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Comparative Seismic Performance of Reinforced Concrete Buildings with Different Shear Wall Configurations

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ABSTRACT

Earthquakes are among the most destructive natural hazards, posing significant threats to the structural stability, safety, and serviceability of buildings. Reinforced concrete (RC) buildings are widely used in modern construction; however, their seismic performance largely depends on structural configuration, lateral load-resisting systems, and the distribution of stiffness and strength. Shear walls play a crucial role in enhancing the earthquake resistance of reinforced concrete structures by providing additional lateral stiffness, strength, and energy dissipation capacity. The present study investigates the comparative seismic performance of reinforced concrete buildings incorporating different shear wall configurations, including centrally located shear walls, corner shear walls, perimeter shear walls, core shear walls, and symmetrical and unsymmetrical arrangements. The primary objective is to identify the most effective shear wall configuration for minimizing earthquake-induced structural responses and improving overall building stability.

The proposed research considers analytical modelling and numerical simulation of multistorey reinforced concrete buildings using structural analysis software such as ETABS or SAP2000. Various structural configurations are evaluated under seismic loading conditions using response spectrum analysis and, where appropriate, nonlinear time-history analysis in accordance with relevant seismic design provisions. Key performance parameters include fundamental natural time period, base shear, storey displacement, inter-storey drift, torsional response, storey stiffness, and overall structural stability. Comparative evaluation is conducted to understand how the location, orientation, and arrangement of shear walls influence the distribution of seismic forces and the deformation characteristics of buildings.

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INTRODUCTION

Earthquakes are among the most significant natural hazards affecting the safety, stability, and durability of buildings and infrastructure. The sudden release of energy within the Earth's crust generates seismic waves that produce ground motion, resulting in horizontal and vertical forces acting on structures. These forces can cause excessive deformation, structural damage, cracking, and, in severe cases, complete building collapse. With rapid urbanization and increasing construction of multistorey buildings, the demand for earthquake-resistant structural systems has become increasingly important. Consequently, the development of effective structural configurations capable of resisting seismic forces has become a major research area in civil and structural engineering.

Reinforced concrete (RC) buildings are widely adopted in residential, commercial, institutional, and industrial construction because of their strength, durability, flexibility in architectural design, and relatively economical

construction. However, conventional reinforced concrete moment-resisting frame structures may experience significant lateral displacement and inter-storey drift during strong earthquakes, particularly in medium-rise and high-rise buildings. Excessive lateral movement can damage structural and non-structural components, affect building functionality, and compromise occupant safety. Therefore, additional lateral load-resisting elements are often incorporated into reinforced concrete structures to improve their seismic performance.

Shear walls are vertical structural elements designed to resist lateral forces generated by earthquakes and wind. They provide considerable lateral stiffness and strength, thereby reducing horizontal displacement and improving the overall stability of buildings. Generally constructed using reinforced concrete, shear walls transfer lateral forces from floor diaphragms to the foundation through their in-plane bending and shear resistance. Their effectiveness depends on several factors, including wall thickness, length, height, reinforcement detailing, position, orientation, and interaction with the surrounding structural frame.

THEORETICAL FRAMEWORK

Concept of Seismic Performance

Seismic performance refers to the ability of a building to withstand earthquake-induced forces without experiencing unacceptable structural damage, excessive deformation, or collapse. During an earthquake, ground acceleration generates inertial forces within a building due to the mass of its structural and non-structural components. These forces are transferred through the structural system to the foundation. The magnitude of the resulting structural response depends on building mass, stiffness, strength, damping characteristics, geometry, and the intensity and frequency content of ground motion.

The seismic behaviour of reinforced concrete buildings is generally evaluated through parameters such as base shear, storey displacement, inter-storey drift, natural time period, torsional response, and structural ductility. A well-designed seismic-resistant structure should possess adequate lateral strength, stiffness, deformation capacity, and energy dissipation characteristics.

Fundamental Principles of Earthquake Engineering

The theoretical foundation of seismic structural analysis is based on the dynamic behaviour of structures subjected to ground motion. When an earthquake occurs, the building experiences acceleration at its base, producing inertia forces that act throughout its height.

The fundamental equation of motion for a single-degree-of-freedom structural system is:

$$m\ddot{u} + c\dot{u} + ku = -m\ddot{u}_g$$

Where:

- m = Mass of the structural system.
- c = Damping coefficient.
- k = Lateral stiffness.
- u = Relative displacement.
- $\dot{u}$ = Relative velocity.
- $\ddot{u}$ = Relative acceleration.
- $\ddot{u}_g$ = Ground acceleration.

This equation represents the relationship between mass, damping, stiffness, and earthquake-induced ground motion. For multistorey buildings, the dynamic behaviour becomes more complex because multiple vibration modes contribute to the overall structural response.

