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ANALYSIS AND DESIGN OF SHEAR WALL FOR HIGH RISE BUILDING (G+10) USING STAAD PRO

G. SANTOSH
M.Tech., Department of Civil Engineering, Visakha Technical Campus, Andhra Pradesh.
gotivadasantosh8@gmail.com

V. BHARGAVI
Assistant Professor, Department of Civil Engineering, Visakha Technical Campus.
vbhargavi1974@gmail.com

ABSTRACT:
Shear wall is the most commonly used to resist lateral force like wind and seismic loads etc. Shear walls has very high stiffness and strength which provide stability to the structure. The scope of the work is to study of different stories of building with and without shear wall, considering different wind load at different heights and lateral moment of the structure with and without shear wall. Wind load will be applied to building for G+10 on different cases of shear wall position. An analysis and design will be performed using STAAD Pro software.

Shear walls are generally used in high wind loads areas, as they are highly efficient in taking the loads. Not only have the wind loads also resists earthquake loads which are quite high in some zones can be taken by these sheared walls effectively and efficiently.

Construction made of shear walls are high in strength they majorly resists the wind loads and seismic loads even can be built on weak soil bases by adopting various ground improvement techniques. Not only the strength and effectiveness to be bare horizontal loads is very high and also increase the quickness in construction process.

The collected data is analyzed and a 3D model is generated using STAAD Pro. The various data is calculated and the structure is analyzed for the various load combination. Manual calculation of wind and loads are done by using non-linear analysis. The obtained results are analyzed and the design of shear wall is done.

1. INTRODUCTION

1.1 General

Shear walls are vertical elements of the lateral forces resisting system. When shear walls design and constructed properly and they will have the strength and stiffness to resist the lateral forces. In building construction shear walls shear walls are straight external walls that form a box which provides all the horizontal support to the building.

Shear walls are became an important part in high-rise residential buildings. As part of an earthquake resistant building design, these walls are placed in building reduce lateral displacement under wind and earthquake loads.

PURPOSE:

- Shear walls are designed and constructed properly, and they strength stiffness to resist the horizontal forces.
- Shear wall structural system are more stable, as there supporting area with reference to total plans area of building, is comparatively more, unlike in the case of RCC framed structures.
- They are also designed for lateral loads of wind and earthquakes.
- Shear walls doesn't need any extra plastering or finishing as the wall itself gives such a high level of precision, that it doesn't require plastering.
- Shear walls are quick in construction, as the method adopted to construct is concreting the members using formwork.
- Shear walls have to resist the uplift forces caused by the pull of the wind.

1. BUILDING MODELING:

These building were designed in conformity to the Indian code of practice for wind load resistant design of structures. The building was modeled using STAAD Pro. Models were analyzed, designed and compared lateral displacement for all structural models.

Table-1: Building Dimensions

S. NO.	PARTICULAR	DIMENSIONS
1	Length of building	24 m
2	Width of building	18 m
3	Height of building (G+10)	33 m
4	Typical story height	3 m
5	Live load on floor	19.25 KN/m^2
6	Floor finishing	4.75KN/m^2
7	Grade of concrete	M40
8	Thickness of slab	0.15 m
9	Thickness of shear wall	0.23 m

Wind Intensity Calculation:

H m	V_b	k_1	k_2	k_3	Vz=Vb× k1× k2 x k3 (m/s)	P_z= 0.6Vz^2 (N/m^2)
10	50	1	0.88	1	44	1161.6
15	50	1	0.94	1	47	1325.4
20	50	1	0.98	1	49	1440.6
30	50	1	1.03	1	51.3	1579.01
33	50	1	1.04	1	52	1622.4

DESIGN WIND SPEED (F):

Height (m)	P_Z	F=$C_fA_eP_z$ (KN/m)	F (KN/m)
0-10	1161.6	5575.68	5.57
10-15	1325.4	6361.92	6.36
15-20	1440.6	6914.88	6.91
20-30	1576.01	7579.25	7.58
30-33	1622.4	7787.52	7.79

