ANALYSIS OF RC FRAMED HIGH RISE STRUCTURAL SYSTEM WITH GROUND AND INTERMEDIATE SOFT STOREY CONSIDERING WIND EFFECT

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Abstract: Generally RC framed high rise building structures are designed neglecting the effect of masonary infill walls . Wheras the masonary infill walls are used for partition . The masonary infill walls are treated as non-strucutural elements . RC frame structures having open first storey is known as soft storey

Meanwhile the soft storey located in the upper part of high rise building does not significantly effect the overall performance compared to the performance of the fully infill frame.

The primary purpose of all kinds of structural systems used in building type of structure is to support gravity loads. The most common loads resulting from the effect of gravity are dead load, live load and snow load. Beside this vertical loads building are also subjected to lateral loads caused by wind, earthquake.

Lateral loads can develop high stresses produces sway moment or cause vibration. Therefore, it is very important for the structure to have sufficient strength against vertical loads together with adequate stiffness to resist lateral forces.

Reinforced concrete building structure can be classified are:

1. Structural frame system: The structural system consists of frames, floor slabs, beams and column are the basis elements of structural system.
2. Structural wall system: In this type of structures, all material members are made of structural walls, generally called shear walls.

Key Words: RC framed building, wind analysis of building, Soft storey, shear walls.

1. INTRODUCTION

In every aspect of human civilization, we needed structures to live in or to get what we need. But it is not only building structure. But to build efficient structure so that it can fulfill the main purpose for what it was made for, here comes the role of civil engineering and more precisely the role of analysis of structure. There are many classical methods to solve design problem and with time new software also coming into play. Here in this project work recent from based software named ETABS has been used.

2. DESCRIPTION OF STRUCTURAL MODEL

The present plan is of residential building which consist of (G+24) storey.30.5X28.6m

Plan area = 866.8m^2

Built-up area = 611.8m^2

Total height = 85m.

- There are 8 flat in each storey.
- The ground floor is made for parking with storey height 3m.
- There are no flat at 13thstorey with storey height of 3m.
- Remaining stories of 3.35m height.
- The head room of 2m is provided at the top.

There are 4 different models are analyzed:

Model 1: G+24 with exterior walls at 13thstorey.

Model 2: G+24 with 13thstorey as soft storey.

Model 3: G+24 with shear walls at 13thstorey.

Model 4: G+24 bare model.

Imposed load: The load assumed to be produced by the intended use or occupancy of a building. Including the weight of movable partitions distributed, concentrated loads, load due to impact and vibration, and dust load but excluding wind, seismic, snow and other loads due to temperatu.re changes, creep, shrinkage, differential settlement, etc.

The imposed loads that are envisaged to act permanently shall be calculated based on type of material and thickness using unit weight specified by IS: 875(part 1)-1987.

Internal partition load shall be calculated based on type of material and thickness using weight specified by IS: 875(part 1)-1987. The super imposed load or otherwise live load is assessed based on occupancy classification as per IS: 875(part 2)-1987 (TABLE 3).

1. Live load = 2KN/m
2. Floor finish = 1KN/m
3. Wall load

For 3.35m height wall

Density of brick wall = 18kn/m

3.35x0.23x18 = 13.86KN/m (230mm wall)

3.35x.0.1x18 = 6.03KN/m (100mm wall)

For 3m height wall

3x18x0.23 = 12.42KN/m (230mm wall)

3x18x0.1 = 5.4KN/m (100mm wall)

Wind exposures parameters:

1. Wind direction angle for x-direction=0
2. Wind direction angle for y-direction=90
3. Wind ward coefficient=0.8
4. Leeward coefficient=0.5

Exposures height:

1. Top story=RF
2. Bottom story=base

Wind coefficients:

1. Wind speed (vb)=44m/s
2. Terrain category=3
3. Structure class=C
4. Risk coefficient (k1 factor) =1
5. Topography (k3 factor) =1

3. MODELS FOR ANALYSIS

Model 1:

The model is regular shape 25 storey building with head room of 2m. First storey is ground floor with 3m height.13thstorey is 3m height and remaining storey are of 3.35m height. The lateral force resisting system consist of intercepting moment frames. The floor consist of 125mm of deep concrete and walls are of 230mm and 100mm thickness. Bottom story of 2m provided

Model 2:

