A COMPARATIVE STUDY ON EFFECT OF VERTICAL AND LATERAL LOADS UNDER DYNAMIC ANALYSIS FOR SHEAR WALLS OF AN R.C.C. STRUCTURE USING STAAD AND ETABS SOFTWARE

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ABSTRACT: Shear wall systems are one of the most commonly used lateral-load resisting systems in the 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. Shear wall, in building construction, a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsional) forces. These forces can literally tear (shear) a building apart. Reinforcing a frame by attaching or placing a rigid wall inside it maintains the shape of the frame and prevents rotation at the joints. Shear walls are especially important in high-rise buildings subject to lateral wind and seismic forces. Presently days, multi-story structures are designed in staad pro and etabs which are most important design software for structure designer. In this study, the seismic response of the structures is investigated by using response spectrum analysis for G+10 Storey by using STAAD. Pro and ETABS designing software.

1. INTRODUCTION

Reinforced concrete framed buildings are adequate for resisting both vertical and horizontal loads acting on them. 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 and for short walls where the shear deformation is more it resists the loads due to Truss Action. These walls are more important in seismically active zones because during earthquakes shear forces on the structure increases. Shear walls should have more strength and stiffness. When a building has a story without shear walls, or with poorly placed shear walls, it is known as a soft story building. Shear walls provide adequate strength and stiffness to control lateral displacements. Concrete Shear wall buildings are usually regular in plan and in elevation. Shear wall buildings are commonly used for residential purposes and can house from 100 to 500 persons per building. Horizontal and vertical distributed reinforcement (ratio 0.25%) is required for all shear walls.

The function of lateral load resisting systems or structure form is to absorb the energy induced by these lateral forces by moving or deforming without collapse. The determination of structural form of a tall building or high rise building would perfectly involve only the arrangement of the major structural elements to resist most efficiently the various combinations of lateral loads and gravity loads. The taller and more the slender a structure, the more important the structural factors become and the more necessary it is to choose an appropriate structural form or the lateral loading system for the building. In high rise buildings which are designed for a similar purpose and of the same height and material, the efficiency of the structures can be compared by their weight per unit floor area.

1.1 Functions of shear wall

Shear walls must provide the necessary lateral strength to resist horizontal earthquake forces. When shear walls are strong enough, they will transfer these horizontal forces to the next element in the load path below them.

- Shear walls also provide lateral stiffness to prevent the roof or floor above from excessive side sway.
- When shear walls are stiff enough, they will prevent floor and roof framing members from moving off their supports. Also, buildings that are sufficiently stiff will usually suffer less non-structural damage.
- Shear walls provide large strength and stiffness to buildings in the direction of their orientation, which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents. Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large.

2. LITERATURE REVIEW

Kevadkar and Kodag (2013) are investigated the concept of using steel bracing is one of the advantageous concepts which can be used to strengthen structure. Shear wall and steel bracing increases the level of safety since the demand curve intersect near the elastic domain. Capacity of the steel braced structure is more as compare to the shear wall structure. Steel bracing has more margin of safety against collapse as compare with shear wall.

Agrawal and Charkha (2012) are investigation reveals that the significant effects on deflection in orthogonal direction by the shifting the shear wall location. Placing Shear wall away from centre of gravity resulted in increase in most of the members forces.

Abhijeet Baikerikar et al., 2014 has presented a study on Lateral load resisting systems of variable heights in all soil types of high seismic zones and the analysis is done by comparing the bare frame and different locations of shear wall. From results it is observed that as the building height increases Lateral displacements and drift increases. Compared to all other cases Bare Frame produces larger lateral displacements and drifts. Lateral displacements and drift is significantly lower after inserting shear wall in the bare frame. One of the important conclusions that can be made from the above study soil changes from hard there is massive increase in base shear, lateral displacements and lateral drifts are less compared to soft soil condition.

