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Seismic Analysis Of Multi-Storey Building With Shear Wall And Floating Columns

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Abstract: Earthquakes are natural phenomena that generate intense ground motions, which can adversely impact structural systems. While mild tremors may not be perceptible to humans, stronger ones can cause serious structural damage. **Shear walls** are introduced in buildings to improve lateral stiffness, enhance ductility, minimise lateral displacements, and increase overall structural safety in seismic design. Controlling storey drift and lateral displacement is essential. Shear walls, which are vertical reinforced concrete (RC) elements extending from the foundation upwards, play a key role in resisting lateral seismic forces and limiting storey displacements. However, enclosing a building entirely with shear walls may negatively affect its architectural appearance. As a result, shear walls are typically positioned at selected locations, such as the sides or corners. In low-rise structures, bracing systems may be an option, but these are often unsuitable for **taller buildings.**

Index Terms - Shear walls, lateral displacement, story drift, story shear, story bending, response spectrum, time history analysis.

I. Introduction

The present study focuses on the comparative seismic analysis of multistorey structures, involving two major aspects: the evaluation of five distinct G+12 RCC building models with varied configurations and the comparative study of RCC and composite structures for different plan layouts in multiple seismic zones, where in the first part of the study, Model 1 represents a conventional RCC building without floating columns or shear walls and serves as a baseline, Model 2 introduces vertical irregularities by incorporating floating columns at the ground floor, Model 3 enhances lateral stability by placing shear walls at the corners of the building, Model 4 combines shear walls and floating columns to examine their joint effect on seismic response, and Model 5 modifies the arrangement of shear walls and floating columns to observe changes in structural behavior, all analyzed using ETABS 2021 in accordance with IS 1893 (Part 1):2016 to evaluate crucial response parameters such as base shear, storey drift, time period, and overall stability, thereby offering insights into the effectiveness of each configuration for earthquake resistance, while the second part of the study, titled “Comparative Study of Multistorey RCC and Composite Structure for Different Plan Configurations in Various Seismic Zones,” aims to investigate the seismic performance of two structural systems—Reinforced Cement Concrete (RCC) and composite systems combining steel and concrete—across varied plan shapes and seismic zones, with the primary objective of understanding how these two structural systems behave when subjected to earthquake forces of different intensities while addressing zone-specific challenges, where Zone II represents low seismic activity and Zone V represents high seismic risk, and by comparing response parameters such as time period, storey drift, base shear, and stability under varying seismic intensities, the research intends to identify which structural system and configuration provide maximum safety, performance, and stability under earthquake loading conditions, ultimately helping to determine the most suitable system for different seismic environments and guiding the selection of an optimal design approach for earthquake-resistant structures that ensures resilience, efficiency, and safety of multistorey buildings across India's seismic zones.

1.1 HISTORY OF SEISMIC ANALYSIS

Seismic analysis has undergone a significant transformation with the advancement of structural engineering and computational technology. Early methods relied on simplified static load estimations derived from empirical observations. The introduction of computer-based analysis in the 1970s enabled the use of linear and dynamic models to better represent structural behaviour during earthquakes. Later developments incorporated response spectrum, time history, and nonlinear analysis techniques, improving the precision of seismic performance evaluation. In recent years, performance-based seismic design—facilitated by advanced tools such as ETABS and SAP2000—has become integral to modern structural analysis and earthquake-resistant design.

2. METHODOLOGY AND MODELLING OF SHEAR WALL

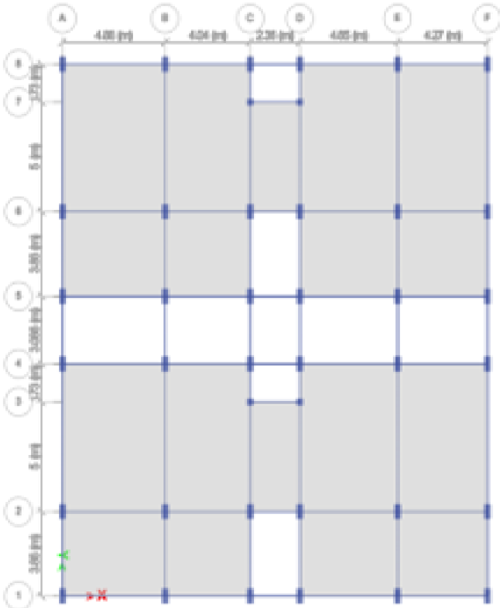
The present objective of this work is to study shear wall models developed for the lateral load analysis of multistorey structures in the elastic region. Since the methods for modelling building structures are analysed separately. Shear wall modelling studies can also be investigated according to the two and three-dimensional approaches. The equivalent frame model was developed by Clough et al. [47], Candy [48], and MacLeod [49] for the analysis of plane-coupled shear wall structures. The model was limited to lateral load analysis of rectangular building frames without torsion. It was improved in the 1970s by McLeod [50, 51] and McLeod and Hosny [52] for the analysis of nonplanar shear walls. In the equivalent frame method, which is also known as the wide column analogy, each shear wall is replaced by an idealised frame structure consisting of a column and rigid beams located at floor levels. The column is placed at the wall's centroidal axis and assigned to have the wall's inertia and axial area. The rigid beams that join the column to the connecting beams are located at each framing level.

The study involves analysing five distinct models of a G+12 RCC building to evaluate their seismic behaviour under various configurations.

Model 1 focuses on an RCC building without floating columns or shear walls, serving as the baseline for comparison.
Model 2 examines the seismic performance of a structure incorporating floating columns at the ground floor, which introduces vertical irregularities.
Model 3 investigates the effects of placing shear walls at the corners of the building, enhancing lateral stability.
Model 4 evaluates the combined impact of shear walls and floating columns on the seismic response of the building.
Model 5 explores a configuration with an alternative arrangement of shear walls and floating columns to determine its influence on structural behaviour under seismic forces. These models are analysed using ETABS-2021 as per IS 1893 (Part-1): 2016 to compare parameters such as base shear, storey drift, and time period, providing insights into the effectiveness of each design.

