ANALYSIS AND DESIGN OPTIMIZATION OF SHEAR-WALL IN CASE OF HIGH-RISE BUILDING USING ETABS

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Abstract - *Shear walls are ordinarily used in excessive earthquake-susceptible areas, as they are tremendously inexperienced in taking the masses, and in excessive-upward thrust homes in which massive column length is not viable and the consignment is additional. Steel-concrete composite, steel, and R.C.C. choices are taken into thought for the comparative study. AN equal static approach of analysis was applied. For modeling of composite, steel, and R.C.C. structures, the ETABS software system program is utilized, and also the outcomes are compared. The analysis is the methodology of deciding the conduct of the form below distinct load mixtures. style is the system, that demands the proper specification of the form. mistreatment software package program analysis and layout system are completed. If there is any surprising shift, it's going to cause constructing stiffness/ torsional instability if the form is stricken with the help of employing a sturdy seismic fore or with the help of employing a few completely different a lot of less horizontal forces. The improvement methodology is employed and during this, it's initially taken into the thought that the scale of the shear wall square measure identical withinside the development when that the analysis is dead, and since that, the failing shear wall dimensions square measure changed to overcome the full form, thereby optimizing for no. of instances until the full structure is powerful to resist the force. There square measure many structural parameters that have a bearing on the general performance of the structure as story drift, base shear, and story displacement that affected the behavior of the structure towards the wind and seismic masses. The optimized shear wall is also determined by the outcomes of shear force, Bending Moment, story shear, story displacement, story drift, and quantity of concrete and steel.* load. Besides those vertical masses, homes also are subjected to lateral masses because of wind, earthquake forces. Lateral masses can broaden excessive stresses, produce sway movement, or cause vibration. Therefore, it's miles very critical for the shape to have enough power against vertical masses collectively with good enough stiffness to face up to lateral forces.

The static and dynamic structural responses of excessive-upward thrust homes are ruled with the aid of using the distributions of transverse shear stiffness and bending stiffness consistent with storey. "Making changes to the structures withinside the constructing or maybe the shape itself sooner or later after its initial creation and occupation."

1..1 FUNCTION OF SHEAR WALL

- Providing Lateral Strength to the building: Shear Wall must provide lateral shear strength to the building to resist the horizontal earthquake forces, wind forces and transfer these forces to the foundation.
- Providing Lateral Stiffness to the building: Shear Walls provide large stiffness to building in the direction of their orientation, which reduces lateral sway of the building and thus reduces damage to the structure.

1.2 TYPE OF SHEAR WALL

1. Concrete Shear Wall
2. Steel Plate Shear Wall
1. 3. Plywood Shear Wall

Key Words*: *Shear wall, ETABS, Earthquake loads, Load combination, Base shear

2. 4. RHCBM (RC Hollow Concrete Wall Masonry.)

1. INTRODUCTION

The layout of tall homes basically includes a conceptual layout, approximate analysis, initial layout, and optimization, to securely convey the gravity and lateral masses. The primary motive of all sorts of structural structures used withinside the constructing sort of systems is to transfer gravity masses effectively. The maximum not unusual place masses as a consequence of the impact of gravity are useless load, stay load, and snow

1.3 ADVANTAGES

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- Fast construction time.
- Significantly reduces lateral sway.
- The shear wall is very Light-weight.
- Shear wall is one type of thinner wall.
- Easy construction and implementation.

- Enough well-distributed reinforcements.
- Shear wall Cost-effectiveness respect of earthquake.
- Minimized damages to structural and Non-structural elements.

1.7 IMPORTANT POINT

- Ratio of breadth/width > 0.4
- Finished corners are possible.
- Clear surface without any offset is possible.
- Normally less consumption of bricks/blocks.
- Shear walls run along the full length of walls.
- The lateral load is resisted by shear deformation.
- The shear wall system is more efficient for high rise structures.

- Shear wall cross-section is like a vertically oriented wide beam.
- More carpet area is available as compared to the column beam system.

2. Literature Review

B. Vamsi Krishna, A.V. Prasanna Kumar, E. Rakesh Reddy
[1] Building R.C.C. is being modeled, studied, and deliberated in this report. Shear wall structure through the state of affairs is a call for Vs functionality ratio evaluation accompanied to the traits of segment shear wall. Considering the earthquake and wind forces, this may be advanced through the precise version produced at Etabs. The primary intention of this plan is to look at and examine diverse fashions of Shear partitions the usage of ETABS is now practiced in the direction of reaching the most advantageous placement of approximately Shear partitions within the shape.

