STM JOURNALS

Journal of
Structural Engineering and Management

ISSN: 2393-8773
Volume 13, Issue 2, 2026
May–August
DOI (Journal): 10.37591/JoSEM

https://journals.stmjournals.com/josem

Research JoSEM

Comparative Seismic Response of Irregular High-Rise RCC 25 Story Buildings with and Without Shear Walls Considering P-Delta Effect

Jayshri S. Sirsat[1,*], Dinesh M. Pandit[2]

Abstract

The seismic performance of high-rise reinforced concrete (RCC) buildings is significantly affected by plan irregularity, lateral stiffness distribution, and second-order (P–Delta) effects. Irregular structural configurations may generate torsional response and increased deformation demand under seismic excitation while geometric nonlinearity further amplifies displacement and internal forces in tall structures. This study presents a comparative seismic assessment of a G+24 story RCC building having overall plan dimensions of 30,000 mm × 30,000 mm. Three H-shaped configurations—Straight-Edge H-Shaped Building, H-shaped Building with Chamfered Corners, and H-shaped Building with Re-entrant Corner Configuration are considered to evaluate the influence of plan geometry on structural response. For each configuration, two structural systems are analyzed: a bare moment-resisting frame and a shear wall-integrated system. Seismic analysis is carried out using ETABS software through linear static and geometric nonlinear (P–Delta) procedures in accordance with IS 1893:2016 provisions. Key response parameters including story displacement, story drift, base shear, and overturning moment are extracted and compared. The results demonstrate that the inclusion of shear walls reduces lateral displacement by approximately 7–12% and story drift by nearly 9–14%, indicating enhanced stiffness and improved deformation control. However, consideration of P–Delta effects increases roof displacement by about 18–22%, emphasizing the necessity of second-order analysis in high-rise buildings. Among the configurations examined, the Straight-Edge H-Shaped Building exhibits comparatively better displacement control, whereas the H-shaped Building with Re-entrant Corner Configuration shows relatively higher flexibility. Overall, the findings confirm that both plan configuration and shear wall integration play a crucial role in ensuring the seismic safety of irregular high-rise RCC structures.

Keywords: ETABS, P-delta effect, plan irregularity, seismic analysis, shear wall

***Author for Correspondence**
Jayshri S. Sirsat
E-mail: s.jayshri77@gmail.com

[1]Student, Department of Civil, Chh.Shahu College of Engineering, Chhatrapati Sambhajinagar (Aurangabad), Maharashtra, India
[2]Assistant Professor, Department of Civil, Chh.Shahu College of Engineering, Chhatrapati Sambhajinagar (Aurangabad), Maharashtra, India

Received Date: February 25, 2026
Accepted Date: March 06, 2026
Published Date: March 07, 2026

Citation: Jayshri S. Sirsat, Dinesh M. Pandit. Comparative Seismic Response of Irregular High-Rise RCC 25 Story Buildings with and Without Shear Walls Considering P–Delta Effect. Journal of Structural Engineering and Management. 2026; 13(2): 1–14p.

INTRODUCTION

Rapid urbanization and population growth have significantly increased the demand for high-rise reinforced concrete (RCC) buildings, particularly in seismic-prone areas. As the building height increases, the structural behavior becomes increasingly sensitive to the lateral loads generated by earthquakes and wind. Among these, seismic forces are particularly critical owing to their sudden occurrence and potential to induce severe structural damage or collapse if not properly accounted for during design. Therefore, a comprehensive understanding of the seismic response of high-rise RCC structures is essential to ensure their safety, serviceability, and overall structural stability [1–3].

© STM Journals 2026. All Rights Reserved

The seismic performance of tall buildings is governed by several parameters, including the structural height, stiffness distribution, mass irregularity, and configuration of lateral load-resisting systems [3, 9]. Buildings with irregular plan geometries often experience torsional responses and non-uniform distributions of seismic forces, which may lead to increased displacement and drift demands [3, 6, 9]. H-shaped configurations, frequently adopted to satisfy architectural and functional requirements, introduce re-entrant corners and stiffness discontinuities that significantly influence the global seismic behavior.

Shear walls are widely recognized as effective lateral force-resisting elements in high-rise structures, enhancing stiffness and reducing lateral displacement and interstory drift [2, 5]. However, their inclusion alters the dynamic characteristics of the building, often resulting in a higher base shear owing to a reduced fundamental time [2, 7].

Furthermore, second-order (P–Delta) effects become increasingly significant in tall buildings, where axial loads interact with lateral displacements to generate additional secondary moments. Neglecting geometric nonlinearity may lead to underestimation of the deformation and force demand [1, 4, 10]. Hence, incorporating the P–Delta analysis is essential for the realistic seismic assessment of high-rise RCC buildings.

This study investigates the earthquake response of irregular high-rise RCC buildings with different H-shaped configurations, namely, straight-edge H-shaped buildings, H-shaped buildings with chamfered corners, and H-shaped buildings with re-entrant corner configurations, by analyzing models with and without shear walls using linear static and second-order (P–Delta) procedures in accordance with IS 1893:2016 provisions.

Problem Statement

Accelerated urbanization has led to the rapid construction of high-rise reinforced concrete (RCC) buildings, many of which adopt irregular plan configurations to satisfy architectural and functional requirements of the buildings. However, structural irregularities, particularly in H-shaped buildings, can significantly influence the seismic response by inducing uneven stiffness distribution, torsional behavior, and increased lateral deformation demand [3, 6, 9]. In seismic regions, these effects become more pronounced as the building height increases, particularly when adequate lateral load-resisting systems are not efficiently incorporated.

Although shear walls are widely used to enhance earthquake resistance and improve lateral stiffness, their effectiveness depends strongly on the structural configuration and stiffness distribution [2, 5]. The performance of shear wall systems is not uniform across different irregular geometries, and inappropriate placement may intensify torsional effects [5]. Furthermore, several studies have highlighted the importance of considering geometric nonlinearity (P–Delta effects) in tall buildings, as second-order behavior can substantially amplify the displacement and internal force demand under seismic loading [1, 4, 7-10].

Despite these individual investigations, comprehensive comparative studies examining the combined influence of plan irregularity, shear wall integration, and geometric nonlinear behavior in high-rise RCC buildings designed according to IS 1893:2016 provisions are limited. The absence of such an integrated assessment restricts a realistic understanding of the seismic response in irregular tall buildings and may lead to unconservative design assumptions or reduced structural efficiency.

Need and Scope of the Study

The increasing adoption of irregular plan configurations in tall reinforced concrete (RCC) buildings located in seismic-prone regions necessitates a comprehensive evaluation of their structural performance under earthquake loading. Irregular geometries are known to amplify the torsional response and deformation demand, thereby increasing the lateral displacement and inter-story drift

© STM Journals 2026. All Rights Reserved

compared to regular configurations [3, 6, 9]. Therefore, a reliable seismic assessment is essential to effectively control excessive deformation demand, ensure structural stability, and prevent potential performance degradation in high-rise buildings. Furthermore, the significance of geometric nonlinearity in tall structures has been emphasized in recent studies, as P–Delta effects may considerably increase the displacement and internal force demand [1, 4, 10].