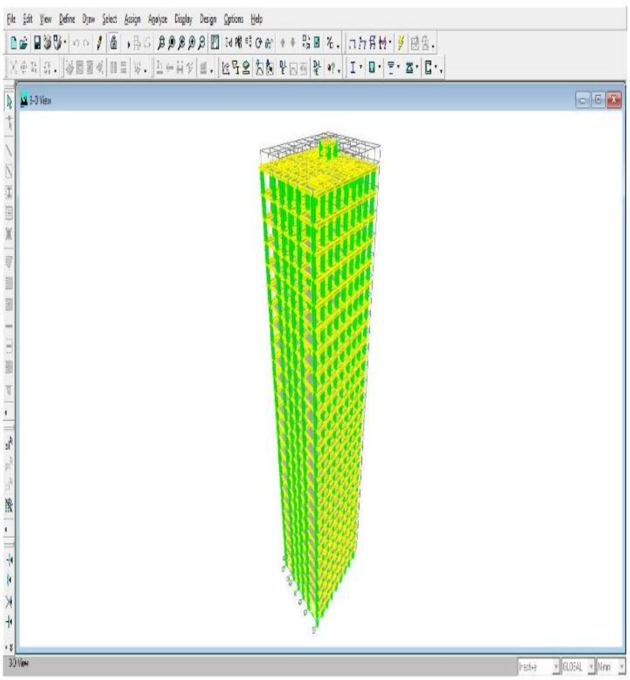
The model is regular shape 25 storey building with head room of 2m. First storey is ground floor with 3m height.13thstorey is soft story with intermediate 3m height and remaining storey are of 3.35m height. The lateral force resisting system consists of intercepting moment frames. The floor consists of 125mm of deep concrete and walls are of 230mm and 100mm thickness. Bottom story of 2m provided

Model 3:

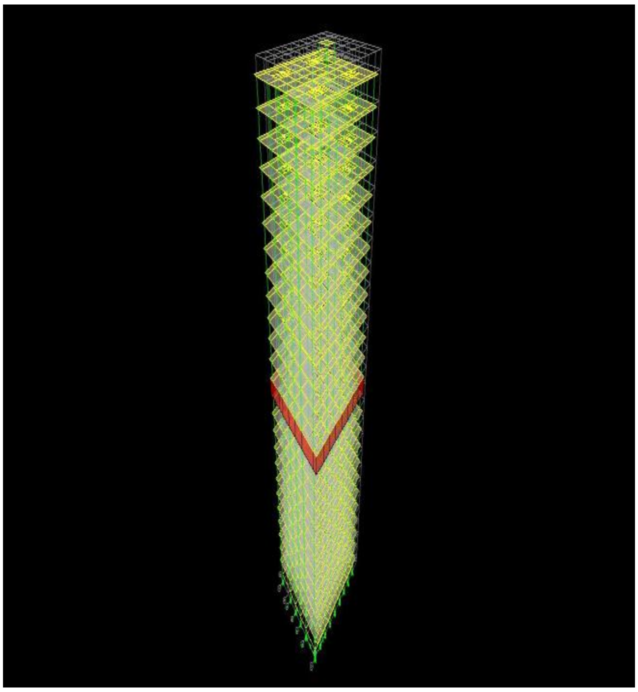
The model is regular shape 25 storey building with head room of 2m. First storey is ground floor with 3m height.13thstorey is made up of shear walls of thickness 230mm 3m height and remaining storey are of 3.35m height. The lateral force resisting system consists of intercepting moment frames. The floor consists of 125mm of deep concrete and walls are of 230mm and 100mm thickness. Bottom story of 2m provide.

Model 4:

