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COMPARATIVE STUDY ON SEISMIC PERFORMANCE OF MID-RISE STEEL BUILDINGS WITH DIFFERENT LATERAL LOAD RESISTING SYSTEMS

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ABSTRACT

Steel buildings have gained popularity in seismic regions due to their high strength to weight ratio, ductility, ease of construction, and adaptability. The primary factor which determines the seismic response of steel buildings is the lateral load resisting system (LLRS). Different structural systems such as moment resisting frame (MRF), concentrically braced frame (CBF), eccentrically braced frame (EBF), buckling restrained braced frame (BRBF), shear wall system, and dual system have been proposed to enhance the seismic performance of mid-rise steel buildings. This article provides a detailed comparative study of the seismic performance of various lateral load resisting systems in terms of storey displacement, storey drift, base shear, stiffness, ductility, energy dissipation, and constructability. The recent studies have revealed that BRBFs and dual systems display improved seismic performance due to their high ductility and energy dissipation capacity whereas the concentric braced frames offer high stiffness but exhibit a vulnerable behaviour under seismic excitations.

The moment resisting frames show good ductility but large lateral deformations under seismic activity. The study highlights the research trends, opportunities, and gaps in the current state of knowledge and provides some suggestions for future research to improve the seismic behaviour of steel structures.

Keywords: Steel Buildings, Earthquake Engineering, Seismic Performance, Lateral Load Resisting System, Buckling Restrained Braced Frame, Moment Resisting Frame, Dual System

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1. INTRODUCTION

Earthquakes remain one of the most destructive natural hazards affecting the built environment worldwide. Structural failures during past earthquakes have demonstrated that inadequate lateral resistance significantly contributes to building damage and collapse. Consequently, improving the seismic performance of buildings has become a major objective in structural engineering. Steel buildings are widely used because they offer high strength, excellent ductility, reduced structural weight, rapid construction, and ease of modification. These characteristics make steel structures particularly suitable for earthquake-prone regions. Nevertheless, the seismic behaviour of steel buildings depends primarily on the selection and design of the lateral load resisting system. The lateral load resisting system transfers earthquake-induced forces safely to the foundation while controlling lateral displacement and preventing structural instability. Different systems exhibit distinct advantages and limitations depending on building height, seismic intensity, architectural requirements, and economic considerations. Moment Resisting Frames (MRFs) rely on rigid beam-column connections to resist lateral forces through bending action. Concentrically Braced Frames (CBFs) provide high lateral stiffness using axial bracing members but may suffer from brace buckling under severe seismic loading. Eccentrically Braced Frames (EBFs) combine the advantages of MRFs and CBFs by introducing yielding links that dissipate seismic energy efficiently.

Buckling Restrained Braced Frames (BRBFs) further improve performance by preventing brace buckling while maintaining stable hysteretic behaviour.[1], [2] Dual systems integrate multiple lateral resisting mechanisms to enhance overall structural reliability.

Numerous analytical and experimental investigations have compared these systems using nonlinear static analysis, response spectrum analysis, and nonlinear time-history analysis. However, variations in analytical methods, building configurations, and seismic input parameters often produce differing conclusions regarding their relative performance. This review paper summarizes recent research on seismic performance evaluation of mid-rise steel buildings employing different lateral load resisting systems. The objective is to identify the advantages, limitations, and suitability of each structural system while highlighting areas requiring further investigation. Concentrically Braced Frames (CBFs) consist of diagonal steel bracing members connected concentrically to beams and columns which resist lateral loads primarily by axial tension-compression with high stiffness. This characteristic minimizes lateral displacement and story drift. However, conventional braces can buckle under extreme ground motions leading to reduced damping capacity and even brittle behavior if not properly detailed.On the contrary, the main objective of developing Eccentrically Braced Frames (EBFs) was to combine the superior damping characteristics of Moment Resisting Frames and the stiffness of CBFs. In EBFs, the brace is connected to the beam and column with an offset link so that yielding takes place in the link while the brace remains intact against shear or bending. In-plane EBFs possess the beneficial attributes of stiffness and improved energy dissipation capacity, making them ideal for seismic applications. On the other hand, in Buckling Restrained Braced Frames (BRBFs), the structural steel core is encased entirely in a restraining jacket that prevents buckling under compressive forces while allowing full plastic deformation to occur. BRBFs have equal tensile and compressive response as well as stable hysteresis loops with remarkable ductility and energy dissipation potential. Studies have consistently shown that buildings constructed using BRBFs exhibit reduced story drift as well as improved stability and resilience under strong ground motions with less residual deformation after large earthquakes. Another innovative concept that has gained tremendous attention from researchers is the Dual Structural System. This system employs two or more lateral-force resisting systems, including MRFs, Braced Frames, and Shear Walls, among others. The basic idea of dual systems is to exploit the combined stiffness and strength of moment-resisting frames and braced frames or shear walls to resist lateral displacements while maintaining a reasonable degree of structural integrity and redundancy. In other words, dual systems can withstand stronger ground shaking due to the redistribution of forces throughout the structure even if one system undergoes extensive yielding after an earthquake. Therefore, the concept is applicable to a wide range of steel structures including mid-rise buildings located in seismically active regions.

