Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
February 2024 5(2), 1562–1572

ANALYSIS OF G+22 BUILDING BY USING SHEAR WALLS IN VARIOUS LOCATIONS UNDER INFLUENCE OF SEISMIC LOAD BY USING ETABS

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

[1] Research Scholar, M. Tech. Student, Department of Civil Engineering, CSMSS Chh. Shahu College of Engineering, Chh. Sambhajinagar, India
[2] Associate Professor, Department of Civil Engineering, CSMSS Chh. Shahu College of Engineering, Chh. Sambhajinagar, India

Corresponding Author
Ganesh Bhagawat,
ganeshbhagawat97@gmail.com

DOI
10.29121/shodhkosh.v5.i2.2024.6510

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

The behavior of high-rise reinforced concrete (RCC) structures during earthquakes is strongly influenced by the placement of shear walls, which serve as primary lateral load-resisting elements. This research aims to investigate the impact of shear wall positioning on the seismic performance of a G+22 commercial building and to identify the most efficient configuration for achieving stability, safety, and economy. A detailed three-dimensional model of the building was developed and analyzed in ETABS software. The seismic response was evaluated using the Response Spectrum Method in compliance with IS 1893:2016 provisions. Three shear wall arrangements were considered for comparison: (i) corner positions, (ii) middle outer positions, and (iii) inner/core positions. The building's response was assessed in terms of story drift, lateral displacement, base shear, and story stiffness. The analysis reveals that shear walls located at the inner/core region of the building deliver superior performance compared to corner and middle-outer placements. The core configuration effectively minimizes lateral displacements and inter-story drifts, while also enhancing stiffness and overall stability under seismic loading. Although other arrangements contribute to resistance, they are less efficient in controlling deformations and ensuring uniform load distribution. The findings highlight that the inner/core positioning of shear walls provides the best structural efficiency for high-rise RCC buildings subjected to seismic forces. This configuration not only improves serviceability by reducing drift but also enhances the overall seismic resilience of the structure. The study underscores the importance of strategic shear wall placement in tall building design and offers practical guidance for engineers and designers in achieving safe, durable, and economical structural systems.

Keywords: Reinforced Concrete (RCC), High-Rise Building, Shear Wall Placement, Seismic Analysis, Response Spectrum Method, ETABS, Story Drift, Lateral Displacement, Structural Stiffness

1. INTRODUCTION

The demand for vertical expansion in modern cities has resulted in a significant rise in the construction of high-rise buildings. These tall structures, while addressing the growing need for commercial and residential spaces, are more vulnerable to lateral loads arising from wind and earthquakes. Among these, seismic forces are particularly critical as they can induce severe damage or even collapse if the structure is not designed with adequate lateral load-resisting mechanisms. Therefore, the seismic performance of high-rise reinforced concrete (RCC) buildings has become an important area of research in structural engineering.

One of the most effective structural components used to enhance the seismic resistance of tall buildings is the shear wall. A shear wall is a vertical structural element that provides considerable strength and stiffness to a building, thereby reducing lateral displacements and inter-story drifts. Its presence significantly improves the overall performance of the structure under earthquake excitations. However, the effectiveness of shear walls is not determined solely by their presence but also by their location within the building. Improper positioning can lead to non-uniform distribution of lateral forces, torsional irregularities, or inefficient structural behaviour. Hence, determining the optimal placement of shear walls in high-rise buildings is a key design consideration.

Shear walls are essential structural elements in high-rise buildings, designed to resist lateral forces such as wind and earthquakes. They provide strength, stiffness, and stability by limiting horizontal displacements and preventing excessive sway. Typically constructed of reinforced concrete, shear walls ensure efficient load transfer and enhance structural safety when strategically positioned. Their effectiveness depends not only on material and design but also on their location within the building. Lateral Loads, generated by wind and seismic activity, these forces act horizontally on the structure. Wind loads are transferred to shear walls through floor diaphragms, while seismic loads arise from ground motion, demanding energy absorption and redistribution. Shear Forces, parallel lateral actions create internal shearing stresses within the wall. Without adequate reinforcement, these stresses may cause cracks, making shear reinforcement critical. Axial Forces, acting vertically, these include compressive forces from gravity loads and tensile forces due to overturning effects. Proper reinforcement is required to balance compression and tension in tall buildings. Overturning Moments, strong lateral forces induce rotation at the wall base, particularly in high-rise structures. Adequate foundation anchorage and reinforcement are necessary to counter this effect. Bending Moments, when resisting lateral loads, shear walls experience bending stresses along their height, with maximum moments at the base. Vertical and horizontal reinforcement enhance flexural strength and ductility. Torsional Forces, arising from misalignment between the center of mass and center of rigidity, torsion causes twisting of the structure. Symmetrical shear wall placement helps reduce torsional effects. Uplift Forces, generated by overturning actions under strong wind or seismic forces, uplift can destabilize shear walls. Proper anchorage and detailing are essential to resist these vertical lifting forces.

