Study of Optimizing Configuration of Multi-Storey Building Subjected to Lateral Loads by Changing Shear Wall Location

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Abstract--- *Shear wall systems are one of the most commonly used lateral load resisting in high rise building.Shear wall has high in planestiffness and strength which can be used to simultaneously resist large horizontal loads and support gravity loads.*

Incorporation of shear wall has become inevitable in multi-storey building to resist lateral forces .It is very necessary to determine effective ,efficient and ideal location of shear wall.

In this paper, study of 25 storey building in zone V is presented with some preliminary investigation which is analysed by changing various position of shear wall with different shapes for determining parameters like bending moment ,base shear and storey drift. This analysis is done by using standard package ETAB.

Keywords--- *Shear Wall, Lateral Loading, Eccentricity, Drift, Forces, Moments*

I. Introduction

RC multi-storey building are adequate for resisting both the vertical and horizontal load. When such building is designed without shear wall , beam and column sizes are quite heavy and there is lot of congestion at these joint and it is difficulty to place and vibrate concrete at these places and displacement is quite heavy which induces heavy forces in member. Shear wall may become imperative from the point of view of economy and control of lateral deflection.

In RC multi-storey building lift well or shear wall are usual requirement. Centre of mass and stiffness of the building is ideal for a structure. However, on many occasions the design has to be based on the off centre position of lift and stair case wall with respect to centre of mass which results into an excessive forces in most of the structural members, unwanted torsional moment and deflection.

II. Structural Data

Building consists of 7 bays of 7.5M in X- direction and 5 bays of 6.5M in Y- direction.

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Table 1: Shows the Structural Data of Building

Zone	V
Height of storey	3.35 m
Number of storeys	25
Shear wall thickness	600mm from base to storey Level 10 400 mm from storey level 10 to 20 230 mm from storey level 20 to 25
Grade of concrete and steel	M20 and Fe 415
Depth of slab	175 mm
Size of beam in longitudinal and transverse direction	400 x 600 mm
Size of Column	850 x 850 mm From Base to Storey level 13 750 x 750 mm From Storey level 13 to 16 650 x 650 mm From Storey level 16 to 19 550 x 550 mm From Storey level 19 to 22 450 x 450 mm From Storey Level 22 to 25 Column around periphery 600 x 600 mm

III. Gravity Loading

Gravity loading consists of dead load due to structural self-weight.

i. Live load is considered as 3 KN per Square meter.

IV. Lateral Loading

Lateral loading consist of earthquake loading which has been calculated by program and it has been applied to the mass centre of the building.

ii. Period Calculation: Users defined

iii. Response Reduction factor (R): 5

V. Results and Discussion

Results obtained from the analysis are recorded in tabular form for the five cases of the building separately for comparison of base shear and displacement.

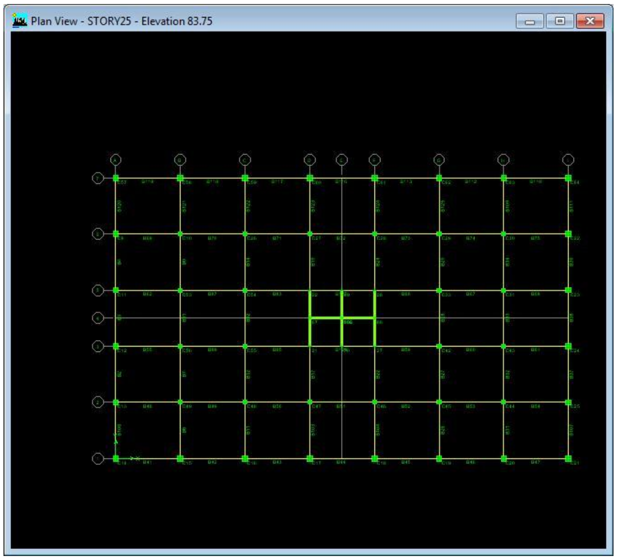
i. Case no. 1 without shear wall

ii. Case no. 2 When Shear wall (Lift core) is placed at centre of building

iii. Case no. 3 When Shear wall (Lift core) is displaced 7.5m from the centroid in X-direction

iv. Case no. 4When Shear wall (Lift core) is displaced 15 m from the centroid in X-direction.

v. Case no. 5 When Shear wall (Lift core) is displaced 22.5 from the centroid in X-direction.



