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OPTIMIZATION OF G + 7 STOREYED RCC BUILDING WITH DIFFERENT POSITIONING OF SHEARWALL

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Abstract —*A study has been carried out to determine the optimum Structural configuration of a multistory building by changing the shear wall locations. Four different cases, one without shear wall and other three with different positioning of shear wall for a 7 storeyed residential building have been analyzed and designed as a space frame system by computer application software, subjected to lateral and gravity loading in accordance with IS provisions. In this study the aim is to analyze the response of structure using static method. Base shear, maximum story displacement, story stiffness, reinforcement in corner column and story drift are observed and compared for all cases. These analyses are done using ETABS.*

Keywords-*Shear walls location, Earthquake loading, Design configuration, Static Analysis, ETABS etc.*

I. INTRODUCTION

Shear wall is a structural member used to resist lateral forces i.e. parallel to the plane of the wall. For slender walls where the bending deformation is more, Shear wall resists the loads due to Cantilever Action. In other words, Shear walls are vertical elements of the horizontal force resisting system.The shear wall is a structural element which is used to resist earthquake forces. Shear wall is plate like slender structure having large value of stiffness, which resist lateral load in their own plane and also resist the gravity load. Shear wall arrangement must be absolutely accurate, if not, we will find negative effect instead. Reinforced concrete (RC) buildings often have vertical plate-like RC walls called Shear Wall in addition to slabs, beams and columns. These walls generally start at foundation level and are continuous throughout the building height. Their thickness can be as low as 150mm, or as high as 400mm in high rise buildings. Shear walls are usually provided along both length and width of buildings. Shear walls are like vertically-oriented wide beams that carry earthquake loads downwards to the foundation.

1.1 Importance of Shear Walls in RC Buildings

- It significantly reduce story displacement, story drift
- Reduces the time period of vibration of the building
- Reduces moments and induced torsion during earthquake
- Increase stiffness of the building
- Shear walls should be strong enough to provide required lateral strength to resist lateral loads in multi storeyed buildings.
- Shear walls should also provide lateral stiffness to reduce side sway of the roof or floor above.
- Buildings provided with shear wall usually suffer from less nonstructural damage as shear wall will impart stiffness to the building.

1.2 Ductile Design and overall geometry of shear wall

- Just like reinforced concrete (RC) beams and columns, RC shear walls also perform much better if designed to be ductile. Overall geometric proportions of the wall, types and amount of reinforcement, and connection with remaining elements in the building help in improving the ductility of walls. The Indian Standard Ductile Detailing Code for RC members (IS:13920-2016) provides special design guidelines for ductile detailing of shear walls.
- Shear walls are oblong in cross-section, i.e., one dimension of the cross-section is much larger than the other. While rectangular cross-section is common, L- and U-shaped sections are also used. Thin-walled hollow RC shafts around the elevator core of buildings also act as shear walls, and should be taken advantage of to resist earthquake forces**.**

II. OBJECTIVE

- To study the behaviour of building by providing the different orientation of shear wall.
- To compare the design output of building with shear wall to building without shear wall.
- To compare the results under seismic load for different shape of shear wall.
- To compare different parameters such as Base shear, story displacement, Story stiffness and reinforcement in column at base for models without shear wall and with shear wall placed at different positions.

III. METHEDOLOGY

Table: 3.1 Material Properties

SR .NO	MATERIAL	GRADE
1.	Concrete(beam, column)	M20
2.	Concrete (slab)	M20
3.	Reinforcing bar	HYSD-500

Table: 3.2 Seismic Data

1.	Earthquake zone	III
2.	Damping ratio	5%
3.	Importance factor	1
4.	Type of soil	Medium soil
5.	Response reduction factor	5
6.	Time period (x)	.52
7.	Time period (y)	.59

Table: 3.3 Load Details

SR.NO	LOAD TYPE	ELEMENT	VALUE
1.	Dead load		
		Self-weight of Slab	3.125KN/m^2
		Floor finish	1KN/m2
		Partition wall load	6.375KN/m
		Parapet wall	2.5KN/m
		Sunk load	3.25KN/m^2
		Water tank load	16.5KN/m^2
2.	Live load		
		Entire floor	2KN/m^2
		Balcony,Staircase,Passage	3KN/m^2