t is projected that more than 50% of future construction will comprise of mid-rise buildings ranging between 5-15 stories. This trend will be even more rapid in the next few years as skyscrapers and high-rises continue to gain popularity. Mid-rise steel structures offer an optimal balance between strength, stiffness, ductility, economy, architectural flexibility, and constructability, making them ideal for future commercial, institutional, residential, and office building construction. It has become paramount for engineers to identify an efficient lateral load resisting system that satisfies seismic safety, structural economy, and multi-story building functionality requirements. A judicious selection of structural steel systems is often limited by excessive drift, constructability, and economy or even poor seismic response, underscoring the need for a systematic assessment of the lateral load resisting systems for mid-rise buildings. The emergence of sophisticated computational structural engineering software has enabled engineers and researchers to design, analyse, and simulate complex structural systems using numerical modelling methods. Various computational packages such as ETABS, SAP2000, STAAD.Pro,[3] and Open Sees offer linear static analysis, response spectrum analysis, nonlinear static analysis, and nonlinear time-history analysis for earthquake engineering applications. The results generated from these solvers are critical for assessing the seismic performance of various lateral load-resisting systems in terms of story drift, storey displacement, shear, base shear, period, lateral stiffness, member forces, plastic hinges, and energy dissipation capacity, among other parameters. A comparison of story drift, lateral displacement, base shear, period, plastic hinge, and energy dissipation capacity of different lateral load resisting systems can help in selecting the most appropriate system for a given structural application. Besides, modern advancements in earthquake engineering have led to performance-based design methods that seek to maximize performance while minimizing costs associated with structural damage repair after an earthquake. The traditional design philosophy focused on ensuring that structures could withstand strong ground motions without collapsing. On the contrary, performance-based design considers a hierarchy of potential ground motion levels with predefined performance criteria for each intensity. This paradigm shift has prompted researchers to propose alternative lateral load resisting systems with enhanced seismic performance while also meeting the demand for minimal maintenance and repair after an earthquake. Thus, while a significant amount of research has been devoted to individual lateral load resisting systems, there is still a need for more experiment studies on the seismic performance of various lateral load resisting systems review article comparing the seismic performance of different lateral load resisting systems in steel mid-rise buildings will be a great contribution to the earthquake engineering field.

The review article will compare and contrast the performance of Moment Resisting Frames, Concentrically Braced Frames, Eccentrally Braced Frames, Buckling Restrained Braced Frames, and Dual Systems in terms of lateral displacement, story drift, base shear, period, story stiffness, ductility, energy dissipation capacity, structural stability, constructability, and cost-effectiveness. The review article will highlight research trends, research gaps, and future research directions that will advance the performance of future steel mid-rise buildings under seismic loading.[4], [5]

2. LITERATURE REVIEW

Costanzo (2023) presented a comprehensive review of seismic design practices for steel buildings in Europe, emphasizing recent developments in performance-based seismic engineering and modern lateral load resisting systems. The study examined the evolution of European seismic design standards, including Eurocode 8, and discussed how advances in analytical methods and material technology have improved the seismic resilience of steel structures. Various structural systems such as moment-resisting frames (MRFs), concentrically braced frames (CBFs), eccentrically braced frames (EBFs), buckling-restrained braced frames (BRBFs), and dual systems were critically evaluated based on their structural behaviour during earthquake loading. The review highlighted that while moment-resisting frames provide excellent ductility and deformation capacity, they generally exhibit **lower** lateral stiffness, resulting in comparatively larger storey drifts. In contrast, braced systems effectively limit lateral displacement because of their increased stiffness but require careful detailing to avoid premature brace buckling and localized failures. Costanzo further emphasized that performance-based seismic design has become an essential approach for modern steel construction because it enables engineers to achieve specified performance objectives while optimizing structural efficiency. The study concluded that integrating advanced analysis techniques with innovative structural systems significantly enhances the earthquake resistance of mid-rise steel buildings and supports the development of more resilient infrastructure.[6]