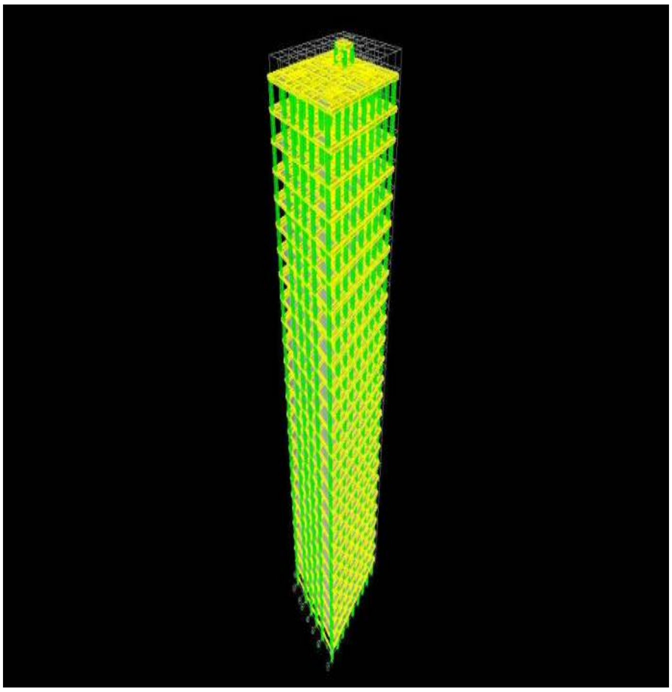
The model is skeleton model with regular shape 25 storey building with head room of 2m. First storey is ground floor with 3m height.13thstorey is3m height and remaining storey are of 3.35m height. The lateral force resisting system consists of intercepting moment frames. The floor consists of 125mm of deep concrete.



3D View of building model 1



3D View of building model 3



4. RESULTS AND DISCUSSIONS

To study the effect of drift and displacement total of four models are analysed for forces generated by wind.

4.1 Storey Displacement.

Displacement-x				
story	model1	model2	model3	model4
1	3.608	3.614	3.61	3.614
2	7.761	7.744	7.765	7.774
3	12.158	12.177	12.158	12.177
4	16.546	16.572	16.54	16.572
5	20.846	20.878	20.83	20.878
6	25.027	25.654	24.997	25.065
7	29.071	29.115	29.022	29.115
8	32.968	33.017	32.891	33.071
9	36.707	36.764	36.579	36.761
10	40.277	40.336	40.032	40.336
11	43.665	43.728	43.072	43.728
12	46.834	46.902	45.082	46.902
13	49.423	49.495	45.404	49.495
14	52.235	52.31	47.117	52.31
15	54.898	54.97	49.419	54.97
16	57.359	57.44	51.756	57.44
17	59.624	59.709	53.95	59.709
18	61.268	61.77	55.967	61.77
19	63.529	63.619	57.773	63.619
20	65.162	65.254	59.367	65.254
21	66.577	66.671	60.744	66.671
22	67.772	67.868	61.902	67.668
23	68.75	68.846	62.842	68.846
24	69.517	69.614	63.57	69.614
25	70.111	70.209	64.128	70.209

Table 5: comparision of values of displacements in x-direction .

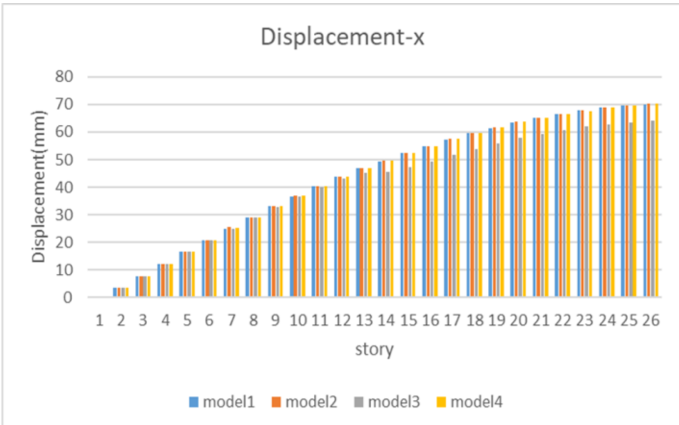


Fig 5: Displacements v/s model in x-direction.

1. From table no 7 ,it is observed that the displacement is maximum at roof level in which the displacement is maximum for model 2 & minimum for model 3.
2. For 13th storey the maximum displacement is for model 2 & 4, but in model 3 displacement get reduced to 9% due to shear wall.

Displacement-Y				
Story	model 1	model 2	model 3	model 4
1	3.411	3.411	3.396	3.411
2	8.059	8.059	8.016	8.059
3	13.582	13.582	13.495	13.582
4	19.518	19.518	19.365	19.518
5	25.597	25.597	25.348	25.597
6	31.663	31.663	31.271	31.663
7	37.621	37.621	37.061	37.621
8	43.411	43.411	42.47	43.411
9	48.992	48.992	47.508	48.992
10	54.334	54.334	51.943	54.334
11	59.412	59.412	55.47	59.412
12	64.196	64.196	57.558	64.196
13	68.208	68.208	58.199	68.208
14	72.462	72.462	59.807	72.462
15	76.453	76.456	62.266	76.453
16	80.162	80.162	65.062	80.162
17	83.574	83.574	67.909	83.574
18	86.68	86.68	70.646	86.68
19	89.476	89.476	73.183	89.476
20	91.957	91.957	75.469	91.957
21	94.127	94.127	77.479	94.127
22	95.991	95.911	79.205	95.991
23	97.569	97.56	80.655	97.569
24	98.873	98.893	81.86	98.893
25	100.03	100.03	82.88	100.03

Table 5: comparision of values of displacements in x-direction.