3.1 Load combinations

1) **1.5**(D.L+L.L)
2) 1.2(DL+LL±Ex)
3) 1.2(D.L+L.L±Ey)
4) 1.5(D.L±Ex)
5) 1.5(D.L±Ey)
6) 0.9D.l±1.5Ex
7) 0.9D.L±1.5Ey

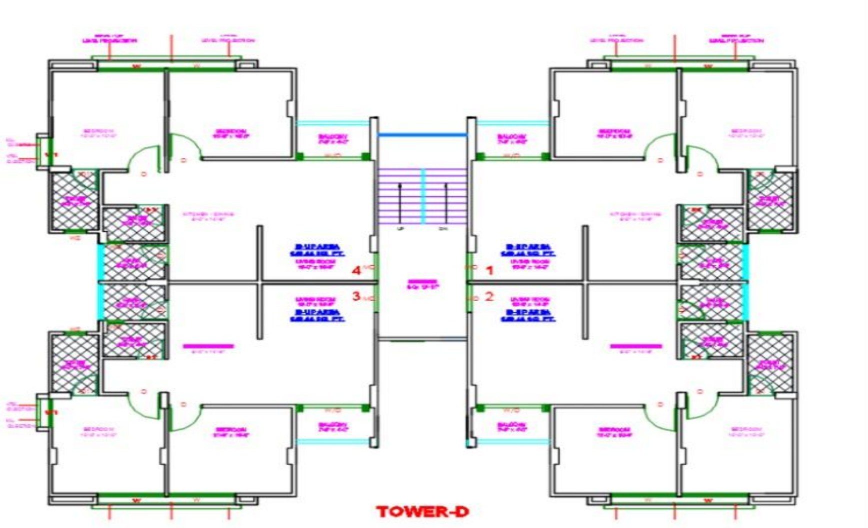

Figure 1 Architectural Layout

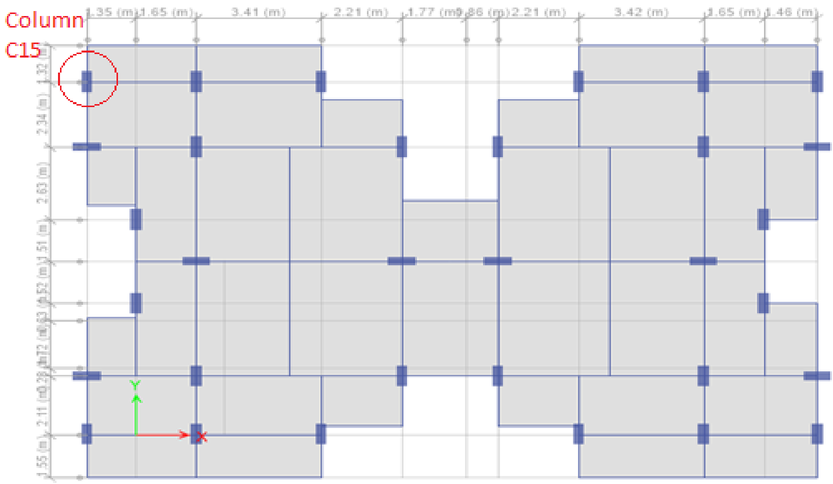

Figure 2. Model 1 without shear wall