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PROPOSED MODELS AND METHODOLOGIES

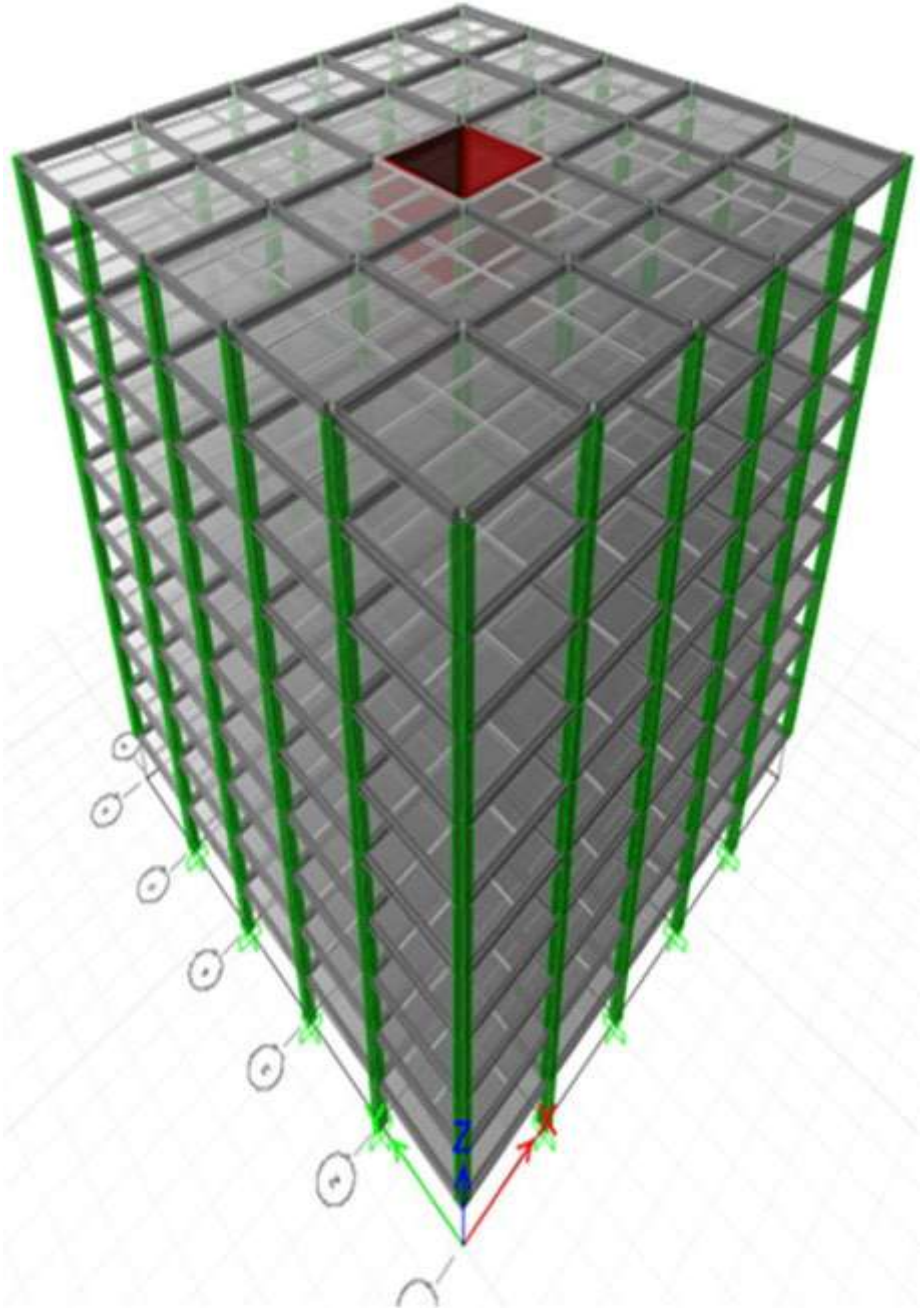
Research Methodology

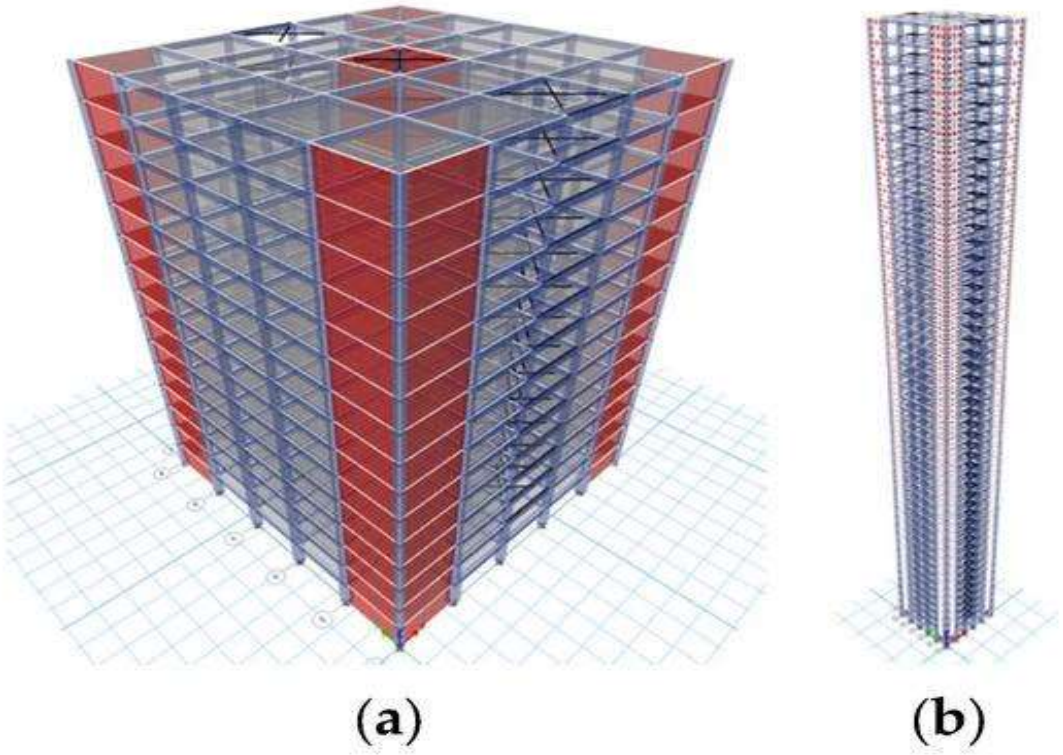
The present study, entitled "Comparative Seismic Performance of Reinforced Concrete Buildings with Different Shear Wall Configurations," adopts a numerical and analytical research methodology to investigate the earthquake-resistant behaviour of multistorey reinforced concrete (RC) buildings. The primary objective is to evaluate the influence of different shear wall arrangements on structural strength, lateral stiffness, displacement, inter-storey drift, base shear, and torsional response.