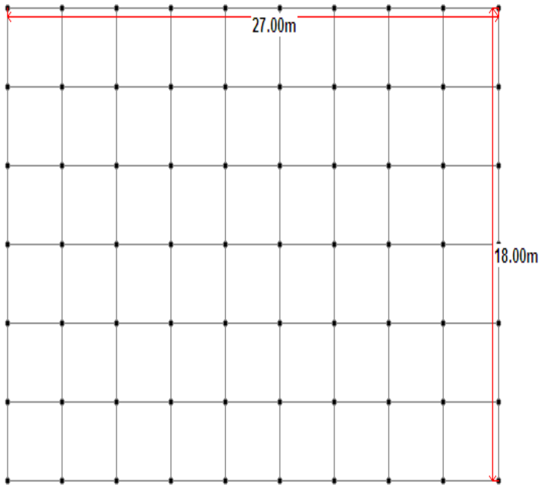


Fig -1: Staad Pro Plan

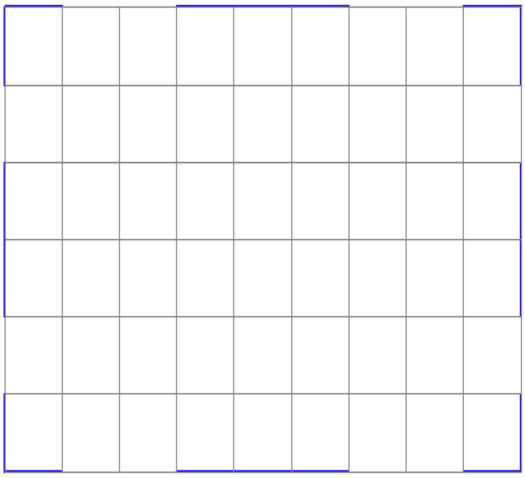


Fig -2: Location of shear wall

Model -1 Elevation of building of different cases

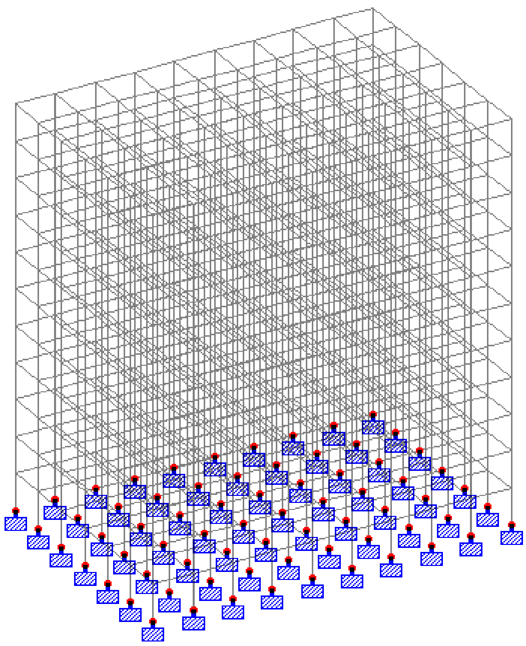


Fig -3: Model-1

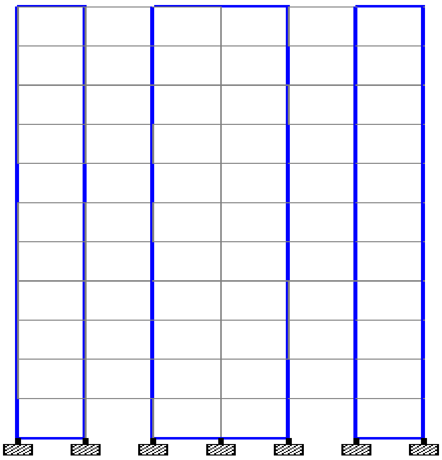


Fig -4: Model-1

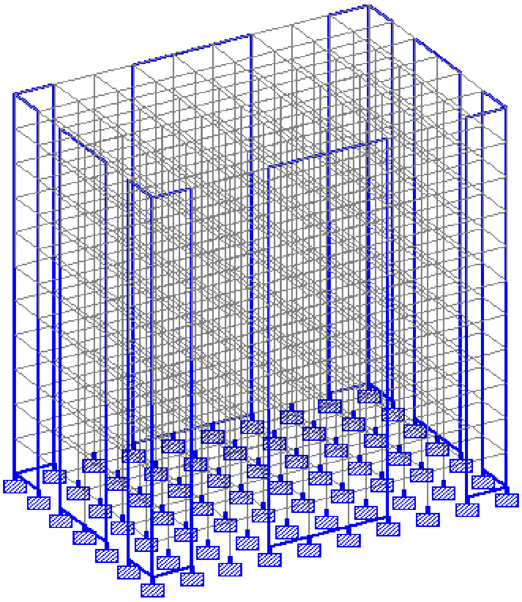


Fig -5: Model-1

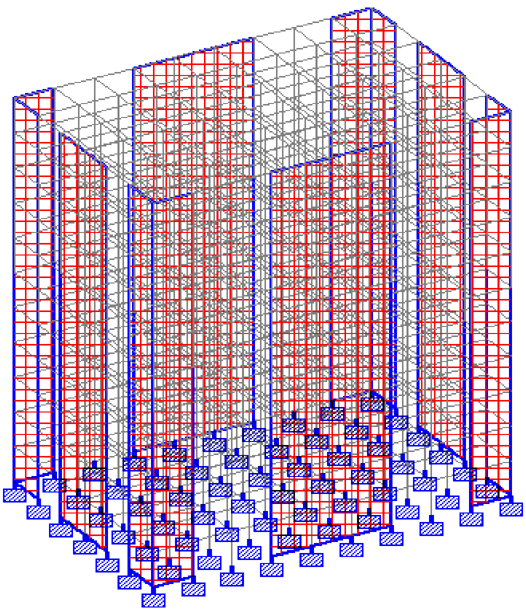


Fig -6: Model-1

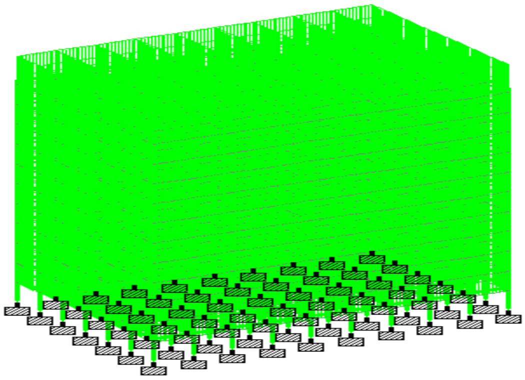


Fig.7 Dead load

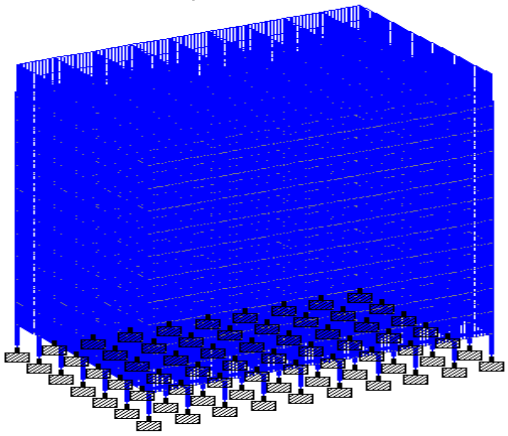


Fig.8 Live load

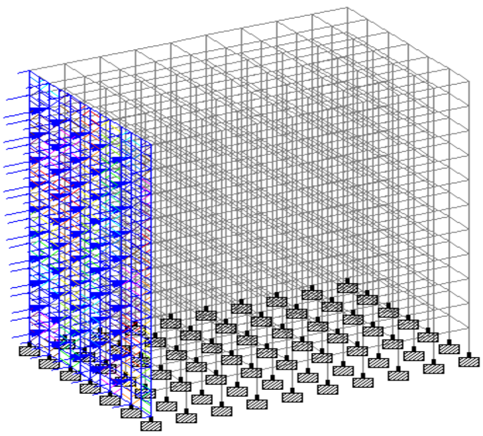


Fig.9 Wind load

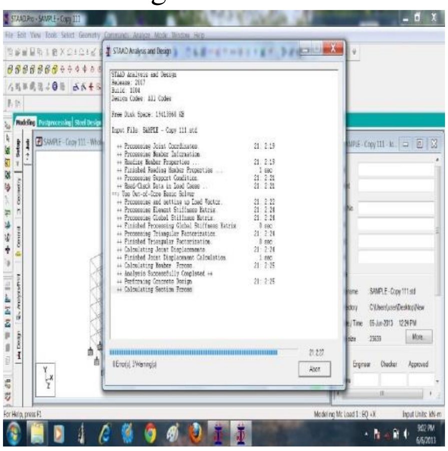


Fig.10 Run analysis

