iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** VII **Month of publication:** July 2026

DOI: https://doi.org/10.22214/ijraset.2026.84303

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue VII July 2026- Available at www.ijraset.com

Analysis of Flat Slab in ETABS and Design of Flat Slab & Footing in Safe

Raghu K J[1], Dr. Shreenivas Reddy Shahapur[2], Madhukaran[3]
[1]M.Tech Student (CADS), [2]Professor, [3]Assistant Professor, Dept. of Civil Engineering, UBDT College of Engineering, Davangere, Karnataka, India – 577004

***Abstract—* A flat slab is a reinforced concrete floor system that is supported directly by columns without the use of beams or girders. Unlike conventional systems where loads travel from slab to beam to column, a flat slab transfers loads directly to the supporting columns. This design is primarily used to achieve minimum construction depth, reduce storey height, and provide architectural flexibility for open floor plans in buildings like malls, hotels, and IT parks.**
***Keywords:* Flat slab, Seismic analysis, RCC Structure, pushover analysis, Structural Analysis, Footing design, ETABS, SAFE, Storey Displacement, Storey Drift.**

I. INTRODUCTION

Flat slab systems have become one of the most widely adopted structural systems in modern reinforced concrete construction due to their architectural flexibility, reduced construction time, and improved economy. Unlike conventional beam–slab systems, flat slabs are directly supported by columns without the use of deep beams, resulting in a flat soffit that simplifies formwork, enhances aesthetic appearance, and provides greater flexibility for architectural planning and service installations. These advantages make flat slab systems particularly suitable for commercial buildings, hospitals, hotels, shopping complexes, office buildings, and high-rise residential structures.

The increasing demand for multi-storey buildings in urban areas has encouraged engineers to adopt structural systems that provide higher efficiency while minimizing construction costs. Flat slab construction reduces floor-to-floor height, decreases the overall weight of the structure, and enables faster construction compared to conventional framed buildings. However, due to the absence of beams, flat slabs possess lower lateral stiffness and are more susceptible to larger storey displacements, storey drifts, and punching shear around column connections when subjected to seismic loading. Therefore, a detailed structural analysis is essential to ensure the safety and serviceability of flat slab buildings located in earthquake-prone regions.

Advancements in structural analysis software have significantly improved the accuracy of modelling and designing reinforced concrete structures. Software packages such as ETABS provide powerful finite element modelling capabilities for analysing complex building behaviour under gravity and earthquake loads, while SAFE offers efficient tools for the design and verification of slabs and foundation systems. The integration of ETABS and SAFE enables engineers to perform comprehensive structural analysis, evaluate seismic performance, design flat slabs, check punching shear, and develop economical footing designs in accordance with Indian Standard provisions.

In the present study, a G+20 reinforced concrete flat slab building is modelled and analysed using ETABS by considering seismic loading through Response Spectrum Analysis and nonlinear Pushover Analysis. Important structural parameters such as base shear, storey displacement, and storey drift are evaluated to assess the seismic behaviour of the building. Subsequently, the foundation system is designed in SAFE to verify the adequacy of isolated footings under the calculated structural loads. The study follows the provisions of IS 456:2000 and IS 1893 for reinforced concrete design and earthquake-resistant analysis.

The findings of this research contribute to a better understanding of the structural performance of flat slab buildings under seismic loading and demonstrate the effectiveness of ETABS and SAFE as integrated tools for analysis and design. The study also provides valuable guidance for structural engineers in selecting efficient flat slab systems that satisfy safety, serviceability, and economic requirements for modern multi-storey reinforced concrete buildings.

II. LITERATURE REVIEW

"Prof. S. B. Tanawade, Mr. Shashikant A. Waghmare, and Mr. Atul S. Chandanshive (2025) conducted a study on the structural behavior of flat beam systems subjected to lateral and seismic loads using the Finite Element Method (FEM). The study highlighted the advantages of flat beam systems, including reduced floor depth, ease of construction, and cost-effectiveness due to direct load transfer to columns without conventional beams. However, concerns such as limited lateral load resistance and punching shear vulnerability were also identified. A comparative analysis of G+15, G+18, and G+21 multi-storey buildings revealed that flat beam structures exhibited lower storey displacement, base reactions, and column forces compared to conventional framed structures. The results showed reductions of up to 15% in displacement, 17% in base reactions, and 19% in column forces. Additionally, significant material savings were achieved, with reductions of more than 43% in concrete consumption and 49% in steel usage. The study concluded that flat beam systems are economical, structurally efficient, and suitable for medium- and high-rise urban buildings, provided that proper design optimization is carried out.

Jessica Sjah, Alfredo, Ayomi Dita Rarasati, and Bambang Trigunarsyah (2025): conducted a comparative study on a 13-storey building to evaluate the performance of a Post-Tensioned Flat Slab (PTFS) system integrated with Building Information Modelling (BIM) against a conventional structural system. The analysis was performed using ETABS 21 and Revit 2023 for a structure classified under Seismic Design Category D. The PTFS system incorporated shear walls and boundary frames as the primary lateral force-resisting elements, while gravity columns were designed using a relegation approach. The results showed that the PTFS system had lower structural mass and higher stiffness, leading to reduced storey drift and lateral displacement, although it experienced higher storey shear and overturning moments compared to the conventional system. Cost analysis revealed structural savings of approximately USD 221,118 (10.2%) with the PTFS system. The study concluded that integrating BIM with the PTFS structural system improves design efficiency, enables seamless data exchange, and provides an economical and seismically resilient solution for multi-storey buildings in high seismic regions.