3. METHODOLOGY

A G+10-story building with 3.0 meters height for every story is chosen for the analysis. These structures were composed in understanding with the Indian Code. The buildings were assumed to be fixed at the base and the floors acts as rigid diaphragms. The areas of structural components are square and rectangular and their measurements are steady for the models. The buildings were modeled using the software Staad pro and Etabs software's. Models were constructed with diverse introduction of shear walls in a building. Models were studied in zone III, comparing parameters such as base shear, lateral displacement, story drift and beam moments for all models.

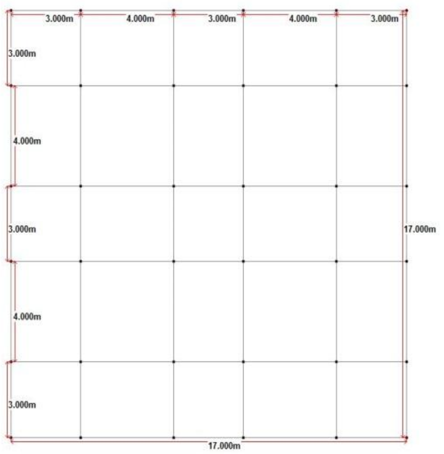

Figure 1. Staad pro model plan

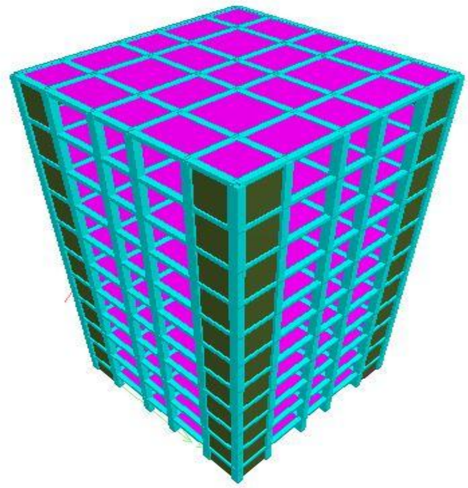

Figure 2. Staad pro 3D model

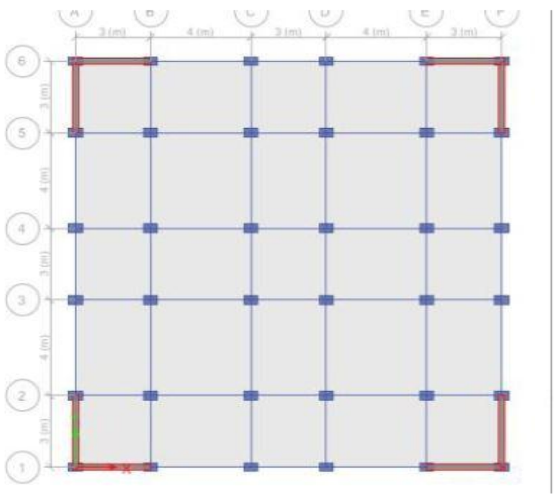

Figure 3. Etabs model plan

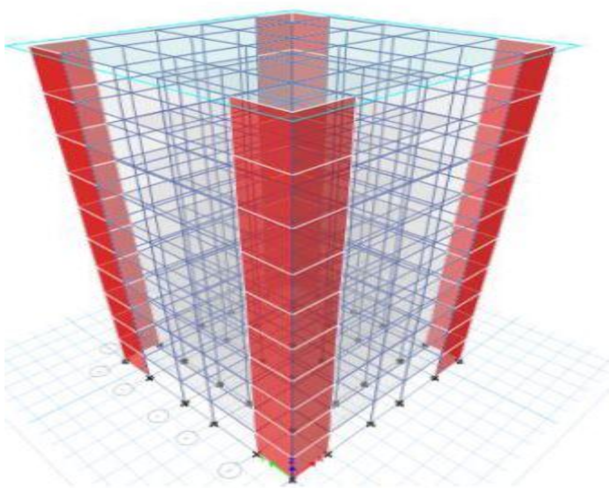

Figure 4. Etabs 3D model plan

3.1 Preliminary Data

Type of frame: Ordinary RC moment resisting frame fixed at the base

- Seismic zone: III
- Number of storeys: G+ 10
- Floor height: 3 m
- Plinth height: 2 m
- Depth of Slab: 150 mm
- Spacing between frames: 4 & 3m alternatively along x directions y direction.
- Live load on floor level: 2 KN/m2
- Live load on roof level: 1.5 KN/m2
- Floor finish: 1.0 KN/m2
- Thickness of outer wall: 230mm (Exterior walls)
- Thickness of inner wall: 115mm (Interior walls)
- Thickness of shear wall : 200mm