The constructing is effectively built using ETABS with the have a look at of reaction spectrum turned into applied in the direction of degree constructing's performance. The gadget labored admirably additionally the effects have been mentioned below.

1. Storey flow approximately shape be within the boundary in the vicinity of clause no 7.11.1 of IS-1893 (Part-1):2002.
2. Storey Rigidity approximately shape be within the boundary of clause no 4.20 of IS-1893 (Part-1):2002.
3. Due to the life of shear partitions on each capacity bend location, the harm that could show up because of wind and earthquake forces may be monitored in this project.

L. Rahul, M.Akbar, M.Sriraman [2] Shear partitions are vertical factors of a pressure resisting machine that is horizontal. They are built to behave in opposition to the consequences of lateral hundreds which can be performing at the shape. In residential construction, shear partitions are immediately outside partitions that shape a field that gives lateral assistance to the construction. Lateral help is due to wind, earthquakes, the burden of the shape, and occupants. These hundreds can tear or shear a construction apart. Reinforcing a body with the aid of using attaching an inflexible wall interior continues the form of the body and forestalls rotation on the joints. Especially in high-upward thrust homes that are subjected to seismic forces and lateral wind forces. Shear wall homes are for residential functions to deal with 100-500 populations consistent with construction.
Dynamic linear evaluation of the usage of the reaction spectrum technique is finished and lateral load evaluation is completed for shape with RC shear wall and Steel plate shear wall. Results are as compared for the earthquake forces and a bending second of each case. It is likewise determined that lateral forces are decreasing while the shear partitions are introduced at the proper places of frames having minimal lateral forces. Therefore, it's far inferred that Steel plate shear partitions (t=6 mm) are greater proof against lateral hundreds in an abnormal shape.
Authors: M. Pavani, G. Nagesh Kumar, Dr. Sandeep Pingale [3] The buildings present on the sloping floor are

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very exceptional from the ones on the plain ground, in the sloping ground, the buildings are very abnormal and unsymmetrical in horizontal and vertical planes. The buildings in the sloping ground motive extra harm in the course of earthquakes because, in the sloping ground, the shape is built with unique column heights. In this examine the 3-D analytical version of 10 storied buildings, the plan of every configuration consists of four bays withinside the Y course and six bays withinside the X course that's saved the identical for all configurations of the constructing frame, the slope became selected in among zero to 30 degrees. The shape was efficiently constructed through the use of ETABS and the response spectrum evaluation was used to measure the behavior of the shape. The shape is executed admirably and the effects are mentioned below.

- The shape now no longer be the identical form all round has modified the displacement of the shape in X and Y course.
- Displacement is extra in X course than in Y course.
- The tale waft is likewise very excessive whilst in comparison to the Y course.
- The quality manner to lessen waft and displacement for the duration of lateral loading is to contain a shear wall in an uneven configuration in each direction.

3. PROJECT DETAILS

3.1 GENERAL PARAMETERS Table 3.1 GENERAL DATA

DESCRIPTION		DATA
Dimension of the plan	:-	25 x 13.5 m
No. of stories	:-	10
Floor to floor height	:-	3.15 m
Type of soil	:-	Medium
Support condition	:-	Fixed

Table 3.2 MATERIAL PROPERTIES

DESCRIPTION		DATA
Grade of Concrete (Beam)	:-	M25
Grade of Concrete (Column)	:-	M25
Grade of Concrete (Slab)	:-	M25
Grade of Steel (Beam & Column)	:-	Fe 500
Grade of Steel (Slab)	:-	Fe 500

Table 3.3 EARTHQUAKE PARAMETERS

DESCRIPTION		DATA
Zone	:-	III
Zone factor	:-	0.16
Importance factor, I	:-	1.5
Response reduction, R	:-	5

Model – 1 (G+10 w/o S. WALL)

Table 3.4 SIZING OF COLUMN & BEAM MEMBERS

DESCRIPTION		DATA
Column	:-	0.45m x 0.75m

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Beam	:-	TB: 0.30m x 0.60m MB: 0.45m x 0.55m (terrace) SB: 0.30m x 0.45 m

3.2 Model – 2 (G+10 w S. WALL)

Table 3.5 SIZING OF COLUMN & BEAM MEMBERS

DESCRIPTION		DATA
Column	:-	0.45m x 0.75m
Beam	:-	TB: 0.30m x 0.60m MB: 0.45m x 0.55m (terrace) SB: 0.30m x 0.45 m