In the past, several studies have emphasized the importance of shear wall placement. Research has shown that shear walls located symmetrically in plan and aligned with the center of rigidity tend to perform better under seismic loads. On the other hand, eccentric or unsymmetrical arrangements may lead to torsional effects and uneven displacement patterns. Despite these findings, there is still a need for comparative analyses of different shear wall configurations in modern high-rise RCC structures, particularly using advanced computational tools. With the advancement of structural analysis software, such as ETABS, engineers are now able to model complex building geometries and evaluate their response under seismic loading more accurately. ETABS provides a reliable platform for dynamic analysis, including the Response Spectrum Method, which is widely adopted as per IS 1893:2016 for seismic design in India. This method captures the dynamic characteristics of a building and helps assess its performance under earthquake excitations.

In the present study, a G+22 RCC commercial building is analyzed using ETABS to evaluate the influence of shear wall positioning under seismic loads. Three different shear wall locations are considered: (i) corner positions, (ii) middle outer positions, and (iii) inner/core positions. The performance of the building is assessed through key structural parameters, including story drift, lateral displacement, base shear, and story stiffness. The objective of this research is to determine the most efficient shear wall configuration that provides maximum seismic safety and structural efficiency. The study aims to bridge the gap between theoretical understanding and practical application by providing a comparative evaluation of different shear wall placements in high-rise buildings. The outcomes of this work are expected to serve as a useful reference for engineers and designers in planning safe, economical, and serviceable RCC structures in earthquake-prone regions.

1.1. NEED FOR THE STUDY

Tall RCC structures are inherently more susceptible to seismic forces because of their height, flexibility, and slender proportions. To safeguard these buildings, shear walls are often introduced as primary lateral load–resisting elements. While their inclusion significantly enhances stability, the effectiveness of shear walls depends greatly on their placement within the structural system. Poor positioning may cause irregular force distribution, excessive inter-story drift, and reduced overall efficiency, ultimately affecting both safety and serviceability. Although the advantages of shear walls are well recognized, only limited research has systematically compared different positioning strategies in high-rise commercial buildings using advanced analytical tools. With the growing use of ETABS in seismic analysis and the increasing demand for cost-effective yet safe design solutions, it becomes crucial to assess how shear wall location influences critical response parameters such as displacement, drift, stiffness, and base shear. This study, therefore, addresses the need to identify the most effective shear wall configuration that can reduce seismic effects, enhance structural performance, and guide engineers in designing safe, durable, and economical RCC high-rise buildings in earthquake-prone regions.

1.2. OBJECTIVES OF THE STUDY

The key objectives of this research are:

1) To study irregularities in structural analysis and analysis of G+22 storeys structure as per Indian standard code.
2) To evaluating the impact of different concrete shear-wall locations on the seismic performance of commercial buildings using ETABS software.
3) To analyse a G+22 RC commercial building in ETABS with alternative shear-wall locations in Seismic Zone IV, identify the best-performing configuration based on code-based seismic criteria, and then evaluate that configuration in Seismic Zone V.
4) To analyse the critical parameters of shear wall such as base shear, story drift, story stiffness and maximum displacement with the help of software

2. LITERATURE REVIEW

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.

3. SYSTEM DESIGN

This research aims to identify the most suitable shear wall placement for a G+22 RCC commercial building, supported by quantitative analysis and compliance with seismic codes. The study will compare how different layouts influence structural performance in terms of period, base shear, displacement, drift, torsional behaviour, floor acceleration, and force redistribution, while also noting detailing requirements such as collectors and boundary elements. The configuration that performs best in Zone IV will be re-evaluated in Zone V to confirm its reliability under higher seismic demand.

Beyond the specific case, the findings will clarify the relative advantages of corner, mid-span perimeter, and interior wall placements in tall buildings, while presenting a reproducible ETABS workflow for use in similar projects. Overall, success will be judged by the ability to rank configurations clearly, satisfy codal limits, and provide practical guidance for economical and safe design. In this study, a G+22 RCC commercial building with plan dimensions of 14 m × 22 m and a storey height of 3.5 m is analyzed in Seismic Zone IV on medium soil, as per IS 1893 (Part 1):2016. The structure is designed as a Special Moment Resisting Frame (SMRF) with shear walls placed at different locations core, corners, and perimeter mid-spans to evaluate their effect on seismic performance. ETABS-V21 is used to model and analyze multiple configurations through response spectrum analysis with 5% damping. Key parameters compared include storey displacement, drift, shear, and fundamental time period. The aim is to identify the most effective shear wall arrangement that minimizes lateral response while ensuring stability and code compliance.