3. METHODOLOGY

It demands to select the exact process to analyse a certain structural frame considering its corresponding characteristics related to seismic as earthquake analysis was very difficult portion in the field in structural engineering.

1. Static analysis
2. Dynamic analysis

1. Static Analysis:

It is known as equivalent static forced method. In this method, the base shear calculated from the weight of building. Wind forces are calculated in the normalized way in this method. Live loads and dead loads are considered according to the norms and distributed along in each storey.

2. Dynamic analysis:

It is related to the inertia forces developed by a structure when it is excited by means of dynamic loads applied suddenly like wind blasts, explosion, earthquake etc. now dynamic loads are always applied as a function of time or frequency and these time of frequency varying load application induces time or frequency response.

- Regular Building:

A structure that has regular in plan. Regular building perform much better than those which have irregularity in plan.

- Irregular Building:

A structure that has difference between center of mass and centre of resistance. That the buildings which are irregular in plan under seismic loading.

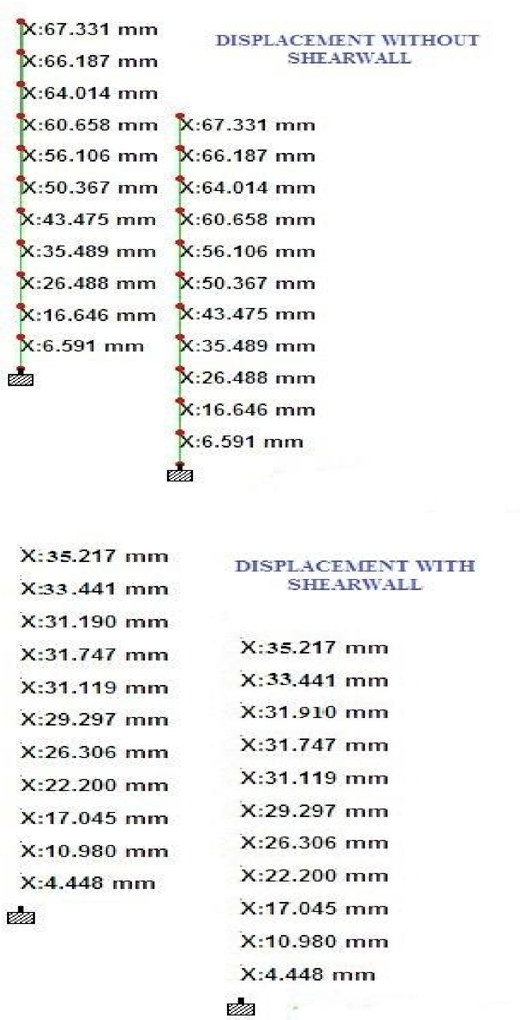
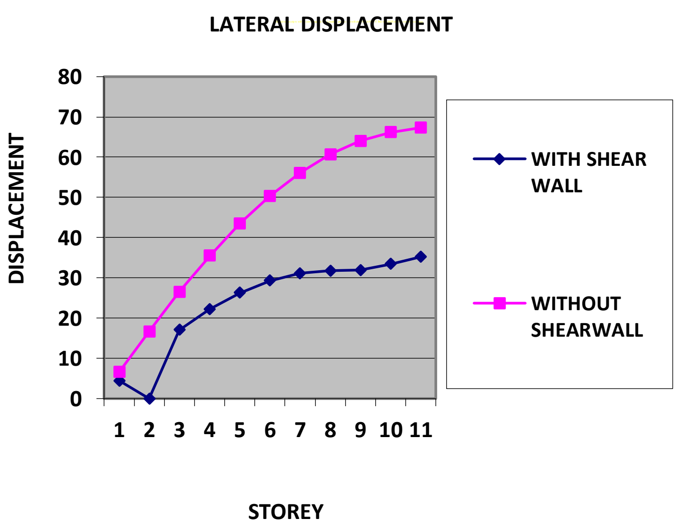