The modelling and seismic analysis of a G+12 multistorey building with shear walls and floating columns can be efficiently carried out using ETABS, designed as per IS 1893:2016. Since the project involves earthquake effects, the first step is to study the seismic provisions in IS 1893:2016, which define earthquake zones, importance factors, and the response spectrum. After this, the model is created in ETABS by defining appropriate units (kN, m) and specifying the building geometry. This includes modelling slabs, beams, columns, and assigning storey heights. Material properties are then defined, such as concrete grade with compressive strength and steel grade with yield strength. Cross-sectional properties of beams, columns, and shear walls are also assigned. Once the structural framework is established, loads are applied. Dead loads include self-weight, finishes, and partitions, while live loads depend on the building's function (residential or commercial). Wind loads are applied as per IS 875 (Part 3), and seismic loads are incorporated based on IS 1893:2016, considering the seismic zone, response spectrum, and importance factor. After the load definition, relevant load combinations are applied. The structure is then analysed in ETABS to obtain results such as time period, storey drift, base shear, and displacement, which are compared for different models.

Model- 1 G+12 Multistoried building, RCC buildings



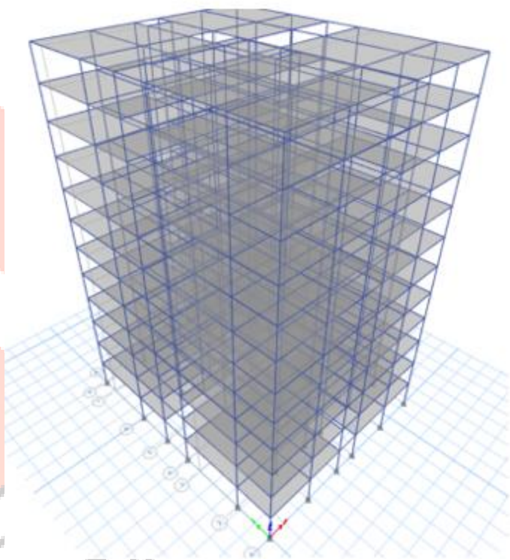


Fig.-1: Plan view of G+12 RCC Building

Fig 2: 3D View of G+12 RCC Building

Model 2: Behaviour of Multistorey Buildings with Floating Columns at Ground Level