3.3 Model – 2 (G+10 w S. WALL) (D.A.1)

Table 3.6 SIZING OF COLUMN & BEAM MEMBERS

DESCRIPTION		DATA
Column	:-	0.45m x 0.75m
Beam	:-	TB: 0.30m x 0.60m MB: 0.45m x 0.55m (terrace) SB: 0.30m x 0.45 m
Wall	:-	230mm

3.4 Model – 2 (G+10 w S. WALL) (D.A.2) Table 3.7 SIZING OF MEMBERS

DESCRIPTION		DATA
Column	:-	0.45m x 0.75m
Beam	:-	TB: 0.30m x 0.60m MB: 0.45m x 0.55m (terrace) SB: 0.30m x 0.45 m
Wall	:-	230mm

3.4 Model – 2 (G+10 w S. WALL) (D.A.3) Table 3.8 SIZING OF MEMBERS

DESCRIPTION		DATA
Column	:-	0.45m x 0.75m
Beam	:-	TB: 0.30m x 0.60m MB: 0.45m x 0.55m (terrace) SB: 0.30m x 0.45 m
Wall	:-	230 mm

ECY												
STORY	TERRACE	9f	8f	7f	6f	5f	4f	3f	2f	1f	plinth/gf	Base
Y- Dir (mm)	61.002	58.197	54.332	49.42	43.62	37.15	30.22	23.04	15.82	8.798	2.281	0
Y- Dir (mm) W S.W.	43.582	40.791	37.255	33.15	28.66	23.87	18.92	13.99	9.237	4.905	1.284	0
Y- Dir (mm) D.A.1	42.941	40.248	36.813	32.81	28.4	23.68	18.8	13.91	9.19	4.879	1.285	0
Y- Dir (mm) D.A.2	28.248	26.203	23.828	21.14	18.19	15.06	11.85	8.668	5.641	2.929	0.764	0
Y- Dir (mm) D.A.3	21.785	19.53	17.139	14.63	12.13	9.645	7.255	5.038	3.088	1.508	0.446	0
Y- Dir (mm) (SPSW)	62.035	59.352	55.529	50.61	44.78	38.26	31.27	24.01	16.67	9.45	2.56	0

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Table 3.9 SIZING OF MEMBERS

DESCRIPTION		DATA
Column	:-	0.45m x 0.75m
Beam	:-	TB: 0.30m x 0.60m MB: 0.45m x 0.55m (terrace) SB: 0.30m x 0.45 m
Wall	:-	230 mm

4. RESULTS

The results of, story displacement & storey drift are compared.

4.1 STORY DISPLACEMENT

STORY DISPLACEMENT												
EQX												
STORY	TERRACE	9f	8f	7f	6f	5f	4f	3f	2f	1f	plinth/gf	Base
X- Dir (mm)	34.747	33.516	31.613	29	25.75	22.04	18	13.75	9.406	5.136	1.35	0
X- Dir (mm) W S.W.	27.226	26.011	24.344	22.19	19.57	16.62	13.45	10.16	6.887	3.763	0.961	0
X- Dir (mm) D.A.1	22.541	21.133	19.446	17.45	15.14	12.6	9.915	7.209	4.622	2.346	0.61	0
X- Dir (mm) D.A.2	22.387	20.879	19.126	17.08	14.77	12.24	9.589	6.936	4.417	2.214	0.558	0
X- Dir (mm) D.A.3	15.733	14.375	12.811	11.12	9.359	7.564	5.785	4.09	2.558	1.278	0.325	0
X- Dir (mm) (SPSW)	33.998	32.777	30.89	28.33	25.16	21.56	17.65	13.54	9.338	5.188	1.368	0