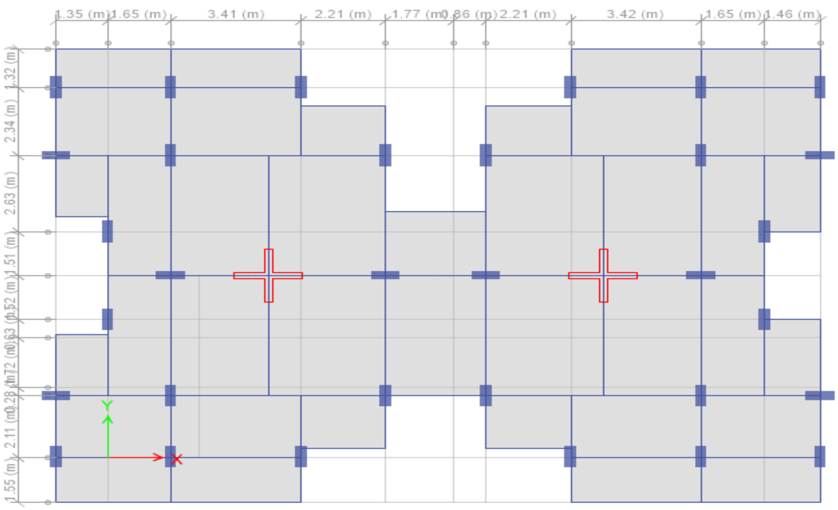

Figure 3. Model 2 with shear wall (+ shape)

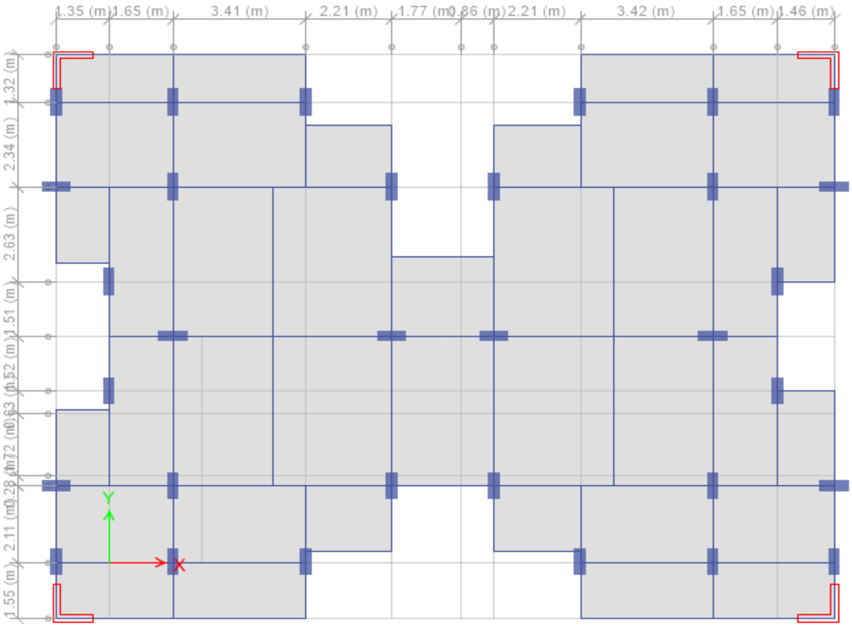

Figure 4. Model 3 with shear wall (L shape)

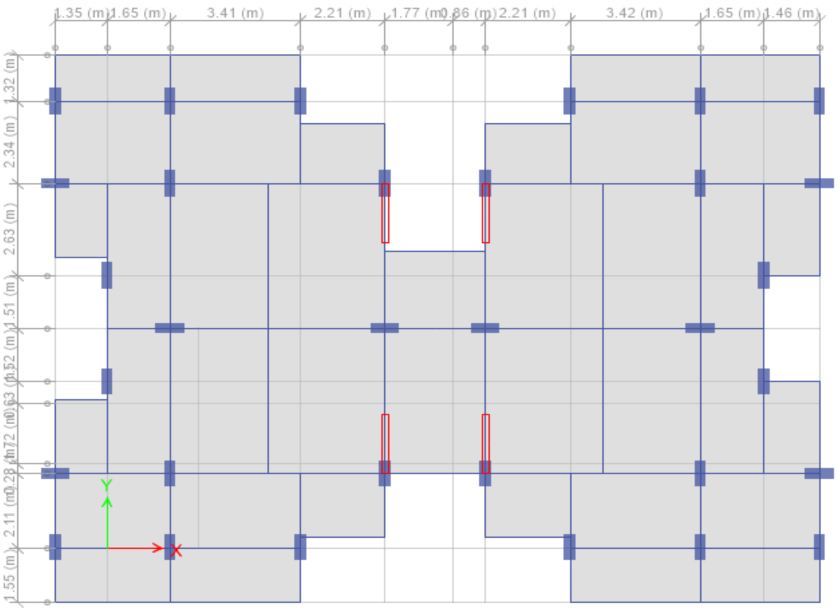

Figure 5. Model 4 with shear wall (I shape)