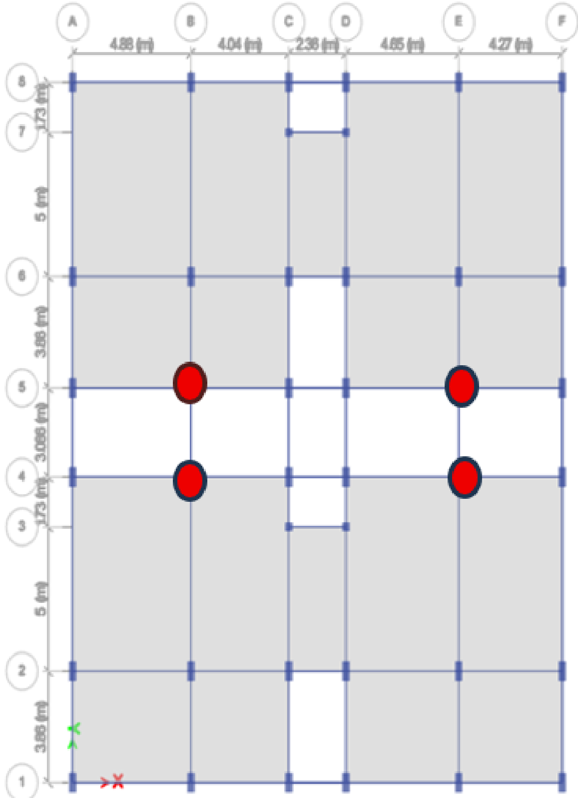


Fig.3 plan view G+12 storey floating column

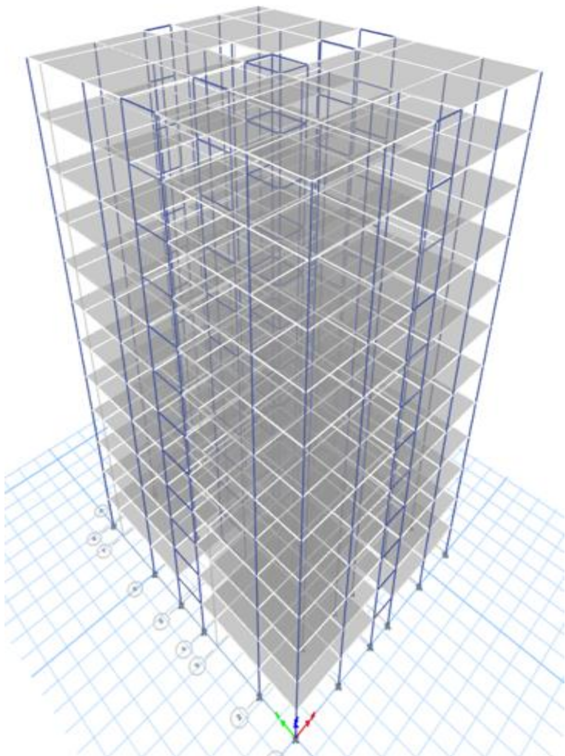


Fig.4 3d view G+12 storey floating column

Model 3: G+12 Multistorey building with shear wall at corners

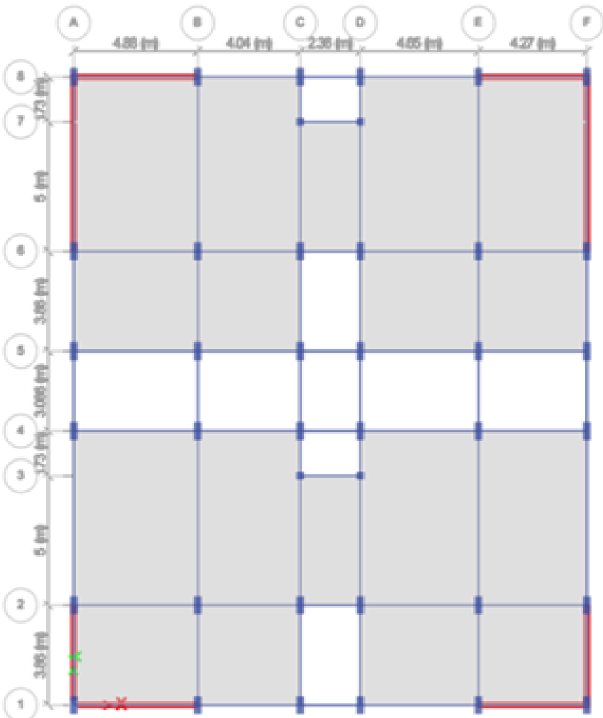


Fig.5 plan view G+12 storey corner shear wall

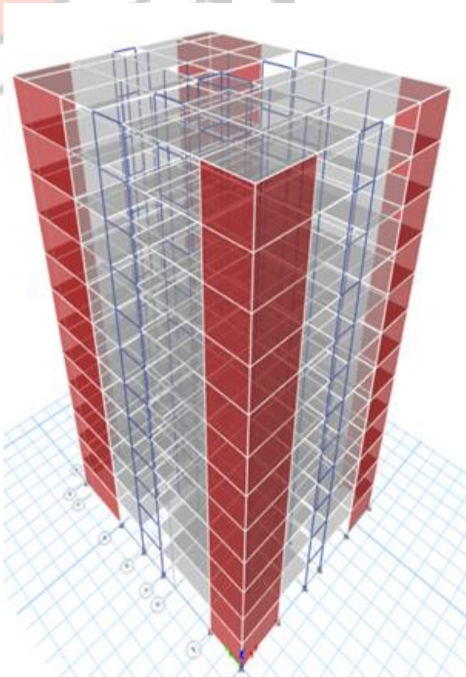
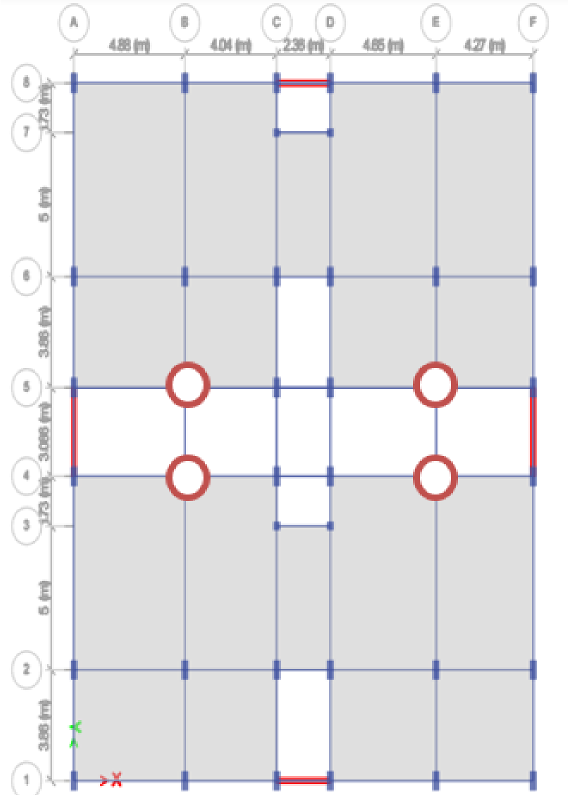


Fig.6 3d view G+12 storey corner shear wall

Model 4: The model takes into account both floating columns and shear walls



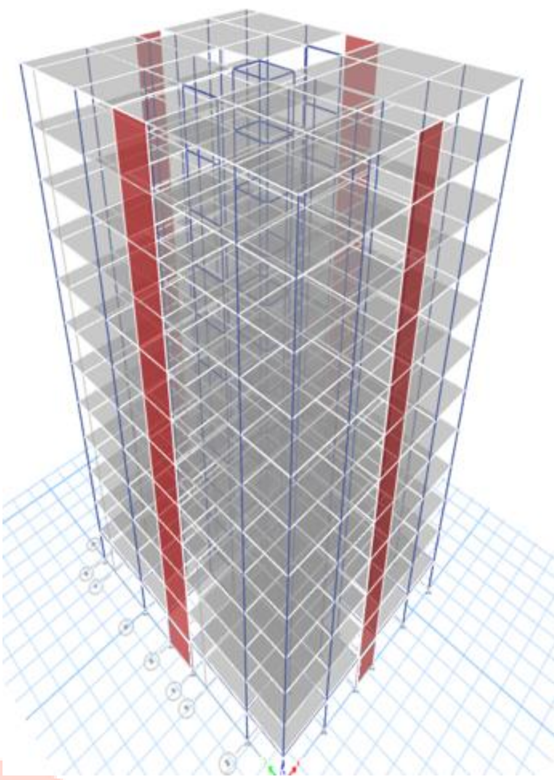
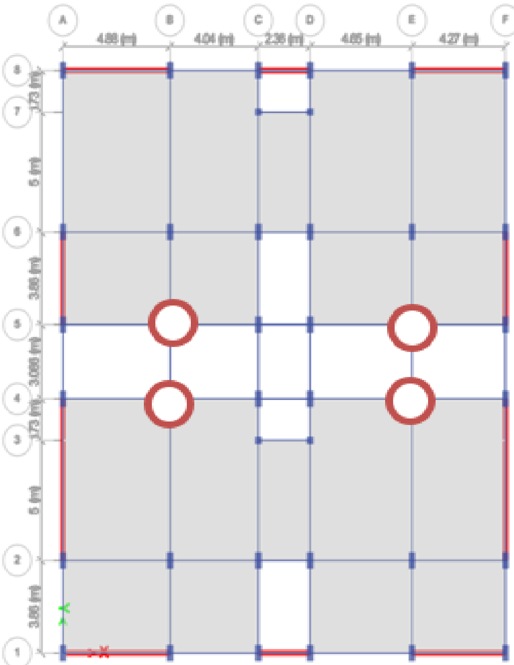


Fig.7 Plan view G+12 storey centre Shear walls shear wall wall

Fig.8 3d view G+12 storey centre shear

Model 5: Model is considered an alternative single shear wall and floating Column