Table 1 Building Description

Sr. No.	Building Data	Parameters
1	Type of Building	Commercial Building
2	Building Frame Type	SMRF with Shear Wall
3	Plan Dimension	14m x 22m
4	Number of Stories	23
5	Height of Building	49m
6	Floor to Floor Height	80.5m
7	Support Condition	Fixed
8	Grade of Concrete	M25
9	Grade of Steel	HYSD Reinforcement of Fe500
10	Column Size	600 mm x 600 mm
11	Beam Size	600 mm x 350 mm
12	Length of Shear Wall in Plan	6m
13	Thickness of Shear Wall	300mm
14	Thickness of Slab	150 mm
15	Thickness of Wall	230 mm
16	Density of Concrete	25 kN/m³
17	Density of Brick	20 kN/m³

4. PLAN AND 3D VIEW OF MODEL

Figure 1

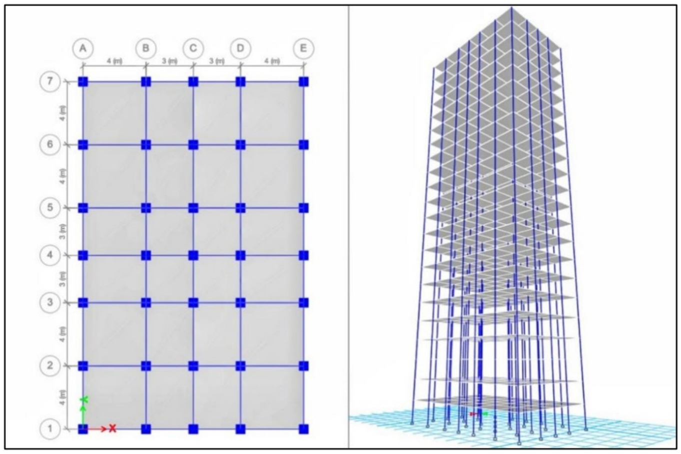

Figure 1 Plan of Structure without Shear Wall

Figure 2

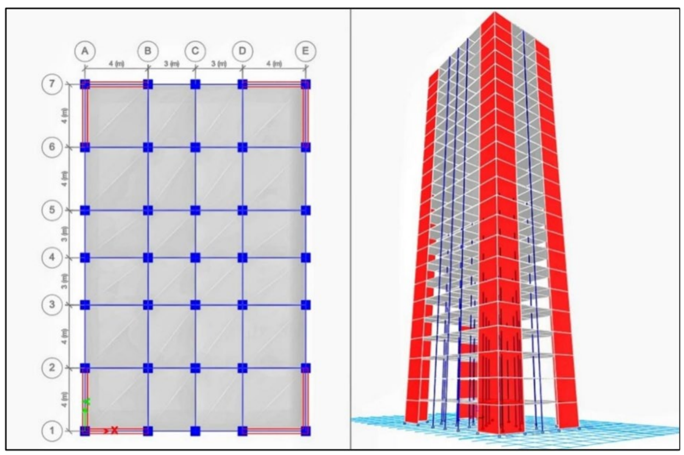

Figure 2 Plan of Structure with Corner Shear wall

Figure 3

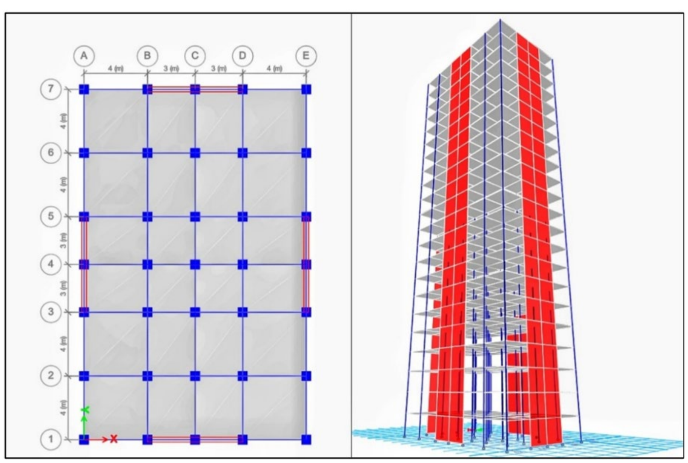

Figure 3 Plan of Structure Outer Middle Shear Wall

Figure 4

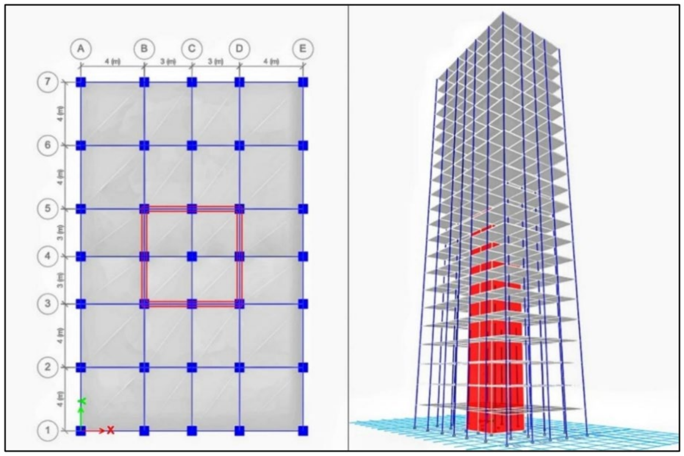

Figure 4 Plan of Structure Inner/Core Middle Shear Wall

The building model is developed using M25 grade concrete and Fe500 HYSD reinforcement steel. Columns are sized 600 × 600 mm and beams 600 × 350 mm, providing adequate stiffness and strength. Shear walls of 6 m length and 300 mm thickness are introduced to improve lateral load resistance and control displacements. The floor system consists of a 150 mm reinforced concrete slab supported by beams and columns. External walls are represented as 230 mm thick brick masonry infill. Material properties follow standard codes, with concrete density assumed as 25 kN/m^3 and brick masonry