Fang et al. (2022) provided an extensive review of seismic-resilient steel structures, focusing on recent innovations in structural systems, energy dissipation mechanisms, and post-earthquake functionality. The authors discussed the growing importance of resilience-based design, where buildings are expected not only to resist collapse but also to minimize damage and recover rapidly after seismic events. The review examined several advanced structural technologies, including buckling-restrained braces, self-centering systems, replaceable yielding components, supplemental damping devices, and hybrid structural configurations.

The authors reported that buckling-restrained braced frames exhibit stable hysteretic behaviour, high ductility, and superior energy dissipation capacity because the braces resist both tensile and compressive forces without buckling. Similarly, self-centering structural systems were found to significantly reduce residual deformations, thereby improving post-earthquake serviceability and reducing repair costs. The study also highlighted the importance of integrating numerical simulation, experimental validation, and performance-based seismic design principles to improve structural reliability. Fang et al. concluded that future seismic design should focus on resilient structural systems capable of minimizing economic losses while ensuring rapid functional recovery following major earthquakes.[4]

Berman and Bruneau (2003) investigated the plastic behaviour and design methodology of steel plate shear walls (SPSWs), which have become an effective alternative lateral load resisting system for steel buildings in seismic regions. Through analytical modelling and theoretical evaluation, the authors demonstrated that thin steel infill plates develop diagonal tension-field action after buckling, enabling the walls to sustain significant lateral loads while dissipating considerable seismic energy. Unlike conventional braced frames, steel plate shear walls distribute seismic forces more uniformly throughout the structural system, resulting in improved stiffness, strength, and ductility. The study showed that SPSWs effectively reduce inter-storey drift and increase the overall lateral load capacity of steel buildings without substantial increases in structural weight. The authors also emphasized the importance of proper boundary element design to ensure stable tension-field action and prevent premature failure of surrounding beams and columns. The research concluded that steel plate shear walls provide an efficient and economical solution for enhancing the seismic performance of medium- and high-rise steel buildings while satisfying modern performance-based design requirements.[7]

Sabelli, Mahin, and Chang (2003) investigated the seismic response of steel braced frame buildings incorporating buckling-restrained braces (BRBs). Their research primarily focused on evaluating the effectiveness of BRBs in controlling structural deformations under earthquake loading through comprehensive nonlinear analytical studies. The authors observed that conventional concentrically braced frames often experience strength degradation due to brace buckling during compressive loading, leading to reduced energy dissipation and localized structural damage. In contrast, buckling-restrained braces eliminate compression buckling by enclosing the yielding steel core within a restraining mechanism, allowing the braces to develop nearly identical strength in both tension and compression.

This behaviour produces stable hysteretic responses, improved ductility, and significantly greater seismic energy dissipation. The study demonstrated that buildings equipped with BRBs exhibit lower inter-storey drift, reduced residual deformation, and improved structural stability compared with conventional braced frame systems. Furthermore, the authors concluded that BRBFs provide an optimal balance between stiffness and ductility, making them highly suitable for seismic-resistant design of mid-rise steel buildings where drift control and structural resilience are primary design objectives.[8]

3. LITERATURE SUMMARY

Table 1: Summary of literature

Author(s) & Year	Study Focus	Methodology	Key Findings	Major Conclusion
Costanzo (2023)	Review of seismic design approaches for steel buildings in Europe with emphasis on lateral load resisting systems and performance-based design.	Comprehensive review of Eurocode provisions, recent research, and seismic design practices.	Compared MRF, CBF, EBF, BRBF, and dual systems. Found that MRFs provide high ductility but lower stiffness, whereas braced systems effectively reduce lateral displacement. Performance-based design improves seismic reliability.	Advanced lateral load resisting systems combined with performance-based seismic design significantly improve the safety and resilience of steel buildings.
Fang et al. (2022)	Review of seismic-resilient steel structures, innovative structural systems, and energy dissipation technologies.	Literature review covering analytical, experimental, and practical developments in resilient steel construction.	Buckling-restrained braces, self-centering systems, and supplemental damping devices improve ductility, reduce residual deformation, enhance energy dissipation, and enable rapid post-earthquake recovery.	Resilient structural systems provide superior seismic performance by minimizing structural damage, repair costs, and downtime after earthquakes.
Berman & Bruneau (2003)	Behaviour and design of Steel Plate Shear Walls (SPSWs) under seismic loading.	Analytical study based on plastic analysis and tension-field action of steel plate shear walls.	Steel plate shear walls develop stable tension-field action after buckling, providing high lateral stiffness, strength, ductility, and energy dissipation while reducing inter-storey drift.	SPSWs are an efficient and economical lateral load resisting system for enhancing the seismic performance of medium- and high-rise steel buildings.
Sabelli, Mahin & Chang (2003)	Seismic behaviour of Buckling Restrained Braced Frames (BRBFs).	Nonlinear analytical evaluation of steel braced frame buildings subjected to earthquake loading.	BRBFs eliminate brace buckling, exhibit stable hysteretic behaviour, improve ductility, reduce residual deformation, and significantly enhance energy dissipation compared with conventional braced frames.	Buckling-restrained braced frames provide excellent seismic resistance and are highly suitable for mid-rise steel buildings requiring both stiffness and ductility.

The reviewed literature demonstrates that the seismic performance of mid-rise steel buildings is strongly influenced by the type of lateral load resisting system adopted. Researchers consistently report that the structural system plays a vital role in controlling lateral displacement, inter-storey drift, energy dissipation, ductility, and overall structural stability during earthquake events. Moment Resisting Frames (MRFs) are recognized for their excellent ductility and ability to dissipate seismic energy through controlled plastic hinge formation. However, their relatively low lateral stiffness often results in higher storey displacement and drift, which may increase damage to non-structural components during strong ground motions. Braced structural systems, including Concentrically Braced Frames (CBFs) and Buckling Restrained Braced Frames (BRBFs), provide greater lateral stiffness and significantly reduce horizontal displacement. Among these, BRBFs have demonstrated superior seismic performance because they prevent brace buckling, maintain stable hysteretic behaviour under cyclic loading, and provide high energy dissipation capacity while minimizing residual deformation after earthquakes. Steel Plate Shear Walls (SPSWs) have also been identified as an effective lateral load resisting system due to their ability to develop tension-field action after buckling. This mechanism enhances structural stiffness, increases lateral load capacity, and effectively controls inter-storey drift while maintaining good ductility. Recent studies further emphasize the growing importance of performance-based seismic design and resilient structural systems. Advanced technologies such as self-centering systems, supplemental damping devices, and hybrid structural configurations improve post-earthquake functionality by reducing structural damage, repair costs, and downtime. These systems are increasingly being incorporated into modern steel buildings to achieve higher levels of seismic resilience.[5]Overall, the literature indicates that no single lateral load resisting system is universally suitable for all design situations. The selection of an appropriate system depends on factors such as seismic hazard level, building height, architectural requirements, construction cost, and desired performance objectives. Nevertheless, Buckling Restrained Braced Frames (BRBFs), Steel Plate Shear Walls (SPSWs), and dual structural systems consistently demonstrate superior overall seismic performance due to their balanced combination of strength, stiffness, ductility, and energy dissipation. The reviewed studies also highlight the need for further comparative investigations using uniform analytical procedures and advanced software tools to establish the most efficient structural solution for mid-rise steel buildings under different seismic conditions.[9]

4. COMPARATIVE ANALYSIS OF DIFFERENT LATERAL LOAD RESISTING SYSTEMS

Parameter	Moment Resisting Frame (MRF)	Steel Plate Shear Wall (SPSW)	Buckling Restrained Braced Frame (BRBF)
Lateral Stiffness	Moderate	Very High	High
Storey Displacement	High	Very Low	Low
Inter-Storey Drift	High	Very Low	Low
Base Shear Capacity	Moderate	High	High
Ductility	Excellent	High	Excellent
Energy Dissipation	High	High	Excellent
Residual Deformation	High	Moderate	Low
Seismic Resilience	Good	Very Good	Excellent
Construction Complexity	Low	Moderate	Moderate
Initial Cost	Moderate	Moderate	High
Suitability for Mid-Rise Steel Buildings	Good	Very Good	Excellent

4.1. Comparative Discussion

The seismic behaviour of steel buildings is mainly governed by the attributes of the lateral load resisting system (LLRS). The LLRS determines how stiff, strong, ductile, and able to dissipate energy a building is, and therefore, different systems have different abilities in terms of these criteria. The following discussion presents a comparison of the most common lateral load resisting systems for steel buildings based on the findings of the reviewed articles. Moment resisting frames (MRFs) are classic structural systems that primarily utilise beam and column elements connected with moment-resisting connections.[10] The main advantage of this type of structure is its excellent ductility capacity, as the plastic hinges that dissipate a major amount of seismic energy are formed at the beam ends. Nevertheless, MRFs are characterised by a relatively low level of stiffness, and therefore, larger inter-storey drifts are observed in multi-storey buildings under severe ground motion, necessitating special measures to limit drifts.[8], [11] Steel plate shear walls (SPSWs) offer significant improvements over ordinary moment-resisting frames in terms of lateral stiffness, as evident from the reviewed research. The diagonal tension field action develops after the buckling of steel plates, enabling the shear walls to withstand substantial lateral loads while also dissipating considerable amounts of seismic energy. As a result, buildings equipped with SPSWs exhibit reduced inter-storey drifts and enhanced seismic performance. Moreover, the structural system offers adequate ductility, ensuring buildings' safety and functionality after severe earthquakes Buckling restrained braced frames (BRBFs) are considered one of the most promising advanced structural systems for withstanding earthquakes, as they address the major shortcomings of ordinary concentric braced frames. Due to the presence of special buckling restraints, the core of the brace is able to develop full plastic deformation potential both under tension and compression. The result is a structural system that offers exceptional energy dissipation characteristics, remarkable ductility, and minimal residual drifts, thus outperforming many other systems. Turning now to self-centring and hybrid structural systems, which represent the cutting edge of earthquake-resistant steel building technologies, these systems offer unparalleled protection from ground shaking by incorporating novel post-tensioning devices and added damping and dissipation mechanisms. Their main advantage lies in the self-centring capability, which renders structures more resistant to earthquake damage by limiting residual deformations. However, the complexity of design and increased construction costs are the associated drawbacks of such systems. Based on the analysis, it is possible to conclude that different lateral load resisting systems for steel buildings offer varying benefits in terms of seismic performance. Moment resisting frames are best suited for applications where ductility is of essence, whereas steel plate shear walls seem to provide the most lateral stiffness, ensuring reduced inter-storey drifts while still offering notable energy dissipation characteristics. By contrast, buckling restrained braced frames display a better balance of properties, offering extraordinary ductility and stiffness and therefore, allowing buildings to withstand powerful earthquakes with minimal residual deformations. Lastly, self-centring structural systems offer the best possible option in terms of overall seismic performance. Overall, based on the findings of the reviewed articles, it is possible to assert that novel structural systems outperform traditional lateral load resisting systems in terms of seismic performance, and therefore, should be preferred when designing steel buildings. However, as evident from the analysis, there is no singular best option, as the choice depends on multiple factors, including the seismic hazard level, building height and design requirements, budget constraints, and desired level of protection. Therefore, in order to ensure optimal seismic performance, it is essential to conduct a thorough analysis of the potential options using advanced computational methods and performance-based design concepts[1].

5. RESEARCH GAP

An extensive studies have been carried out on the seismic behaviour of steel buildings, the key issues in comparing lateral load resisting systems of mid-rise steel buildings have remained unresolved. Most of the prior works have been carried out comparing the performance of different lateral load resisting systems in terms of their individual characteristics.