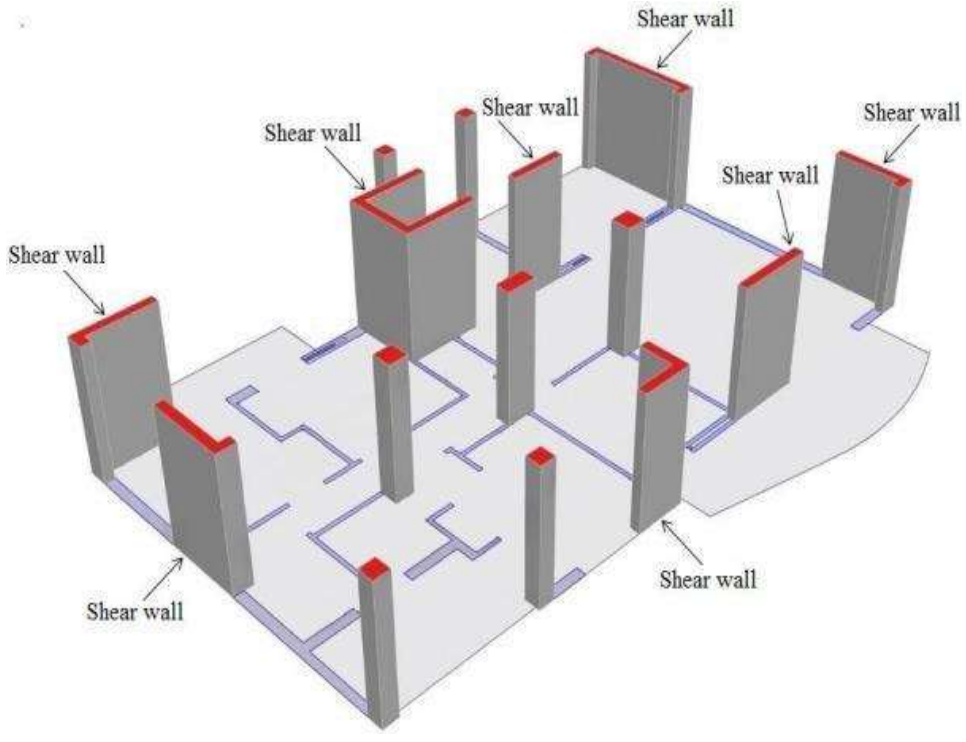
The research involves developing three-dimensional structural models using structural analysis software such as ETABS or SAP2000. Different shear wall configurations are incorporated into geometrically identical building models to ensure a consistent comparative assessment. All models are analysed under identical loading conditions, material properties, structural dimensions, and seismic parameters.

The proposed methodology consists of structural modelling, material property definition, load application, seismic analysis, extraction of structural response parameters, and comparative performance evaluation.

Proposed Structural Models







To investigate the influence of shear wall positioning, six different structural models are proposed.

Model	Structural configuration	Description
Model 1	Bare RC Frame	Conventional moment-resisting frame without shear walls.
Model 2	Central Shear Wall	Shear walls positioned near the centre of the building.
Model 3	Corner Shear Wall	Shear walls located at the building corners.
Model 4	Perimeter Shear Wall	Shear walls distributed along the exterior boundaries.
Model 5	Core Shear Wall	Shear walls arranged around the lift and staircase core.
Model 6	Combined Shear Wall	Combination of central and perimeter or corner shear walls.

The bare frame model serves as the reference model, allowing the improvements achieved through the introduction of shear walls to be quantified.

Geometrical Properties of the Proposed Building

For a controlled comparative investigation, a representative multistorey reinforced concrete building is considered. The following preliminary dimensions and properties are proposed for numerical modelling.

Structural parameter	**Proposed specification**
Building type	Reinforced Concrete Residential/Commercial Building
Number of storeys	G + 10 (11 storeys)
Storey height	3.0 m
Total building height	33 m
Plan dimensions	24 m × 24 m
Number of bays	6 × 6
Bay spacing	4 m
Structural system	RC Moment-Resisting Frame with Shear Walls
Concrete grade	M30
Reinforcement grade	Fe500
Column dimensions	600 mm × 600 mm (preliminary)
Beam dimensions	300 mm × 450 mm (preliminary)
Slab thickness	150 mm
Shear wall thickness	200–250 mm
Foundation condition	Fixed-base assumption
Analysis software	ETABS / SAP2000

Note: These are proposed modelling assumptions, not experimentally verified or code-approved final design dimensions. Member sizes and reinforcement must be checked through structural design.