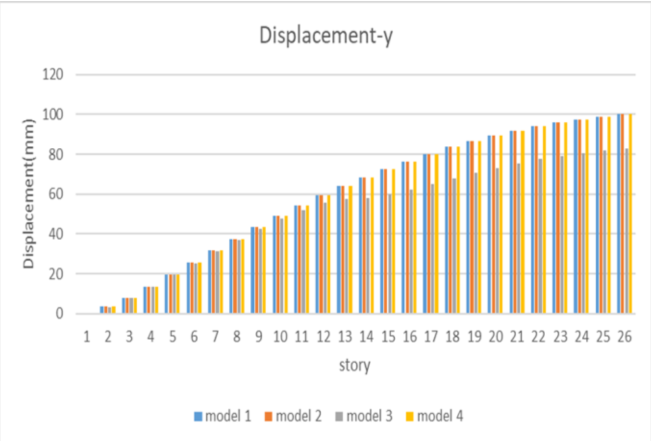


Fig 5: Displacements v/s model in y-direction.

1.From table no 8 ,it is observed that the displacement is maximum at roof level in which the displacement is maximum for model 2 & minimum for model 3.

2.For 13th storey the maximum displacement is for model 2 & 4, but in model 3 displacement get reduced to 9% due to shear wall.

4.2 Storey Drift.

DRIFT X				
Storey	MODEL 1	MODEL 2	MODEL 3	MODEL 4
1	0.000951	0.00095	0.00095	0.000951
2	0.00124	0.00124	0.00124	0.00124
3	0.00131	0.00134	0.00124	0.00131
4	0.00131	0.00131	0.00131	0.00131
5	0.00128	0.00129	0.00131	0.00129
6	0.00125	0.00125	0.00124	0.00125
7	0.00121	0.00121	0.0012	0.00121
8	0.00116	0.00117	0.00116	0.00117
9	0.00116	0.00112	0.0011	0.00112
10	0.00107	0.00107	0.00103	0.00107
11	0.00101	0.00101	0.00091	0.00101
12	0.00095	0.00095	0.0006	0.00095
13	0.00086	0.00086	0.00013	0.00086
14	0.00084	0.00084	0.00049	0.00084
15	0.00079	0.00079	0.00069	0.00079
16	0.00074	0.00074	0.0007	0.00074
17	0.00068	0.00068	0.00066	0.00068
18	0.00061	0.00062	0.0006	0.00062
19	0.00055	0.00055	0.00054	0.00055
20	0.00049	0.00049	0.00048	0.00049
21	0.00042	0.00042	0.00041	0.00042
22	0.00035	0.00036	0.00035	0.00036
23	0.00029	0.00029	0.00028	0.00029
24	0.00023	0.00023	0.00028	0.00023
25	0.00018	0.00018	0.00017	0.00018

Table 7: Comparision of values of Drift along X-direction .

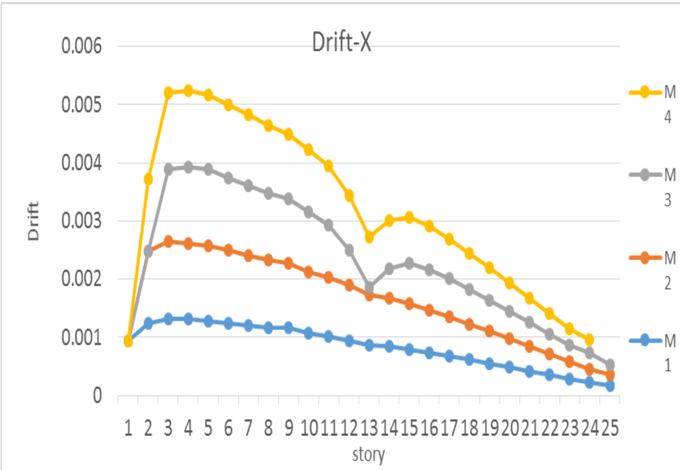


Fig 7: Drift values v/s models along X-direction

1. From table no 9 ,it is observed that the drift is maximum at 3rd storey in which the driftt is maximum for model 2 & minimum for model 3.