- Density of concrete: 25 KN/m2
- Type of soil: Medium
- Response spectrum analysis: As per IS 1893(Part1):2002
- Damping of structure: 5 %
- Support conditions : Fixed
- Grade of concrete M_{30}
- Type of soil : Medium

The analysis can be carried out on the basis of the external action, the behaviour of the structure or structural materials, and the type of structural model selected. Based on the height of the structure and zone to which it belongs to the type of analysis. For Dyanamic analysis Response spectrum method is used in Staad and Etabs software for zone III.

4. RESULTS AND DISCUSSIONS

4.1 Lateral loads along x-direction

Table 1: Lateral loads of staad pro and Etabs Model along Y-direction.

Storey	Staad pro model (mm)	Etabs model(mm)
10	157.30	154.24
9	133.14	131.10
8	109.45	106.28
7	88.07	87.84
6	69.02	63.83
5	53.71	51.56
4	40.0	35.94
3	24.22	21.98
2	16.90	15.82
1	9.02	7.81
Plinth	1.85	1.43
0	0	0

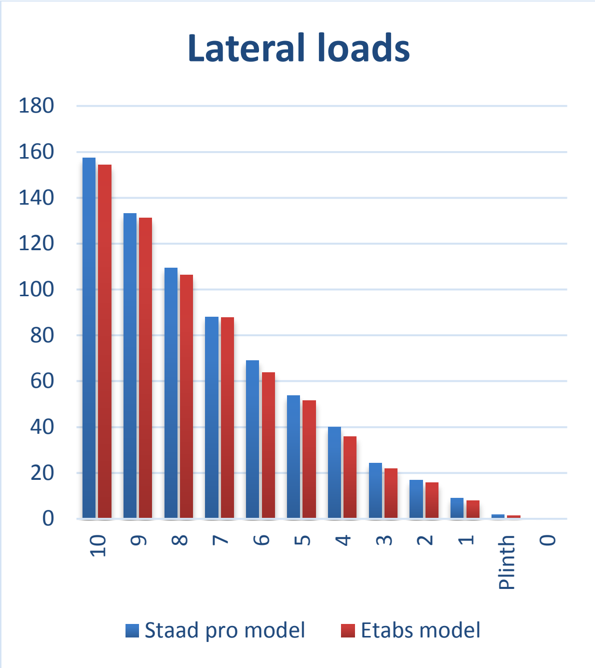

Figure 5.Lateral loads along x-direction

4.2 Storey Displacement

Table 2: Comparison of storey displacement for staad pro and Etabs Model

Storey	Staad pro model (mm)		Etabs model(mm)	
	X-Dir	Y-Dir	X-Dir	Y-Dir
10	148.09	115.86	134.92	111.73
9	130.96	101.20	119.69	99.14
8	113.98	86.93	102.95	82.31
7	97.31	74.19	85.84	71.28
6	81.10	60.11	79.12	57.21
5	65.58	47.89	61.76	43.84
4	51.04	36.74	48.24	34.84
3	37.46	32.58	34.86	29.52
2	25.19	17.66	21.43	13.56
1	14.65	10.20	12.35	9.83
Plinth	5.59	3.68	5.06	3.28
0	0	0	0	0