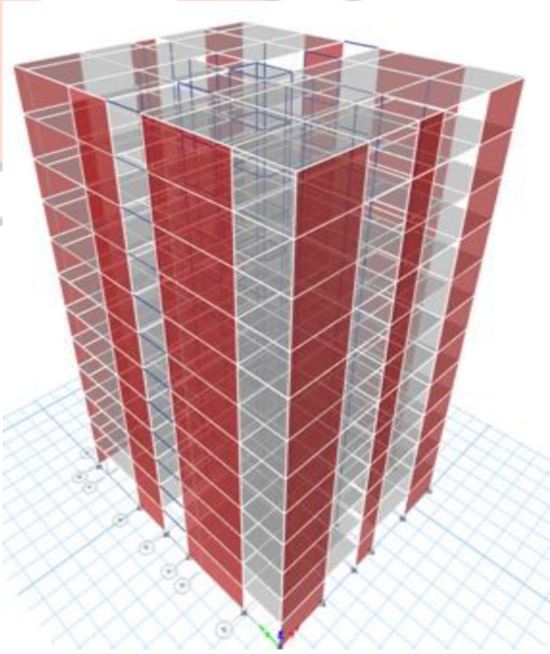
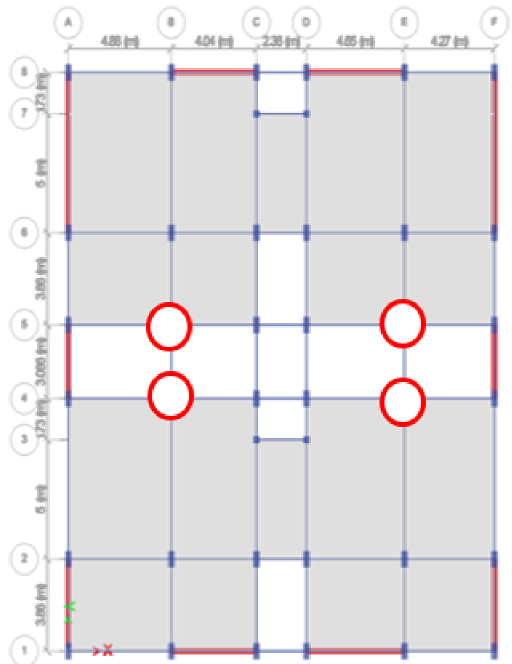


Fig.9 Plan view G+12 storey alternative single Shear walls single Shear walls

Fig.10 3d view G+12 storey alternative

Model 6: Alternative Two Shear Wall Layout with Floating Columns



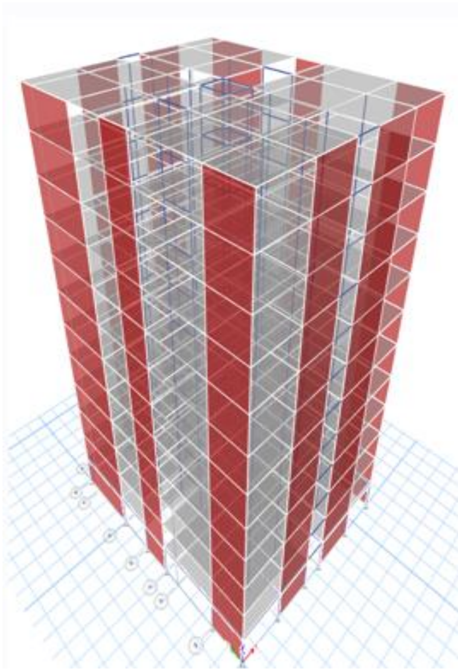


Fig.11 Plan view G+12 storey alternative two Shear walls two Shear walls

Fig.12. 3d view G+12 storey alternative

3.0 ANALYSIS OF RESULTS

Table 3.1.1 Maximum Storey Drift Values for all five models

Storey Number	Excluding Shear Walls Model 1	Corner Shear Wall Model 2	With centre shearwalls Model 3	Alternative 1 Shear Wall Model	With Alternative 2, Shear walls Model 5
12	0.00021	0.00038	0.0003	0.0003	0.00023
11	0.00035	0.0004	0.00037	0.00032	0.00026
10	0.00046	0.00042	0.00043	0.00035	0.00029
9	0.00055	0.00044	0.0005	0.00038	0.00032
8	0.00063	0.00046	0.00056	0.00041	0.00035
7	0.00069	0.00046	0.00061	0.00043	0.00036
6	0.00074	0.00045	0.00065	0.00043	0.00037
5	0.00079	0.00043	0.00068	0.00042	0.00037
4	0.00083	0.00039	0.00068	0.0004	0.00036
3	0.00087	0.00033	0.00064	0.00035	0.00032
2	0.0009	0.00025	0.00054	0.00026	0.00026
1	0.00092	0.00014	0.00033	0.00014	0.00016

Table 3.1.2. Maximum Base Shear Values

Storey Number	Excluding Shear Walls Model 1	Corner Shear Wall Model 2	With centre shearwalls Model 3	Alternative 1 Shear Wall Model	With Alternative 2, Shear walls Model 5
1	1483.342	2842.12	1834.226	3176.086	3443.442

Table 3.1.3 Maximum Storey Shear Values

Storey Number	Excluding Shear Walls Model 1	Corner Shear Wall Model 2	With centre shearwalls Model 3	Alternative 1 Shear Wall Model	With Alternative 2, Shear walls Model 5
12	557.07495	482.9381	318.5373	502.764	521.2557
11	1074.2093	937.0747	598.4316	994.8866	1045.007
10	1493.4296	1307.703	820.4907	1412.044	1497.637
9	1833.98	1618.069	1006.763	1773.021	1892.937
8	2112.5491	1884.224	1167.432	2088.799	2239.69
7	2350.1078	2114.565	1307.364	2363.351	2541.557
6	2564.3505	2314.232	1434.176	2598.824	2800.88
5	2767.1381	2484.935	1550.506	2795.517	3018.114
4	2964.9969	2625.829	1653.034	2952.555	3192.179
3	3150.0487	2735.377	1739.442	3069.554	3322.344
2	3309.0636	2809.109	1803.571	3144.507	3406.606
1	3411.6864	2842.12	1834.226	3176.086	3443.442

3.2.GRAPHS

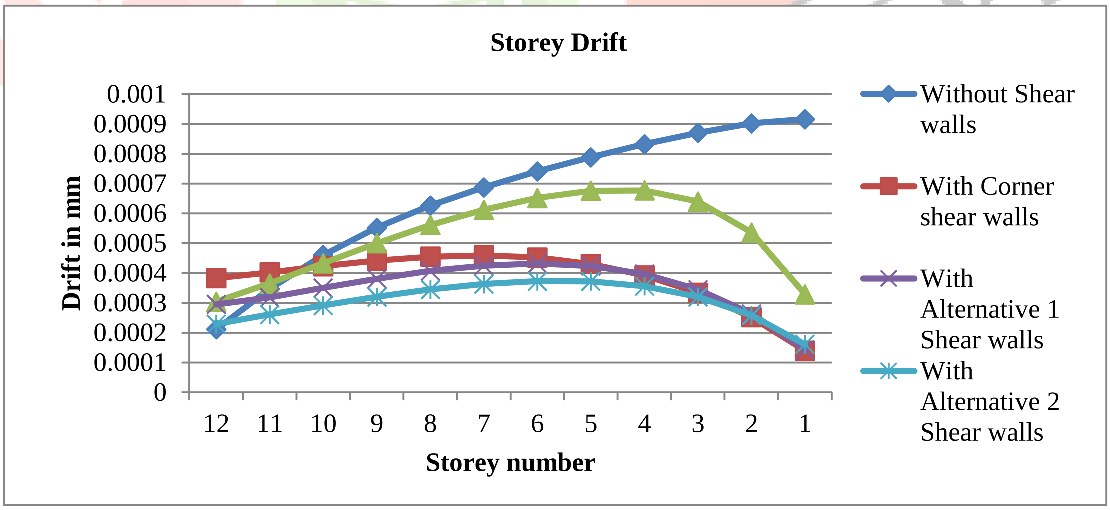


Fig.12: Five models were analysed: Model 1 (Excluding Shear Walls), Model 2 (Corner Shear Walls), Model 3 (Centre Shear Walls), Model 4 (Alternative 1 Shear Walls), and Model 5 (Alternative 2 Shear Walls).

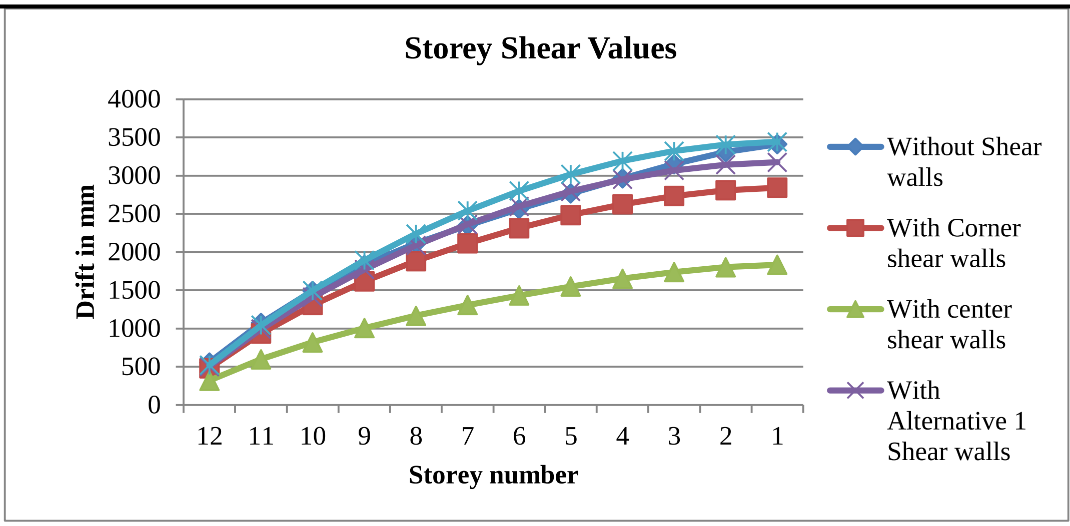


Fig.13 Storey shear values. Five models were analysed: Model 1 (Excluding Shear Walls), Model 2 (Corner Shear Walls), Model 3 (Centre Shear Walls), Model 4 (Alternative 1 Shear Walls), and Model 5 (Alternative 2 Shear Walls).

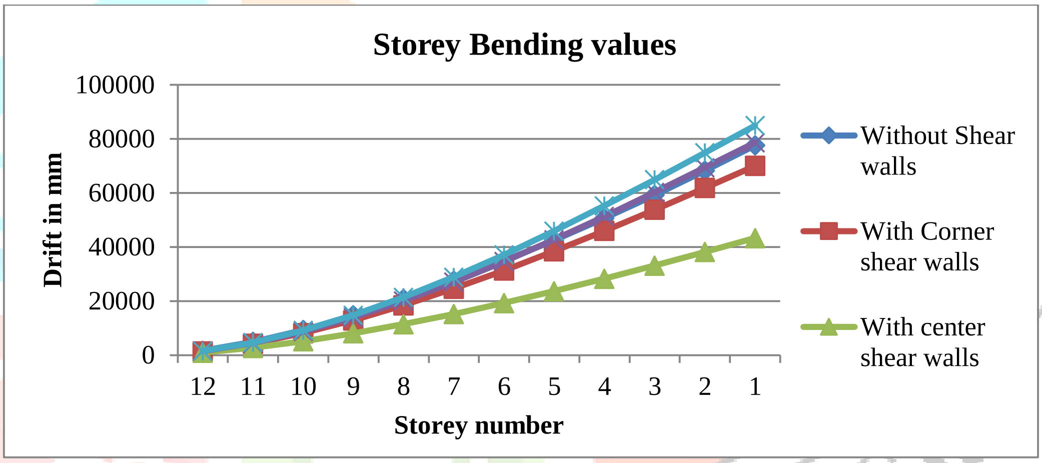


Fig.14 Storey bending values for different shear wall configurations: no shear wall, corner shear wall, central shear wall, alternative shear wall configuration 1, and alternative configuration 2

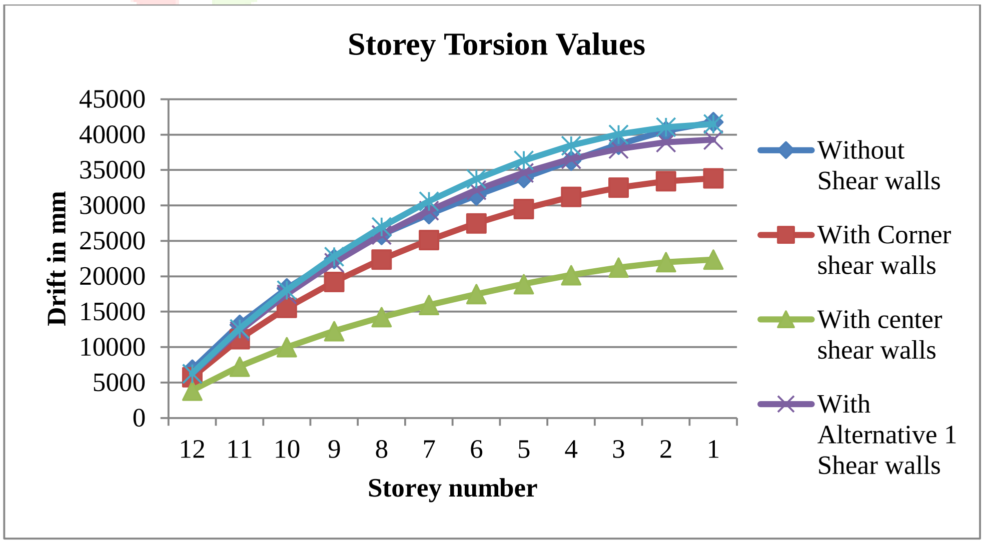


Fig.15 A c storey twisting moments under different structural configurations: absence of a shear wall, inclusion of a corner shear wall, placement of a central shear wall, and two distinct alternative shear wall setups (1 and 2)

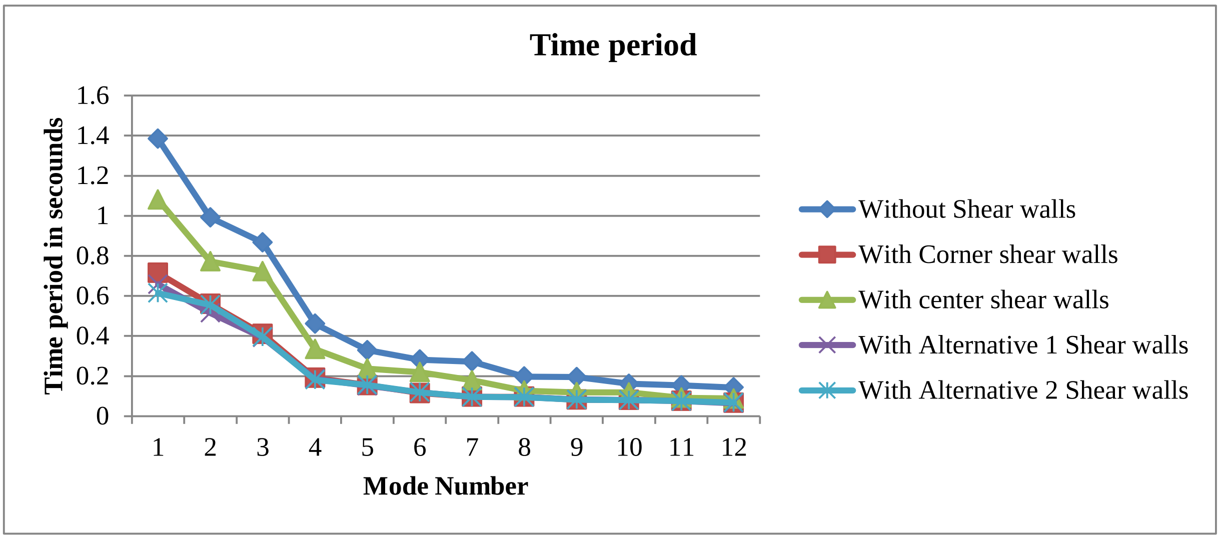


Fig.16 Time period values for all five models

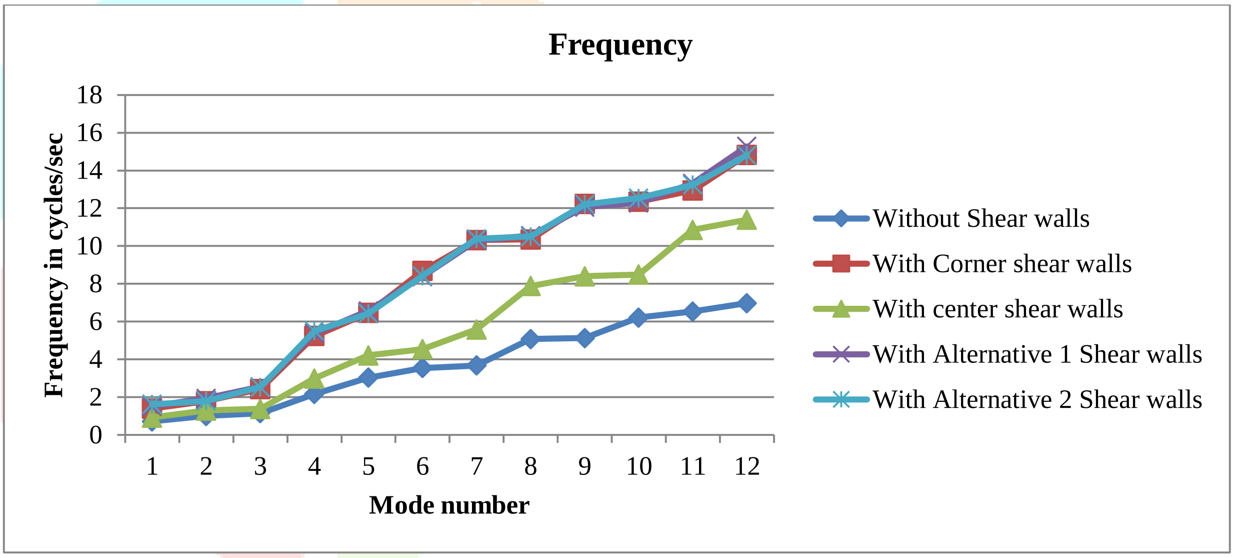


Fig. 17 Variation in frequency across different structural setups: no shear wall, corner shear wall, centre shear wall, and two alternative shear wall configurations.