EXPERIMENTAL STUDY

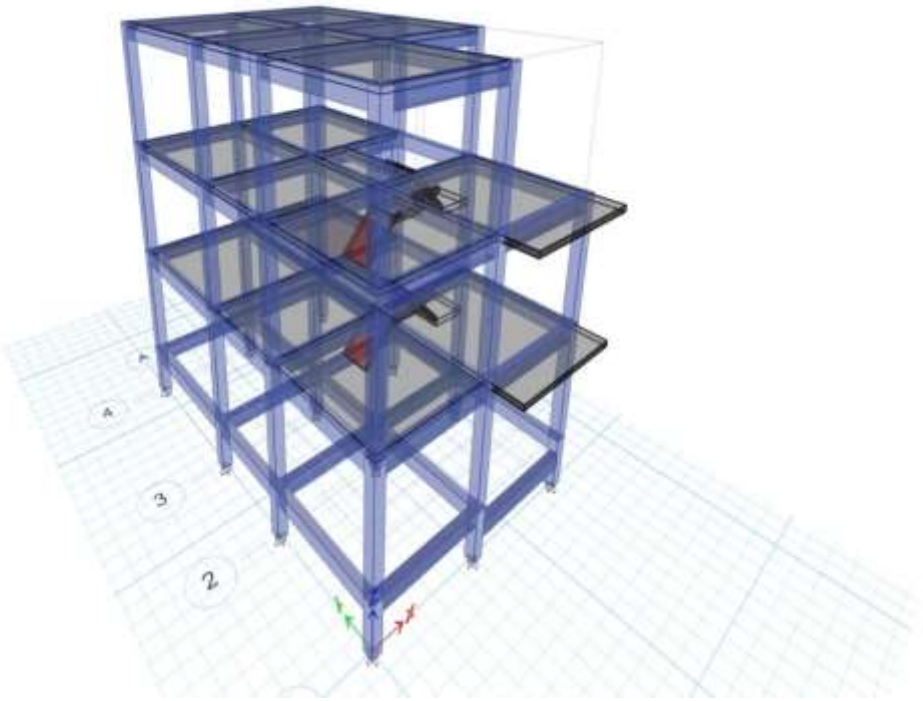
Overview of the Experimental Study

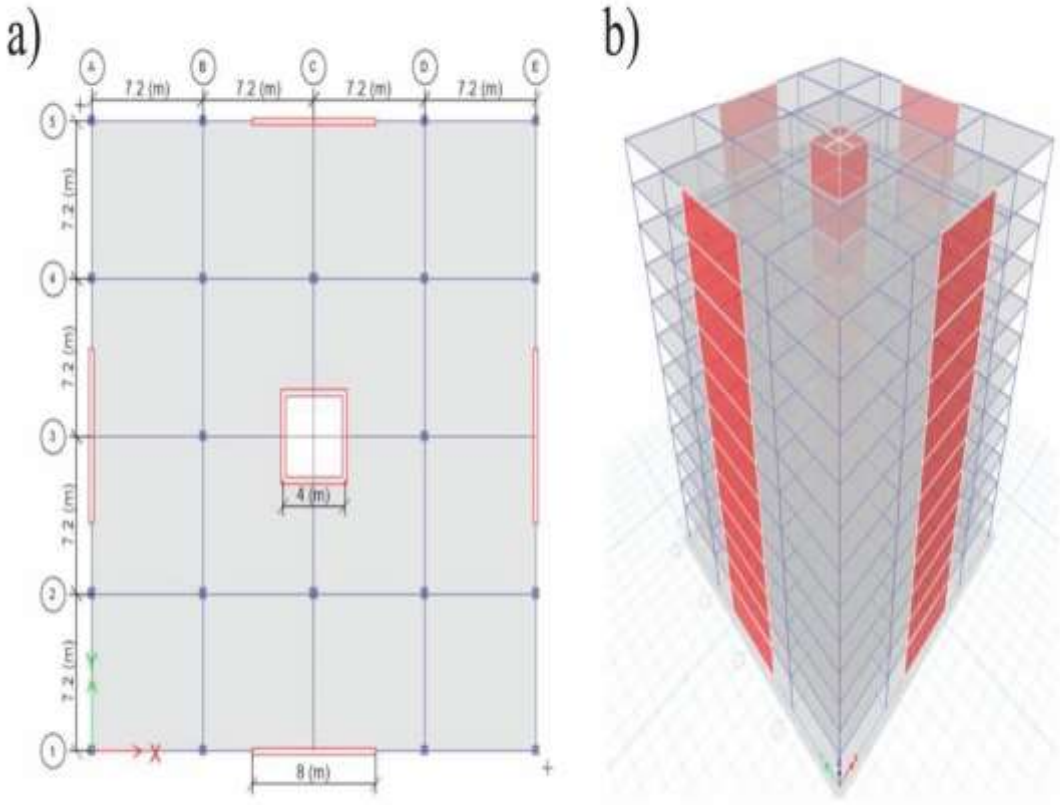
The experimental study focuses on investigating the seismic performance of reinforced concrete (RC) buildings with different shear wall configurations under earthquake-induced loading conditions. The primary objective is to examine how the location, arrangement, orientation, and distribution of shear walls influence the structural behaviour of multistorey reinforced concrete buildings.