density as 20 kN/m^3. These specifications define the adopted structural configuration for the study.The loading conditions in this study are adopted in accordance with IS 875 and IS 1893 guidelines. Dead load includes the structural self-weight of 1.0 kN/m^2, supplemented by wall loads of 14 kN/m for external walls, 9 kN/m for internal walls, and 5 kN/m for the parapet. An additional 1.5 kN/m^2 is considered for floor finish and ceiling plaster. Live loads are taken as 4 kN/m^2 for floors and 2 kN/m^2 for the roof, following IS 875 (Part 2). Seismic loading is evaluated as per IS 1893 (Part 1), with the structure situated in Zone IV (Z = 0.24) on medium soil. The analysis assumes a damping ratio of 5%, a response reduction factor of 5 (for SMRF), and an importance factor of 1.2.

5. RESULT AND DISCUSSION

5.1. STORY DISPLACEMENT IN X DIRECTION

The study shows that shear wall placement significantly influences lateral displacement. The bare frame exhibited the highest sway, while the addition of shear walls reduced displacements across all cases. Among the configurations, inner middle shear walls provided the best performance, reducing the top story displacement to 16.767 mm, lower than both corner and outer middle placements. This layout forms a stiff central core, enhancing structural stability and minimizing drift. Overall, central placement of shear walls emerges as the most effective strategy for ensuring safety and serviceability of high-rise buildings under seismic loading.

Figure 5

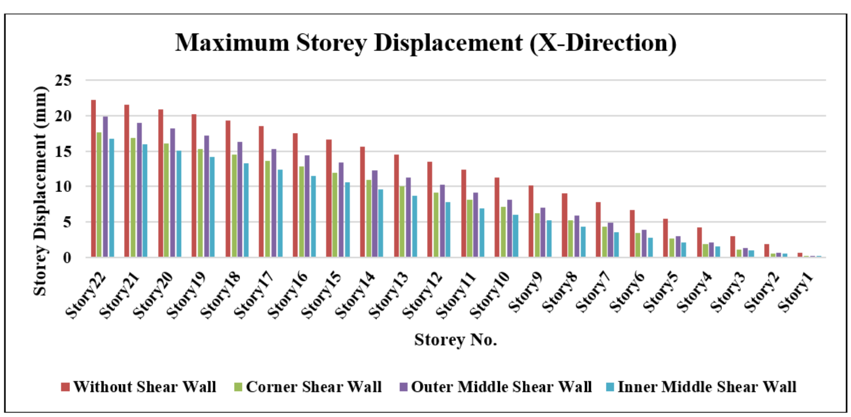

Table 1 Comparison of Lateral Displacement in X-Direction (mm)