A comparative evaluation of shear wall systems with different H-shaped configurations provides a clearer understanding of the efficiency of lateral load-resisting mechanisms in irregular buildings. Previous investigations have demonstrated that shear wall integration enhances stiffness and reduces deformation demand, although its effectiveness varies depending on the configuration and placement [2, 5, 7].

The present investigation focuses on the seismic assessment of a ground floor +24 RCC building incorporating three distinct H-shaped plan geometries: straight-edge H-shaped, chamfered corners, and re-entrant corner configurations. Two structural systems were considered for each configuration: a bare moment-resisting frame and a shear wall-integrated frame. Seismic analysis was performed using ETABS software through linear static and geometric nonlinear (P–Δ) procedures in accordance with IS 1893:2016 provisions. Key response parameters, including story displacement, inter-story drift, base shear, and overturning moment, were extracted and compared to evaluate the combined influence of plan irregularity and shear wall inclusion on the overall seismic performance.

Objectives of the Study

1. To analyze the seismic behavior of Ground Floor + 24 story RCC building with different irregular H-shaped plan configurations.
2. To compare structural performance with and without shear walls.
3. To quantify the influence of second-order P–Delta effects.
4. To identify the most efficient H-shaped plan configuration (i.e., straight-edge, chamfered corner, or re-entrant) in terms of seismic performance and overall structural stability

LITERATURE SURVEY

R. Kumar and S. Verma (2024) [1]: Kumar and Verma examined the impact of second-order (P–Δ) behavior on the seismic response of high-rise reinforced concrete buildings exhibiting plan irregularity. Using ETABS, they compared regular and irregular configurations through linear static and geometric nonlinear analyses in accordance with the IS 1893 provisions. Their findings indicated that the consideration of second-order effects notably increased story displacement and inter-story drift, particularly in taller structures. Buildings with irregular plans demonstrated greater susceptibility to stability-induced amplification, highlighting the importance of incorporating geometric nonlinearity into seismic evaluations. The authors concluded that neglecting these effects may result in unconservative design outcomes in earthquake-prone regions [1].

A. Sharma and P. Mehta (2024) [2]: Sharma and Mehta investigated the seismic performance of multi-story RCC buildings with and without shear wall systems while accounting for axial load–displacement interaction effects. Several structural models were analyzed under earthquake loading using the ETABS software. The study reported a considerable reduction in lateral displacement and drift when shear walls were introduced, although an increase in base shear was observed owing to the enhanced stiffness. When second-order behavior was included, all models exhibited displacement amplification; however, the shear wall systems demonstrated comparatively lower sensitivity. This research emphasized the necessity of integrating both shear wall systems and geometric nonlinear analysis for an accurate seismic assessment [2].

M. Patel and N. Joshi (2024) [3]: Patel and Joshi explored the influence of plan geometry on the seismic response by comparing regular, L-, C-, and H-shaped reinforced concrete buildings. Linear static and response spectrum analyses were conducted using the ETABS software. Their results showed that irregular configurations experienced higher torsional response, greater lateral displacement, and

© STM Journals 2026. All Rights Reserved

increased inter-story drift compared to regular forms. The study highlighted that H-shaped buildings with re-entrant corners are particularly prone to stress concentration and torsional effects during seismic excitation, necessitating robust lateral load-resisting mechanisms such as shear walls [3].

S. Iyer and K. Rao (2024) [4]: Iyer and Rao evaluated the seismic behavior of tall RCC structures considering stiffness irregularity and geometric nonlinear response. Both linear dynamic and second-order analyses were performed to compare parameters, including drift, bending moment, and shear force. The results demonstrated that the combination of stiffness variation and geometric nonlinearity reduces the effective global stiffness and increases the lateral deformation demands. The authors stressed that the accurate seismic design of tall buildings requires careful consideration of second-order stability effects, particularly where irregular stiffness distributions exist [4].

T. Singh and R. Kulkarni (2024) [5]: Singh and Kulkarni assessed the influence of shear wall positioning on the earthquake performance of high-rise reinforced cement concrete (RCC) buildings. Multiple shear wall the arrangements were modeled in ETABS, incorporating geometric nonlinear analysis to capture realistic structural behavior. Their findings revealed that centrally aligned and symmetrically distributed shear walls significantly improved drift control and reduced lateral displacement, whereas eccentric placement intensified the torsional response. The study concluded that an optimal shear wall configuration combined with a second-order analysis is essential for enhancing the seismic resilience of irregular tall buildings Figures 1-8 and Tables 1-2 [5].

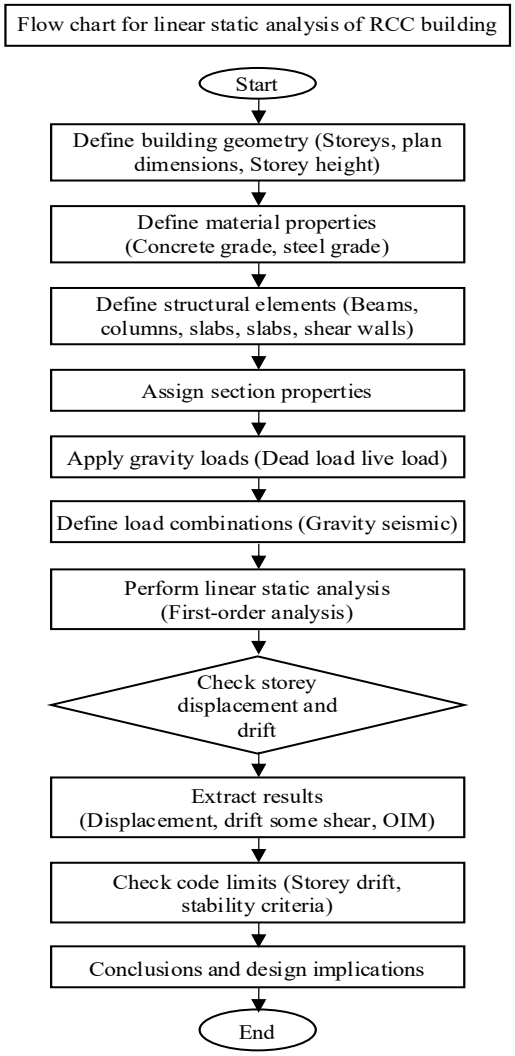


Figure 1. Steps linear static analysis.

© STM Journals 2026. All Rights Reserved

Different Models Considered for Analysis

Different Models Considered for Analysis are described in Figures 3-8 where shown in 3 dimensional model and different shapes of buildings.