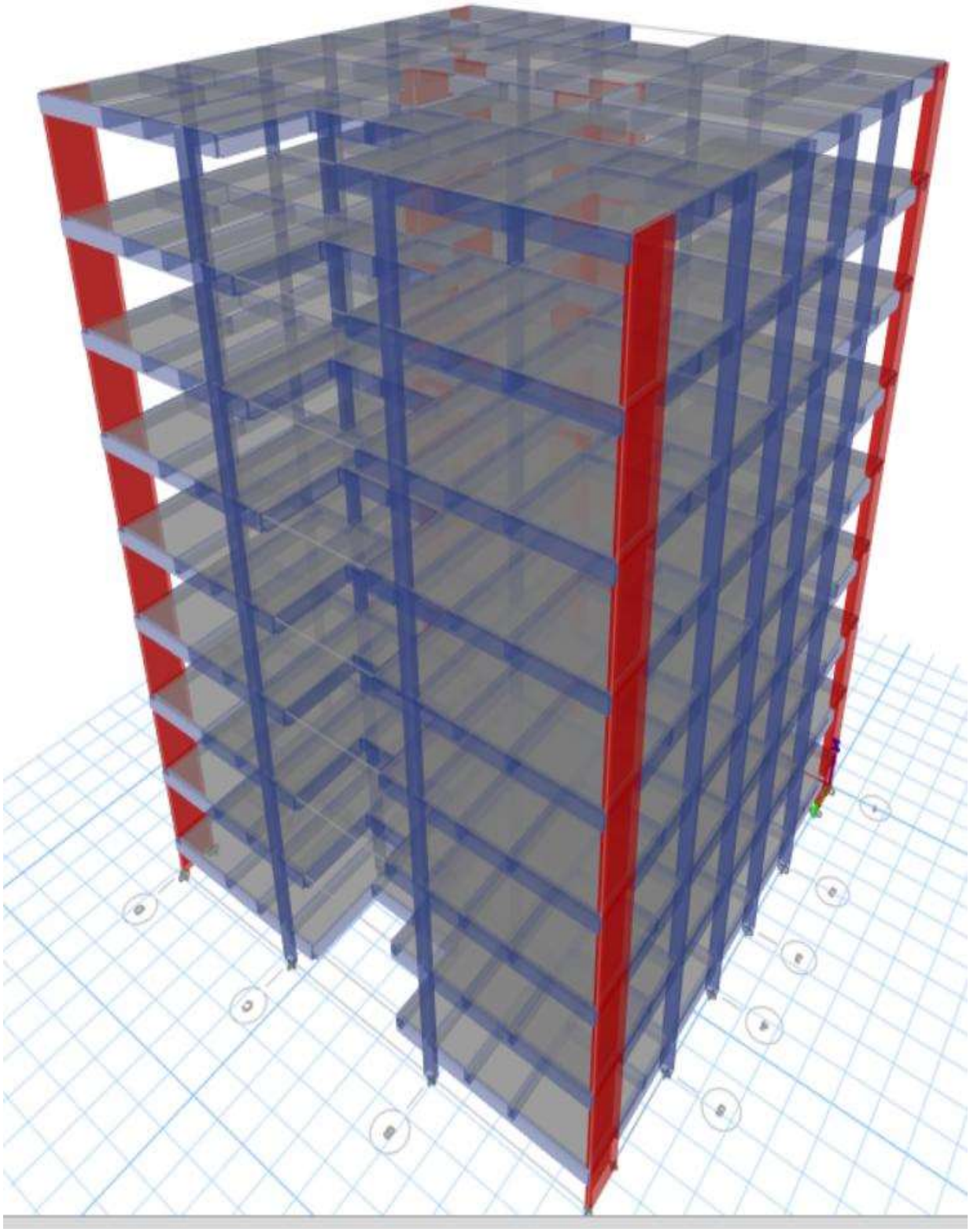
The study adopts a numerical experimental approach using structural modelling and seismic simulation software such as ETABS or SAP2000. Six different structural configurations are developed and evaluated under identical geometrical, material, and loading conditions. The experimental investigation considers important seismic response parameters, including fundamental natural time period, base shear, maximum storey displacement, inter-storey drift, storey stiffness, and torsional response.

The comparative analysis is designed to identify the shear wall configuration that provides improved lateral stability, deformation control, and earthquake resistance.

Description of Experimental Models
Six reinforced concrete building models are considered for the investigation.







Model	Configuration	Experimental purpose
Model 1	Bare RC Frame	Establishes the reference seismic response.
Model 2	Central Shear Wall	Evaluates the influence of centrally located walls.
Model 3	Corner Shear Wall	Examines lateral resistance and torsional behaviour.
Model 4	Perimeter Shear Wall	Investigates the effect of exterior wall distribution.
Model 5	Core Shear Wall	Evaluates the seismic performance of central core walls.
Model 6	Combined Shear Wall	Examines the effect of multiple wall arrangements.

All models are developed using consistent structural dimensions and material properties to maintain comparability.

Experimental Parameters and Building Specifications

The following preliminary building specifications are adopted for the numerical investigation.

Parameter	**Specification**
Building type	Multistorey RC building
Number of storeys	G + 10
Total height	33 m
Storey height	3 m
Building plan	24 m × 24 m
Bay spacing	4 m
Concrete grade	M30
Reinforcement grade	Fe500
Beam size	300 mm × 450 mm
Column size	600 mm × 600 mm
Slab thickness	150 mm
Shear wall thickness	200–250 mm
Structural software	ETABS / SAP2000
Foundation assumption	Fixed base

These parameters provide a common structural basis for investigating the influence of different shear wall configurations.