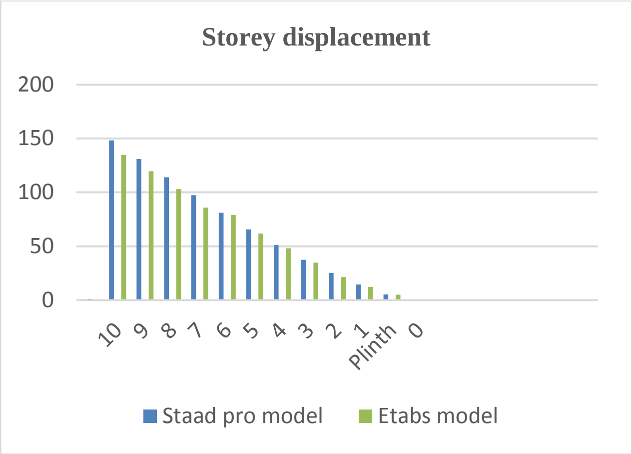

Figure 6.Storey displacement along x-direction

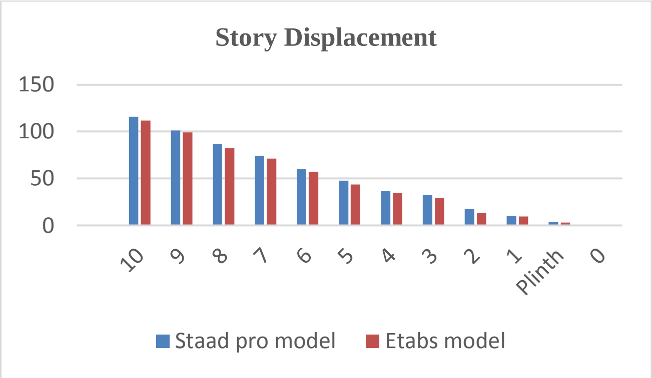

Figure 7.Storey displacement along y-direction

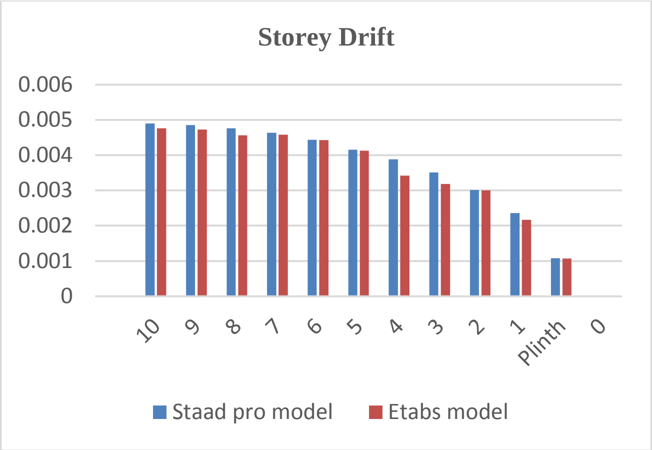

Figure 8. Storey drift along x-direction

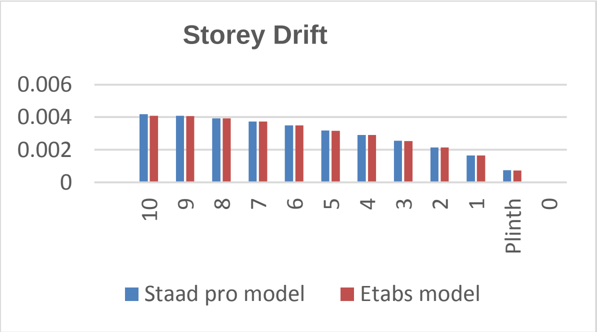

Figure 9. Storey drift along y-direction

4.3 Storey Drift

Table 3: Comparison of Storey Drift for staad pro and Etabs Model.

Storey	Staad pro model (m)		Etabs model(m)	
	X-Dir	Y-Dir	X-Dir	Y-Dir
10	0.004897	0.00419	0.004764	0.004078
9	0.00485	0.004077	0.004721	0.004072
8	0.004764	0.003926	0.004563	0.003919
7	0.004631	0.003736	0.004582	0.003724
6	0.004433	0.003493	0.004422	0.003493
5	0.004154	0.003187	0.004128	0.003168
4	0.00388	0.002901	0.00342	0.002900
3	0.003507	0.002548	0.003186	0.002543
2	0.003011	0.002132	0.003004	0.002131
1	0.00236	0.001652	0.00217	0.001648
Plinth	0.001079	0.000749	0.001068	0.000735
0	0	0	0	0

4.4 storey stiffness

Table 4: Comparison of storey stiffness for staad pro and Etabs Model.

Storey	Staad pro model		Etabs model	
	X-Dir	Y-Dir	X-Dir	Y-Dir
10	779832.28	951180.04	779792.25	951130.02
9	796404.38	991814.36	795412.32	991788.34
8	818604.22	1043844.75	818624.19	1043804.68
7	848765.42	1109749.81	848726.41	1109730.76
6	891211.33	1197560.37	891232.38	1197528.32
5	953457.38	1321130.92	953447.39	1321108.94
4	1025959.53	1466950.93	1025859.52	1466898.92
3	1140450.75	1690646.81	1140448.76	1690618.78
2	1334039.24	2046043.73	1334039.26	2045742.71
1	1721543.63	2694593.56	1721542.53	2694481.36
Plinth	2202708.66	3491010.80	2202702.63	3490898.62
0	0	0	0	0

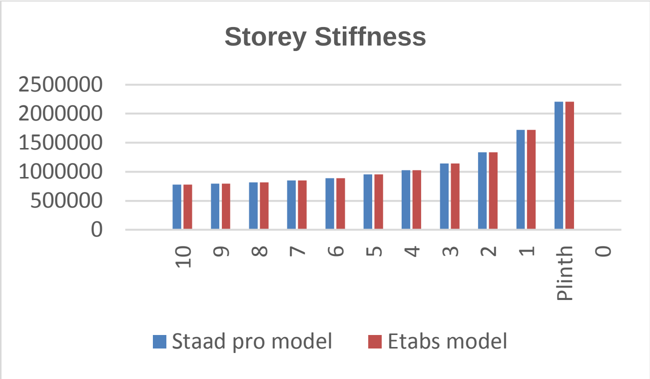

Figure 10. Storey Stiffness along x-direction

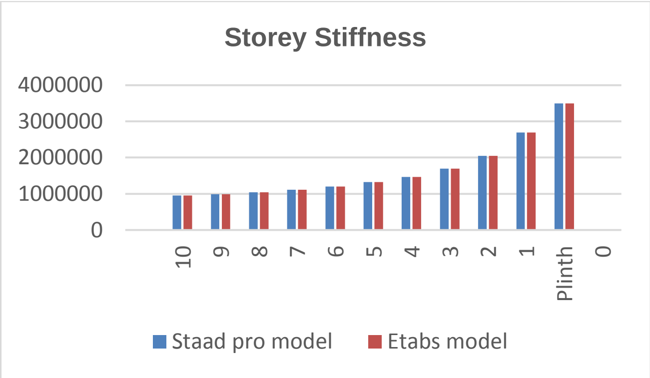

Figure 11.Storey Stiffness along y-direction

4.5 Storey Moment

Table 3: Comparison of Storey Moment for staad pro and Etabs Model.

Storey	Staad pro model (N-mm)		Etabs model (N-mm)	
	X-Dir	Y-Dir	X-Dir	Y-Dir
10	11022009	-11953446	11021862	-11953024
9	11560754	-12537719	11560642	-12536706
8	12099499	-13121992	12099152	-13120961
7	12638244	-13706265	12637149	-13705242
6	13176989	-14290538	13175963	-14290138
5	13714795	-14873792	13714742	-14872742
4	14280650	-15487466	14280524	-15486423
3	14846506	-16101140	14846387	-16101021
2	15412361	-16714814	15412209	-16714598
1	15978216	-17328488	15978072	-17328231
Plinth	16203165	-17572447	16203043	-17572127
0	16384929	-17769570	16384738	-17769446

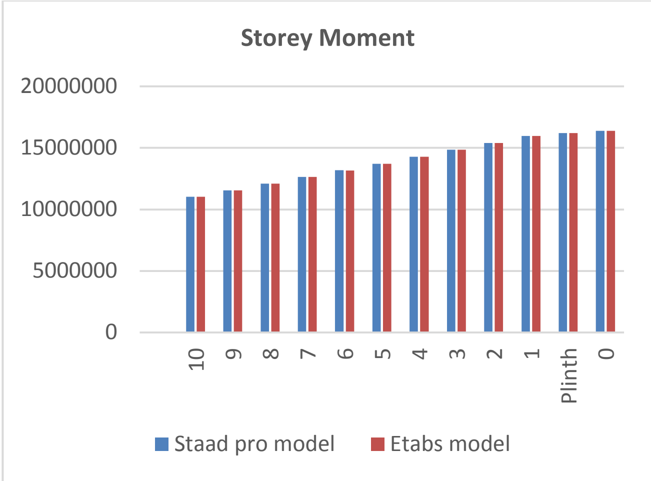

Figure 12. Storey moment along x- direction

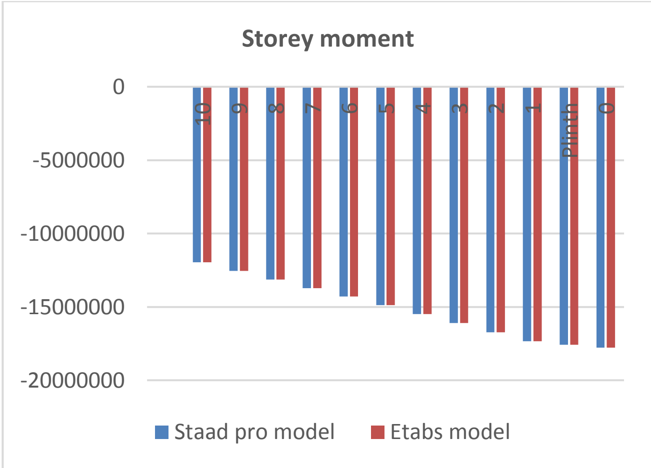

Figure 12. Storey moment along y- direction

5. CONCLUSIONS

The result obtained from the analysis models will be discussed and compared as follows:

- Maximum lateral displacement increases as storey height increases for all models.
- Minimum lateral displacement of the building has been reduce due to the presence of shear wall.
- As per Indian standard, Criteria for earthquake resistant design of structures, IS 1893 (Part 1): 2002, the story drift in any Story due to service load shall not exceed 0.004 times the story height. The height of the each storey is 3.5 m. So, the drift limitation as per IS 1893 (part 1): 2002 is 0.004 X 3 m = 12 mm from Staad pro model we have received 4.8mm storey but where as in Etabs model the value is 4.7mm.so when compare to Staad pro model Etabs gives lesser Storey Drift value at top storey.
- Maximum displacement is seen at top floor of the model along x-direction 148.09mm for staad pro model and for Etabs model it is 134.92 mm.

this shows that staad pro model value is greater than Etabs model.

- Maximum storey stiffness is seen at plinth level along y- direction which is 3491010.80 N-mm for staad pro model and 3490898.62 N-mm.for Etabs is
- Maximum storey moment is seen at plinth level along x- direction which is 16384929 N-mm and 16384738 N-mm for Etabs model at base level.
- Maximum lateral loads are acting at top storey of the model 157.30mm is for staad pro model and 154.24mm for Etabs model.
- From the research work it has been concluded that the results shown by staad pro software is 1-3% more than Etabs Software.

6. REFERENCES

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