2. For 13th storey the maximum drift is for model 2 & 4, but in model 3 drift get reduced to 84% due to shear wall.

3. Due to shear wall there is sudden reduction in the drift.

DRIFT Y				
STOREY	MODEL 1	MODEL 2	MODEL 3	MODEL 4
1	0.00139	0.00139	0.00138	0.00139
2	0.00165	0.00165	0.00164	0.00165
3	0.00177	0.00177	0.00175	0.00177
4	0.00182	0.00182	0.00179	0.00182
5	0.00181	0.00181	0.00177	0.00181
6	0.00178	0.00178	0.00172	0.00178
7	0.00173	0.00173	0.00163	0.00173
8	0.00167	0.00167	0.0015	0.00167
9	0.0016	0.0016	0.00132	0.0016
10	0.00151	0.00152	0.00105	0.00152
11	0.00143	0.00143	0.00062	0.00143
12	0.00134	0.00134	0.00021	0.00134
13	0.00127	0.00127	0.00048	0.00127
14	0.00119	0.00119	0.00073	0.00119
15	0.00111	0.00111	0.00084	0.00111
16	0.00102	0.00102	0.00085	0.00102
17	0.00093	0.00093	0.00082	0.00093
18	0.00083	0.00083	0.00076	0.00083
19	0.00074	0.00075	0.00068	0.00074
20	0.00065	0.00065	0.0006	0.00065
21	0.00056	0.00056	0.00052	0.00056
22	0.00047	0.00047	0.00043	0.00047
23	0.0004	0.0004	0.00036	0.0004
24	0.00034	0.00034	0.0003	0.00034

Table 7: Comparision of values of Drift along y-direction .

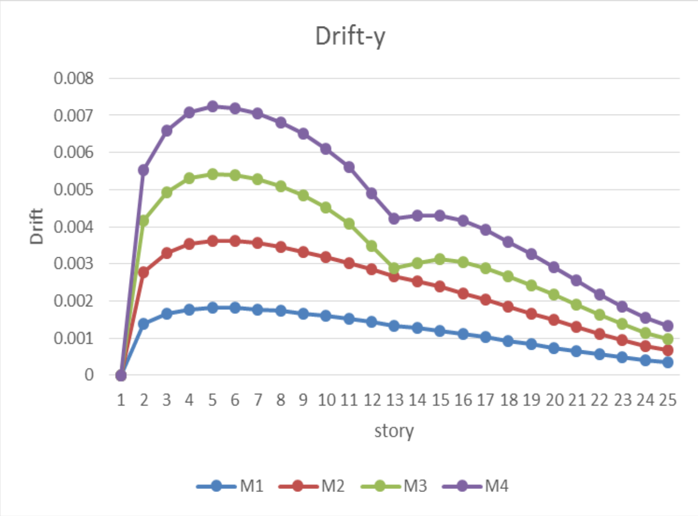


Fig 7: Drift values v/s models along y-direction

1. From table no 10 ,it is observed that the drift is maximum at 3rd storey in which the driftt is maximum for model 2 & minimum for model 3.

2. For 13th storey the maximum drift is for model 2 & 4, but in model 3 drift get reduced to 84% due to shear wall.

3. Due to shear wall there is sudden reduction in the drift.

CONCLUSIONS:

1. Displacement slightly decreases when concrete shear wall is considered.
2. Storey drifts are found within permissible limit as specified by IS 875 PART 3 1987.
3. The drift in X- direction is slightly increases and then goes on decreasing for model 1&2.
4. Drift in model 3 is decreasing at 13 storey and then slightly increasing due to shear wall.
5. Drift in model 3 is lesser compared to other models.
6. A service storey of lesser height can be safer at higher altitude in tall buildings as long as it is properly managed.
7. If brick wall is replaced by shear wall the maximum bending moment will get reduced to more than 50%.
8. If brick wall replaced by shear wall the maximum shear force will get reduced to more than 50%.
9. Shear wall will provide higher rigidity than normal brick wall.
10. By reducing height of storey stiffness will get reduced.

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