Experimental Loading Conditions

The proposed structural models are subjected to different loading conditions to simulate realistic building behaviour.

A. Dead Load

Dead load includes the self-weight of beams, columns, slabs, shear walls, and other permanent structural components.

B. Live Load

Live load represents occupancy-related loads such as people, furniture, and movable equipment. Appropriate values are selected according to the intended building occupancy and applicable design standards.

C. Seismic Load

Seismic loading is applied in the horizontal X and Y directions to evaluate the structural response under earthquake excitation. For an Indian case study, the relevant provisions of IS 1893 are adopted, using consistent seismic parameters for all models.

D. Load Combinations

Appropriate combinations of dead load, live load, and earthquake load are considered according to the applicable seismic and structural design standards. Both positive and negative earthquake directions are examined.

RESULTS & ANALYSIS

Introduction

The results and analysis section presents a comparative evaluation of the seismic performance of reinforced concrete (RC) buildings incorporating different shear wall configurations. The primary objective is to examine how the location, orientation, and distribution of shear walls influence the structural response of multistorey buildings subjected to earthquake loading.

The analysis considers six structural models, including a bare reinforced concrete frame, central shear wall, corner shear wall, perimeter shear wall, core shear wall, and combined shear wall configuration. These models are evaluated using structural analysis software such as ETABS or SAP2000 under consistent geometrical, material, and seismic loading conditions.

The major performance indicators considered in this investigation include fundamental natural time period, base shear, maximum storey displacement, inter-storey drift, storey stiffness, and torsional response. The comparative analysis helps identify the advantages and limitations of different shear wall arrangements and their contribution to earthquake-resistant structural design.

Note: Since actual ETABS/SAP2000 output data have not been provided, the following analysis presents theoretically expected trends and an illustrative comparison. The numerical values below are hypothetical and must not be reported as verified simulation or experimental findings.

Comparative Analysis of Different Structural Models
The six proposed structural configurations are examined to understand their relative seismic behaviour.

Model	Shear wall configuration	Expected seismic behaviour
Model 1	Bare RC Frame	Relatively higher lateral deformation
Model 2	Central Shear Wall	Improved lateral stiffness
Model 3	Corner Shear Wall	Improved resistance with configuration-dependent torsion
Model 4	Perimeter Shear Wall	Potentially improved lateral and torsional resistance
Model 5	Core Shear Wall	Efficient central lateral load-resisting system
Model 6	Combined Shear Wall	Potentially balanced stiffness and deformation control

The bare frame serves as the reference model for evaluating the improvements associated with different shear wall configurations.

Analysis of Fundamental Natural Time Period
The fundamental natural time period is an important dynamic characteristic that determines the vibration behaviour of a building under earthquake excitation.

The addition of shear walls generally increases the lateral stiffness of reinforced concrete buildings, which can reduce the fundamental natural time period when the mass remains approximately constant.

The relationship is expressed as:

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Where:

- T = Fundamental natural time period.
- m = Effective structural mass.
- k = Effective lateral stiffness.

Results Interpretation:

- The bare RC frame is expected to exhibit a relatively longer natural time period because of its comparatively lower lateral stiffness.
- Central and core shear wall configurations may significantly increase structural stiffness.
- Perimeter and corner arrangements may improve stiffness in both principal directions when appropriately distributed.
- Combined shear wall arrangements may produce a substantial reduction in the natural time period.

However, a shorter natural time period does not automatically indicate superior seismic performance because earthquake demand also depends on the response spectrum and structural characteristics.

Analysis of Storey Displacement

Storey displacement represents the horizontal movement of individual floors during earthquake excitation. Excessive lateral displacement may cause damage to structural and non-structural components.

The introduction of shear walls is expected to reduce lateral displacement by increasing the overall stiffness of the structural system.

Illustrative comparison of maximum storey displacement:

Structural model	Illustrative displacement (mm)	Reduction relative to bare frame
Bare RC Frame	85	0%
Central Shear Wall	55	35.29%
Corner Shear Wall	60	29.41%
Perimeter Shear Wall	48	43.53%
Core Shear Wall	52	38.82%
Combined Shear Wall	40	52.94%

Illustrative values only; not obtained from actual structural simulation.

Analysis:

The illustrative comparison indicates that the combined shear wall configuration produces the lowest maximum displacement, followed by perimeter and core shear wall arrangements. The bare RC frame exhibits the highest displacement due to the absence of additional lateral load-resisting walls.

The reduction in displacement demonstrates the potential contribution of shear walls in controlling lateral deformation and improving building stability.

COMPARATIVE ANALYSIS IN TABULAR FORM

The comparative analysis evaluates the seismic performance of reinforced concrete (RC) buildings incorporating different shear wall configurations. Six structural models are considered: bare RC frame, central shear wall, corner shear wall, perimeter shear wall, core shear wall, and combined shear wall configuration.

The comparison focuses on fundamental natural time period, base shear, maximum storey displacement, inter-storey drift, lateral stiffness, torsional response, and overall structural performance. The objective is to identify the advantages and limitations of different shear wall arrangements and determine their suitability for earthquake-resistant building design.