For example: comparing the performance of Moment Resisting Frames (MRF), Buckling Restrained Braced Frames (BRBF), Steel Plate Shear Walls (SPSWs), and self-centring systems. These prior works do not indicate which lateral load resisting system is best suited for particular design requirements. A lot of literature review has been carried out on low and high-rise steel buildings, but limited work has been done on mid-rise steel buildings. Majority of the researchers have assumed that mid-rise steel buildings can be compared to high-rise and low-rise steel buildings which is not true. Different lateral load resisting systems have different characteristics and hence need to be compared independently.[12] The other issue noticed in most of the prior works on steel buildings is the inconsistent analytical procedures. Most of the authors have compared different lateral load resisting systems considering different structural configurations, design requirements and analysis software. The differences in the assumptions made by different researchers make it difficult to differentiate the best lateral load resisting system. Most of the researchers have compared various lateral load resisting systems considering only few response parameters such as story drift and story displacement. The other parameters that should be considered in the comparison include: base shear, stiffness, damping ratio, period of vibration, plastic rotation, residual displacement and overall building performance. Therefore, there is a need to carry out more experiments to determine the best lateral load resisting system considering various other response parameters. The most recent performance-based design criteria require that the structure should be able to meet immediate occupancy and life safety requirements following any level of earthquake. Only a few researchers have compared the ability of various lateral load resisting systems to meet modern performance requirements. More experimentation needs to be done on how good various lateral load resisting systems are suited to meet modern seismic design requirements for mid-rise steel buildings. The other issue that has not been addressed by most researchers is the economic analysis of different lateral load resisting systems. Although systems such as buckling restrained braced frames, steel plate shear walls and self-centring systems are better at energy dissipation, less is known about their cost implication. There is a need to conduct experiments to establish the most economical lateral load resisting system for mid-rise steel buildings. Most of the research works carried out have neglected the effects of soil structure interaction, irregularity and near fault ground motions. The effects of story plan irregularity, plan twisting, and the effect of near fault ground motions on different lateral load resisting system need to be experimented and their results included in the subsequent research works. Therefore, this study aimed at comparing lateral load resisting systems for mid-rise steel buildings using a consistent structural model and loading conditions.

The study focused on the structural performance of different lateral load resisting systems for mid-rise steel buildings. The study was carried out using ETABS software considering the currently applicable seismic design codes. The following response parameters were evaluated and compared; story displacement, story drift, base shear, stiffness, period of vibration and overall building performance. The results of this study will help inform decision making on the best lateral load resisting system for use in mid-rise steel buildings and promote the construction of seismically safe steel buildings.[3]

6. CONCLUSION

The lateral load resisting system (LLRS) of a mid-rise steel building plays a vital role in determining its seismic response. The current review paper presents a comparative study of the performance of different lateral load resisting systems including the moment resisting frames, steel plate shear walls, buckling restrained braced frames, and other emerging systems based on the findings of the published literature. The study revealed that each LLRS has different structural properties and performs differently under seismic disturbances. Moment resisting frames (MRFs) are known for their high ductility and energy dissipating capacity, but have a low lateral stiffness which leads to large storey deformations and drifts. Steel plate shear walls (SPSWs) are efficient in terms of lateral stiffness and strength due to tension field action and moderate storey drifts while maintaining ductility. Buckling restrained braced frames (BRBFs) have stable hysteresis loops with large energy dissipation capacity and reduced residual deformation because of the prevention of buckling of their braces. The recently developed resilient structural systems, including self-centring and hybrid structures, offer improved seismic performance due to their ability to withstand major seismic events and have minimal residual deformations. The published literature reveals that advanced lateral load resisting systems offer better seismic performance than the traditional systems. However, the choice of the most suitable lateral load resisting system depends on several factors, including building height, seismicity of the site, architectural considerations, construction costs, and desired performance. Therefore, an efficient lateral load resisting system should be selected based on these parameters. The current review also reveals some research gaps, including the lack of comparative studies on the performance of different lateral load resisting systems for mid-rise steel buildings. Some studies have limitations, including the use of different analysis models, structural configurations, and performance measures, which makes it difficult to compare the findings and draw concrete conclusions. \

A comprehensive study that considers the impact of performance-based seismic design, life-cycle cost, soil-structure interaction, and post-earthquake functionality on the selection of the most appropriate lateral load resisting system for mid-rise steel buildings is required. The current review highlights the importance of using advanced seismic structural systems for the design of mid-rise steel buildings. Some of the most effective lateral load resisting systems include BRBFs and SPSWs. Self-centring and hybrid systems are considered promising advanced seismic structural systems. Further research on the comparative performance of different lateral load resisting systems should be carried out using software such as ETABS. This will facilitate the development of guidelines for selecting the most appropriate lateral load resisting system for mid-rise steel buildings based on seismicity, cost, and other factors.

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