Sr. No.	No. of Floors	Story Height (m)	Without Shear Wall	Corner Shear Wall	Outer Middle Shear Wall	Inner Middle Shear Wall
1	Story22	66	22.203	17.623	19.891	16.767
2	Story21	63	21.608	16.884	19.043	15.932
3	Story20	60	20.937	16.121	18.157	15.064
4	Story19	57	20.188	15.329	17.244	14.183
5	Story18	54	19.37	14.51	16.31	13.292
6	Story17	51	18.494	13.663	15.352	12.391
7	Story16	48	17.567	12.793	14.369	11.483
8	Story15	45	16.598	11.901	13.365	10.571
9	Story14	42	15.592	10.988	12.339	9.657
10	Story13	39	14.556	10.059	11.297	8.746
11	Story12	36	13.495	9.116	10.24	7.841
12	Story11	33	12.411	8.163	9.174	6.947
13	Story10	30	11.306	7.205	8.101	6.068
14	Story9	27	10.181	6.249	7.03	5.21
15	Story8	24	9.036	5.302	5.968	4.38
16	Story7	21	7.873	4.376	4.926	3.585
17	Story6	18	6.691	3.482	3.921	2.835
18	Story5	15	5.493	2.636	2.969	2.139
19	Story4	12	4.28	1.859	2.095	1.511
20	Story3	9	3.06	1.173	1.328	0.965
21	Story2	6	1.85	0.606	0.698	0.516
22	Story1	3	0.715	0.197	0.232	0.186

5.2. STORY DRIFT IN X DIRECTION

The analysis shows that shear wall placement greatly affects inter-story drift. The bare frame recorded the highest values, making it the most vulnerable. Introducing shear walls reduced drift across all cases, with the inner middle configuration giving the best performance. At the roof, drift dropped to 0.000294, and at the ground story to just 6.20E-05, far below the bare frame condition. This arrangement acts like a stiff central core, distributing forces uniformly and minimizing both sway and local drifts. Overall, inner middle shear walls are the most effective for controlling drift and enhancing stability in high-rise buildings under seismic loads.

Table 2 Comparison of Story Drift in X-Direction

Sr. No.	No. of Floors	Story Height (m)	Without Shear Wall	Corner Shear Wall	Outer Middle Shear Wall	Inner Middle Shear Wall
1	Story22	66	0.00021	0.00027	0.000313	0.000294
2	Story21	63	0.000245	0.000279	0.000323	0.000302
3	Story20	60	0.000282	0.00029	0.000336	0.000308
4	Story19	57	0.000314	0.000301	0.000346	0.000313
5	Story18	54	0.00034	0.000311	0.000356	0.000317
6	Story17	51	0.000361	0.000319	0.000364	0.00032
7	Story16	48	0.000376	0.000326	0.00037	0.000321
8	Story15	45	0.000389	0.00033	0.000374	0.000321
9	Story14	42	0.000397	0.000333	0.000377	0.000319
10	Story13	39	0.000402	0.000335	0.000378	0.000315
11	Story12	36	0.000405	0.000335	0.000377	0.00031
12	Story11	33	0.000406	0.000333	0.000375	0.000303
13	Story10	30	0.000407	0.00033	0.000371	0.000294
14	Story9	27	0.000408	0.000324	0.000364	0.000283
15	Story8	24	0.000408	0.000315	0.000355	0.00027
16	Story7	21	0.000409	0.000302	0.000341	0.000254
17	Story6	18	0.000409	0.000284	0.000321	0.000234
18	Story5	15	0.000409	0.000261	0.000294	0.000211
19	Story4	12	0.000409	0.00023	0.000258	0.000183
20	Story3	9	0.000404	0.000189	0.000211	0.00015
21	Story2	6	0.00038	0.000138	0.000156	0.000113
22	Story1	3	0.000238	6.60E-05	7.70E-05	6.20E-05

5.3. STORY SHEAR IN X DIRECTION

The study shows that shear wall placement significantly affects story shear distribution. The bare frame records the lowest shear due to its flexibility, but with poor drift control. Adding shear walls increases shear capacity, improving resistance to lateral loads. The inner middle configuration performs best, with a maximum base shear of 1728.82, as it acts like a central core that efficiently transfers forces to the foundation while minimizing deformation. Corner walls also perform well, while outer middle walls provide moderate improvement. Overall, inner middle shear walls offer the most effective balance of strength and stability under seismic and wind loads.