Comparative Analysis of Different Shear Wall Configurations

Model	Shear Wall Configuration	Lateral Stiffness	Displacement Control	Torsional Resistance	Overall Performance
Model 1	Bare RC Frame	Low	Low	Frame-dependent	Reference
Model 2	Central Shear Wall	High	Good	Good if centrally balanced	Very Good
Model 3	Corner Shear Wall	High	Good	Good if symmetrical	Very Good
Model 4	Perimeter Shear Wall	Very High	Excellent	Potentially Excellent	Excellent
Model 5	Core Shear Wall	High	Very Good	Good if core is centred	Very Good
Model 6	Combined Shear Wall	Very High	Excellent	Depends on arrangement	Potentially Excellent

Note: The performance descriptions represent expected qualitative behaviour and are not experimentally verified rankings.

Comparative Analysis of Seismic Response Parameters

The following table presents an illustrative numerical comparison of different structural models.

Seismic Parameter	Bare Frame	Central Wall	Corner Wall	Perimeter Wall	Core Wall	Combined Wall
Maximum displacement (mm)	85	55	60	48	52	40
Inter-storey drift ratio	0.0045	0.0030	0.0033	0.0027	0.0029	0.0022
Base shear (kN)	1850	2050	2000	2150	2100	2250
Displacement reduction (%)	0	35.29	29.41	43.53	38.82	52.94
Base shear increase (%)	0	10.81	8.11	16.22	13.51	21.62

All numerical values are hypothetical and provided only to demonstrate comparative tabulation. They must be replaced with actual structural analysis results.

Comparison Based on Structural Characteristics

Structural Characteristics	Central Wall	Corner Wall	Perimeter Wall	Core Wall	Combined Wall
Lateral load resistance	High	High	Very High	High	Very High
Structural stiffness	High	High	Very High	High	Very High
Architectural flexibility	Moderate	Good	Moderate	Very Good	Moderate
Torsional control	Good if centred	Good if symmetrical	Potentially high	Good if centred	Configuration-dependent
Construction complexity	Moderate	Moderate	High	Moderate	High
Material requirements	Moderate	Moderate	High	Moderate	Potentially high
Foundation demand	Moderate	Moderate	High	Moderate	Potentially high

Comparison of Advantages and Limitations

Shear Wall Configuration	Major Advantages	Major Limitations
Central Shear Wall	Balanced stiffness, effective lateral resistance, reduced displacement	May occupy valuable central floor space
Corner Shear Wall	Effective lateral resistance and potential torsional improvement	Unsymmetrical placement may increase torsion
Perimeter Shear Wall	High lateral stiffness and potentially improved torsional resistance	May restrict façade openings and architectural flexibility
Core Shear Wall	Efficient use of lift and staircase areas, concentrated lateral resistance	Eccentric core placement may introduce torsion
Combined Shear Wall	Flexible stiffness distribution and potentially improved seismic performance	Higher construction complexity and material requirements

SIGNIFICANCE OF THE TOPIC

The study entitled “Comparative Seismic Performance of Reinforced Concrete Buildings with Different Shear Wall Configurations” is significant because it addresses one of the most important challenges in earthquake-resistant structural engineering: improving the safety, stability, and serviceability of reinforced concrete (RC) buildings under seismic loading. Earthquakes generate complex dynamic forces that can cause excessive lateral displacement, inter-storey drift, structural damage, torsional irregularities, and, in severe cases, partial or total building collapse. Therefore, selecting an appropriate shear wall configuration is essential for developing earthquake-resistant structures.

The significance of this study can be explained through the following aspects:

1. Improvement in Earthquake Resistance

Shear walls provide substantial lateral stiffness and strength to reinforced concrete buildings. By comparing different configurations, such as central, corner, perimeter, core, and combined arrangements, the study helps identify how wall placement influences the building's ability to resist earthquake-induced forces. Appropriate positioning of shear walls can reduce excessive lateral movement and improve overall structural stability.

2. Reduction in Lateral Displacement
Excessive lateral displacement during an earthquake can damage structural and non-structural components, including beams, columns, partitions, glazing, and building services. This study evaluates how different shear wall arrangements influence maximum storey displacement. Identifying configurations that effectively control lateral displacement can contribute to safer and more serviceable buildings.

3. Control of Inter-Storey Drift
Inter-storey drift is an important indicator of seismic damage. Large differences in displacement between adjacent floors may cause damage to structural and non-structural elements. The comparative assessment of shear wall configurations helps determine which arrangements provide better drift control and improve the performance of buildings during earthquake excitation.

4. Understanding Torsional Behaviour
Uneven distribution of shear walls may create eccentricity between the centres of mass and rigidity, resulting in torsional movement during earthquakes. This study examines the influence of different wall locations on torsional response. Its findings can help structural engineers select more balanced and symmetrical arrangements to minimize undesirable twisting effects.

LIMITATIONS & DRAWBACKS

The study entitled “Comparative Seismic Performance of Reinforced Concrete Buildings with Different Shear Wall Configurations” provides valuable insights into the seismic behaviour of reinforced concrete (RC) buildings. However, like other structural engineering investigations, it has certain limitations related to modelling assumptions, analytical methods, material properties, seismic loading conditions, and practical construction considerations. These limitations should be considered while interpreting the results and applying the findings to real-world structures.

1. Limitations of Numerical Modelling
The study primarily relies on structural analysis software such as ETABS or SAP2000. Although these tools are widely used for seismic analysis, their results depend on the accuracy of the input data, modelling assumptions, boundary conditions, and selected analysis parameters. Any errors in model development may influence the predicted structural response.