The results of the five models are summarised in **Table 3.1.1** and illustrated in **Fig. 9**, which presents the variation of storey drift across the height of the building for different shear wall configurations. The model without shear walls shows the maximum storey drift, highlighting excessive lateral deformation under seismic loads and the structure's vulnerability to instability. By contrast, the inclusion of shear walls significantly reduces storey drift values, demonstrating improved lateral stiffness and overall structural stability. Among all arrangements, the **Alternative Shear Wall 2** configuration provides the least displacement, making it the most effective in resisting horizontal seismic forces. These results emphasise the vital role of shear walls in maintaining the lateral stability of multistorey buildings.

The **storey shear values** for the different shear wall configurations—including no shear wall, corner placement, central placement, Alternative Shear Wall 1, and Alternative Shear Wall 2—are presented in **Table3.1.2** and depicted in **Fig.10**. The results show that the model without shear walls exhibits the lowest shear resistance, reflecting its limited ability to transfer seismic or wind-induced lateral loads. On the other hand, the inclusion of shear walls significantly enhances shear resistance across all models. Once again, the

Alternative Shear Wall 2 configuration performs best, achieving the highest storey shear values and demonstrating superior efficiency in lateral load transfer. This arrangement enhances structural performance under both seismic and wind forces by effectively distributing lateral loads throughout the structure.

As shown in **Table 3.1.3** and **Fig. 11**, the **bending moment variation** across storeys highlights the impact of different shear wall configurations. The model without shear walls records the highest bending moments, indicating greater stress levels and reduced stability. The inclusion of shear walls reduces these bending moments significantly, thereby improving the overall strength and performance of the building. Among the configurations, Alternative Shear Wall 2 yields the greatest reduction in bending values, confirming its ability to minimise localised stress concentrations and enhance lateral stability during earthquakes.

The study further compares **base shear values** across models, representing the resistance of each structure to seismic and wind forces. Results show that the model without shear walls has the lowest base shear value, approximately **1483.342 kN**, indicating poor seismic performance. By contrast, models with shear walls exhibit much higher base shear capacities, underscoring their contribution to improved seismic resilience.

In terms of **torsional response**, shown in **Fig.12**, the structure without shear walls suffers from maximum torsional effects, resulting in increased instability. The introduction of shear walls, particularly Alternative Shear Wall 2, significantly reduces torsion, thereby enhancing rigidity and dynamic stability. Finally, **Fig.13** compares the natural frequencies across vibration modes. The model without shear walls records the lowest frequencies, reflecting weak stiffness and poor resistance to dynamic excitations. Adding shear walls increases frequencies, with Alternative Shear Wall 2 consistently achieving the highest values, confirming its effectiveness in improving vibrational performance and overall structural stiffness.

Together, these findings highlight the critical role of shear walls in enhancing the seismic performance of multistorey buildings by improving lateral stability, reducing stress concentrations, and strengthening dynamic behaviour.

3.3 BARCHATS

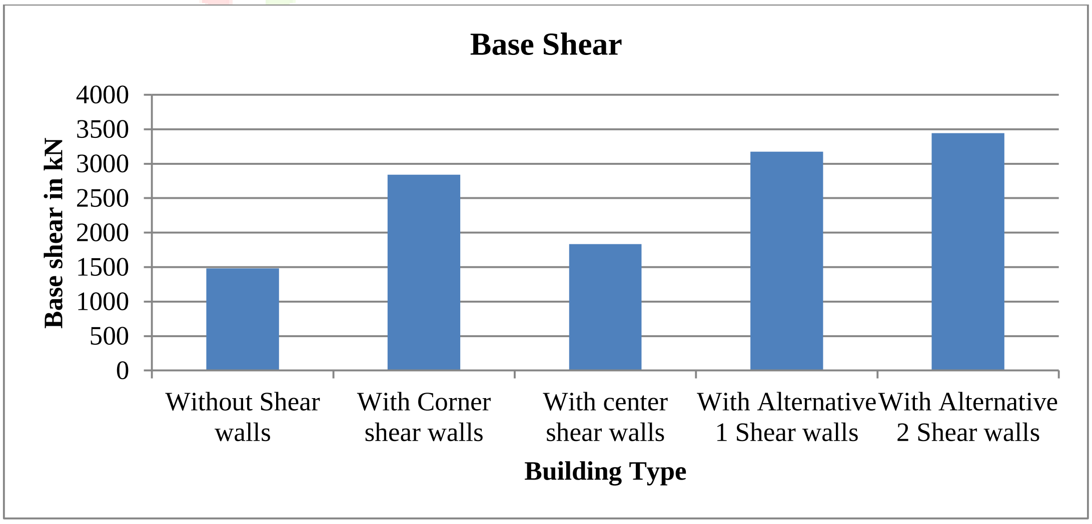


Fig. 17 Five models were analysed: Model 1 (Excluding Shear Walls), Model 2 (Corner Shear Walls), Model 3 (Centre Shear Walls), Model 4 (Alternative 1 Shear Walls), and Model 5 (Alternative 2 Shear Walls).

4 CONCLUSIONS

The outcomes of the present analysis indicate the following conclusions.

1. It is observed that the Storey Displacements and Storey Drifts values are the lowest values observed in alternative shear walls. Compared to all models V alternative shear wall gives the best seismic resistance.
2. The analysis shows that shear wall configuration greatly affects the lateral performance of buildings. Compared to Model 5 with two shear walls, story displacement increased by 46.27%, 42.23%, 33.63%, and 10.88% in Models I–IV, respectively. Similarly, story drift increased by 51.00%, 43.67%, 32.67%, and 28.67%. These results confirm that providing shear walls significantly enhances lateral stiffness and reduces deformation. Among all, Model 5 demonstrated the best seismic performance and overall structural stability.

5. FUTURE SCOPE OF THE WORK

This study's scope includes multi-story structures with different layouts that include shear walls and floating columns in accordance with IS 1893 (Part-1): 2016 requirements. The following five structural models will be examined: a standard RCC building with neither floating columns nor shear walls; a building with floating columns on the ground floor; a structure with shear walls at the corners; a building with floating columns and shear walls; and a building with a varied arrangement of both. Important seismic features, such as base shear, storey drift, time period, and storey displacements, will be evaluated for each model. The analysis contrasts the structural behaviour of different models in an attempt to understand

6. RECOMMENDATIONS OF THE WORK

Shear walls should be placed centrally or at corners to improve stiffness and reduce storey drift. Floating columns must be minimised or supported by transfer girders in seismic zones. Structural symmetry should be maintained to control torsion, and designs must follow IS 1893 (Part 1): 2016. Modal analysis helps avoid resonance, and quality construction practices are essential for better seismic performance.