Figure 4.1 DATA
Figure 4.2 DATA

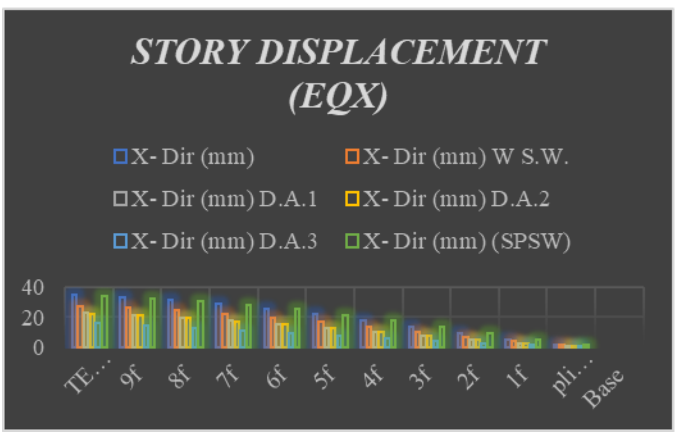


Figure 4.3 STORY STIFFNESS

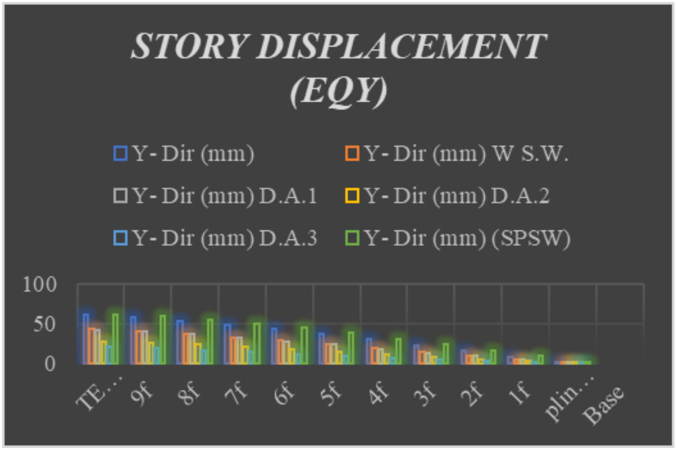


Figure 4.4 STORY STIFFNESS

4.2 STORY DRIFT

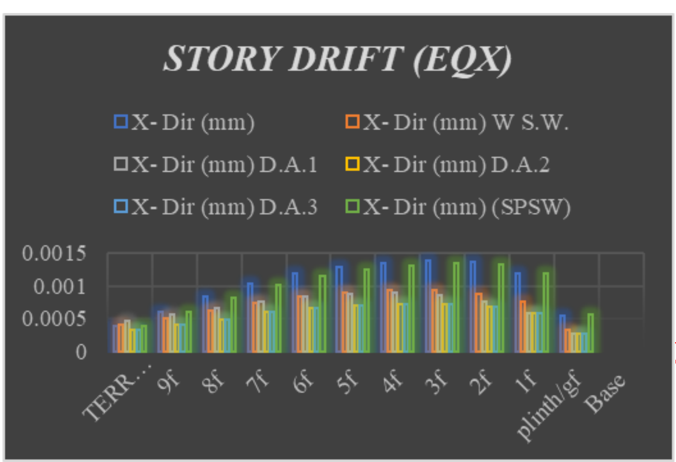
STORY	TERRACE	9f	8f	7f	6f	5f	4f	3f	2f	1f	plinth/gf	Base
X- Dir (mm)	0.00039	0.0006	0.00083	0.001	0.001	0.001	0.001	0.001	0.001	0.001	6E-04	0
X- Dir (mm) W S.W.	0.0004	0.0005	0.00062	7E-04	8E-04	9E-04	9E-04	9E-04	9E-04	8E-04	3E-04	0
X- Dir (mm) D.A.1	0.00047	0.00057	0.00066	8E-04	8E-04	9E-04	9E-04	9E-04	8E-04	6E-04	3E-04	0
X- Dir (mm) D.A.2	0.00033	0.00041	0.00049	6E-04	7E-04	7E-04	7E-04	7E-04	7E-04	6E-04	3E-04	0
X- Dir (mm) D.A.3	0.00033	0.00041	0.00049	6E-04	7E-04	7E-04	7E-04	7E-04	7E-04	6E-04	3E-04	0
X- Dir (mm) (SPSW)	0.00039	0.0006	0.00081	0.001	0.001	0.001	0.001	0.001	0.001	0.001	6E-04	0