Atul Chavan, Pritesh Deshmukh, Shreyash Shetti, Prof. Mithun Kumar, and Dr. N. V. Khadake (2023): reviewed the design principles and applications of flat slab systems with emphasis on the use of column heads to improve load distribution and reduce punching shear failure. The study compared flat slab design approaches based on Indian and American standards and discussed their suitability for modern construction practices. The authors observed that although flat slab systems offer advantages such as reduced structural depth, improved architectural flexibility, and enhanced aesthetics, certain provisions in Indian design codes require further refinement. The study also noted that post-tensioned flat slab systems do not always provide economic benefits in practical applications, particularly for spans up to 10 m, where conventional reinforced concrete beam–slab systems remain more cost-effective. The authors concluded that flat slab construction is a promising structural solution for modern buildings, provided that appropriate design optimization and code improvements are implemented to ensure safety, serviceability, and economic feasibility.

Mohamed Shafeek K. V., P. Gokuldeepan, and Dr. Sunilaa George (2023): investigated the structural and economic performance of flat slab systems under varying loading and span conditions. The study evaluated the influence of span length and structural dimensions on the behavior of flat slabs without altering the applied loads. Comparative analyses between flat slab and conventional reinforced concrete (RCC) beam–slab systems were carried out using structural analysis software such as ETABS and STAAD.Pro, supported by preliminary numerical calculations. The results indicated that the structural efficiency and economy of flat slab systems are highly dependent on span length and support conditions. The study concluded that flat slab systems are most economical and structurally efficient for spans ranging from 5 m to 9 m, while longer spans become less economical without appropriate design modifications

Shirin K. P. and B. Mary Sonia George (2022): investigated the seismic performance of a 15-storey reinforced concrete post-tensioned flat slab building by replacing selected RCC columns with steel (sword) columns to improve lateral stiffness. The structure was modelled and analysed using ETABS for a high seismic zone, and its performance was evaluated based on base shear, storey drift, and storey displacement. A comparative cost analysis between conventional RCC post-tensioned flat slab systems and composite post-tensioned flat slab systems was also carried out. The results indicated that incorporating steel columns significantly enhanced the lateral load resistance and reduced seismic response while maintaining the architectural and economic advantages of post-tensioned flat slab construction. The study concluded that the use of steel columns in post-tensioned flat slab systems is an effective solution for improving seismic performance and controlling drift in multi-storey buildings.

III. OBJECTIVES

The objective of the current research study is

1) To evaluate seismic demand variation to ascertain the percentage increase in base shear when moving from Seismic Zone II (Z=0.10) to Zone III (Z=0.16) for both conventional frame and RCC wall systems
2) To assess lateral stiffness enhancement by comparing the percentage reduction in top-storey lateral displacement in both X and Y directions provided by the RCC wall system compared to the conventional frame system.
3) To check, compare & verify code compliance the storey drift of all four G+20 models against the permissible limit of 0.004 times the storey height specified in IS 1893:2002.
4) To evaluate foundation feasibility for isolated footing design using SAFE software

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue VII July 2026- Available at www.ijraset.com

5) To study structural system efficiency & compare the performance of high-strength concrete and when utilized in a flexible flat-slab frame versus a rigid RCC wall system

IV. METHODOLOGY

Software. Initially, a G+20 reinforced concrete flat slab building was modelled in ETABS by considering the architectural layout, structural configuration, and material properties. The structural model was developed using M40 grade concrete and Fe500 reinforcement steel. The slab thickness, column dimensions, drop panels, and storey height were defined according to the design requirements.

Gravity loads, including self-weight, floor finish, live load, wall load, and parapet wall load, were assigned to the analytical model. Seismic loading was defined in accordance with IS 1893 (Part 1):2016 by considering the appropriate seismic zone, medium soil condition, response reduction factor, importance factor, and damping ratio. Standard load combinations were generated following the recommendations of IS 456:2000 and IS 1893 (Part 1):2016.

The structural behaviour of the building was evaluated using Response Spectrum Analysis and Nonlinear Pushover Analysis in ETABS. The analysis was performed to determine important seismic response parameters, including base shear, storey displacement, storey drift, and overall structural performance under earthquake loading. The analytical results obtained from ETABS were used to assess the seismic behaviour of the flat slab building.

Finally, the analytical and design results were interpreted and compared based on structural performance parameters such as base shear, storey displacement, and storey drift. The study provides an integrated approach for the seismic analysis and design of reinforced concrete flat slab buildings using ETABS and SAFE, thereby demonstrating the effectiveness of these software tools in achieving safe, efficient, and economical structural designs.