Figure 6

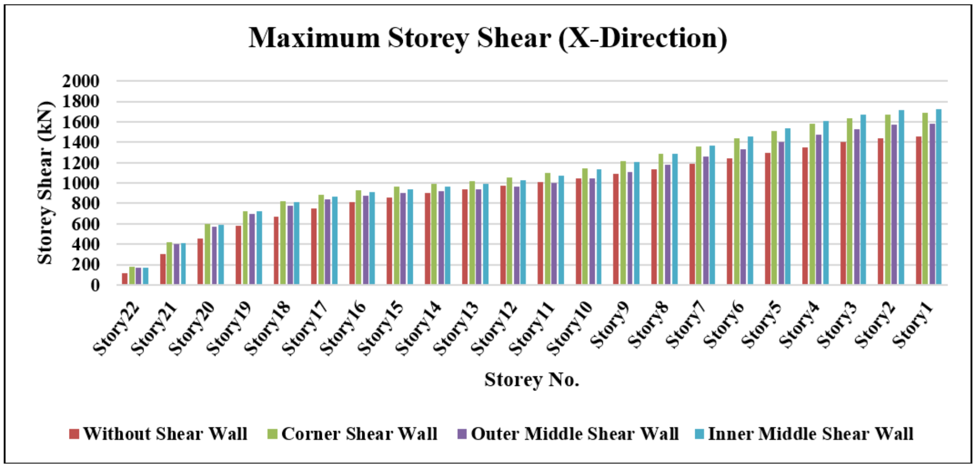

Table 3 Comparison of Story Shear in X-Direction (kN)

Sr. No.	No. of Floors	Story Height (m)	Without Shear Wall	Corner Shear Wall	Outer Middle Shear Wall	Inner Middle Shear Wall
1	Story22	66	120.2086	177.4511	173.4043	173.5568
2	Story21	63	299.5316	417.4268	405.2888	411.33
3	Story20	60	453.0396	597.8167	576.1149	593.1357
4	Story19	57	577.3512	728.0173	695.9996	723.5364
5	Story18	54	674.3081	820.8758	779.0426	812.1509
6	Story17	51	749.4763	887.0063	836.2905	870.7999
7	Story16	48	809.2691	933.2666	874.2144	910.3904
8	Story15	45	861.8588	967.7847	900.0495	941.3866
9	Story14	42	904.0004	994.2669	918.2949	966.5317
10	Story13	39	940.2924	1021.3278	937.6125	992.5383
11	Story12	36	973.7213	1054.2689	963.8053	1025.8059
12	Story11	33	1008.0549	1095.849	999.8071	1071.7883
13	Story10	30	1046.256	1147.8591	1047.4309	1132.4666
14	Story9	27	1089.2113	1211.2073	1107.6687	1205.621
15	Story8	24	1136.1804	1284.1374	1178.7426	1286.712
16	Story7	21	1186.4022	1362.0021	1255.674	1371.3845
17	Story6	18	1239.9216	1439.7854	1332.9774	1456.334
18	Story5	15	1296.4522	1514.0469	1406.9951	1538.2289
19	Story4	12	1353.1734	1581.5519	1474.6983	1612.2458
20	Story3	9	1403.6933	1636.8113	1530.9613	1672.0589
21	Story2	6	1439.6618	1673.0868	1568.9453	1711.8213

22	Story1	3	1454.9789	1687.399	1584.5422	1728.8177

5.4. STORY SHEAR IN Y DIRECTION

Figure 7

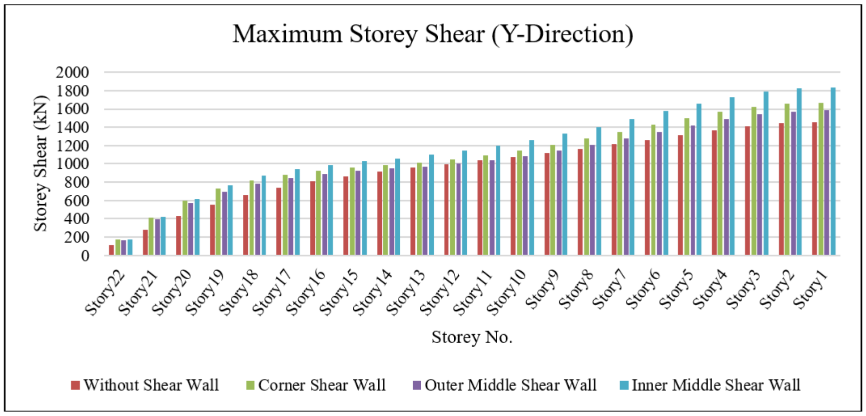

Table 4 Comparison of Story Shear in Y-Direction (kN)