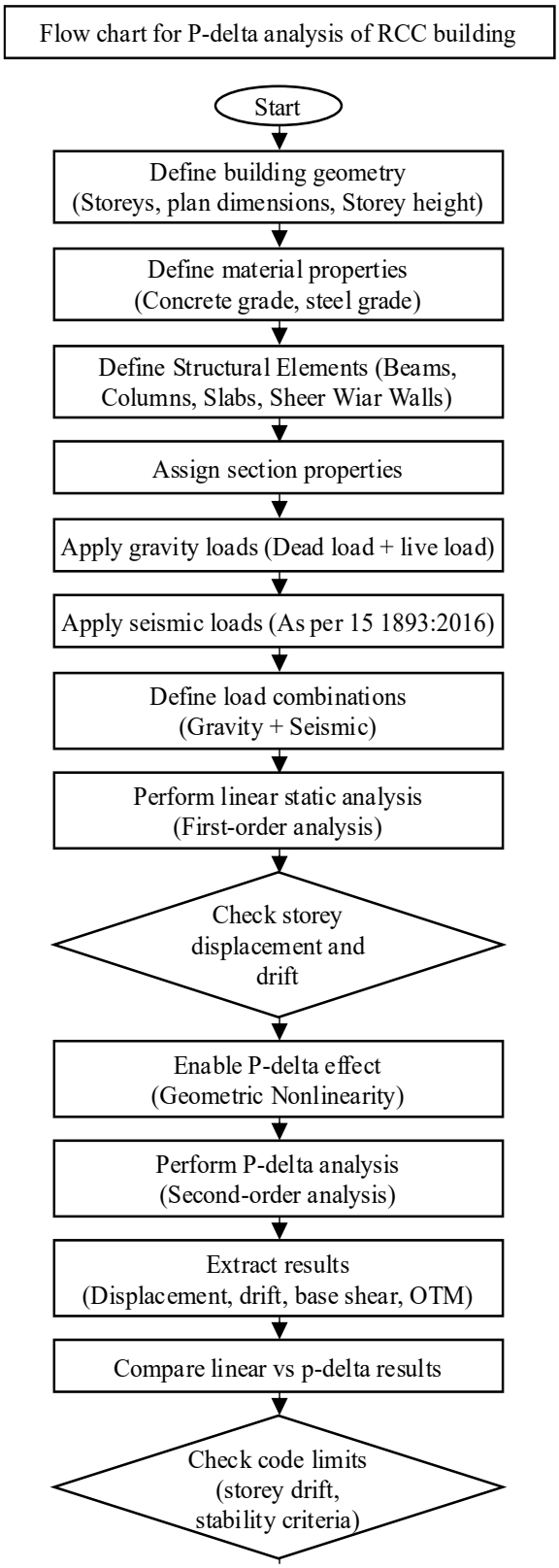


Figure 2. Steps P-delta analysis.

© STM Journals 2026. All Rights Reserved

Table 1. Geometry of model.

Property	Value	Unit
Number of Storeys	G+24	–
Building Shapes	1. Straight-Edge H-Shaped Building, 2. Chamfered Corners H-Shaped Building, 3. Re-entrant Corner H-Shaped Building	–
Floor-to-Floor Height	3000	mm
Total Elevation Height	75,000	mm
Seismic Zone	V	–
Length in X-direction	30,000	mm
Length in Y-direction	30,000	mm
Slab Thickness	150	mm
Beam Size	0.28 × 0.60	m
Column Size	0.70 × 0.80	m
Thickness of Shear Wall	250	mm
Thickness of Brick Wall	0.23	m

Table 2. Load properties.

S. N.	Load Type	Description / Location	Basis / Calculation	Load (kN/m or kN/m²)
1	Dead Load	Self-weight of structural members	As per IS 875:1987 (Part 1), calculated by ETABS	Software calculated
2	Dead Load	Floor finish	Given	1.5 kN/m²
3	Dead Load	Roof finish	Given	1.5 kN/m²
4	Dead Load	Wall load	(3000 − 600) × 230 × 0.00000002	0.011 kN/mm
5	Dead Load	Parapet wall load	230 × 1500 × 0.00000002	0.0069 kN/mm
6	Imposed Load (LL)	Live load on slab	As per IS 875:1987 (Part 2)	4.0 kN/m²
7	Imposed Load (LL)	Live load on roof	As per IS 875:1987 (Part 2)	1.5 kN/m²

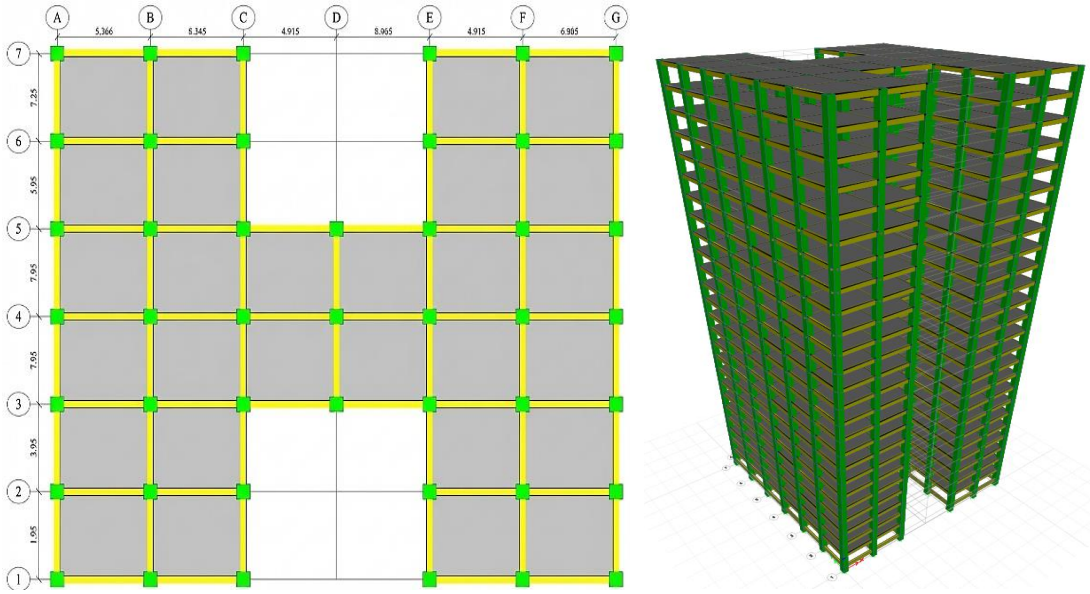


Figure 3. Plan and three-dimensional views of the straight-edge h-shaped building.