Plan of the Building

Table 2: Case No. 01 Deflection at the Roof without Shear Wall

Load combination	Deflection in mm
1.2(DL+LL+EQ)	185
1.5(DL+EQ)	231
0.9DL+1.5EQ	231

Table 3: Case No. 01 Base Shear without Shear Wall in Y Direction

Load combination	Base Shear (KN)
1.2(DL+LL+EQ)	10493.21
0.9DL+1.5EQ	13116.52
Earthquake	8744.34

Table 4: Case No. 02 Deflection at Roof when Shear Wall (Lift Core) at Centre

Load combination	Deflection in mm (without shear wall	Deflection in mm (X direction)	Deflection in mm (Y direction)
1.2(DL+LL+EQ)	185	84.70	118
0.9DL+1.5EQ	231	105.80	147.81

Table 5: Case No. 02 Base Shear when Shear Wall (Lift Core) at Centre

Load combination	Base Shear (KN) X direction	Base Shear (KN) Y direction
1.2(DL+LL+EQ)	10019.59	10016.97
0.9DL+1.5EQ	12524.49	12521.21
Earthquake	8349.66	8347.47

Table 6: Case No. 03 Base Shear when Shear Wall (Lift Core) Placed at Second Position

Load combination	Base Shear (KN) X direction	Base Shear (KN) Y direction
1.2(DL+LL+EQ)	10008.54	10036.58
0.9DL+1.5EQ	12510.67	12545.73
Earthquake	8340.45	8363.82

Table 7: Case No. 03 Deflection at Roof when Shear Wall (Lift Core) at Second Position

Load combination	Deflection in mm(without shear wall	Deflection in mm(X direction)	Deflection in mm (Y direction)
1.2(DL+LL+EQ)	185	85	0
		64	139
0.9DL+1.5EQ	231	105	0
		80	214 & 174

Table 8: Case No. 04 Base Shear when Shear Wall (Lift Core) Placed at Third Position

Load combination	Base Shear (KN) X direction	Base Shear (KN) Y direction
1.2(DL+LL+EQ)	9991.59	9995.56
0.9DL+1.5EQ	12489.49	12494.45
Earthquake	8326.33	8329.63

Table 9: Case No. 04 Deflection at Roof when Shear Wall (Lift Core) at Third Position

Load combination	Deflection in mm(without shear wall)	Deflection in mm(X direction)	Deflection in mm(Y direction)
1.2(DL+LL+EQ x)	185	87	0
1.2(DL+LL+EQ y)		91	163 & 216
0.9DL+1.5EQx	231	107	0
0.9DL+1.5EQy		112	204 & 270

Table 10: Case No. 05 Base Shear when Shear Wall (Lift Core) Placed at Fourth Position

Load combination	Base Shear (KN) X direction	Base Shear (KN) Y direction
1.2(DL+LL+EQ)	9961.81	10012.19
0.9DL+1.5EQ	12452.26	12515.24
Earthquake	8301.51	8343.49

Table 11: Case No. 05 Deflection at Roof when Shear Wall (Lift Core) at Forth Position

Load combination	Deflection in mm (without shear wall)	Deflection in mm(X direction)	Deflection in mm (Y direction)
1.2(DL+LL+EQx)	185	111	0
1.2(DL+LL+EQy)		115	138 & 262
0.9DL+1.5EQx	231	121.20	0
0.9DL+1.5EQy		126.20	173.30 & 328

VI. Conclusion

From preliminary investigation, it reveals that the significant effects on deflection in orthogonal direction and base shear by shifting the shear wall location. Placing Shear wall away from centre of gravity resulted in increase in most of the members forces.It may be observed from tables no 2 and table no 4 that displacement of the building floor at storey 25 has been reduced due to presence of shear wall placed at centre. From the table no. 6, 8 and 10, as the eccentricity increases in X-direction, the lateral force in Y- direction develop the deflection in both direction. From the table of Base shear, Base shear in Y- direction increases with increase in eccentricity. The displacement of building isuni-directional and uniform for all the grids in the case of Zero eccentricity for seismic loading. With the increase in eccentricity, the building shows non-uniform movement of right and left edges of roof due to torsion and induces excessive moment and forces in member

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