Sr. No.	No. of Floors	Story Height (m)	Without Shear Wall	Corner Shear Wall	Outer Middle Shear Wall	Inner Middle Shear Wall
1	Story22	66	111.9968	176.6233	168.6807	176.1673
2	Story21	63	282.4448	416.2644	397.2724	422.7269
3	Story20	60	431.8137	597.5834	570.3995	618.5194
4	Story19	57	556.359	727.6592	694.926	765.7224
5	Story18	54	657.0904	817.8647	781.8211	870.0188
6	Story17	51	738.4422	880.6091	842.8115	940.3697
7	Story16	48	805.6875	925.8789	887.0961	987.8421
8	Story15	45	866.5235	962.3844	922.6454	1026.2653
9	Story14	42	916.2039	990.6601	949.4259	1061.0479
10	Story13	39	959.4095	1016.8679	973.2642	1099.5587
11	Story12	36	998.6084	1047.4135	1000.4352	1144.6238
12	Story11	33	1037.0126	1088.0812	1036.8271	1197.2182
13	Story10	30	1077.2453	1141.155	1085.0085	1257.8643
14	Story9	27	1120.2407	1204.853	1143.5288	1327.1219
15	Story8	24	1165.5624	1275.5501	1209.0408	1404.9467
16	Story7	21	1212.7264	1350.2206	1278.7361	1489.5442
17	Story6	18	1261.9229	1426.6757	1350.626	1576.6661
18	Story5	15	1313.0792	1501.7707	1421.7856	1659.9531
19	Story4	12	1363.9419	1569.8663	1486.8216	1732.2607
20	Story3	9	1409.0859	1623.6398	1538.652	1787.4508
21	Story2	6	1441.2377	1657.3091	1571.5944	1822.0889
22	Story1	3	1454.9825	1670.1956	1584.5412	1836.3128

The inner middle shear wall configuration shows the best performance in the Y-direction, attracting the highest story shear values across all levels. At the base, the shear reaches 1836.31, the maximum among all cases, confirming its role as a stiff central core that efficiently transfers lateral forces to the foundation. Compared to bare and other wall placements, this layout offers superior stiffness, reduced drift, and improved seismic and wind resistance. Thus, central placement provides the most effective and reliable solution for tall building stability.

5.5. STORY STIFFNESS IN X DIRECTION

The inner middle shear wall system provides the highest stiffness, reaching 9,574,995.97 at the base, far exceeding other configurations. Acting as a rigid central core, it minimizes drift and torsional irregularities while efficiently transferring lateral loads to the foundation. Compared to corner and outer middle placements, this layout delivers the greatest stiffness and stability, confirming its effectiveness as the optimal solution for high-rise buildings under seismic and wind forces.

Figure 8

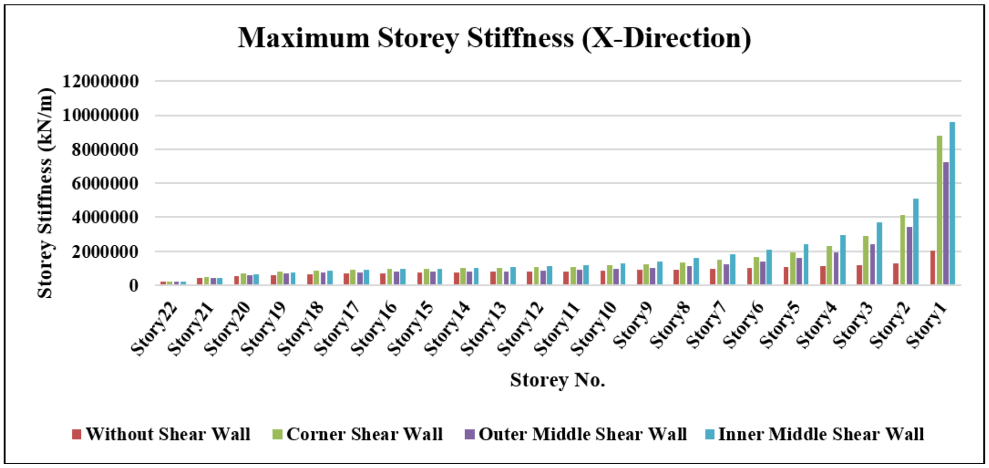

Table 5 Comparison of Story Stiffness in X-Direction (mm)