© STM Journals 2026. All Rights Reserved

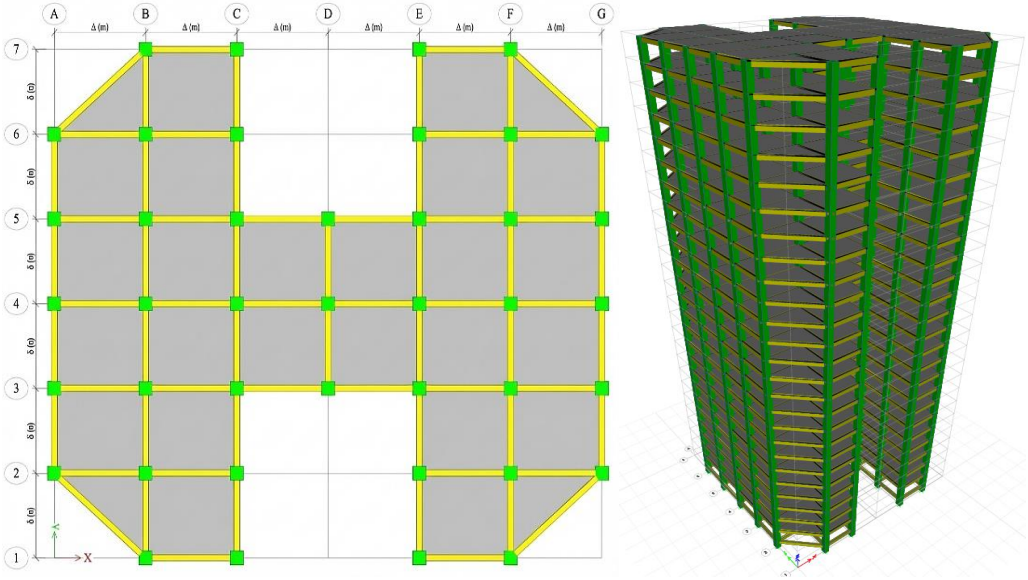


Figure 4. Plan and three-dimensional views of the H-shaped building with chamfered corners.

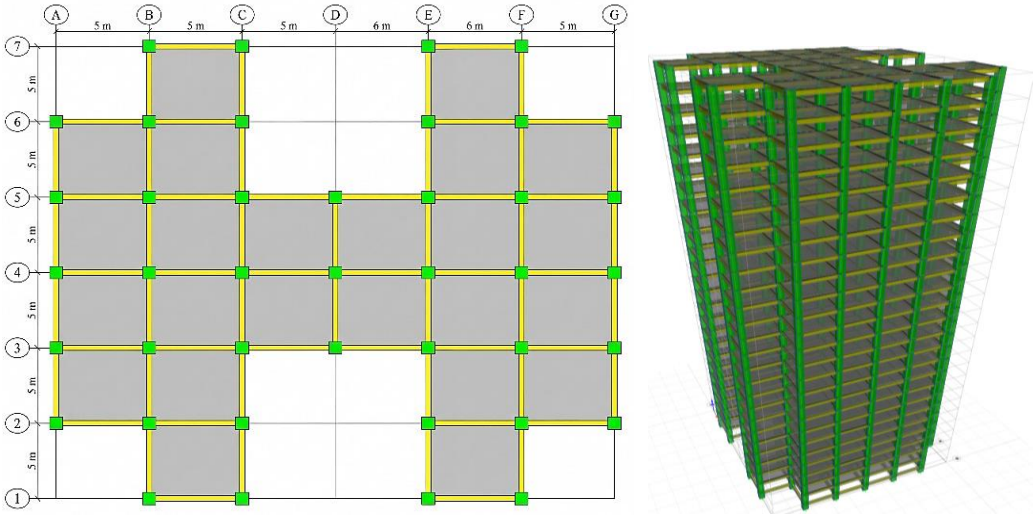


Figure 5. Plan and three-dimensional views of the H-shaped building with re-entrant corner configuration.

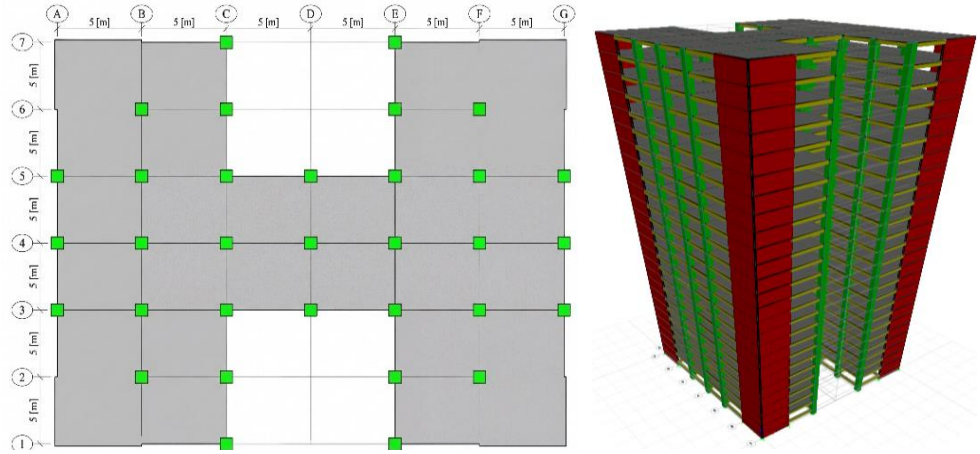


Figure 6. Plan and three-dimensional views of the Straight-Edge H-Shaped Building provided with shear walls.

© STM Journals 2026. All Rights Reserved

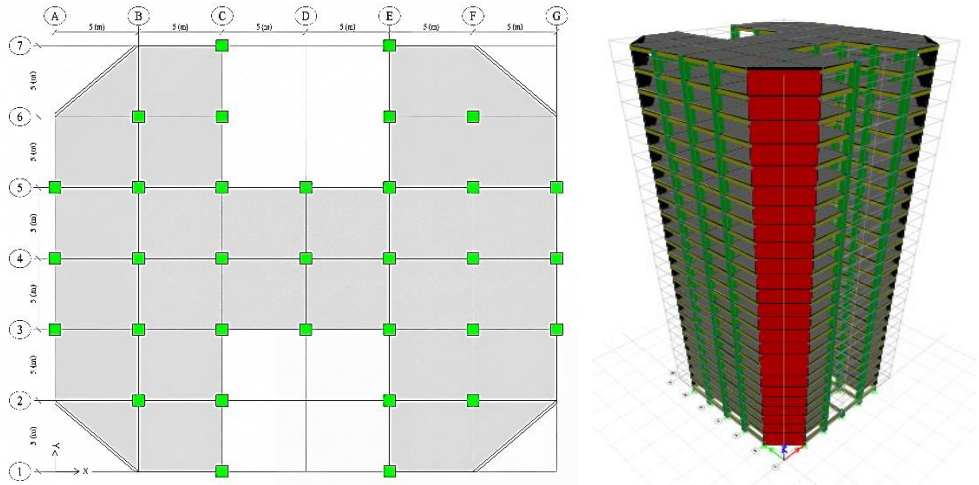


Figure 7. Plan and three-dimensional views of the H-shaped building with chamfered corners provided with shear walls.