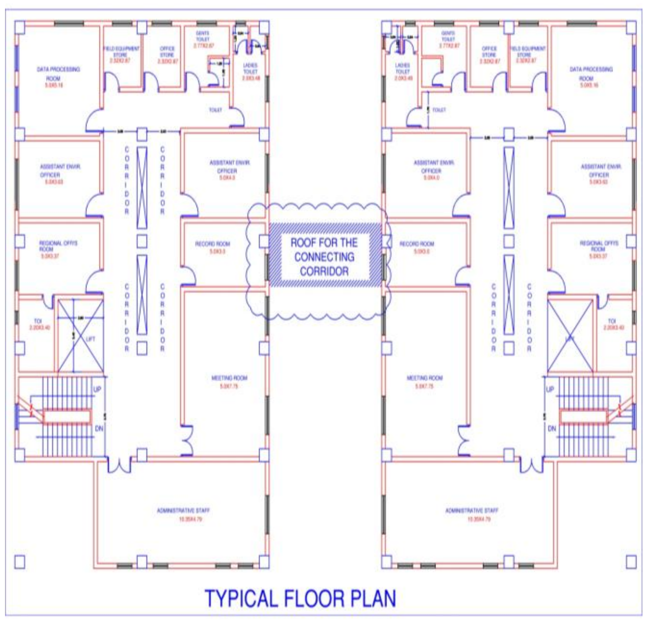


Fig.1. Typical Floor plan

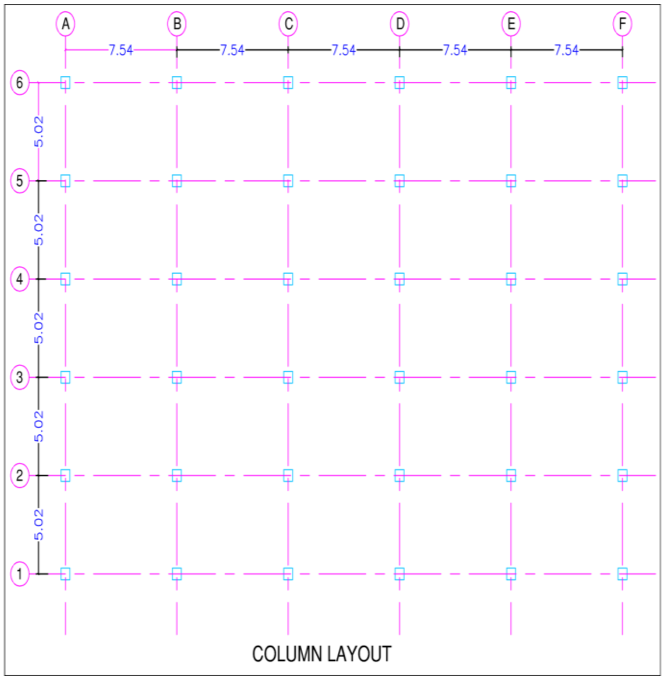


Fig.2. Column Layout

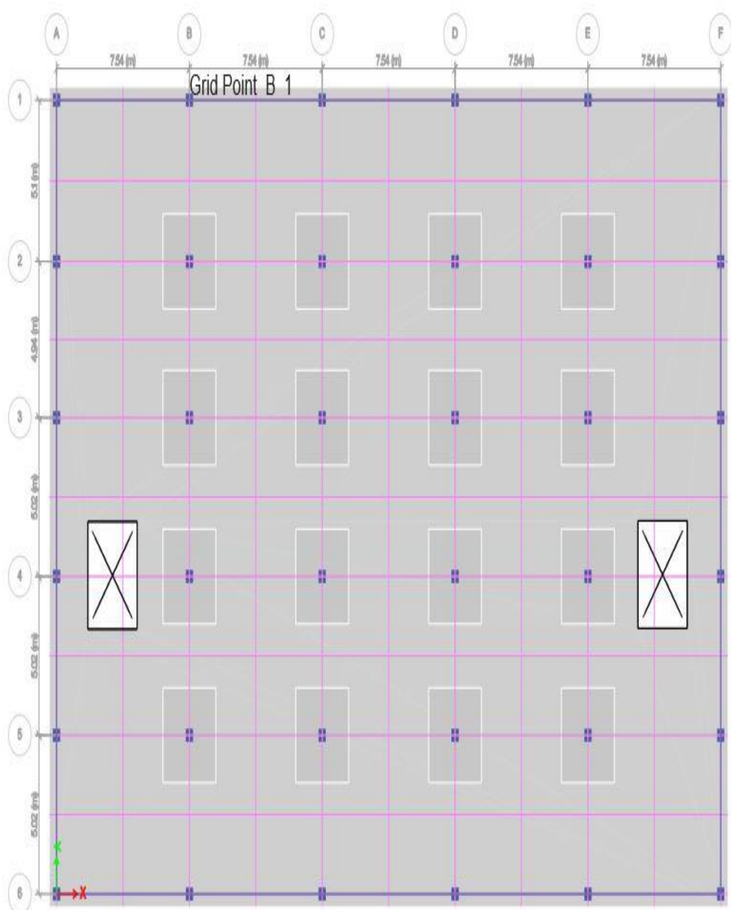


Fig.3.Flat slab plan

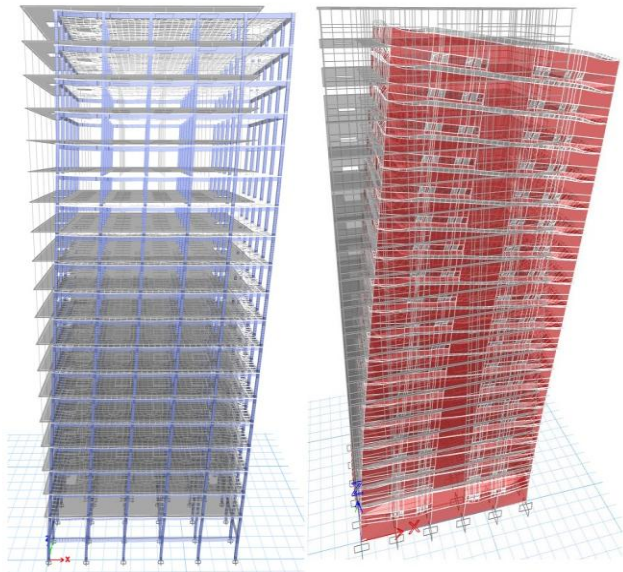


Fig.4.3D model of conventional & Mivan types

A. Analytical data

1) Building details

- Structure ▬ RCC (OMRF)
- Structure Type ▬ Plane flat slab
- Plan Dimension ▬ As shown in the above figure
- Storey Ht. ▬ 4.0m
- In X-direction ▬ 5 bay of different lengths
- In Y-direction ▬ 5 bay of different lengths

