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Study of Multistoried Building with and Without Shear Wall Using Software: A Review

Ravi Dipak Hirurkar[1], Prof. Ms. S. C. Sagane[2]
[1]PG student, Department of Civil Engineering, Prof. Ram Meghe Institute of Technology & Research, Badnera, Maharashtra, India
[2]Assistant Professor, Department of Civil Engineering, Prof. Ram Meghe Institute of Technology & Research, Badnera, Maharashtra, India

Abstract: This review article offers a thorough summary of current studies regarding the structural performance of multistorey structures, both with and without shear walls, emphasising their behaviour under seismic stresses. The study incorporates several approaches and results from prior experimental, analytical, and computational research to emphasise the function and enhancement of shear wall systems in bolstering structural robustness. Researchers have investigated several layouts, materials, and jointing methods in precast and cast-in-place shear walls to improve seismic performance. Innovative design concepts, including damage avoidance, the use of replacement components, and advanced connecting procedures, have demonstrated potential in reducing post-earthquake damage and facilitating swift recovery. Moreover, the strategic placement of shear walls, the incorporation of self-centering materials, and adherence to contemporary seismic regulations have been analysed as pivotal elements influencing the overall performance of structures. This analysis highlights deficiencies in present understanding and advocates for enhanced modelling, material innovation, and standardised assessment methods to guarantee structural safety in future designs.
Keywords: shear walls, seismic performance, reinforced concrete, precast systems, structural resilience, damage mitigation.

I. INTRODUCTION

The design and analysis of multistorey buildings are critical processes in modern construction, aimed at ensuring structural integrity, safety, and functioning throughout the building's lifespan. Multistorey buildings, due to their height and complexity, withstand many loads, including vertical forces from gravity and lateral forces caused by external causes such as wind, seismic activity, and other dynamic effects. Lateral pressures provide a significant challenge, since they can cause excessive deflections, instability, and, in severe cases, structural failure. Lateral forces, such as those generated by wind and seismic activity, apply horizontal pressure on the structure, leading to significant stress on its structural elements. These forces can induce bending, twisting, and shear in the structure, possibly resulting in undesirable movements or failure if not properly controlled. The magnitude of these forces is exacerbated in high-rise structures due to their elevation, increased wind pressure exposure, and the dynamic amplification of seismic effects. Engineers employ several lateral load-resisting solutions in the structural construction of multistory buildings to mitigate these challenges. These systems are designed to endure lateral forces and ensure the stability and safety of the structure. The shear wall system is recognised as one of the most effective and often employed options. Shear walls are vertical structural elements, often made of reinforced concrete or masonry, designed to resist lateral forces applied to the building. They work by conveying these stresses from the upper portions of the structure to the foundation, acting as vertical cantilevers. Their increased stiffness and strength make them highly effective in reducing lateral displacements, controlling inter-story drift, and preventing potential damage or collapse under dynamic loads. In addition to its structural benefits, shear walls demonstrate adaptability in their placement inside a structure. They are sometimes situated along the building's perimeter, within the core (e.g., near stairwells or elevator shafts), or symmetrically constructed to maintain balance and mitigate torsional effects. Their integration into the structural framework enhances lateral load resistance and strengthens the overall stability of the building under vertical and horizontal forces.

II. LITERATURE REVIEW

A. Introduction

The purpose of this chapter is to review and synthesize existing literature related to the structural performance of multistorey buildings with and without shear walls. It covers key research findings, methodologies, and analytical approaches adopted by previous studies. The chapter also identifies gaps in the existing knowledge and highlights the need for further investigation into the comparative performance of buildings with varying configurations of shear walls.

B. Literature Review

Tulay Aksu Ozkul et al. (2019) noted that time history studies were performed using SAP 2000. Furthermore, material properties were enhanced, and shear walls were engineered in accordance with the Turkish Seismic Code 2007 stipulations for both structures. Nonlinear time history studies were performed on the improved structures, and damage distributions were ascertained. Consequently, the damage distributions of both existing and upgraded structures were compared, and an assessment was conducted regarding the damage distribution, even when just appropriate concrete, reinforced materials, and shear walls were utilised in the building design, excluding beams and columns. The study's results indicate that utilising appropriate materials and shear walls can mitigate significant damage, even when the seismic response of beam and column parts is inadequate.

Wael El-Dakhakhni et al. (2017) provide a succinct state-of-the-art assessment on research concerning the seismic response of reinforced masonry shear walls (RMSW), emphasising published studies from the 1980s mostly involving RMSW constructed with concrete blocks. The document is structured around two primary focal points: RMSW components (i.e., individual walls) and RMSW systems (i.e., entire structures). The components literature survey is divided into five pieces to enhance readability. This section emphasises the experimental, numerical, and analytical investigations concerning the seismic response of RMSW, categorised as follows: (1) fully grouted and squat; (2) fully grouted and slender; (3) fully grouted and end-confined; (4) fully or partially grouted and coupled or featuring openings; and (5) partially grouted.