Sr. No.	No. of Floors	Story Height (m)	Without Shear Wall	Corner Shear Wall	Outer Middle Shear Wall	Inner Middle Shear Wall
1	Story22	66	191257.658	229799.329	193698.166	203090.33
2	Story21	63	407732.755	501173.152	418698.815	455799.624
3	Story20	60	536075.548	689049.993	573735.003	643676.282
4	Story19	57	613074.692	808114.574	671991.519	771904.773
5	Story18	54	660770.654	882124.12	731401.756	854577.273
6	Story17	51	692630.659	928676.849	767323.169	908032.839
7	Story16	48	716651.266	957734.521	788348.735	945604.886
8	Story15	45	739479.986	978553.288	801864.564	978407.166
9	Story14	42	759498.617	995836.467	812502.034	1011058.308
10	Story13	39	779750.643	1018010.795	827597.945	1050500.755
11	Story12	36	801564.865	1050547.644	852207.637	1104436.365
12	Story11	33	826679.576	1097082.597	889326.831	1180740.801
13	Story10	30	856234.725	1161257.639	942090.569	1285111.001
14	Story9	27	890167.793	1247320.308	1014179.897	1420703.49
15	Story8	24	927610.613	1359658.955	1108965.071	1590753.843
16	Story7	21	967800.22	1503110.316	1230128.893	1802814.986
17	Story6	18	1010477.65	1688478.388	1386137.613	2073023.913
18	Story5	15	1055539.076	1938639.291	1597459.908	2431748.546
19	Story4	12	1103120.22	2303694.401	1908446.235	2937716.434
20	Story3	9	1158346.282	2904554.97	2421083.354	3720779.693
21	Story2	6	1266325.409	4116039.223	3427387.519	5115525.02
22	Story1	3	2040625.123	8790234.546	7213257.027	9574995.972

6. CONCLUSION

From the results discussed in the previous section, following conclusions are drawn.

1) The bare frame performs poorly, showing excessive displacement, drift, and low stiffness, making it unsuitable for seismic and wind resistance. .
2) corner and outer middle shear walls improve performance but create torsional effects or provide only moderate gains.
3) The inner middle shear wall (core system) achieves the lowest displacement and drift, fully meeting codal requirements.
4) This configuration also attracts the highest base shear, confirming its superior load-resisting capacity.
5) Stiffness is maximized in the inner core system, ensuring stability, uniform force transfer, and minimum torsional irregularity.
6) Overall, the inner middle shear wall placement is the most effective and is recommended as the optimal solution for high-rise seismic design.

CONFLICT OF INTERESTS

None .

ACKNOWLEDGMENTS

None.

REFERENCES

P. P. Chandurkar, D. R. P. S. Pajgade. 2013. Seismic analysis of RCC building with and without shear wall. IJMER. 3(3): 1805-1810.

Varsha. R. Harne. 2014. Comparative study of strength of RC Shear wall at different locations on multistoried Residential buildings. International Journal of Civil Engineering Research. ISSN 2278 3652, 5(4): 391-400.

Shahabodin. Zaregairizi. Comparative investigation on using shear wall and infill to improve seismic performance of existing buildings. 14th World Conference on Earthquake Engineering.

Ugale Ashish B. and Raut Harshlata R. 2014. Effect of steel plate shear wall on the behavior of the structure. International Journal of Civil Engineering Research. ISSN 2278-3652, 5(3): 295-300.

Anshuman S., Dipendu Bhunia, Bhavin Ramjiyani. 2011. Solution of shear wall location in a multistorey building. International Journal of Civil and Structural Engineering. 2(2).

Dr. B. Kameswari, Dr. G. Elangovan, P. Sivabala, G. Vaisakh. 2011. Dynamic Response of High-rise Structures under the Influence of discrete staggered shear wall. IJEST.

J. W. Berman. 2011. Seismic behavior of code designed metallic Plate Shear walls. Engineering systems, Elsevier. 33: 230-244.

Dangi S. K., Akhtar S. 2019. Seismic analysis of an RC building on sloping ground with shear wall at different positions. AIP Conference Proceedings.

Shaik AkhilAhamad and K. V. Pratap. 2021. Dynamic analysis of G + 20 multi-storied buildings by using shear walls in various locations for different seismic zones by using Etabs. Materials today: proceedings. 43: Part 2.

Koshy, A. J., Sofi, A., Santhakumar A. R. 2021. Lateral Load Analyses of Multi-storeyed Frames with and Without Shear Walls. Lecture Notes in Civil Engineering. 78, pp. 19-35.

Banerjee R., Srivastava J. B., Gupta N. 2022. Seismic Response of Y-Shape Multi-Storey Building with Optimum Location of Shear Walls. Indian Journal of Engineering and Materials Sciences. 29(5): 615-621.

Banerjee R., Parashar A. K., Gupta N., Srivastava, J. B. 2023. Study on earthquake-induced torsional irregularity and lateral displacement of RC building with shear wall storey. Asian Journal of Civil Engineering. 24(8): 3463-3471.

IS 875 (Part-1) 2015: Code of Practice for Design Loads for Buildings and Structures, part-1: Dead Loads.

IS 875 (Part-2) 2015: Code of Practice for Design Loads for Buildings and Structures, part -2: Imposed Loads.

IS 875 (Part-3) 2015: Code of Practice for Design Loads for Buildings and Structures, part -2: wind Loads.

IS 1893 (Part-1) 2016: Code of Practice for earthquake resistant design of structures.