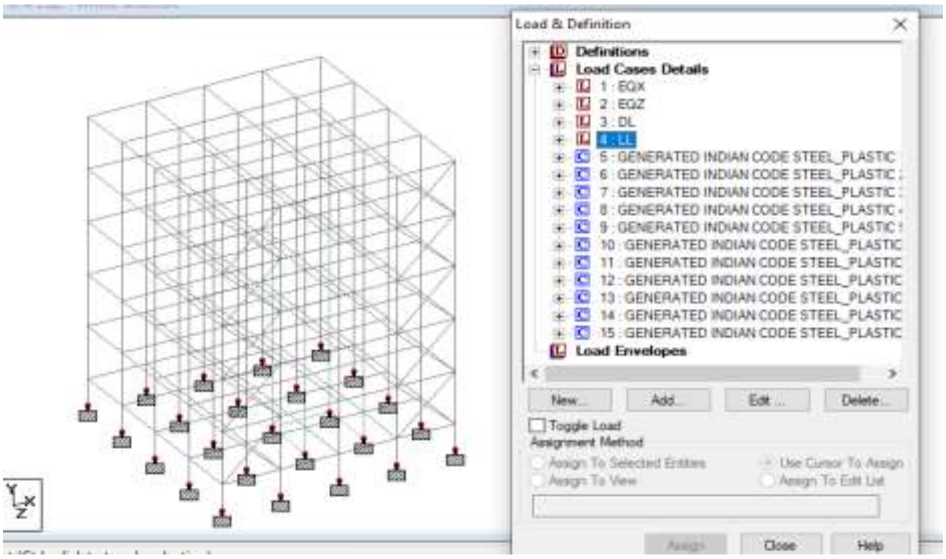

Fig.4: Load Assigned to the steel building

4. RESULTS

Following results are obtained in the STTAD-PRO software

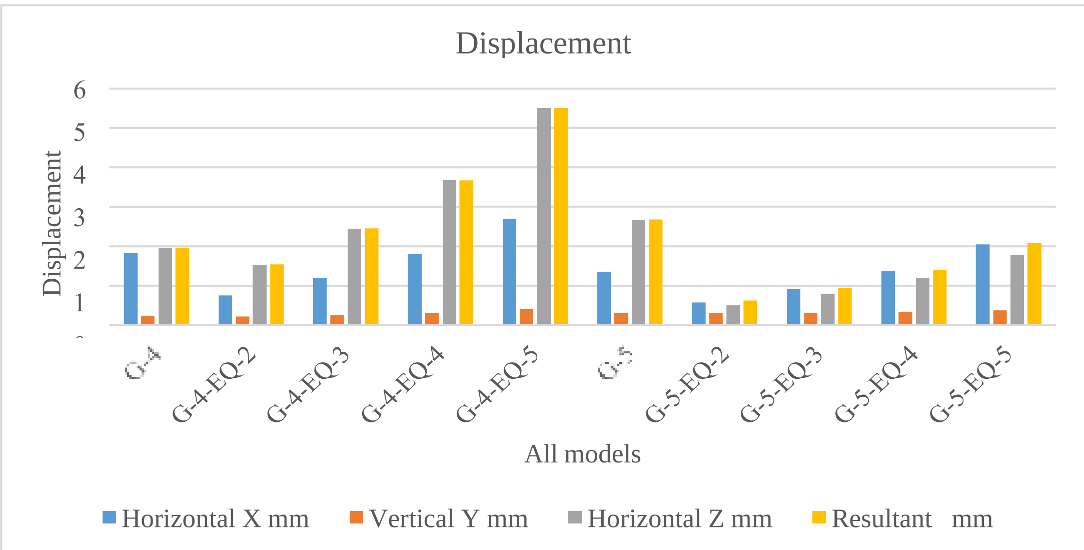

Fig.5: Displacement for all the models

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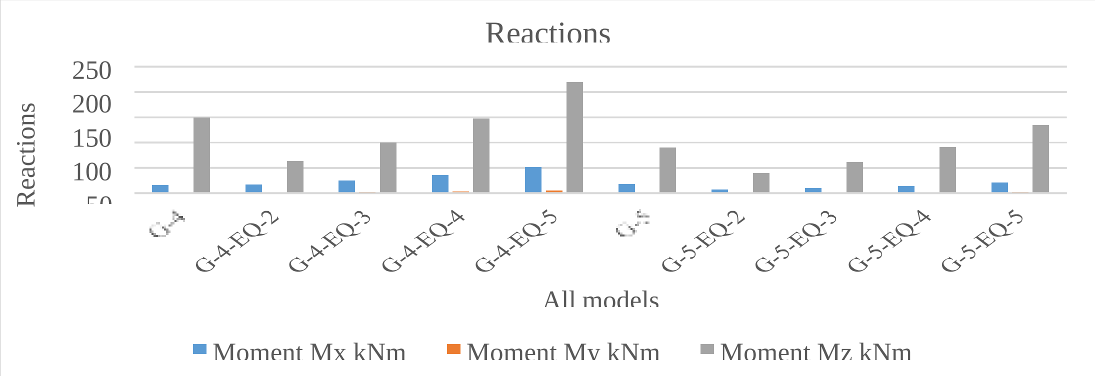

Fig.6: Reactions for all the models

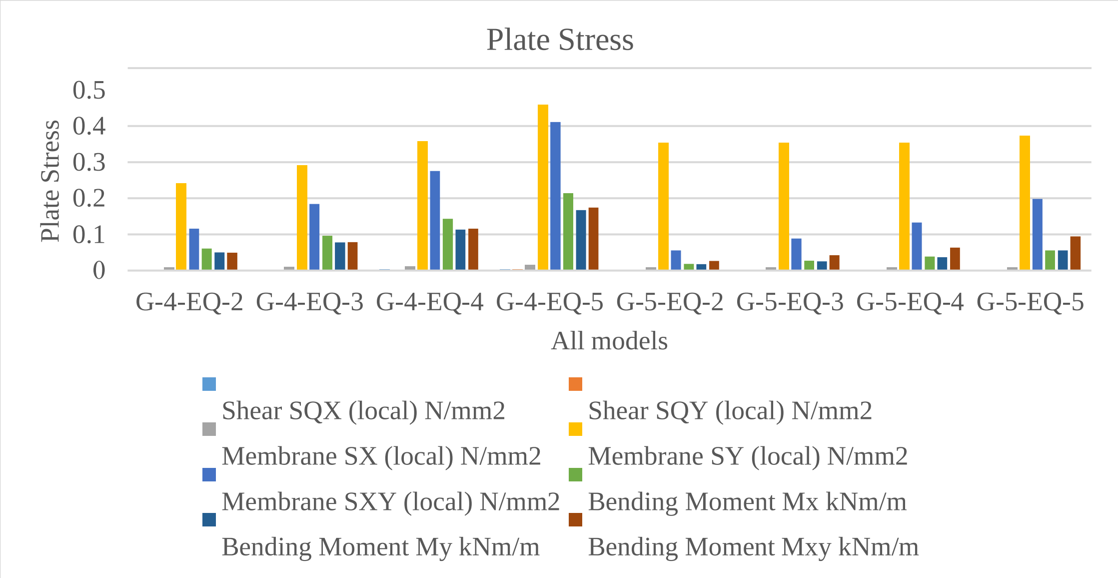

Fig.7 : Plate Stresses for all the models

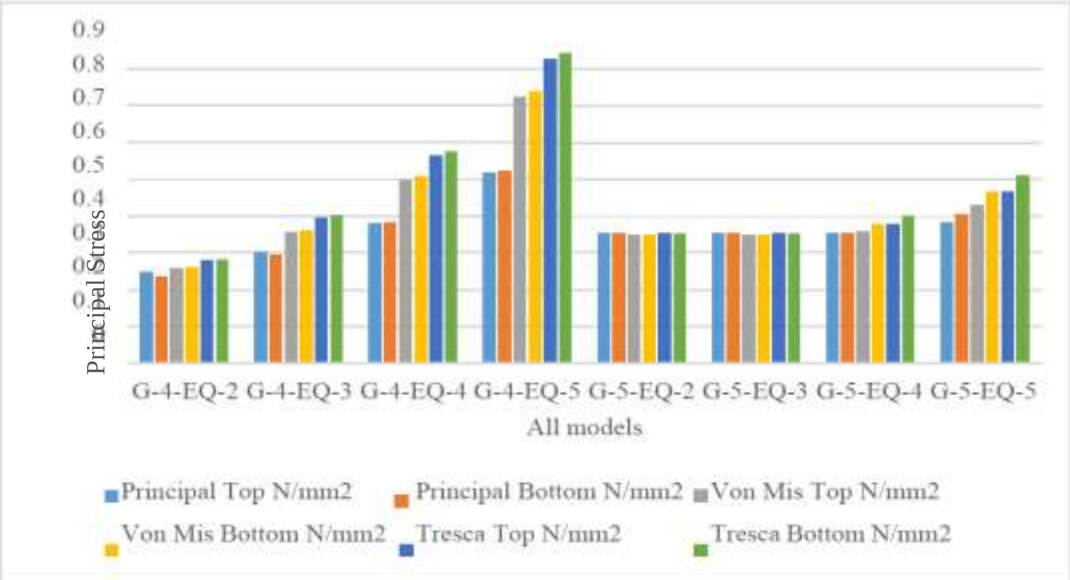

Fig.8: Principal Stresses for all the models

5. CONCLUSIONS

This excerpt appears to discuss the seismic performance of different structural systems, particularly concrete shear walls and steel bracings, in hybrid steel buildings subjected to earthquake loading, with a specific focus on seismic Zone-V.
Hybrid Structural System:
The term "hybrid" suggests that the building employs a combination of concrete shear walls and steel bracings as its primary lateral force resisting system. This approach is common in seismic design, as it combines the strengths of both materials to enhance overall structural performance.

Displacement and Reactions:
The statement indicates that the maximum displacement and reactions occur in models located in seismic Zone-V. Seismic Zone-V typically represents regions with the highest level of seismic activity and therefore experiences the most significant ground motion during earthquakes. Consequently, structures in Zone-V are subjected to larger displacements and higher forces, leading to increased reactions at the supports.

Plate Stresses:
The observation that plate stresses increase as the seismic zone becomes more severe is consistent with the behavior expected in earthquake-prone regions. Higher seismic forces experienced in Zone-V lead to increased demands on building components, including floor plates. This results in higher stress levels within the plates, which can affect their performance and may necessitate design modifications or reinforcement.

Effectiveness of Hybrid System:
The conclusion that the hybrid shear wall and bracing system are effective in counteracting seismic forces suggests that the chosen structural configuration successfully mitigates the effects of seismic loading. Hybrid systems leverage the strengths of both concrete and steel elements to provide robust resistance against lateral forces, ensuring the structural integrity and stability of the building during earthquakes.

Overall, this excerpt highlights the importance of selecting appropriate structural systems and designs to withstand the challenges posed by seismic activity, particularly in high seismic zones like Zone-V. It underscores the effectiveness of hybrid structural systems in enhancing seismic resilience and reducing the vulnerability of buildings to earthquake- induced damage.

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