Fig.11 Lateral Displacement of with and without shear wall In X-direction

4. RESULT:

Table - 1: Comparison of lateral displacement along X-direction in frame system with and without shear wall location

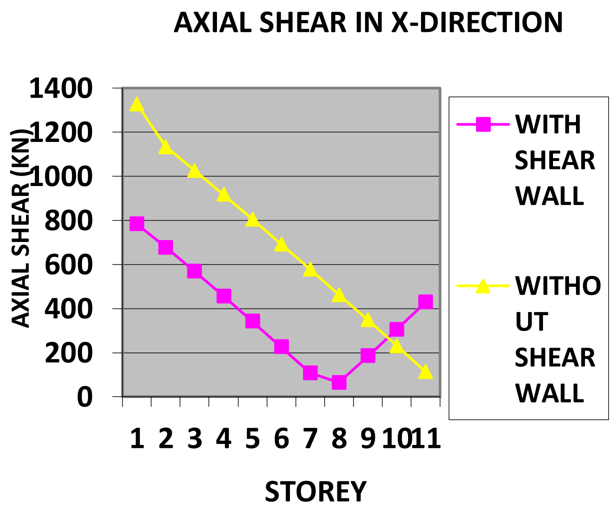
Storey No.	Lateral Displacement in X-direction (mm)	
	Without Shearwall	With Shearwall
11	67.331	35.217
10	66.187	33.441
9	64.014	31.910
8	60.658	31.747
7	56.106	31.119
6	50.367	29.297
5	43.475	26.306
4	35.489	22.200
3	26.488	17.045
2	16.646	10.980
1	6.591	4.448



Graph– 1: Comparison of lateral displacement along X-direction in frame system with and without shear wall location

Table - 2: Comparison of axial shear along X-direction in frame system with and without shearwall location

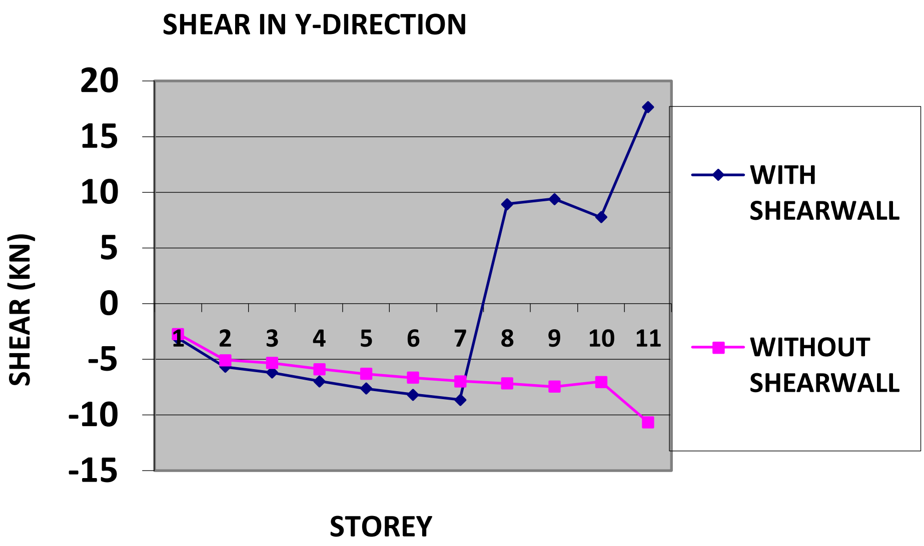
Storey No.	Axial Shear in X-direction (KN)	
	Without Shearwall	With Shearwall
11	112.62	429.30
10	230.32	305.68
9	346.83	184.66
8	462.80	63.94
7	577.91	107.46
6	691.96	225.67
5	804.72	342.09
4	915.93	456.35
3	1025.31	568.12
2	1132.61	677.09
1	1327.16	782.54