Figure 4.5 DATA

STORY	TERRACE	9f	8f	7f	6f	5f	4f	3f	2f	1f	plinth/gf	Base
Y- Dir (mm)	0.00091	0.00123	0.00156	0.002	0.002	0.002	0.002	0.002	0.002	0.002	9E-04	0
Y- Dir (mm) W S.W.	0.00082	0.00095	0.00111	0.001	0.001	0.001	0.001	0.001	0.001	1E-03	5E-04	0
Y- Dir (mm) D.A.1	0.00089	0.00106	0.00125	0.001	0.001	0.002	0.002	0.002	0.001	0.001	5E-04	0
Y- Dir (mm) D.A.2	0.00067	0.00078	0.00089	1E-03	0.001	0.001	0.001	0.001	9E-04	8E-04	4E-04	0
Y- Dir (mm) D.A.3	0.00067	0.00078	0.00089	1E-03	0.001	0.001	0.001	0.001	9E-04	8E-04	4E-04	0
Y- Dir (mm) (SPSW)	0.00086	0.00121	0.00156	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0

Figure 4.6 DATA

Figure 4.7 STORY DRIFT



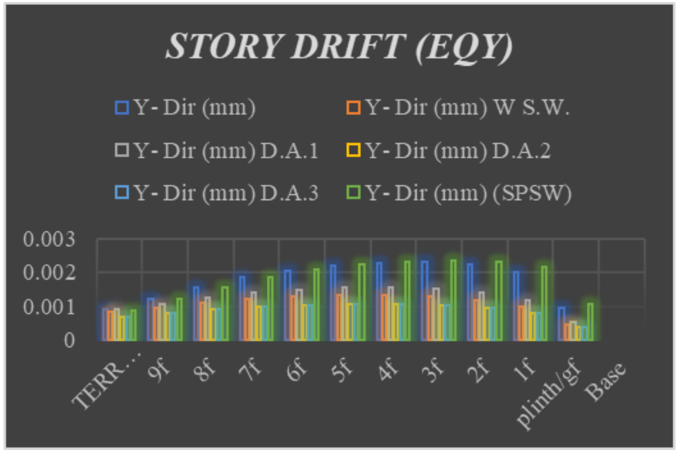


Figure 4.8 STORY DRIFT

3. CONCLUSIONS

Similarly, another 12 models of G+15 and G+20 have been analyzed and from that, it is concluded that

1. When in comparison to a building w/o a shear wall, the building with the shear wall is effective.
2. When compared to a typical building, the weight of a building with a shear wall is relatively more.
3. When it comes to story stiffness steel plate shear wall has a little bit less story stiffness compared to a building w/o a shear wall.
4. When it comes to story displacement building with a shear wall (D.A.3) has the least displacement of the others.
5. In short, building with a shear wall is more economical than building w/o a shear wall, and the economy of a shear wall depends on the materials used, arrangement and convenience of construction of a shear wall.

REFERENCES

[1] Institute for steel development & Growth, "B+G+40 Storied Residential Building with Steel-Concrete Composite Option" India Dec 2007.
[2] M. Nageh, "How to Model and Design High Rise Building Using ETABs Program" Cairo 2007.
[3] M. Willford, A. Whittaker and R. Klemencic, "Recommendations for Seismic Design of High-Rise Buildings" Council of Tall building and Urban habitat Feb 2008.
[4] J. Zils and J. Viis, "An Introduction to High Rise Design" Structure Magazine Nov 2003.
[5] IS: 456, Code of practice for plain and reinforced concrete code of practice, Bureau of Indian Standards, New Delhi, 2000.
[6] IS: 1893, Criteria for earthquake resistant design of structures – general provisions for buildings, Part 1, Bureau of Indian Standards, New Delhi, 2002.
[7] IS: 875, "code of practice for design load (other than earthquake) for buildings and structures" Bureau of Indian Standards, New Delhi, 2002.
[8] IS: 800, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi, 2007.
[9] AISC 360-05, Specification of structural steel building, An American national standard, American Institute of Steel Construction, Inc., 2005
[10] IS: 11384, Code of practice for composite construction in structural steel and concrete, Bureau of Indian Standards, New Delhi, 1985.
[11] Esmail s. epackachi m. samadzad and s.r. mirdhaderi— study of RC shear wall system in a 56-storey tall building (14WCEE-2008).
[12] Abiffazl shamsai, loghman rahemi, kamal rahemi,saber peroti — arangement of shear walls in control of lateral displacement of 16 and 32 storey concrete frames (WASJ- 2012).
[13] Peter K. Dean1 and Harry W. Shenton (2005), "Experimental Investigation of the Effect of Vertical Load on the Capacity of Wood Shear Walls", Journal of Structural Engineering; ASCE, pp 1104 – 1113.

Links of the photos of the models

https://drive.google.com/drive/folders/1_cPPWc7gYtarDM vNHWlGJpMN7TlfC0yD?usp=sharing