IV. RESULT AND DISCUSSION

Table 4.1 Amount of steel in column C15

Arrangement of shear wall	% steel in C15	Ast(mm^2) in C15
Without shear wall	2.49	5612
+ shape	0.8	1800
L shape	0.8	1800
I shape	1.87	4198

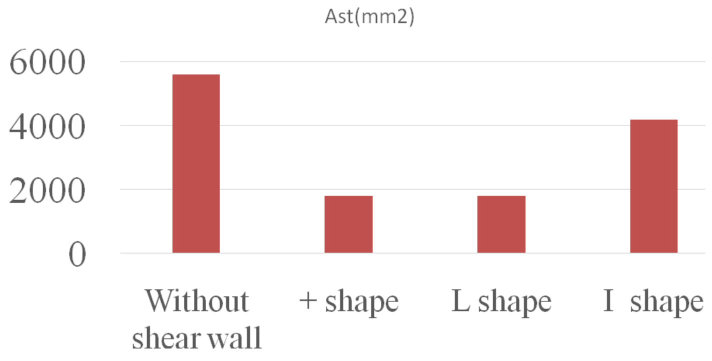

Figure 6. Comparison of Area of steel reinforceent

Table 4.2 Base shear

Arrangement of shear wall	EQX(kN)	EQY(kN)
Without shear wall	1359	1253
+ shape	1390	1281
L shape	1400	1290
I shape	1388	1280

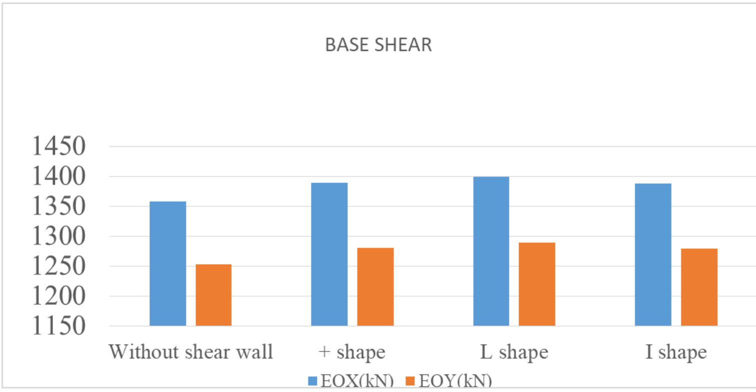

Figure 7.Comparison of Base shear

Table 4.3 Maximum storey displacement

Arrangement of shear wall	EQX(mm)	EQY(mm)
Without shear wall	36.11	22.69
+ shape	17.70	18.61
L shape	28.44	17.28
I shape	36.10	14.81

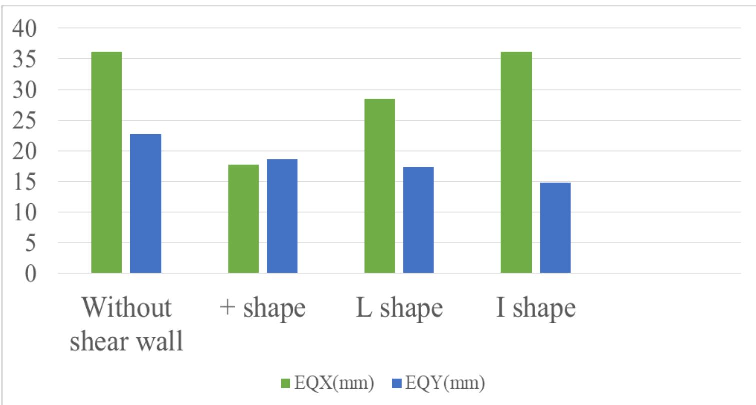

Figure 8. Comparison of Max. Storey Displacement (mm)

