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Review on Analysis of G+22 Building By Using Shear Walls In Various Locations Under Influence of Seismic Load By Using ETABS

Ganesh Bhagawat[1], Dr. Dnyaneshwar B. Mohite [2]

[1]PG M.Tech Student of Civil Engineering Department, CSMSS College Of Engg. Chh. Sambhajinagar
[2]Associate Professor, Department of Civil Engineering, CSMSS College Of Engg. Chh.Sambhajinagar

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Abstract - *An The seismic response of high-rise reinforced cement concrete (RCC) buildings is highly sensitive to how shear walls are positioned, as these elements form the primary lateral force–resisting system. This study evaluates the influence of shear wall layout on a 23-storey (G+22) commercial building and identifies the configuration that best balances stability, safety, and economy. A detailed three-dimensional ETABS model was developed, and response spectrum analysis was conducted in accordance with IS 1893 (Part 1): 2016. Three arrangements were examined (i) corner walls, (ii) mid-side perimeter walls, and (iii) a central/core system and performance was quantified using inter-storey drift, lateral displacement, base shear, and storey stiffness.*

Key Words: Reinforced cement concrete (RCC), Tall buildings, Shear wall configuration, Seismic response analysis, Response-spectrum method, ETABS numerical modelling, Inter-storey drift

1.INTRODUCTION

Rapid vertical urban growth has intensified reliance on tall RCC buildings, whose safety is governed by resistance to lateral actions from wind and, critically, earthquakes. Shear walls are the principal lateral system in such structures; their ability to curb horizontal displacements and inter storey drifts depends as much on placement as on size and detailing. Poorly located walls can trigger torsion, uneven demand, and inefficient behaviour. Prior work Favors symmetric, well-cantered layouts but comparative evidence for modern high-rise RCC systems using advanced analysis remains limited. Using ETABS and the Response Spectrum Method per IS 1893:2016, a G+22 commercial building was modelled with three schemes corner, mid-side perimeter, and central/core walls and evaluated for drift, roof displacement, base shear, and storey stiffness. The core arrangement delivered the most uniform and efficient response, achieving the lowest drifts and displacements while enhancing stiffness and stability. These results reinforce strategic, core-centric placement as a practical route to safer, more resilient, and economical tall RCC buildings, offering actionable guidance for design in seismic regions.

This review addresses the earthquake vulnerability of tall RCC buildings, where height, flexibility, and slenderness amplify seismic demand. It focuses on shear walls as the primary lateral system and emphasizes that their seismic effectiveness hinges on placement: poorly arranged walls can trigger torsion, concentrate forces, and raise interstorey drift, undermining safety and serviceability. Given the limited comparative evidence for commercial high-rises, the review synthesizes ETABS-based studies to examine how wall location influences displacement, drift, storey stiffness, and base shear. The aim is to pinpoint configurations that consistently mitigate seismic effects and to translate these insights into practical guidance for safe, durable, and economical RCC high-rises in earthquake-prone regions.

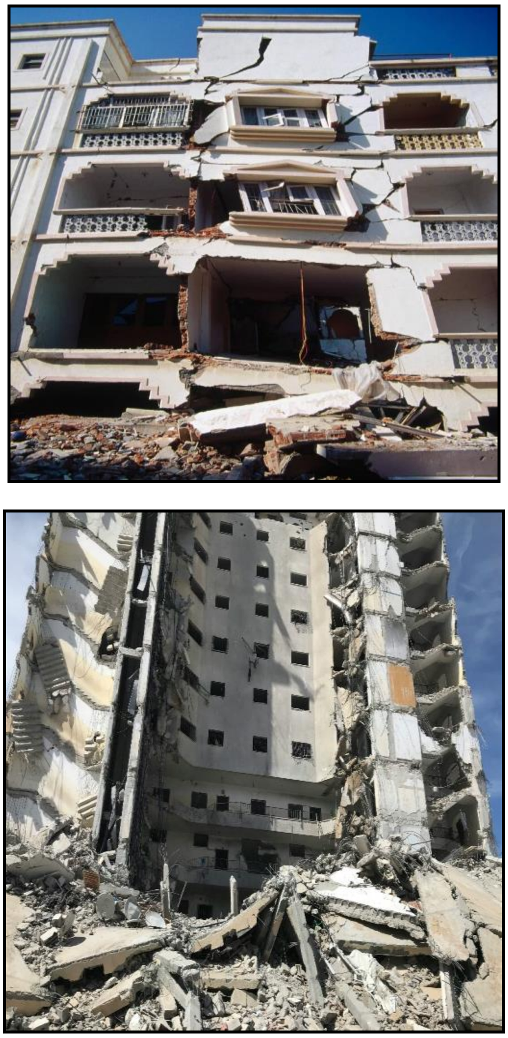

Figure - Building Collapsed Due to Earthquake

2. LITERATURE REVIEWS

Chandurkar et al. [1] studied different shear wall layouts in high-rise RCC buildings under IS 1893:2016 provisions. Their analysis across seismic Zones II–V showed that placing walls at the corners, especially along short spans, gave the best seismic performance by reducing drift, displacement, and torsion. This arrangement also proved more economical by lowering frame demands and material use. The study concluded that shear wall efficiency depends not only on size but also on strategic placement.

Varsha R. et al. [2] analyzed the effect of shear wall height on seismic performance of RCC frames. They found that providing walls up to mid-height significantly reduces displacement and drift, offering results comparable to full-height walls while saving materials. The study emphasized that stiffness concentrated at lower stories is most effective due to higher seismic demands, though care must be taken to avoid stiffness irregularities where walls terminate.