2) Material properties

- Concrete Grade ▬ M40
- Steel Grade ▬ Fe500
- Concrete Density ▬ 25kN/m3

3) Section properties

- Column ▬ 800mmx800mm
- Beam ▬ 300X600
- Slab Thickness ▬ 200mm
- Drop Size ▬ 3.0m X 3.0m X 300mm

TABLE 1: LOAD CONSIDERATION

Floor Finish ▬ 1kN/sqm,
Live Load ▬ 4kN/sqm
Main wall Load ▬ 13.70 kN/m
Parapet wall Load ▬ 3.60 kN/m

V. RESULTS AND DISCUSSION

A. Storey Displacement

TABLE-2: RESULTS OF Storey displacement in x direcion

Storey Displacements-1.2(DL + LL + EQX)				
Storey	RCC - ZoneII	RCC - ZoneIII	Mivan - ZoneII	Mivan - ZoneIII
20	132.126	207.904	17.325	26.907

19	130.516	205.36	16.477	25.595
18	127.965	201.337	15.581	24.208
17	124.473	195.834	14.643	22.755
16	120.133	188.999	13.67	21.245
15	115.047	180.991	12.668	19.692
14	109.312	171.965	11.647	18.106
13	103.021	162.064	10.614	16.502
12	96.26	151.425	9.578	14.893
11	89.109	140.172	8.547	13.290
10	81.641	128.421	7.529	11.708
9	73.922	116.278	6.533	10.160
8	66.014	103.836	5.568	8.659
7	57.971	91.18	4.641	7.218
6	49.838	78.386	3.761	5.849
5	41.657	65.516	2.936	4.565
4	33.455	52.612	2.174	3.379
3	25.223	39.66	1.483	2.303
2	16.744	26.324	0.87	1.348
0	0.000	0.000	0.000	0.000

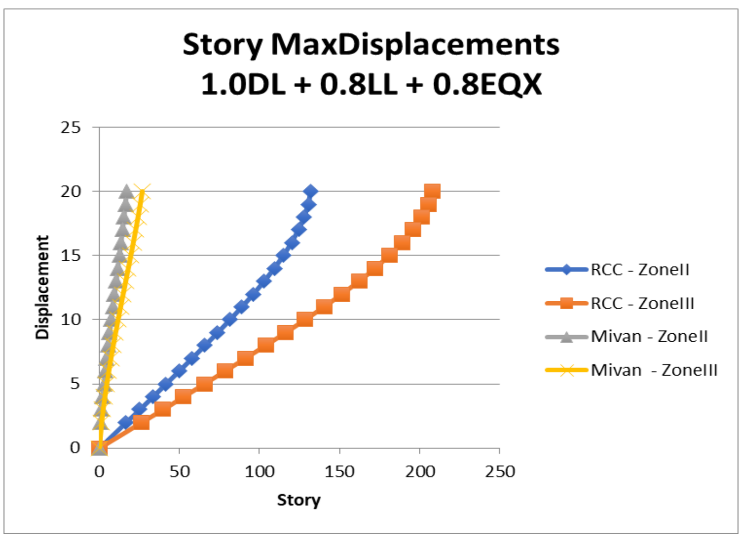


Fig.5. Storey displacement in x direction

TABLE-3: RESULTS OF Storey displacement in Y direcion

StoreyDisplacements-1.2(DL + LL + EQY)				
Storey	RCC - ZoneII	RCC - ZoneIII	Mivan - ZoneII	Mivan - ZoneIII
20	119.195	186.371	19.914	32.782
19	117.141	183.216	18.99	31.224

18	114.3	178.824	18.01	29.577
17	110.693	173.229	16.975	27.844
16	106.404	166.561	15.891	26.037
15	101.519	158.953	14.767	24.168
14	96.119	150.536	13.612	22.252
13	90.285	141.432	12.435	20.304
12	84.089	131.757	11.245	18.342
11	77.601	121.62	10.055	16.38
10	70.885	111.121	8.873	14.437
9	64.001	100.353	7.711	12.529
8	57.004	89.403	6.58	10.673
7	49.943	78.348	5.489	8.888
6	42.862	67.257	4.45	7.189
5	35.802	56.193	3.475	5.595
4	28.793	45.202	2.575	4.125
3	21.839	34.29	1.763	2.8
2	14.76	23.177	1.056	1.643
0	0.000	0.000	0.000	0.000

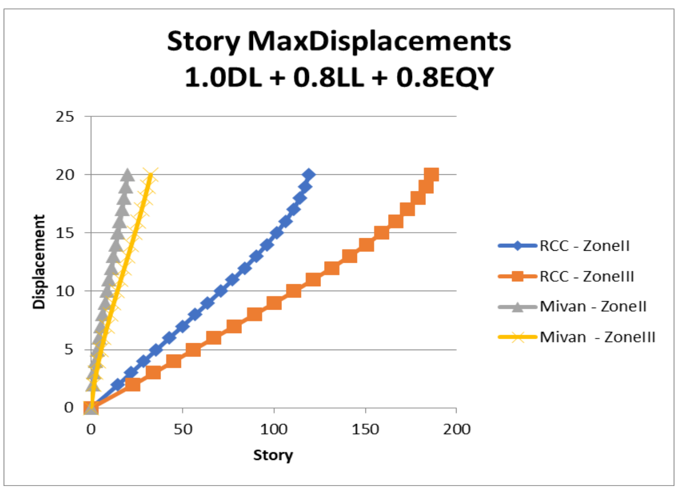


Fig.6. Storey displacement in Y direction

Table 2– and Figures 5–6 present the storey displacement in the X- and Y-directions under seismic loading. In both directions, the storey displacement increases progressively from the base to the roof level, with the maximum displacement occurring at the top storey. The conventional RCC building exhibits considerably higher displacement than the Mivan structural system in both Zone II and Zone III. The Mivan building shows significantly lower lateral displacement due to its higher structural stiffness and improved lateral load resistance. Furthermore, displacement values increase from Zone II to Zone III because of the higher seismic intensity. Overall, the results indicate that the Mivan structural system provides superior seismic performance and enhanced structural stability compared to the conventional RCC building