Table 3.4 Story stiffness (story 2)

Arrangement of shear wall	EQX(kN/m)	EQY(kN/m)
Without shearwall	327728	449097
+ shape	722971	516565
L shape	391696	579063
I shape	324056	868221

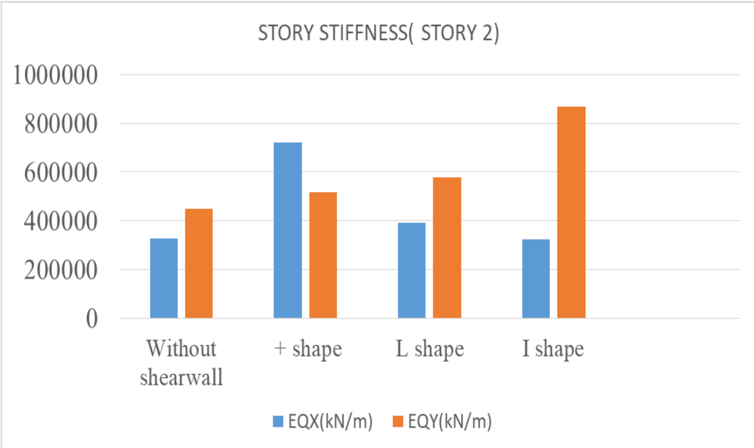

Figure 9. Comparison of Max. Storey Displacement(kN/m)

Table 3.5 Story drift

Arrangement of shear wall	EQX(mm)	EQY(mm)
Without shearwall	7.8	4.53
+ shape	2.517	3.036
L shape	4.5	2.835
I shape	8.1	1.92

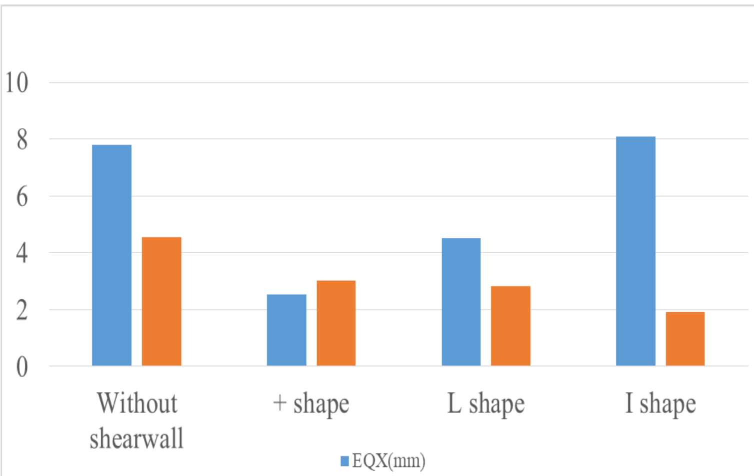

Figure 10. Comparison of Storey Drift (mm)

V. CONCLUSION

- We conclude that % steel in a column C15 is less in bildings provided with shear wall as compared to that in model without shear wall. We get less % steel in + and L shape model as compared to I shape model.
- Base shear will increase if we provide shear wall as stiffness of building will increase. The Base shear for EQX case is highest in L shape model as compared to + and I shape models.
- We conclude that story displacement will decrease in building with shear wall as compared to the building without shear wall.In "I" shape model displacement along X direction remains same as it is not effective in that direction but we get minimum story displacement along Y direction in this case.Along X direction we get minimum story displacement in + shape model .
- Story stiffness will increase in building provided with shear wall as compared to that without shear wall.We have compared story stiffness at story 2 and we observed maximum stiffness in + shape model for X direction and that for Y direction we get it maximum in I shape model.
- Story drift will decrease in building provided with shear wall as compared to that without shear wall.Story drift is minimum in X direction for + shape model and in Y direction for I shape model.
- From the above results we can conclude that a building with shear wall is better as compared to that without shear wall in resisting lateral loads.
- Also the effectiveness of shear wall will depend on orientation of shear wall.In this case '+' shape is better as compared to other two shapes.

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