Graph – 2: Comparison of axial shear along X-direction in frame system with and without shear wall location

Table - 3: Comparison of shear along Y-direction in frame system with and without shearwall location

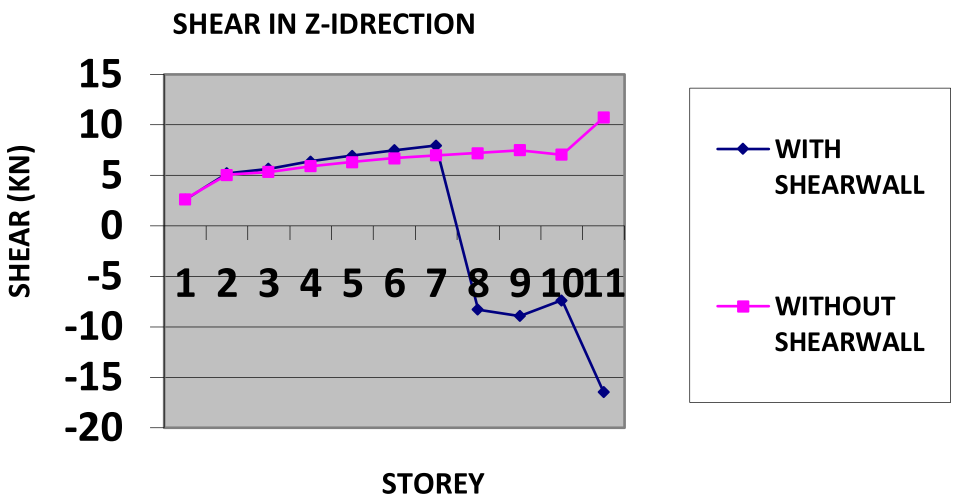
Storey No.	Shear in Y-direction (KN)	
	Without Shearwall	With Shearwall
11	-10.64	17.68
10	-7.02	7.78
9	-7.46	9.41
8	-7.18	8.94
7	-6.96	-8.63
6	-6.66	-8.17
5	-6.30	-7.62
4	-5.88	-6.98
3	-5.33	-6.19
2	-5.07	-5.67
1	-2.71	-3.12



Graph – 3: Comparison of shear along Y-direction in frame system with and without shearwall location

Table - 4: Comparison of shear along Z-direction in frame system with and without shear wall location

Storey No.	Shear in Z-direction (KN)	
	Without Shearwall	With Shearwall
11	10.72	-16.48
10	7.04	-7.37
9	7.51	-8.91
8	7.22	-8.29
7	6.99	7.96
6	6.69	7.49
5	6.32	6.97
4	5.90	6.38
3	5.34	5.65
2	5.07	5.21
1	2.66	2.62



Graph – 4: Comparison of shear along Z-direction in frame system with and without shearwall location

Table – 5: Comparison of Moment along Y-direction in frame system with and without shearwall location

Storey No.	Moment in Y-direction (KN-m)	
	Without Shearwall	With Shearwall
11	-13.43	-30.24
10	-11	-9.83
9	-11.15	-13.68
8	-10.79	-12.51
7	-10.42	-11.81
6	-9.94	-11.10
5	-9.37	-10.29
4	-8.73	-9.40
3	-7.62	-8.23
2	-7.67	-7.81
1	-2.63	-2.37

Graph – 5: Comparison of Moment along Y-direction in frame system with and without shearwall location