B. STOREY DRIFT

TABLE-4: RESULTS OF STOREY DRIFT IN X DIRECTION

StoreyDrift-1.2(DL + LL + EQX)

Storey	RCC - ZoneII	RCC - ZoneIII	Mivan - ZoneII	Mivan - ZoneIII
20	0.000403	0.000636	2.12E-04	3.28E-04
19	0.000638	0.001006	2.24E-04	3.47E-04
18	0.000873	0.001376	2.35E-04	3.63E-04
17	0.001085	0.001709	2.43E-04	3.77E-04
16	0.001272	0.002002	2.50E-04	3.88E-04
15	0.001434	0.002257	2.55E-04	3.96E-04
14	0.001573	0.002475	2.58E-04	4.01E-04
13	0.00169	0.00266	2.59E-04	4.03E-04
12	0.001788	0.002813	2.58E-04	4.01E-04
11	0.001867	0.002938	2.55E-04	3.96E-04
10	0.00193	0.003036	2.49E-04	3.87E-04
9	0.001977	0.003111	2.41E-04	3.75E-04
8	0.002011	0.003164	2.32E-04	3.60E-04
7	0.002033	0.003199	2.20E-04	3.42E-04
6	0.002045	0.003218	2.06E-04	3.21E-04
5	0.002051	0.003226	1.90E-04	2.97E-04
4	0.002058	0.003238	1.73E-04	2.69E-04
3	0.00212	0.003334	1.53E-04	2.39E-04
2	0.002819	0.004311	1.78E-03	1.84E-03
1	0.001792	0.002738	1.81E-03	1.86E-03
0	0.000000	0.000000	0.000000	0.000000

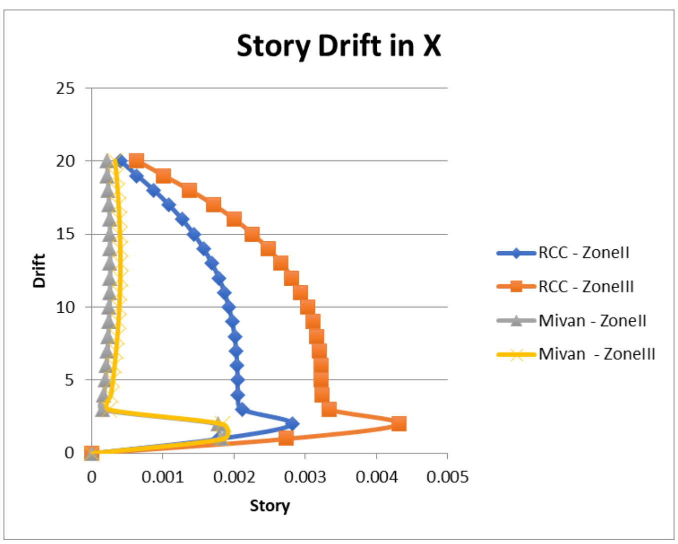


Fig.7. Storey Drift in X direction

TABLE-5: RESULTS OF STOREY DRIFT IN Y DIRECTION

StoreyDrift-1.2(DL + LL + EQY)				
Storey	RCC - ZoneII	RCC - ZoneIII	Mivan - ZoneII	Mivan - ZoneIII
20	0.000513	0.000789	2.31E-04	3.90E-04
19	0.00071	0.001098	2.45E-04	4.12E-04
18	0.000902	0.001399	2.59E-04	4.33E-04
17	0.001072	0.001667	2.71E-04	4.52E-04
16	0.001221	0.001902	2.81E-04	4.67E-04
15	0.00135	0.002104	2.89E-04	4.79E-04
14	0.001459	0.002276	2.94E-04	4.87E-04
13	0.001549	0.002419	2.97E-04	4.91E-04
12	0.001622	0.002534	2.98E-04	4.90E-04
11	0.001679	0.002625	2.95E-04	4.86E-04
10	0.001721	0.002692	2.91E-04	4.77E-04
9	0.001749	0.002738	2.83E-04	4.64E-04
8	0.001765	0.002764	2.73E-04	4.47E-04
7	0.00177	0.002773	2.60E-04	4.25E-04
6	0.001765	0.002766	2.44E-04	3.98E-04
5	0.001752	0.002748	2.25E-04	3.68E-04
4	0.001739	0.002728	2.03E-04	3.31E-04
3	0.00177	0.002778	1.77E-04	2.89E-04
2	0.002378	0.003666	1.27E-03	1.35E-03
1	0.001575	0.002467	1.09E-03	1.15E-03
0	0.000000	0.000000	0.000000	0.000000