Zaregarizi et al. [3] compared retrofitting of RC frames using shear walls and masonry infills through pushover analysis. Shear walls greatly increased stiffness and base shear capacity but reduced displacement capacity if not detailed for ductility. Masonry infills improved stiffness and energy dissipation, though irregular layouts risked soft-storey effects. Concrete infills offered higher strength but less deformability, while brick infills provided greater ductility with lower strength. A hybrid of both achieved balanced performance, highlighting the importance of element type, distribution, and symmetry in retrofit design.

Ugale Ashish et al. [4] studied a G+6 frame in Zone III using STAAD.Pro, comparing a bare frame with one incorporating steel plate shear walls (SPSWs). They found that SPSWs significantly increased stiffness, reducing storey displacements, drift, and frame forces, thereby improving efficiency and allowing material savings. SPSWs also offered architectural benefits due to their thin profile and lighter weight compared to RC walls. However, the study emphasized the need for proper boundary element design and detailing to fully develop tension-field action and ensure reliable seismic performance.

Bhunia et al. [5] investigated shear wall placement in a 15-storey building under Zone IV seismic conditions using STAAD.Pro and SAP2000. Both elastic and elastoplastic analyses were performed to evaluate stiffness, drift, and member forces. Results showed that well-balanced wall layouts minimize inter-storey drift, reduce torsion, and avoid soft-storey effects, whereas poorly located walls increase twisting and damage concentration. The study stressed that elastic analysis is useful for preliminary assessment, but elastoplastic evaluation is essential to confirm performance beyond first yield.

Kameswari et al. [6] studied different shear wall layouts in high-rise RC frames, comparing displacement and drift with a bare frame. Results showed that diagonal and zigzag configurations significantly reduced drift and torsion by improving stiffness distribution and altering mode shapes. The zigzag pattern was most effective due to its truss-like action, while lift-core walls reduced torsion but were less efficient at controlling edge drifts. The study concluded that geometry and continuity of shear walls are as important as quantity, with staggered-diagonal layouts offering superior seismic performance.

Berman et al. [7] assessed steel plate shear walls (SPSWs) using nonlinear response history analysis under design-basis and maximum-considered earthquakes. SPSWs met drift limits and showed strong ductility through tension-field action. Low-rise walls concentrated inelastic demands in fewer stories, while taller walls distributed them more evenly due to higher-mode effects. Infill plates carried 60–80% of story shear, highlighting their primary role. The study noted that abrupt thickness changes increased local stresses and that current boundary element design for tall SPSWs may be overly conservative, suggesting scope for more economical detailing.

Naresh K. V. et al. [8] performed 3D analyses of typical 8–12-storey RC apartment buildings common in Indian metros to evaluate perforated (opening-containing) shear walls. They quantified how opening size and placement influence interstorey drift, storey-level stiffness, shear and bending demands, and stress distributions within the walls. The study distills design-oriented guidance for positioning and detailing openings so that medium-rise buildings retain adequate lateral performance.

Husain et al. [9] developed a calibrated 3D nonlinear finite element model in ABAQUS (v6.10) to simulate RC shear walls with openings strengthened using CFRP wraps under monotonic lateral loading. Validation against prior experiments showed good agreement, and the analyses demonstrated that appropriate CFRP layouts markedly increase lateral strength and deformation capacity while improving ductility and energy dissipation in perforated walls.

Darabi et al. [10] examine tunnel-form construction, where walls and slabs are cast in a single pour to create a monolithic RC system with few cold joints; the rigid forms are repositioned by lifters/cranes. Using ABAQUS, they analyzed two one-storey models one with wall openings and one without. The solid (no-opening) model showed superior seismic behavior, achieving higher base shear capacity and better ductility/resistance parameters that inform the response modification factor (R). Openings reduced strength and ductility, highlighting the need for careful detailing when perforations are required in tunnel-form buildings.

Montazeri et al. [11] addressed the seismic behavior of reinforced concrete shear walls by investigating the influence of staggered opening patterns on failure modes. Emphasizing the need for ductile over brittle failure, the study used finite element analysis (ABAQUS) to simulate 1:4 scale models of a four-story wall under lateral loads. The numerical models, which included walls with both vertically aligned and angled openings, were validated against experimental results to assess their performance.

3. CONCLUSIONS

1. Seismic performance is governed more by wall layout, continuity, and symmetry than by wall quantity alone. Balanced configurations control drift and torsion most effectively: corner walls along short spans are efficient in regular plans, while a central core best limits torsional irregularity in asymmetric layouts.

2. Concentrating stiffness in the lower stories is beneficial; partial-height walls up to mid-height can approach full-height behavior if transition zones are carefully detailed to avoid soft-storey effects. Steel plate shear walls deliver large stiffness and ductility through tension-field action, enabling material and architectural efficiency provided boundary elements are robust and plate thickness transitions are not abrupt.

3. RC shear walls used for retrofit substantially raise base shear capacity but can suppress deformability unless detailed for ductility; masonry infills improve stiffness and energy dissipation, with hybrid infill strategies yielding balanced strength–ductility when layouts are regular.

4. Openings reduce strength, stiffness, and ductility; performance depends on opening size, position, and pattern. Staggered layouts alter failure modes, and targeted CFRP strengthening around openings can recover capacity and deformation ability.

5. Elastic analyses are useful for preliminary checks, but nonlinear pushover/response-history analyses calibrated with FE models are required to validate performance beyond first yield and capture higher-mode effects in taller systems. Overall, the most reliable solutions pair symmetric wall placement and continuous load paths with ductile detailing.

6. For high-rise design, a well-proportioned central core or carefully balanced corner systems are preferred, with openings and stiffness transitions detailed to maintain drift control and minimize torsion.

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