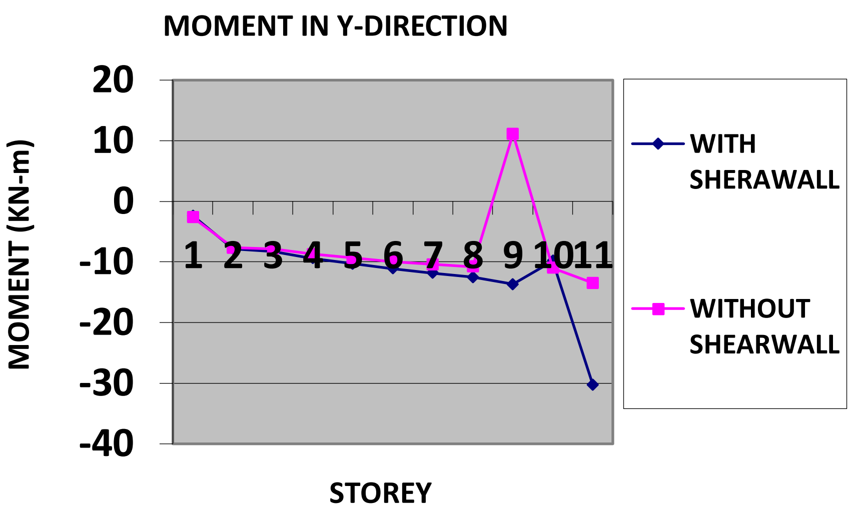


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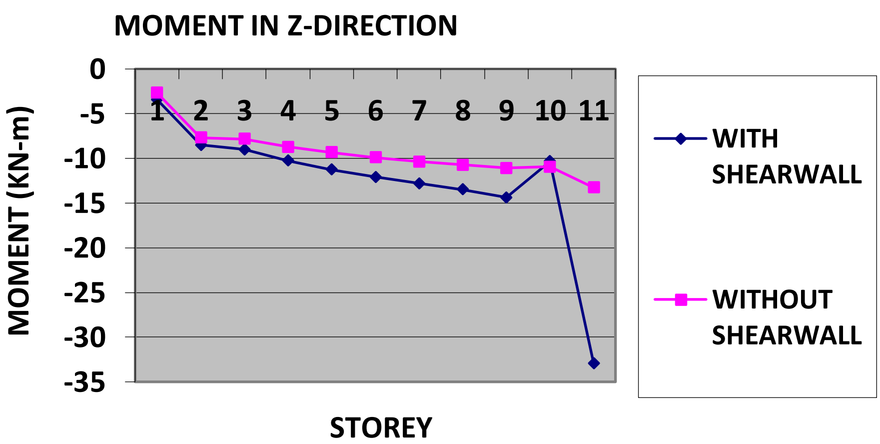
Table - 6: Comparison of axial shear along Z-direction in frame system with and without shearwall location

Storey No.	Moment in Z-direction (KN-m)	
	Without Shearwall	With Shearwall
11	-13.27	-32.93
10	-10.94	-10.32
9	-11.08	-14.38
8	-10.72	-13.48
7	-10.36	-12.81
6	-9.90	-12.10
5	-9.34	-11.25
4	-8.71	-10.28
3	-7.82	-9.02
2	-7.68	-8.51
1	-2.67	-3.42



Graph – 6: Comparison of Moment along Z-direction in frame system with and without shearwall location

5. CONCLUSIONS

Thus shear walls are one of the most effective building elements in resisting lateral forces during high wind. By constructing shear walls damages due to effect of lateral forces due to high winds can be minimized. Shear walls construction will provide larger stiffness to the buildings there by reducing the damage to structure and its contents.

Not only has its strength, in order to accommodate huge number of population in a small area tall structured with shear walls are considered to be most useful.

Hence for a developing nation like India shear wall construction is considered to be a back bone for construction industry.

- It is evident from the observing result that the shear wall are making value of torsion very low.
- The moment is maximum when the shear force is minimum or changes sign.
- For the columns located away from the shear walls the torsion is high when compared with the column connected to shear wall.
- For the columns located away from the shear wall the bending moment is high and shear force is less when compared with the column connected to the shear wall.

The vertical reinforcement that is uniformly distributed in the shear wall shall not be less than the horizontal reinforcement. This provision is particularly for square walls (i.e. Height-to-width ratio is about 1.0) However, for walls with height to width ratio less than 1.0, a major part of the shear force is resisted by the vertical reinforcement. Hence, adequate vertical reinforcement should be provided for such walls.

1. Designing using software like Staad reduces lot of time in design work.
2. Details of each and every member can be obtained using STAAD Pro.
3. All the list of failed beams can be obtained and also Better Section is given by the software.
4. Accuracy is improved by using software.

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