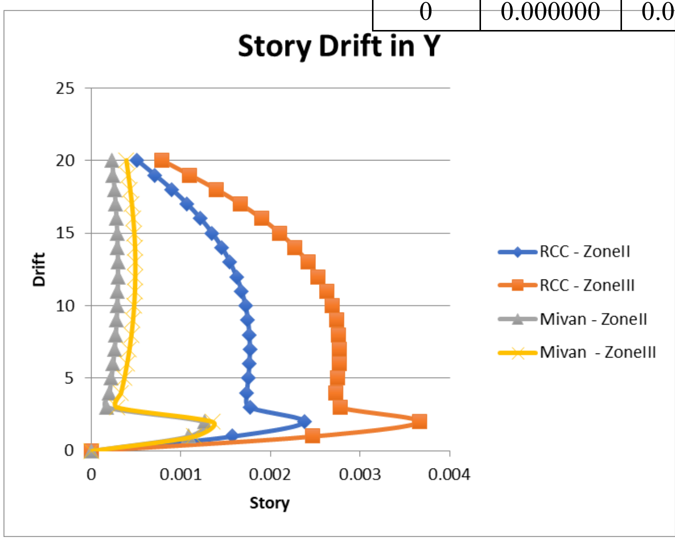


Fig.8. Storey Drift in Y direction

Table 4–5 and Figures 7–8 present the storey drift in the X- and Y-directions under seismic loading. The maximum storey drift is observed in the intermediate storeys and gradually decreases towards the top and bottom of the building. The conventional RCC building exhibits higher storey drift than the Mivan structural system in both Zone II and Zone III.

The Mivan building shows comparatively lower drift values due to its higher lateral stiffness and better resistance to earthquake-induced deformations. Moreover, storey drift increases from Zone II to Zone III because of the higher seismic intensity. Overall, the results indicate that the Mivan structural system provides better seismic performance and satisfies the storey drift requirements more effectively than the conventional RCC building

C. FLAT SLAB DESIGN

TABLE 6 Sample 'Concrete Slab' Design

Building Model	Seismic Zone	Maximum Bottom Reinforcement Area (mm²)	Maximum Shear Reinforcement (mm²/m)	Design Status
Conventional RCC	Zone II	7041	4482.3	OK
Conventional RCC	Zone III	8644.5	6429.9	OK
Mivan	Zone II	12014	7656.8	OK
Mivan	Zone III	10789	9548.6	OK

The flexure and shear design results show that all flat slab sections are safe under both Zone II and Zone III seismic conditions. The Mivan building requires slightly higher reinforcement than the conventional RCC building due to higher load transfer. However, all slab sections satisfy the flexural and shear design requirements and achieved an "OK" design status in SAFE. This confirms that both structural systems are safe and comply with the requirements of IS 456:2000

D. BASE REACTION

TABLE-7: Base shear in X direction

Base Reaction-1.2(DL + LL +EQX)			
RCC - ZoneII	RCC - ZoneIII	Mivan - ZoneII	Mivan - ZoneIII
1724.2151	2709.4809	4271.479	6719.308

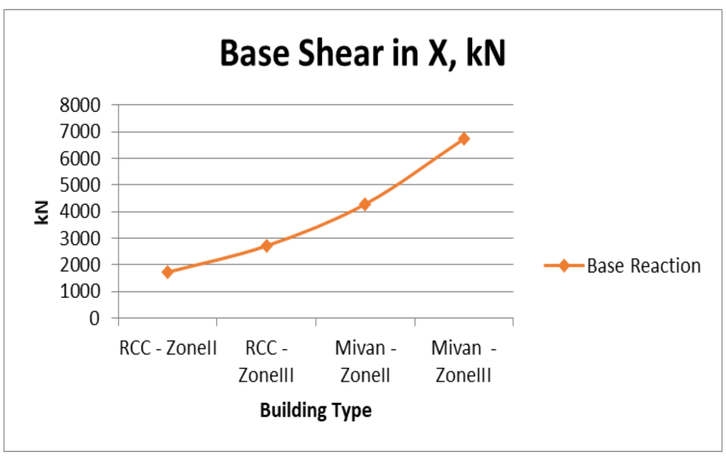


Fig.9. Base shear in X direction

TABLE-8: Base shear in Y direction

Base Reaction-1.2(DL + LL + EQY)			
RCC - ZoneII	RCC - ZoneIII	Mivan - ZoneII	Mivan - ZoneIII

1724.2173	2709.4844	3196.5941	5018.5813

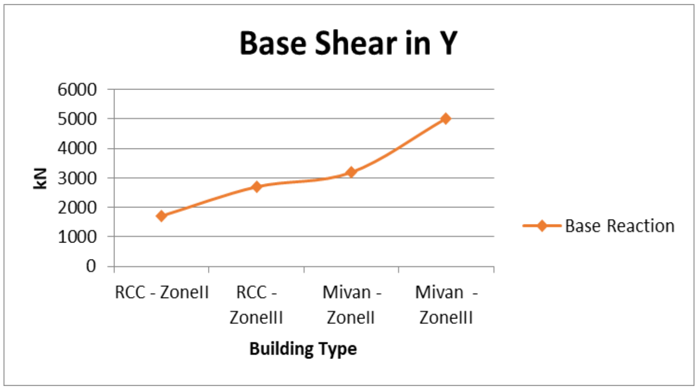


Fig.10. Base shear in Y direction

Table 7&8 and Figure 9&10 show the base reaction values of the conventional RCC and Mivan buildings in Zone II and Zone III. The base reaction increases by **57.1%** for the conventional RCC building and **57.3%** for the Mivan building when moving from Zone II to Zone III due to the increase in seismic intensity.

The Mivan building shows slightly higher base reaction because of its higher stiffness. Overall, both structural systems satisfy the seismic design requirements, and the Mivan building provides better seismic performance.