REFERENCES:

1. Ahamad, Shaik Akhil, and K. V. Pratap. "Dynamic analysis of G+ 20 multi-storied building by using shear walls in various locations for different seismic zones by using Etabs." Materials Today: Proceedings 43 (2021) ELSIVER: pp.1043-1048.
2. Harsha, P. V., and Shilpa Valsakumar. "Seismic analysis of multi-storey building with floating columns using ETABS." Int. Res. J. Eng. Tech. 7 (2020) IRJET: pp.2930-2936.
3. Isha Rohilla, S.M. Gupta, Babita Saini SEISMIC ANALYSIS OF MULTI-STOREY BUILDING WITH FLOATING COLUMNS USING ETABS(2020) IRJET
4. Heerema, Paul, Marwan Shedid, and Wael El-Dakhakhni. "Seismic response analysis of a reinforced concrete block shear wall asymmetric building." Journal of Structural Engineering 141, no. 7 (2015) ASCE: pp. 04014178.
5. LovaRaju.k, Dr K.V.G.D.Balaji, Effective location of shear wall on the performance of building frame subjected to earthquake load, International Advanced Research Journal in Science, Engineering, and Technology, ISSN 2394-1588 Vol. 2, Issue 1, January 2015.
6. R.S. Mishra, V. Kushwaha, S. Kumar, et al. (2015).Seismic analysis of reinforced concrete structures with different shear wall configurations using STAAD.Pro.Technical study conducted in accordance with IS 1893:2002, IS 13920:1993, and IS 456:2000.
7. Syed Farrukh Anwar, Zeeshan Baseer.Finite Element Modelling of Shear Walls with Openings Under Seismic Loading Using ETABS.Technical study analysing storey drift and displacement in 20-storey RC structures with varied shear wall opening configurations, 2015.

8. Varsha R. Harne, Comparative Study of Strength of RC Shear Wall at Different Locations on Multi-storied Residential Building, International Journal of Civil Engineering Research.ISSN 2278-3652 Volume 5, Number 4 (2014), pp. 391- 400.
9. Dr Shaik Kamal Mohammed Azam, Syed Khasim Mutwalli, Seismic performance assessment of a 30-storey high-rise building using the capacity spectrum method in ETABS.Includes analysis through linear static, response spectrum, and nonlinear pushover methods, 2014
10. Shahzad Jamil Sardar and Umesh. N. Karadi, "EFFECT OF CHANGE IN SHEAR WALL LOCATION ON STOREY DRIFT OF MULTISTOREY BUILDING SUBJECTED TO LATERAL LOADS", International Journal of Innovative Research in Science, Engineering, and Technology, Vol. 2, Issue 9, September 2013.
11. Najma Nainan, Alice T V, Dynamic Response of Seismo-Resistant Frames, International Journal of Engineering Science and Technology (IJEST) ISSN: 0975-5462 Vol. 4 No.05, May 2012.
12. Ashwin Sanjay Balwaik, Comparative Analysis of G+1 Structure With and Without Floating Column, International Journal of Scientific & Engineering Research, Volume-6, Issue-6, June 2015.Harsha P V . Valsakuma, SEISMIC ANALYSIS OF MULTI-STOREY BUILDING WITH FLOATING COLUMNS USING ETABS Volume: 07 Issue: 07 | July 2020 IRJET
13. Ehsan Salimi Firoozabad, Dr K. Rama Mohan Rao, Bahador Bagheri, Effect of Shear Wall Configuration on Seismic Performance of Building, Proc. of Int. Conf. on Advances in Civil Engineering 2012
14. Gazanfer, Mohammed, and Rajashree Chinta. "Analysis Of Multistoried Irregular Building With And Without Floating Column Using ETABS." Journal of Scientific Research and Technology (2023): pp.100-118.
15. Kakatkar, Varsha, Nikhil Jambhale, Veerendrakumar C. Khed, and Shivanand Mendigeri. "Comparative study on the position of floating column for RCC multistorey building subjected to seismic forces." In International Conference on Structural Engineering and Construction Management, pp. 219-230. Cham: Springer International Publishing, 2022.
16. Lingampally, Krishna Chaitanya, and Swathi Veerupakshi. "Seismic Analysis and Positioning of Floating Columns in a Multistorey Building using ETABS." International Journal of Research in Engineering, Science and Management 5, no. 7 (2022): pp. 84-89.
17. Lingeshwaran, N., Surya Kranthi Nadimpalli, Shaik Sameeruddin, Y. Himath Kumar, and Sateesh Babu Madavarapu. "A study on seismic analysis of high-rise buildings with and without floating columns and shear walls." *Materials Today: Proceedings* 47 (2021): pp. 5451-5456.
18. Mundada, A. P., and S. G. Sawdatkar. "Comparative Seismic Analysis of Multistorey Building with and without Floating Column." International Journal of Current Engineering and Technology 4, no. 5 (2014): pp. 3395-3400.
19. Mohan Rahekwal, Sushant Patil, Piyush Pensalwar, Vishwas More, Prof. Mahesh Mohite(2023) ANALYSIS OF BUILDINGS WITH AND WITHOUT FLOATING COLUMN USING ETABS (ijert) Volume:05/Issue:05/May-2023
20. Mandwale, Shubham, and Nikhil Pitale. "Review on Analysis of Multi-storey Building with and without Floating Columns." International Journal for Research in Applied Science & Engineering Technology 8 (2020): pp.1395-1398.
21. Misam Abidi and Mangulkar Madhuri N. "Review on Shear wall for soft storey high rise building, , International Journal of Civil and Advanced Technology, ISSN 2249-8958, Volume-1, Issue-6, August 2012.
22. Sukumar Behera (May 2012), Seismic Analysis of Multistorey Building with Floating Column, NIT, Rourkela- 769008. Paz Mario (2010). Structural dynamics, CBS publishers
23. Shama Banu.SK and Shahani Priyanka. G (2015), "Study of behaviour of Seismic Evaluation of Multistoried Building with Floating Column", Journal of Computer Engineering in Research Trends, Volume 2, Issue 12, pp. 983-988