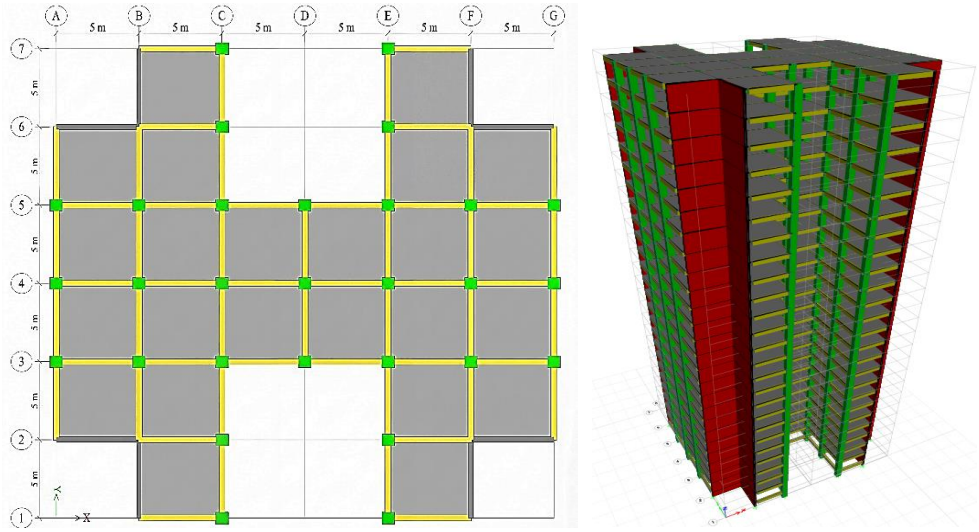


Figure 8. Plan and three-dimensional views of the H-shaped building with re-entrant corner configuration with shear wall.

RESULTS AND DISCUSSION

Storey Displacement

General Behavior of Story Displacement

For all the H-shaped configurations, the lateral displacement progressively increased along the height of the building from the ground level to the uppermost story. In each model considered, the maximum displacement occurred at the roof level of the ground floor +24 floor structure, reflecting the cantilever-type behavior commonly observed in tall reinforced concrete buildings subjected to seismic loading [1, 4]. Lower stories exhibit relatively smaller displacements owing to greater stiffness and base restraint, whereas upper stories experience higher deformation demands as lateral flexibility increases with height [3, 9]. This vertical distribution of displacement is consistent with the previously reported seismic response characteristics of high-rise RCC buildings incorporating plan irregularities and geometric nonlinear effects [7, 10].

*Storey Displacement Under EQX Linear Static Analysis**

The EQX linear static analysis results were compared for shear wall (SW) and without shear wall (WSW) models.

© STM Journals 2026. All Rights Reserved

Top Storey (G+24) Displacement – EQX Linear

- Re-entrant-Corner H-Shaped Building
  - SW: 122.75 mm
  - WSW: 136.87 mm
  - Reduction due to shear wall: 10.3%
- Straight-Edge H-Shaped Building
  - SW: 120.37 mm
  - WSW: 136.59 mm
  - Reduction due to shear wall: 11.9%
- Chamfered Corners H-Shaped Building
  - SW: 129.07 mm
  - WSW: 139.39 mm
  - Reduction due to shear wall: 7.4%

DISCUSSION

The provision of shear walls led to a noticeable reduction in the lateral displacement across all plan configurations by increasing the overall structural stiffness. Among the models studied, the straight-edge configuration demonstrated the greatest improvement in displacement control, primarily because of its comparatively higher sensitivity to plan irregularity effects.

Influence of P-Delta Effect on Story Displacement*

The second-order P–Delta analysis showed a clear amplification of the displacement owing to the axial load–lateral displacement interaction.

Top Story (Ground Floor +24) Displacement – P-Delta

- Re-entrant-Corner H-Shaped Building
  - SW: 148.04 mm → 20.6% increase
  - WSW: 164.64 mm → 20.3% increase
- Straight-Edge H-Shaped Building
  - SW: 145.44 mm → 20.8% increase
  - WSW: 164.21 mm → 20.2% increase
- Chamfered Corners H-Shaped Building
  - SW: 153.06 mm → 18.6% increase
  - WSW: 167.56 mm → 20.2% increase

Discussion

The P–Delta effects increase the displacement by approximately 18–21%, confirming that geometric nonlinearity becomes significant for Ground Floor+24 floor buildings, particularly in seismic Zone V.

Storey Drift

For all H-shaped building configurations, the story drift varied along the height of the structure and generally attained its maximum value at the mid-height stories, after which it gradually decreased toward the roof level. This pattern is characteristic of tall moment-resisting frame systems subjected to seismic loading, where the stiffness distribution and dynamic characteristics govern the inter-story deformation demand [3, 4]. Lower stories typically exhibit smaller drifts owing to higher lateral stiffness and base restraint, whereas intermediate stories experience larger relative displacements owing to increased flexibility and cumulative lateral effects [1, 9]. Similar mid-height peak drift behavior has been reported in previous studies on irregular high-rise RCC buildings, particularly when plan irregularity and geometric nonlinearity are considered [6, 10].

Story Drift Under EQX Linear Static Analysis

The story drift results obtained from the EQX linear static analysis were compared for the shear wall (SW) and without shear wall (WSW) models.

© STM Journals 2026. All Rights Reserved

Maximum Drift Values – EQX Linear

- Re-entrant-Corner H-Shaped Building
  - SW: 0.002028 (at G+11)
  - WSW: 0.002325 (at G+6)
  - Drift reduction due to shear wall: ≈ 12.8%
- Straight-Edge H-Shaped Building
  - SW: 0.001991 (at G+11)
  - WSW: 0.002312 (at G+6)
  - Drift reduction due to shear wall: ≈ 13.9%
- Chamfered Corners H-Shaped Building
  - SW: 0.002131 (at G+10)
  - WSW: 0.002354 (at G+6)
  - Drift reduction due to shear wall: ≈ 9.5%

Discussion

The incorporation of shear walls resulted in a noticeable reduction in inter-story drift across all plan configurations by enhancing the overall lateral rigidity and restricting relative floor displacement. Among the models examined, the straight-edge configuration exhibited the most substantial improvement, as its geometric characteristics made it more susceptible to torsional response and stiffness variation.

Influence of P-Delta Effect on Story Drift*

The effect of geometric nonlinearity on inter-story drift was evaluated by comparing the linear static (EQX) results and second-order analysis outcomes.

Maximum Drift Values – P-Delta

- Re-entrant-Corner H-Shaped Building
  - SW: 0.002444 (G+11)
  - WSW: 0.002790 (G+6)
  - Drift increase due to P–Delta: ≈ 20.5% (SW), ≈ 20.0% (WSW)
- Straight-Edge H-Shaped Building
  - SW: 0.002393 (G+11)
  - WSW: 0.002775 (G+6)
  - Drift increase due to P–Delta: ≈ 20.2% (SW), ≈ 20.0% (WSW)
- Chamfered Corners H-Shaped Building
  - SW: 0.002568 (G+10)
  - WSW: 0.002825 (G+6)
  - Drift increase due to P–Delta: ≈ 20.5% (SW), ≈ 20.0% (WSW)

Discussion

The P–Delta effects amplified the story drift by approximately 20–21%, clearly demonstrating the significance of geometric nonlinearity in Ground+24 floor buildings, particularly under high seismic demand conditions (Zone V).

Base Shear

General Behavior of Base Shear

Base shear represents the total lateral seismic force transferred to the foundation level of a structure and is widely considered a fundamental parameter for evaluating the seismic demand. It is primarily influenced by the seismic weight distribution, global stiffness characteristics, and fundamental dynamic properties of the building [2, 3]. Structures with higher stiffness generally attract greater base shear under equivalent static procedures because of the reduced natural time [2, 7]. Furthermore, plan irregularity and geometric nonlinearity may alter the force distribution and amplify the seismic demand in tall buildings [1, 6, 10].

© STM Journals 2026. All Rights Reserved

In the present study, base shear values were extracted for different H-shaped configurations using EQX linear static analysis and geometric nonlinear (P–Δ) procedures, considering both shear wall-integrated systems and bare moment-resisting frame systems. The comparative evaluation enables the assessment of the combined influence of the plan geometry, stiffness enhancement due to shear wall inclusion, and second-order effects on the overall seismic force demand.

Base Shear Under EQX Linear Static Analysis

The EQX linear base shear values for different configurations are summarized below Figures 9-12.

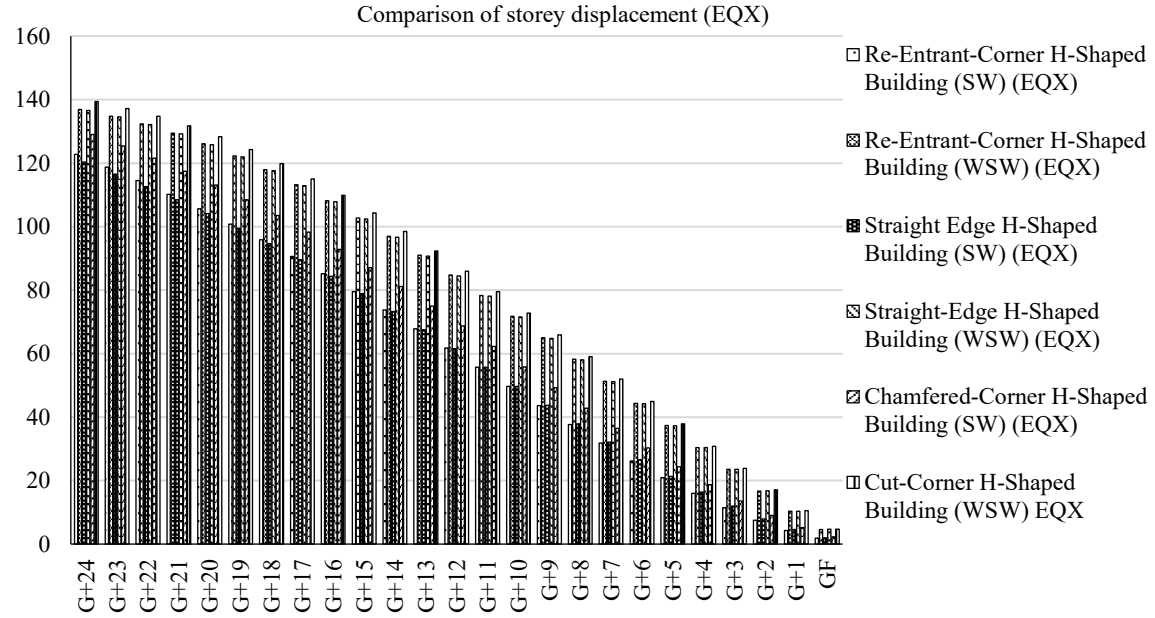


Figure 9. Comparative evaluation of story displacement in the X-direction (EQX).

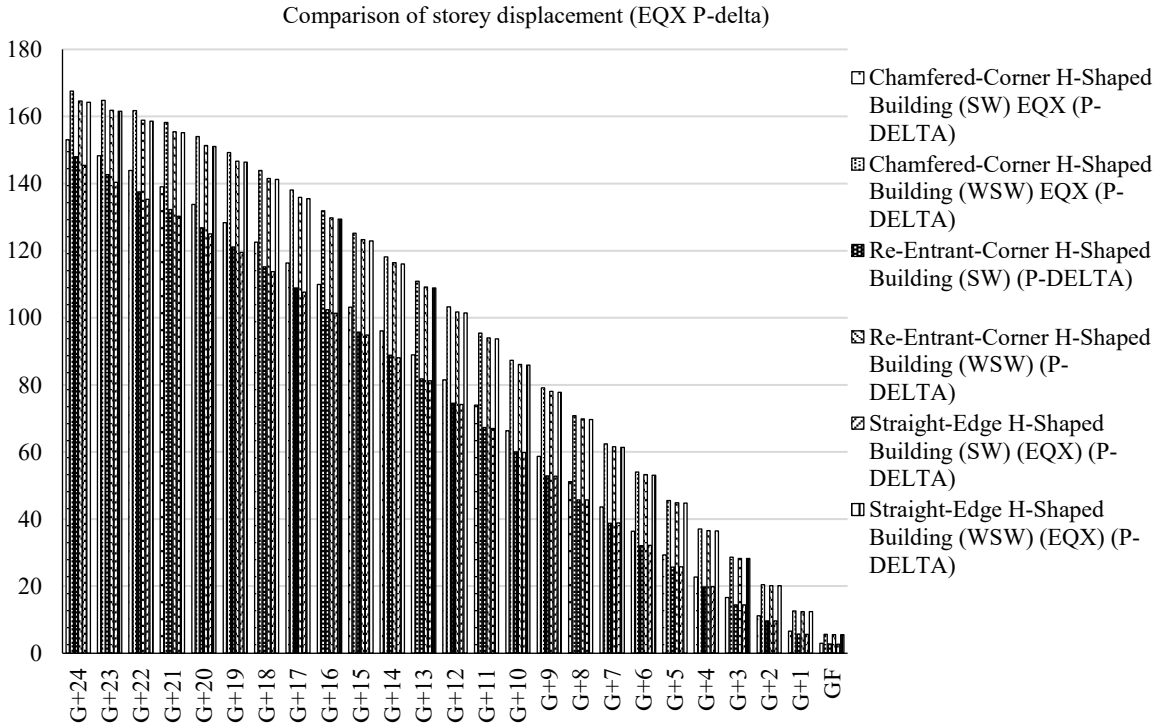


Figure 10. Comparison of story displacement (EQX P-Delta).

© STM Journals 2026. All Rights Reserved

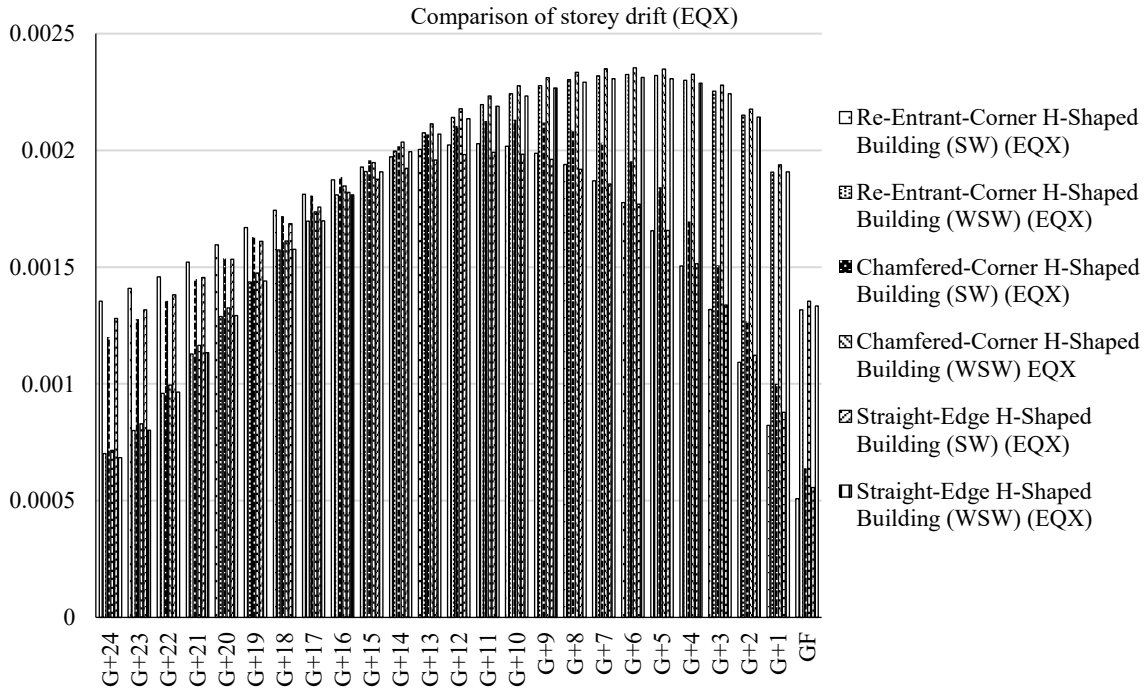


Figure 11. Comparison of Story Drift (EQX).

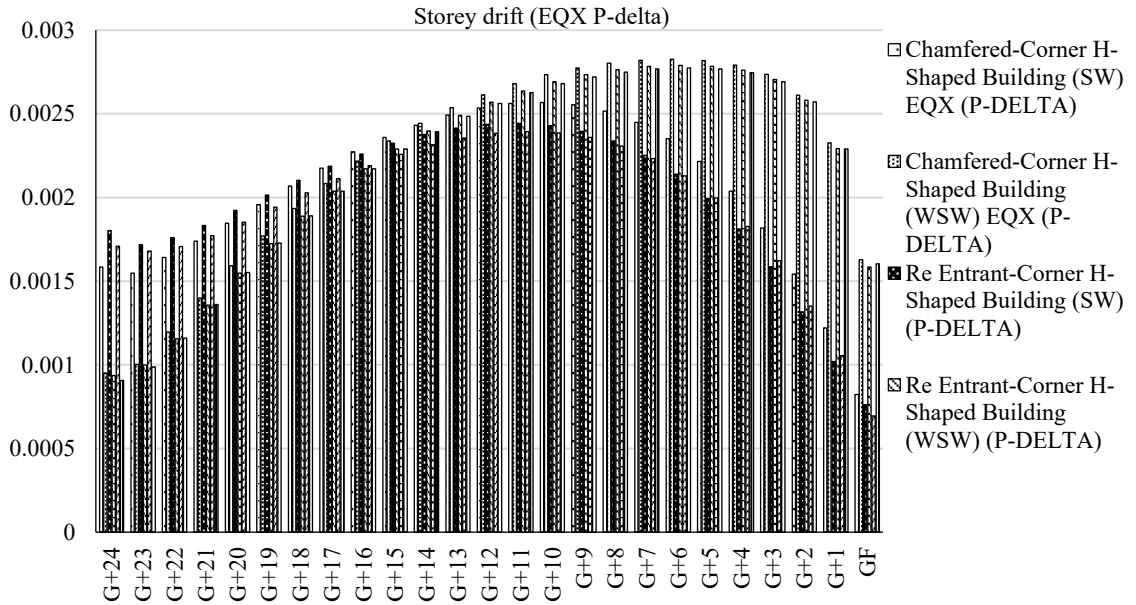


Figure 12. Comparison of Story Drift (EQX P-Delta).

EQX Linear Base Shear Values

- Chamfered Corners H-Shaped Building
  - SW: 6388.55 kN
  - WSW: 5425.41 kN
  - Increase due to shear wall: ≈ 17.7%
- Re-entrant-Corner H-Shaped Building
  - SW: 6299.16 kN
  - WSW: 5150.69 kN
  - Increase due to shear wall: ≈ 22.3%

© STM Journals 2026. All Rights Reserved

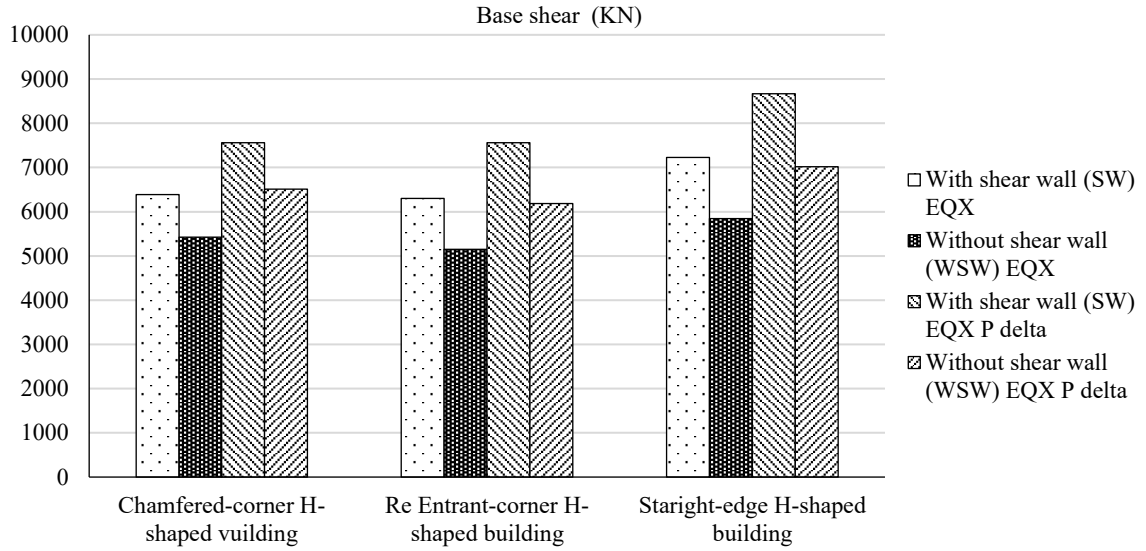


Figure 13. Base shear.

- Straight-Edge H-Shaped Building
  - SW: 7225.38 kN
  - WSW: 5847.99 kN
  - Increase due to shear wall: ≈ 23.6%

Discussion

Structures incorporating shear walls develop greater base shear than bare moment-resisting-frame systems. This increase is attributed to the enhanced lateral stiffness provided by the shear walls, which leads to a higher seismic force demand under code-based equivalent static procedures. Among the configurations analyzed, the straight-edge H-shaped model recorded the maximum base shear, primarily owing to its torsional response characteristics and non-uniform stiffness distribution.

Influence of P-Delta Effect on Base Shear*

The influence of the second-order P–Delta effects on the base shear was evaluated by comparing the EQX linear and EQX P-Delta results.

Base Shear Increase due to P-Delta

- Chamfered Corners H-Shaped Building
  - SW: from 6388.55 kN to 7561.04 kN ≈ 18.4% increase
  - WSW: from 5425.41 kN to 6511.63 kN ≈ 20.0% increase
- Re-entrant-Corner H-Shaped Building
  - SW: from 6299.16 kN to 7559.10 kN ≈ 20.0% increase
  - WSW: from 5150.69 kN to 6181.57 kN ≈ 20.0% increase
- Straight-Edge H-Shaped Building
  - SW: from 7225.38 kN to 8670.52 kN ≈ 20.0% increase
  - WSW: from 5847.99 kN to 7018.76 kN ≈ 20.0% increase

Discussion

The P–Delta analysis results in a **uniform increase of approximately 18–20% in base shear** across all configurations. This increase is attributed to the additional secondary forces generated by the axial load lateral displacement interaction, which enhances the overall seismic demand Figure 13.

CONCLUSIONS

The comparative seismic analyses of the three H-shaped configurations, namely, the Straight-Edge H-Shaped Building, H-Shaped Building with Chamfered Corners, and H-Shaped Building with Re-

© STM Journals 2026. All Rights Reserved

entrant Corner Configuration, demonstrated that the inclusion of shear walls significantly enhanced the overall structural performance by reducing horizontal deformation. The lateral displacement decreased by approximately 7–12%, with reductions of approximately 7.4%, 10.3 %, and 11.9% for the H-Shaped Building with Chamfered Corners, H-Shaped Building with Re-entrant Corner Configuration, and 11.9% for the Straight-Edge H-Shaped Building, respectively. Among the models studied, the Straight-Edge H-Shaped Building exhibited the lowest displacement response owing to its comparatively higher stiffness, whereas the chamfered configuration showed relatively greater flexibility.

The consideration of geometric nonlinearity (P–Delta effects) results in a notable amplification of roof displacement by approximately 18–22%, confirming the importance of second-order analysis in tall RCC buildings [1, 10]. The story drift values were consistently reduced in the shear wall models, with a drift reduction ranging between 9% and 14%, and the straight-edge configuration demonstrated the maximum improvement. The maximum drift was observed at the intermediate stories (approximately G+6 to G+12), indicating that the story height and stiffness distribution govern the inter-story deformation demand.

The base shear increases by approximately 18–24% in shear wall-integrated systems owing to the enhanced stiffness and reduced fundamental time, which is consistent with previously reported trends [2, 7]. Overturning moments were also higher in the shear wall models, particularly under the P–Delta analysis, reflecting improved force transfer and global stability. However, models without shear walls exhibit lower base shear and overturning moments at the expense of excessive displacements and drifts.

Overall, the findings confirm that shear wall integration combined with geometric nonlinear analysis is essential for achieving a safe and reliable seismic design of high-rise irregular RCC buildings designed in accordance with IS 1893:2016.

REFERENCES

1. Kumar, R., & Verma, S. (March 2024). Effect of P–Delta analysis on seismic performance of high-rise RCC buildings with plan irregularity. International Journal of Structural Engineering, 15(2), 145–156.
2. Sharma, A., & Mehta, P. (January 2024). Seismic behaviour of high-rise RCC buildings with and without shear walls considering P–Delta effects. Journal of Earthquake Engineering and Structural Dynamics, 18(1), 89–101.
3. Patel, M., & Joshi, N. (April 2024). Influence of plan irregularity on seismic response of RC buildings. International Journal of Civil Engineering and Technology, 15(3), 210–221.
4. Iyer, S., & Rao, K. (June 2024). Evaluation of geometric nonlinearity and stiffness irregularity in tall RCC buildings. Journal of Structural Analysis, 12(4), 305–318.
5. Singh, T., & Kulkarni, R. (May 2024). Effect of shear wall location on seismic performance of high-rise RCC buildings. International Journal of Advanced Structural Engineering, 11(2), 134–146.
6. Blasi, G., Scarlino, A. S., Chirivì, S., Perrone, D., & Aiello, M. A. (October 2024). Seismic response of irregular reinforced concrete buildings designed for gravity and seismic loads. Bulletin of Earthquake Engineering, 22(10), 5231–5257.
7. Özuygur, A. R. (April 2024). Degrading seismic performance of tall shear wall buildings incorporating P–Delta effects. Canadian Journal of Civil Engineering, 51(4), 412–426.
8. Malik, S. U. J., Khan, M. I., & Khan, N. A. (June 2024). Performance-based seismic assessment of high-rise RC buildings considering P–Delta effects. Journal of Building Engineering, 79, 107934.
9. Singh, M., & Das, R. (August 2024). Seismic performance comparison of plan-irregular reinforced concrete buildings using response spectrum analysis. Journal of Structural Engineering (ASCE), 150(8), 04024056.
10. Rossi, L., & Boschi, A. (May 2024). Influence of geometric nonlinearity and P–Delta effects on seismic response of tall RC buildings. Journal of Earthquake Engineering, 28(5), 987–1005.

© STM Journals 2026. All Rights Reserved