E. FOOTING DESIGN

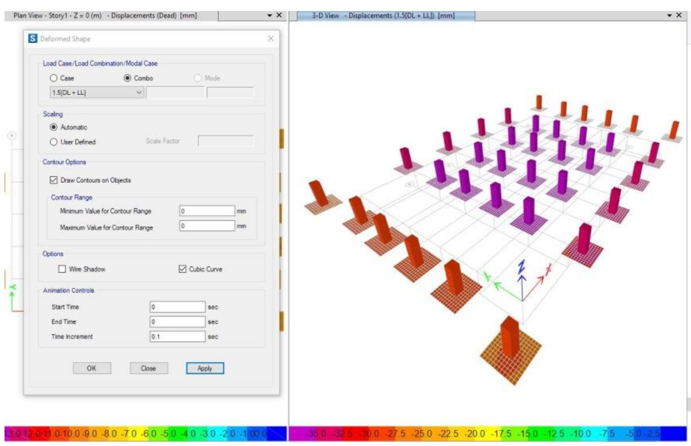


Fig.11. Deformed shape

The deformed shape obtained from ETABS shows the structural response of the flat slab building under seismic loading. The displacement increases gradually from the base to the top of the building, with the maximum displacement occurring at the roof level. The deformation pattern is smooth and indicates that the structure behaves safely under the applied earthquake loads

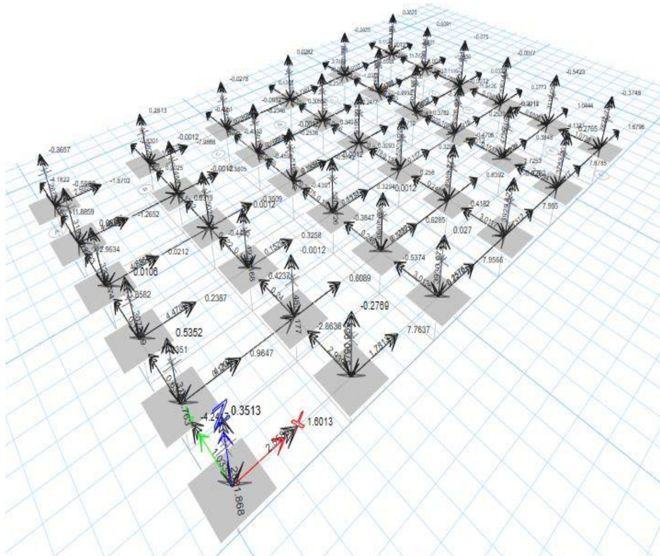


Fig.12. Loads imported from Etabs Mivan ZONE II

The support reaction results obtained from ETABS show how the structural loads are transferred to the foundation through the columns. Higher reactions are observed at the interior columns, while lower reactions occur at the edge and corner columns. The results indicate that the building has a stable and efficient load transfer system under the applied loading conditions.