2. Simplified Building Geometry
The proposed investigation may consider a regular reinforced concrete building with a uniform floor plan and storey height. Actual buildings often contain irregularities, setbacks, projections, open ground floors, and variations in floor dimensions. Therefore, the findings obtained from a regular building model may not be directly applicable to all building configurations.

3. Limited Shear Wall Configurations
The study examines selected arrangements, such as central, corner, perimeter, core, and combined shear walls. However, numerous other configurations and combinations are possible. The performance of unexamined arrangements may differ depending on building geometry, wall dimensions, structural layout, and architectural requirements.

4. Assumptions Regarding Material Properties
Concrete and reinforcing steel are generally modelled using specified strength and stiffness values. In actual construction, material properties may vary because of manufacturing quality, workmanship, curing conditions, ageing, and environmental exposure. Simplified material models may not fully represent cracking, crushing, yielding, degradation, and other nonlinear behaviours.

CONCLUSION

The comparative study of the seismic performance of reinforced concrete (RC) buildings with different shear wall configurations highlights the significant role of shear wall positioning and arrangement in improving the earthquake-resistant capacity of structures. Shear walls are essential structural elements that enhance lateral stiffness, increase load-resisting capacity, control storey displacement, and reduce inter-storey drift during seismic events. The effectiveness of a shear wall system depends not only on its dimensions and strength but also on its location, distribution, symmetry, and interaction with the overall structural framework.

The study considers different shear wall arrangements, including central core walls, corner walls, perimeter walls, and coupled shear walls, to evaluate their influence on important seismic response parameters such as base shear, storey displacement, storey drift, torsional effects, fundamental time period, and structural stiffness. A properly designed and symmetrically distributed shear wall configuration is expected to provide better structural stability and minimize undesirable torsional responses. In contrast, irregularly positioned shear walls may result in stiffness imbalance, increased torsional effects, and uneven distribution of seismic forces.

Furthermore, the selection of an appropriate shear wall configuration should consider architectural requirements, functional space utilization, construction costs, material consumption, and applicable seismic design codes. Advanced structural modelling and seismic analysis techniques can help engineers identify the most suitable configuration for different building heights and seismic conditions.

REFERENCES

1. American Concrete Institute. (2019). Building code requirements for structural concrete (ACI 318-19) and commentary. American Concrete Institute.
2. ASCE. (2022). Minimum design loads and associated criteria for buildings and other structures (ASCE/SEI 7-22). American Society of Civil Engineers.
3. Chopra, A. K. (2017). Dynamics of structures: Theory and applications to earthquake engineering (5th ed.). Pearson.
4. Clough, R. W., & Penzien, J. (2003). Dynamics of structures (3rd ed.). Computers & Structures, Inc.
5. Computers and Structures, Inc. (2023). ETABS: Integrated building design software—Technical documentation. Computers and Structures, Inc.
6. Computers and Structures, Inc. (2023). SAP2000: Integrated software for structural analysis and design—Technical documentation. Computers and Structures, Inc.
7. Computers and Structures, Inc. (2017). CSI analysis reference manual. Computers and Structures, Inc.
8. Federal Emergency Management Agency. (2000). Prestandard and commentary for the seismic rehabilitation of buildings (FEMA 356). FEMA.
9. Federal Emergency Management Agency. (2009). Quantification of building seismic performance factors (FEMA P695). FEMA.
10. Federal Emergency Management Agency. (2018). Seismic performance assessment of buildings, Volume 1—Methodology (FEMA P-58-1) (2nd ed.). FEMA.
11. Huang, Y., He, L., & Huang, W. (2022). Parametric analysis on seismic performance of reinforced concrete frame-shear wall structures with different setback configurations. The Structural Design of Tall and Special Buildings, 31(15), e1970. https://doi.org/10.1002/tal.1970
12. IS 456. (2000). Plain and reinforced concrete—Code of practice (4th rev.). Bureau of Indian Standards.
13. IS 875 (Part 1). (1987). Code of practice for design loads (other than earthquake) for buildings and structures: Dead loads—Unit weights of building materials and stored materials. Bureau of Indian Standards.
14. IS 875 (Part 2). (1987). Code of practice for design loads (other than earthquake) for buildings and structures: Imposed loads. Bureau of Indian Standards.
15. IS 1893 (Part 1). (2016). Criteria for earthquake resistant design of structures: General provisions and buildings (6th rev.). Bureau of Indian Standards.
16. IS 13920. (2016). Ductile design and detailing of reinforced concrete structures subjected to seismic forces—Code of practice. Bureau of Indian Standards.
17. Kappos, A. J. (Ed.). (2009). Earthquake-resistant structures: Design, assessment and rehabilitation. Springer.
18. Kim, T. W., Foutch, D. A., & LaFave, J. M. (2005). A practical model for seismic analysis of reinforced concrete shear wall buildings. Journal of Earthquake Engineering, 9(3), 393–417. https://doi.org/10.1142/S1363246905001980 Illinois Experts
19. Paulay, T., & Priestley, M. J. N. (1992). Seismic design of reinforced concrete and masonry buildings. John Wiley & Sons.
20. Priestley, M. J. N., Calvi, G. M., & Kowalsky, M. J. (2007). Displacement-based seismic design of structures. IUSS Press.