IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 7, May 2025
Impact Factor: 7.67

Investigating the Role of Shear Walls in Enhancing Seismic Performance of Buildings

Prof. K. S. Patil, Kalshetti Sanket Dayanand[1], Lavhate Ajit Niwas[2], Wadje Rohan Bhagwat[3], Gawali Pratik Mohan[4], Kundan Patil Vijay[5]
Professor, Department of Civil Engineering[1]
Students, Department of Civil Engineering[2-5]
Imperial College of Engineering, Pune, India

Abstract: *Shear walls are a crucial component of seismic-resistant building design, providing lateral strength, stiffness, and deformation capacity to structures. This study investigates the role of shear walls in enhancing the seismic performance of buildings, with a focus on reducing seismic damage and improving building resilience. A comprehensive review of existing literature and numerical analysis reveals that shear walls can significantly reduce inter-story drift, floor accelerations, and structural damage.*
The study examines the impact of shear wall design parameters, such as wall thickness, reinforcement ratio, and aspect ratio, on seismic performance. The results show that optimized shear wall design can lead to improved building performance, reduced damage, and enhanced resilience. The study also explores the effectiveness of different types of shear walls, including reinforced concrete, steel plate, and midply shear walls, in enhancing seismic performance

Keywords: Shear wall, Seismic performance, Lateral strength , Deformation capacity

I. INTRODUCTION

As urban populations continue to grow and building densities increase, the need for structures that can withstand seismic forces becomes ever more critical. Earthquakes pose significant risks to buildings, leading to loss of life and substantial economic damage. Among the various strategies to enhance a building's resistance to seismic activity, the incorporation of shear walls has gained prominence in modern architectural and engineering practices.
Shear walls are vertical structural elements designed to resist lateral forces, particularly those generated by seismic events and wind. These walls play a crucial role in enhancing the stiffness and strength of a building, effectively transferring lateral loads to the foundation and providing stability. The strategic placement and design of shear walls can significantly influence a building's overall seismic performance, impacting factors such as displacement, story drift, and structural integrity during and after seismic events.

II. PROBLEM STATEMENT

Buildings in seismically active regions are susceptible to significant damage and collapse during earthquakes, posing a threat to human life and infrastructure. Shear walls play a crucial role in resisting lateral loads and enhancing seismic performance, but their design and behaviour are complex. This study aims to investigate the role of shear walls in enhancing seismic performance of buildings, focusing on their impact on structural response, damage mitigation, and collapse prevention.

III. OBJECTIVE & ANALYSIS

- Investigate the effect of shear wall placement.
- To evaluate the seismic performance of buildings with and without shear walls, assessing their ability to withstand seismic forces.

DOI: 10.48175/IJARSCT-26815

ISSN 2581-9429 IJARSCT

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 7, May 2025
Impact Factor: 7.67

- To provide practical design recommendations for incorporating shear walls in new and existing Structures to improve seismic performance.

Model Details:

The building considered here is G+5 storey office building located in seismic zone III. The 3-D isometric view is shown in figure 2 and figure 3. The plan of building is shown in figure 4.

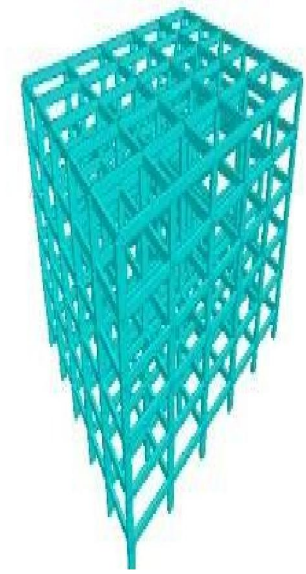

Figure 2: 3D Rendered view of model on STAAD-Pro

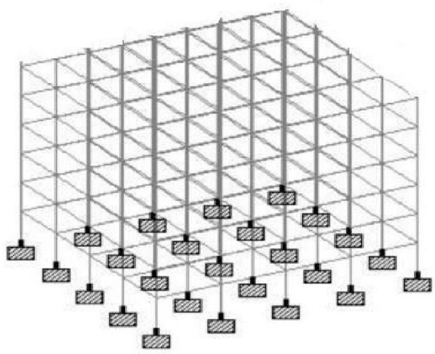

Figure 3: 3-D View of Model in STAAD-Pro

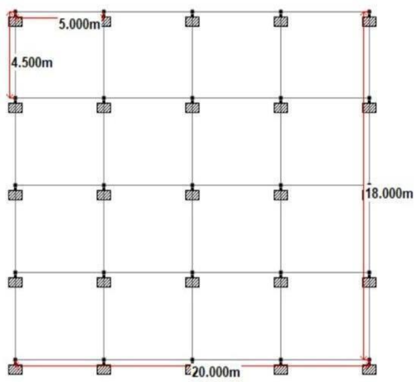

Figure 4: 3-D View of Model in STAAD-Pro

DOI: 10.48175/IJARSCT-26815

The basic planning and the loading conditions are considered same for both RCC & CompositeSteel Concrete Structure. In case of RCC structure, the structural members slab, beam and column are designed as per IS456:2000 and in case of Steel Concrete Composite Structure, members are designed as per IS 11384

Composite beams are designed with structural steel section anchored to the steel deck slab withthe help of shear studs and columns are considered made of RCC having structural steel section in its core and reinforcement in the concrete outside. Lateral loads are considered to be carriedby the beam column frame as a moment resisting frame.

For the analysis and design, following design data is considered:

Type of building	Office Building(G+5)
Type of frame	Moment Resisting Frame
Height of each storey	3.0m
Total height of building	16.5 m
Plinth height	1.5m
Plan of the building	20m ×18m
Thickness of external walls	230mm
Live load	3.0 kN/sq.m
Grade of Concrete	M20
Grade of reinforcing Steel	Fe 415
Grade of structural steel	Fu= 410N/mm2
	Fy = 250 N/mm2
Density of Concrete	25 kN/m3
Density of brick masonry	20 kN/m3
Zone	III
Soil type	Medium soil
Importance factor	1.0
Response reduction	5.0
Seismic zone factor	0.16 for zone III
Damping ratio	5% For RCC structure 3% Composite structure

Table 1.: Design data considering in Modelling in STAAD-Pro

The explained 3D building model is analyzed using Equivalent Static Method and Response Spectrum Method. The building models are then analyzed by the software STAAD-Pro. Different parameters such as storey stiffness, storey drift, base shear, weight of structure, lateralforces, mode shapes, natural time period, frequency are studied for the seismic loads in X- direction. Seismic codes are unique to a particular region of country. In India, Indian standardcriteria for earthquake resistant design of structures IS 1893 (PART-1): 2002 is the main codethat provides outline for calculating seismic design force.

IV. CONCLUSION

Based on our analysis, Steel-Concrete Composite structures offer several advantages over RCC structures. Our key findings are:

1. Seismic Performance:

The composite structure handled earthquake forces better than the RCC structure. Since composite materials are lighter, they experienced less seismic force and showed better stability.

2. Base Shear, Displacement & Member Forces:

Story Displacement: The RCC structure moved more under seismic loads, while the composite structure had less displacement, making it more stable.

Base Shear: The composite structure had lower base shear, meaning it absorbed less earthquake energy, reducing the risk of failure.

Member Forces: The forces on beams and columns were more evenly distributed in the composite structure, reducing stress on individual elements.

3. Stiffness Comparison:

The composite structure was stiffer, which helped in reducing excessive lateral movement. On the other hand, the RCC structure was more flexible, making it more prone to deformations during earthquakes.

4. Effect of Different Earthquake Intensities:

When we tested both structures under different earthquake strengths, the composite structure performed better in all cases. The RCC structure showed more movement and stress, which means it would need extra reinforcement to handle strong earthquakes.

REFERENCES

[1]. Gorakh Vinit, et al. (2018). Analysis and design of high-rise buildings in STAAD.pro. Journal of Construction and Steel Research.

[2]. Jyothi, D. N. (2018). Comparative analysis of steel and RCC frames for high-rise buildings. International Journal of Civil Engineering and Technology.

[3]. Patel, A., et al. (2019). Seismic performance evaluation of steel frames in high-rise buildings. Earthquake Engineering and Structural Dynamics.

[4]. Kumar, R., et al. (2020). Energy-efficient design strategies for high-rise steel buildings. Journal of Building Performance..

[5]. Singh, V., et al. (2021). Advances in high-strength steel for high-rise buildings. Journal of Construction and Building Materials.

[6]. Rai, P., et al. (2021). Environmental sustainability of steel structures in high-rise construction. Journal of Cleaner Production.

[7]. Bhatia, K., & Sharma, R. (2022). Economic feasibility of steel versus RCC structures in high-rise buildings. International Journal of Engineering Research and Technology.

[8]. Verma, S., et al. (2022). Fire safety in high-rise buildings: Steel frames versus RCC structures. Fire Safety Journal.

[9]. Khan, M., et al. (2023). Performance evaluation of composite structures in high-rise buildings. Journal of Civil Engineering and Management.

[10]. Chaudhary, R., et al. (2023). Modular construction of high-rise steel buildings: Opportunities and challenges. Advances in Structural Engineering.

[11]. Singh, P., & Kumar, A. (2024). Smart technologies in high-rise steel buildings: A review. Smart Structures and Systems.