Shubham Singhal et al. (2019) identified that precast reinforced concrete (RC) structures sustained significant damage in previous earthquakes, which was ascribed to the seismic performance of the connections among components. Therefore, enhancing joint connection details and implementing seismic-resistant characteristics in precast structures, such as the inclusion of precast shear walls, is very important. Global researchers have conducted comprehensive experimental investigations to assess the behaviour of precast reinforced concrete walls under lateral stress. This study examines general ideas, codal provisions, precast reinforced concrete wall connections, a review of experimental data, and the impact of post-tensioning on precast reinforced concrete walls.

Mohammad Khanmohammadi et al. (2015) examined the emergence of a damage avoidance design philosophy in recent years, as opposed to the conventional damage-oriented design approach, to alleviate the damage sustained by buildings. Consequently, the rocking system, a technique for mitigating seismic stresses on buildings, together with energy dissipation devices and restoring force systems, has been thoroughly established. A significant number of studies have been undertaken to examine the seismic performance of base-rocking systems on precast segmental bridge piers, shear walls, and steel braced frames. In recent years, several studies have examined the behaviour of numerous rocking systems; yet, ambiguities remain regarding the specifics and responses of this system.

Shao-Dong Shen et al. (2019) found that reinforced concrete precast shear walls are widely utilised in practical engineering due to their rapid construction speed. Due to shipping conditions, RC precast shear walls must be divided into smaller parts during the factory prefabrication process before to on-site assembly. Generally, wet-type jointing techniques are employed to connect the segments, which is labour-intensive and leads to inconsistent strength in the post-pouring area. A unique solution to this issue is offered, including a steel shear key (SSK) that incorporates steel shear panels and a combination of fillet and plug welding. Three RC precast shear wall specimens, designated as weakened SSK wall, normal SSK wall, and strengthened SSK wall, together with an integrated shear wall specimen, were developed with varying connecting strengths.

Jesper Harrild Sørensen et al. (2016) introduces an innovative and construction-friendly shear connection for the assembly of precast reinforced concrete shear wall parts. The suggested design has precast components with indented interfaces, joined by a thin zone filled with mortar and strengthened by overlapping U-bar loops. Unlike traditional shear connections, the planes of the U-bar loops are aligned parallel to the plane of the wall components. This characteristic facilitates a construction-friendly installation of the components, eliminating the possibility of rebar interference. The mortar in the centre of each U-bar loop is fortified with a transverse double T-headed bar to facilitate stress transmission between the overlapping U-bars.

Mohammad Javad Tolou Kian et al. (2018) [7] describe the experimental findings of a pilot research on the seismic performance of three varieties of damage-resistant, slender reinforced concrete (RC) shear walls. The paper examines three novel strategies for alleviating post-earthquake damage, encompassing persistent lateral deformation and concrete deterioration in reinforced concrete shear walls. Each novel shear wall possessed an aspect ratio of 2.0 and was fortified with a hybrid reinforcement system including mild steel and a self-centering reinforcement type, such shape memory alloy bars, glass fibre reinforced polymer bars, or high-strength steel strands. To prevent concrete deterioration, the walls were constructed using fiber-reinforced cementitious composites, specifically designed cementitious composite or steel fiber-reinforced concrete.

Yasamin Rafie Nazari and Murat Saatcioglu (2017) noted that the seismic vulnerability assessment of shear wall structures can be performed via non-linear dynamic analysis, necessitating comprehensive analytical modelling, the evaluation of varying earthquake intensities, and structural performance metrics. Reinforced concrete shear wall structures were engineered for Vancouver, an area of significant seismic activity in Canada, to evaluate the seismic vulnerability of edifices built prior to and following the implementation of contemporary seismic design regulations. The structures were either two or five stories tall, constructed in accordance with the 1965 or 2010 National Building Code of Canada.

Qizhou Liu and Huanjun Jiang (2017) identified that reinforced concrete (RC) shear walls are widely utilised as lateral load-resisting structural elements in high-rise structures. In the past, significant seismic occurrences caused substantial damage to reinforced concrete structural walls in some structures, primarily concentrated at the base, rendering repairs exceedingly challenging. The placement of replaceable corner components (RCCs) at the base of the structural wall is an innovative approach to creating an earthquake-resistant structural wall, since the functionality may be rapidly reinstated by substituting the RCCs following significant seismic events due to damage being localised to the RCCs. This work presented a novel replaceable energy-dissipation component situated at the bottom corner of reinforced concrete structural walls.

Mayssa Dabaghi et al. (2019) investigate the performance of reinforced concrete shear wall structures during intense seismic ground vibrations, emphasising collapse behaviour. The impact of altering the number of storeys, size of shear walls and boundary elements, and reinforcing details on seismic collapse fragility is examined. The structures are engineered for seismic resilience in accordance with the ASCE 7-10 and ACI 318-14 standards, with supplementary measures for capacity design and dynamic amplification. The shear walls are represented using a shear-flexure interaction model comprising several vertical line elements with nonlinear hysteretic material properties.

LovaRaju, K., & Balaji, D. K. (2015) conducted a non-linear study of a frame considering alternative placements of shear walls within a building structure. This study aims to determine the optimal placement of shear walls in multi-storey buildings. Model one is a bare frame structural system, whereas the other three models are dual-type structural systems. An earthquake load is imposed on an eight-storey structure situated in zones II, III, IV and V according to the provisions of Code IS 1893-2002. The study was conducted via ETABS software. Pushover curves have been generated and analysed for many models. It has been noted that a building incorporating a shear wall at an optimal location is more critical concerning displacement and base shear.

Xiong, C., Lu, X., & Lin, X. (2019) observed that, based on the plane cross-sectional assumption and sectional analysis, damage limits can be determined by considering the influences of key design parameters of the shear wall, including the axial load ratio, shear wall component length, and material properties, resulting in a more precise estimation. The suggested approach is ultimately validated by comparison with the numerical results of various wall panels and a reinforced concrete frame-shear wall construction. This is further corroborated by comparing it with experimental data from six shear wall tests and a full-scale shaking table test of a seven-story shear wall construction.

III. CONCLUSIONS

1) Significant Role of Shear Walls: Shear walls play a critical role in enhancing the lateral load resistance of multistorey buildings, particularly in seismic-prone areas. Their inclusion significantly reduces displacement, base shear, and potential for structural collapse.
2) Material and Design Innovations: The use of high-performance materials such as fiber-reinforced concrete, shape memory alloys, and energy-dissipating components has improved the ductility and resilience of shear walls. Precast systems with innovative joint designs, such as steel shear keys and indented interfaces, offer both structural efficiency and construction feasibility.
3) Damage Mitigation Strategies: New design philosophies, such as damage avoidance and replaceable energy-dissipating components, are effective in reducing long-term repair costs and improving building recoverability after strong earthquakes.
4) Importance of Configuration and Placement: The structural performance is influenced by the placement and geometry of shear walls. Optimal positioning, particularly in dual structural systems, has shown improved response under seismic loading, as revealed through nonlinear and pushover analyses.
5) Need for Updated Seismic Design Practices: Studies emphasize the necessity of updating design standards to incorporate lessons from past earthquakes and modern materials. Comparative analyses of buildings designed under older and newer codes demonstrate the superior performance of code-compliant structures.
6) Research Gaps and Future Scope: Despite advancements, further research is required in the areas of multi-hazard performance, behavior of hybrid systems, life-cycle cost analysis, and full-scale dynamic testing. Standardizing analytical models and performance criteria will contribute to more robust and resilient structural designs.

REFERENCES

[1] Ozkul, T. A., Kurtbeyoglu, A., Borekci, M., Zengin, B., & Kocak, A. (2019). Effect of shear wall on seismic performance of RC frame buildings. Engineering Failure Analysis, 100, 60-75.

[2] El-Dakhakhni, W., & Ashour, A. (2017). Seismic response of reinforced-concrete masonry shear-wall components and systems: State of the art. Journal of Structural Engineering, 143(9), 03117001.

[3] Singhal, S., Chourasia, A., Chellappa, S., & Parashar, J. (2019). Precast reinforced concrete shear walls: State of the art review. Structural Concrete, 20(3), 886-898.

[4] Khanmohammadi, M., & Heydari, S. (2015). Seismic behavior improvement of reinforced concrete shear wall buildings using multiple rocking systems. Engineering Structures, 100, 577-589.

[5] Shen, S. D., Pan, P., Miao, Q. S., Li, W. F., & Gong, R. H. (2019). Test and analysis of reinforced concrete (RC) precast shear wall assembled using steel shear key (SSK). Earthquake Engineering & Structural Dynamics, 48(14), 1595-1612.

[6] Sørensen, J. H., Hoang, L. C., Olesen, J. F., & Fischer, G. (2017). Test and analysis of a new ductile shear connection design for RC shear walls. Structural Concrete, 18(1), 189-204.

[7] Tolou Kian, M. J., & Cruz-Noguez, C. (2018). Reinforced concrete shear walls detailed with innovative materials: seismic performance. Journal of Composites for Construction, 22(6), 04018052.

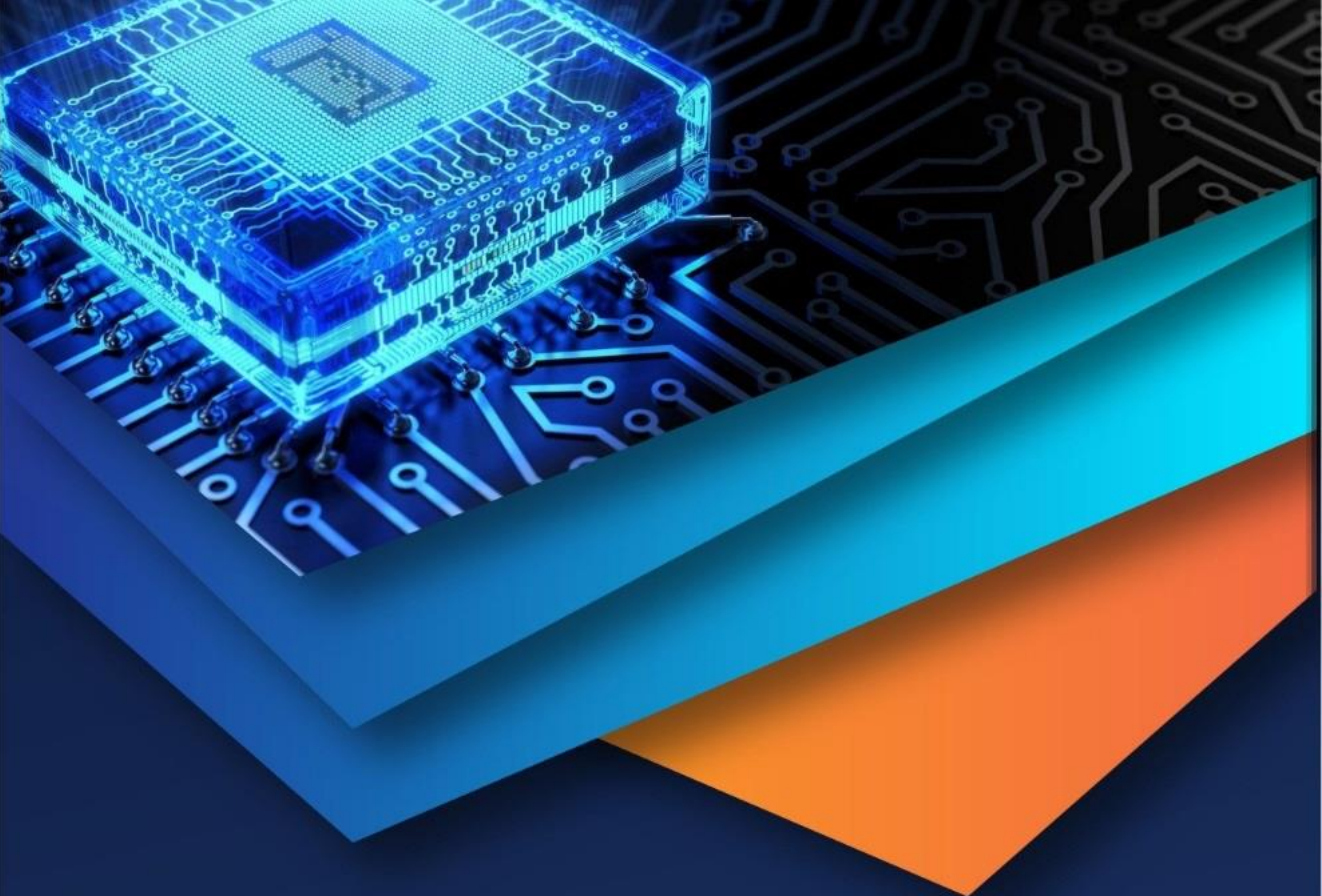
[8] Nazari, Y. R., & Saatcioglu, M. (2017). Seismic vulnerability assessment of concrete shear wall buildings through fragility analysis. Journal of Building Engineering, 12, 202-209.

[9] Liu, Q., & Jiang, H. (2017). Experimental study on a new type of earthquake resilient shear wall. Earthquake Engineering & Structural Dynamics, 46(14), 2479-2497.

[10] Dabaghi, M., Saad, G., & Allhassania, N. (2019). Seismic collapse fragility analysis of reinforced concrete shear wall buildings. Earthquake Spectra, 35(1), 383-404.

[11] LovaRaju, K., & Balaji, D. K. (2015). Effective location of shear wall on performance of building frame subjected to earthquake load. Int Adv Res J Sci Eng Technol, 2(1).

[12] Xiong, C., Lu, X., & Lin, X. (2019). Damage assessment of shear wall components for RC frame–shear wall buildings using story curvature as engineering demand parameter. Engineering Structures, 189, 77-88.



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