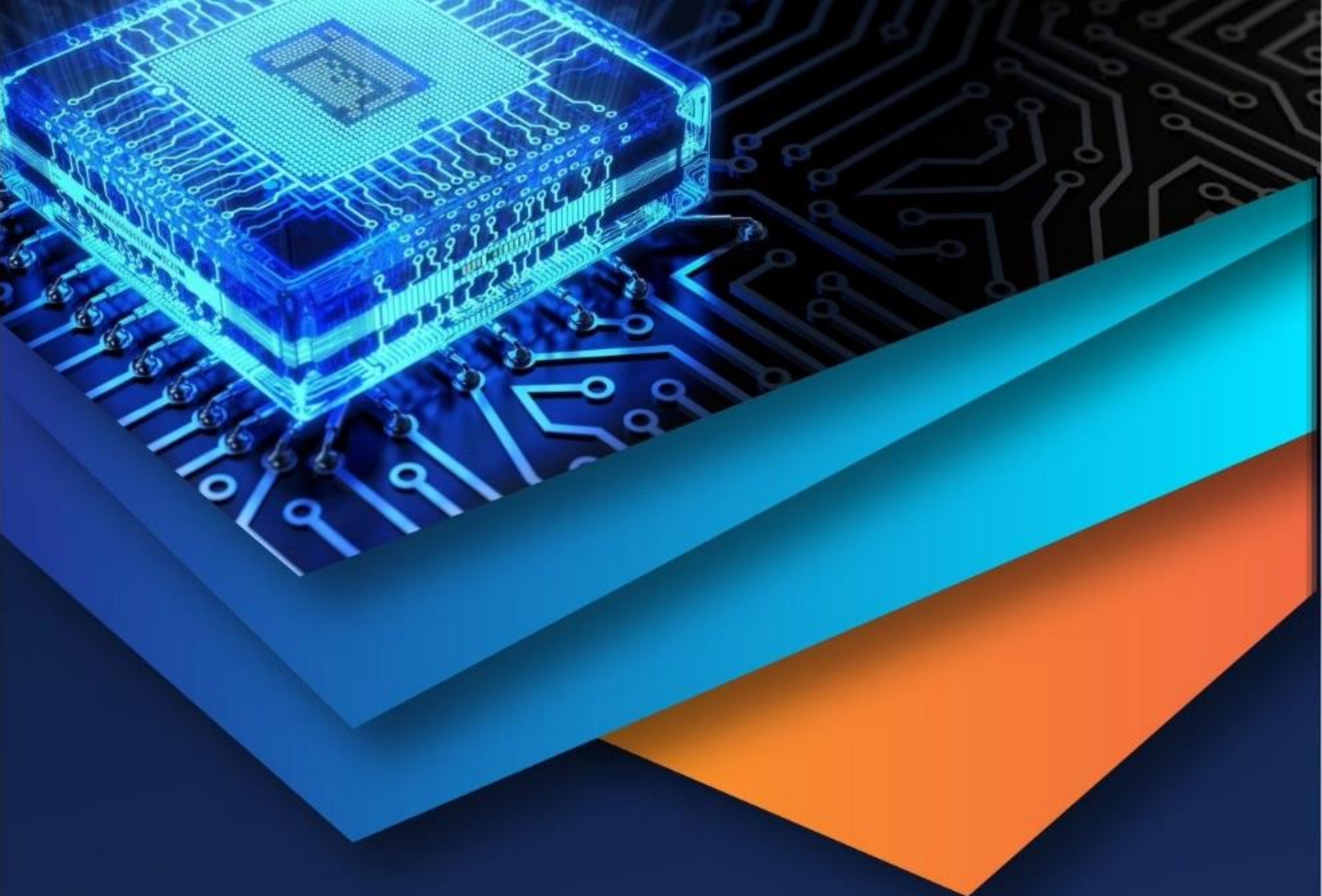
VI. CONCLUSION

This chapter presents the results obtained from ETABS and SAFE analysis & design of four 80 m high flat slab RCC buildings with different structural systems and seismic zones. The results include base shear, storey displacement, and isolated footing design data. The conclusions are drawn based on the comparative study of conventional frame system and RCC wall system in Zone II and Zone III as per IS 1893:2002

- Base shear increases by 57.1% for conventional frame and 57.3% for Mivan system when seismic zone changes from II to III. This is directly proportional to the increase in zone factor Z from 0.10 to 0.16 as per IS 1893:2002. Therefore, seismic zone is a critical parameter in design of tall buildings.
- The RCC wall system reduces top storey displacement by 86.9% in Zone II and 87.1% in Zone III compared to conventional frame system in X-direction. In Y-direction, reduction is 83.3% and 82.4% respectively. The continuous RCC walls around the perimeter provide significantly higher lateral stiffness and reduce torsional effects.
- All models satisfy the storey drift limit of 0.004 times storey height (80000mm X 0.004 = 320 mm) as per IS 1893:2002 Cl. 7.11.1. The maximum average drift observed is 1207.90 for M2, which is 35% below the permissible limit. Mivan models show lesser drift values of 32.78, indicating excellent serviceability performance.
- Isolated footings of size 3000 mm × 3000 mm × 1200 mm with SBC 500 kN/m² are found safe for all four models. SAFE analysis confirms that bearing pressure and punching shear remain within limits even for G+20 Mivan model in Zone III. This indicates that isolated footing is viable up to 80 m height for soil with moderate bearing capacity.
- Conventional flat slab frame without shear wall exceeds comfortable serviceability limits for displacement in Zone III. The top displacement of 207.90 mm may cause non-structural damage and occupant discomfort. RCC wall system keeps displacement below 33 mm even in Zone III, making it suitable for high-rise construction.
- For 80 m high flat slab buildings in Zone II and Zone III, the RCC wall system is recommended over conventional frame system. It provides superior seismic performance, better drift control, and improved occupant comfort with manageable increase in base shear. Isolated footings are adequate provided soil SBC is ≥ 500 kN/m².

REFERENCES

[1]S. B. Tanawade, S. A. Waghmare, and A. S. Chandanshive, “Analysis of Flat Slab Using Finite Element Method,” International Research Journal of Engineering and Technology (IRJET), Vol. 12, Issue 07, July 2025.
[2]J. Sjah, Alfredo, A. D. Rarasati, and B. Trigunarsyah, “Comparative Analysis of Post-Tensioned Flat Slab with Conventional Design Using Building Information Modelling (BIM) Integration in Tower Structure,” Journal of Applied Engineering Science, Vol. 23, No. 3, pp. 394–404, September 2025. DOI: 10.5937/jaes0-51237.
[3]A. Chavan, P. Deshmukh, S. Shetti, M. Kumar, and N. V. Khadake, “Analysis and Design of Flat Slab,” International Journal for Scientific Research & Development (IJSRD), Vol. 11, Issue 03, 2023.
[4]M. Shafeek K. V., P. Gokuldeepan, and S. George, “Effective Span and Economic Behavior of Flat Slab,” International Journal of Creative Research Thoughts (IJCRT), Vol. 11, Issue 10, October 2023.
[5]S. K. P. Shirin and B. M. Sonia George, “Comparative Analysis and Seismic Performance Improvement of RCC Post-Tensioned Flat Slab with Steel Composite PT Flat Slab System Using ETABS,” International Journal of Engineering Research & Technology (IJERT), ICART Special Issue, pp. 189–196, 2022.
[6]Bureau of Indian Standards, IS 456:2000, Plain and Reinforced Concrete – Code of Practice, New Delhi, India, 2000.
[7]Bureau of Indian Standards, IS 1893 (Part 1):2016, Criteria for Earthquake Resistant Design of Structures, New Delhi, India, 2016.
[8]Bureau of Indian Standards, IS 875 (Part 1):1987, Design Loads for Buildings and Structures – Part 1: Dead Loads, New Delhi, India, 1987.
[9]Bureau of Indian Standards, IS 875 (Part 2):1987, Design Loads for Buildings and Structures – Part 2: Imposed Loads, New Delhi, India, 1987.
[10] Bureau of Indian Standards, IS 875 (Part 3):2015, Design Loads for Buildings and Structures – Part 3: Wind Loads, New Delhi, India, 2015.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY