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RCC Building Design Using Shear Wall & Difference

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Abstract— Shear wall is a structural element which is provided for resisting horizontal forces (like wind force, earthquakeforce, etc) parallel to the plane of the wall and for supporting gravity loads simultaneously. These are basically flexural members which are generally provided in high rise buildings to avoid the total collapse of the building exposed to seismic forces. For seismic design of buildings, RC structural walls or shear walls are major earthquake resisting members which offer lateral load resistance by providing an efficient bracing system.

The response of the buildings is dominated by the properties of seismic shear walls and so it becomes important to evaluate the seismic response of the shear walls appropriately. In this study, the effect of presence of shear walls in RCC and composite structures in being analysed on basis of storey displacement, storey drift, stiffness, lateral force and base shear for G+19 buildings.. The earthquake load is applied to a building in zone IV and the analysis is done using both static analysis method and response spectrum analysis method.

Indexed Terms-- ETAB 2017, RCC buildings,, Seismic analysis, Shear wall.

I. INTRODUCTION

In recent time, a lot of effort is given to develop the structural control devices so that seismic impact in buildings can be reduced. One such practice is introduction of shear wall in the buildings. Shear walls are one of the best means to provide earthquake resistance in multi- storied building**.** Behaviour of building under earthquake load depends on how the weight, stiffness and strength are distributed in the horizontal and lateral direction. Shearwalls are used in the building to reduce the effect of earthquake by improving the seismic response of buildings. It becomes important to ensure adequate lateral stiffness to resist lateral load. For high- rise buildings, beam and column sizes are very heavy and requirement of steel is large because of which there is a lot of congestion at the joints and making it difficult to vibrate concrete at thejoints and also the displacement is quite heavy.

In India most of the buildings are low rise. So, RCC members are used widely as it is easy to construct and is economical. However with the growth of population there is increasing growth in high-rise buildings in metropolis. It is observed that the use of composite members over RCC members is much more effective and economical in high rise buildings. When a steel component like I-beam is attached to a concrete component like floor slab or bridge deck, a composite member is formed. In composite structures the high strength of the concrete in compression and high strength of the steel in tension are utilized in combination. Thus steel- concrete composite construction makes use of compressive strength of concreteand tensile strength of steel together to give more economical and effective structure. Such an advanced system is gaining recognition in high rise buildings.

In this paper effectiveness of shear wall in RCC building and building with composite columns have been studied with the help of four different models using Etabs in zone IV . The analysis is done by response spectrum analysis method and static analysis method. The models considered for the analysis are as follows:

Model 1 is RCC building without shear wall,Model 2 is RCC building with shear wall,

II. BUILDING MODELING

For the analysis 20 storey building has been considered having a height of 3m for each story including the ground storey. The structure modelled in symmetrical about both the axis. The modelling has been done in accordance to IS 456 and IS 1893 .The buildings has the fixed support at the base. The buildings are modelled using software ETAB for zone IV. Centre to centre distance between the two consecutive columns are 4m, the columns provided is square as they resist earthquake loading better. The study iscarried out for the same building plan with and without shear wall for both RCC columns and composite columns by making four different models. Equivalent static method and response spectrum method have been used for the analysis and analysis has been done considering the parameters like storey displacement, storey drift, stiffness , lateral force and base shear

Table 1: Building description

Building storey	G+19
Total height of building	60 m
Height of each storey	3.0 m
Beam size	350mm x700mm
Column size	600 mm X 600 mm
Shear wall thickness	250 mm
Slab thickness	225 mm
Thickness of external walls	230m
Thickness of internal walls	115
Live load	3 KN/m^2
Floor finish	2 KN/m^2
Grade of Concrete	M30
Grade of reinforcing Steel	HYSD 415
Grade of Steel	Fe250
Density of Concrete	25 KN/m3
Zone	IV
Importance factor	1.2
Soil condition	Medium soil
Response reduction factor	5.0
Damping ratio	5%

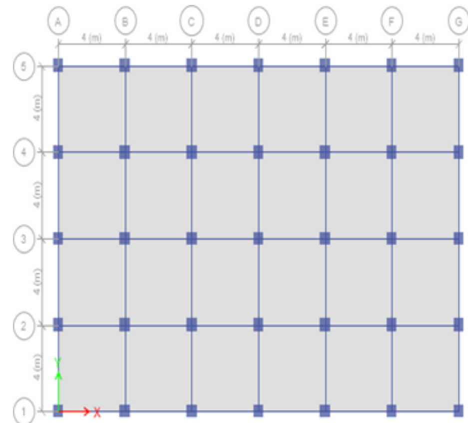

Fig 1: Plan view of building without shear wall

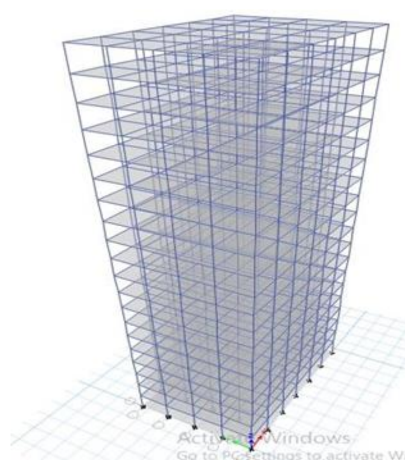

Fig 2: Elevation view of building without shear wall

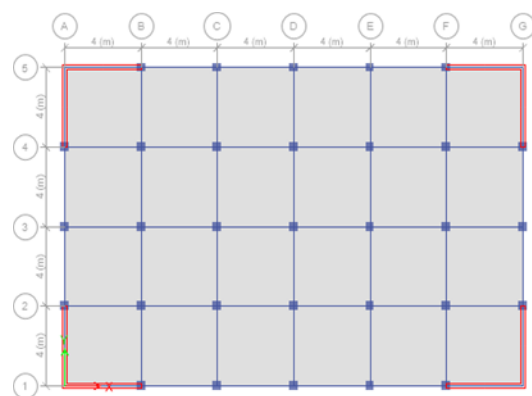

Fig 3: Plan view of building with shear

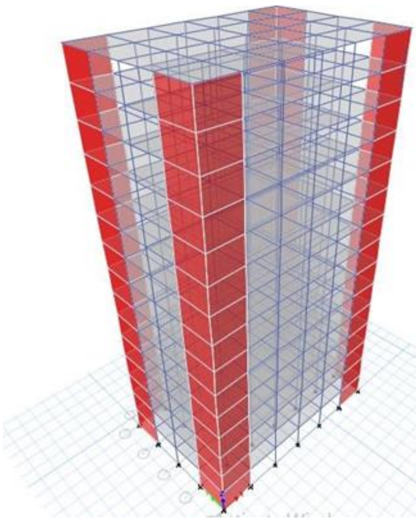

Fig 4: Elevation view of building with shear wall

III. RESULTS AND DISCUSSIONS

Equivalent static method and response spectrum method is used to analyse the results of all four models. Loads are calculated and distributed as per IS 1893:2016 and results obtained is compared as per following parameters.

3.1 STATIC ANALYSIS OF G+19 BUILDINGS

1. Lateral Displacement- From the observed results it was found that building with composite column in presence of shear wall showed minimum displacement. Also it is observed that the building on introduction of shear wall reduced displacement in the building substantially.

Table 2: Storey displacement

STOREY	RCC (mm)	RCC WITH SHEAR WALL (mm)	COMPOSITE (mm)	COMPOSITE WITH SHEAR WALL (mm)
1	6.562	1.427	4.123	1.154
2	17.534	4.305	12.168	3.458
3	29.419	8.29	21.505	6.599
4	41.539	13.165	31.266	10.43
5	53.728	18.744	41.146	14.814
6	65.909	24.868	51.019	19.637
7	78.016	31.398	60.809	24.794
8	89.979	38.211	70.457	30.192
9	101.723	45.199	79.902	35.748
10	113.168	52.261	89.078	41.386
11	124.227	59.311	97.917	47.037
12	134.808	66.271	106.344	52.638
13	144.813	73.071	114.28	58.137
14	154.139	79.655	121.64	63.486
15	162.678	85.977	128.336	68.647
16	170.318	92.002	134.274	73.591
17	176.943	97.714	139.363	78.302
18	182.435	103.115	143.517	82.774
19	186.693	108.234	146.69	87.029
20	189.744	113.06	148.965	91.014

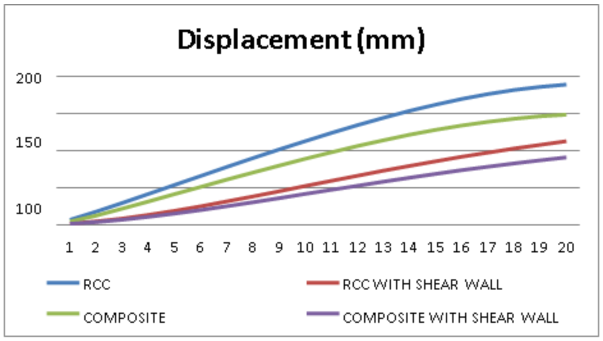

Fig 5: Comparison of storey displacement

2. Storey Drift-Decrease in storey drift was observed in presence of shear wall in both building with RCC column as well asbuilding with Composite column. Maximum drift was observed in RCC building without shear wall.

Table 3: Storey drift

STOREY	RCC (mm)	RCC WITH SHEAR WALL (mm)	COMPOSITE (mm)	COMPOSITE WITH SHEAR WALL (mm)
1	6.562	1.427	4.123	1.154
2	10.972	2.879	8.045	2.304
3	11.885	3.985	9.337	3.141
4	12.12	4.875	9.761	3.83
5	12.189	5.579	9.88	4.385
6	12.181	6.124	9.872	4.823
7	12.107	6.53	9.791	5.157
8	11.963	6.814	9.648	5.398
9	11.744	6.987	9.444	5.556
10	11.445	7.063	9.176	5.638
11	11.059	7.05	8.839	5.651
12	10.581	6.959	8.427	5.602
13	10.005	6.801	7.936	5.499
14	9.326	6.584	7.36	5.349
15	8.539	6.321	6.696	5.161
16	7.64	6.025	5.939	4.944
17	6.624	5.712	5.089	4.511
18	5.492	4.702	4.154	3.673
19	4.258	3.719	3.172	2.855
20	3.051	2.64	2.276	1.984

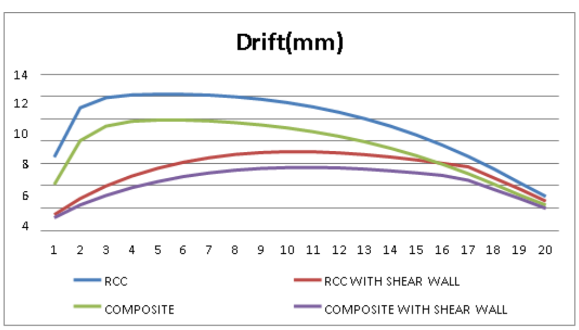

Fig 6: Storey drift

3. Stiffness- It is observed that building with composite column having shear wall has maximum stiffness and RCC building without shear wall shows minimum stiffness as evident from the graph below.

Table 4: Stiffness

STOREY	RCC (KN/m)	RCC WITH SHEAR WALL (KN/m)
Base	0	0
1	1268830	6058615.79
2	758607.9	3000926.082
3	699311.8	2164984.441
4	683496.6	1764036.19
5	675719.4	1532494.518
6	670043.4	1383341.694

7	665269	1280102.383
8	661009	1204476.322
9	657014.2	1146030.216
10	653038.4	1098099.278
11	648797.8	1055899.696
12	643937.4	1015525.479
13	637982.4	973324.746
14	630252.7	925436.317
15	619704	867387.251
16	604599.5	793723.815
17	581758.1	697717.153
18	544364.9	571451.642
19	474687.1	405781.908
20	308690.8	197581.503

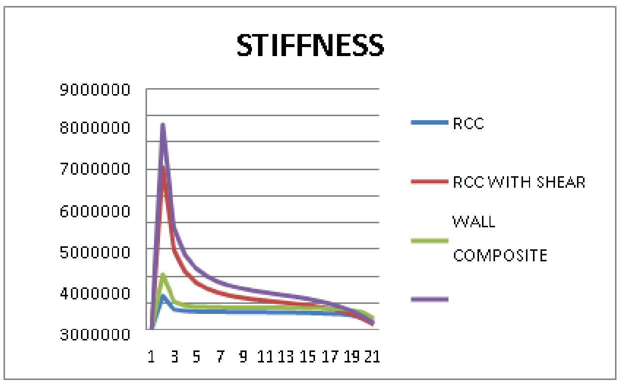

Fig 7: Comparison of stiffness

3.2 RESPONSE SPECTRUM ANALYSIS OF G+19 BUILDINGS

1. Lateral displacement- It is observed that displacement is reduced substantially in presence of shear wall. Building with composite column in presence of shear wall showed minimum displacement while the RCC building without shear wall showed maximum displacement.

Table 6: Lateral displacement by response spectrum

STOREY	RCC (mm)	RCC WITH SHEAR WALL (mm)
1	4.295	0.835
2	11.3	2.413
3	18.614	4.509
4	25.759	6.984
5	32.64	9.725
6	39.241	12.64
7	45.563	15.659
8	51.605	18.726
9	57.358	21.798
10	62.811	24.844
11	67.948	27.842
12	72.752	30.774
13	77.205	33.627
14	81.289	36.393
15	84.985	39.062
16	88.27	41.63
17	91.115	44.092
18	93.486	46.45
19	95.346	48.713
20	96.714	50.871

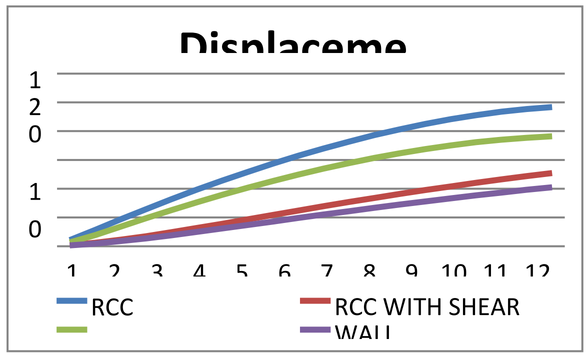

Fig 10: Comparison of displacement by response spectrum method

2. Lateral drift- There is decrease in drift in building with composite column than building with RCC column. Building with composite column in presence of shear wall showed minimum drift among all the four models

Table 6: Lateral drift by response spectrum

STOREY	RCC (mm)	RCC WITH SHEAR WALL (mm)
1	4.295	0.835
2	7.015	1.581
3	7.355	2.103
4	7.243	2.49
5	7.059	2.766
6	6.87	2.957
7	6.683	3.082
8	6.483	3.158
9	6.269	3.197

10	6.033	3.209
11	5.777	3.202
12	5.505	3.177
13	5.214	3.137
14	4.904	3.081
15	4.567	3.007
16	4.18	2.913
17	3.717	2.801
18	3.146	2.673
19	2.436	2.141
20	1.665	1.286

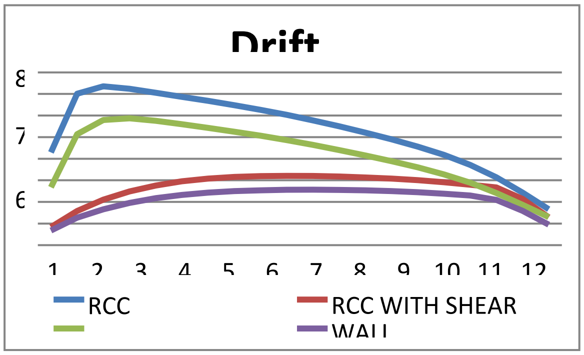

Fig 11: Comparison of drift by response spectrum method

3. Stiffness- It is observed that building with composite column having shear wall has maximum stiffness and RCC building without shear wall shows minimum stiffness as evident from the graph below.

Table 7: Lateral drift by response spectrum

STOREY	RCC (KN/m)	RCC WITH SHEAR WALL (KN/m)
Base	0	0
1	1292503	6903487.031
2	774342.8	3580772.778
3	714501.7	2603232.877
4	697616.7	2100287.83
5	690112.3	1790395.946
6	684098.4	1576977.717
7	679372.2	1422627.942
8	674405.3	1307964.745
9	670043.8	1223756.894
10	665350.3	1163540.138
11	660542.6	1122271.362
12	656247	1096152.405
13	651791.5	1079304.053
14	647886.4	1065735.302
15	645048.4	1049062.173
16	641406.4	1018441.574
17	635356.8	960059.353
18	622575.9	855676.38
19	580528.6	670223.997
20	412496.8	361815.448

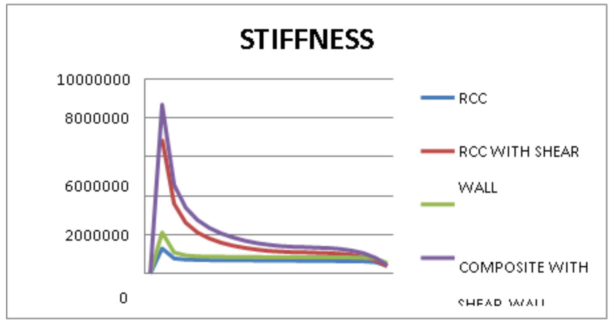

Fig 12: Comparison of stiffness by response spectrum method

CONCLUSION

- From all the above analysis, it is observed that for high rise building of 20 storey, building with composite column is more efficient. It is observed that displacement and drift is reduced substantially and stiffness of the building increases in presence of shear walls. Hence it is concluded that composite column building with shear wall counter seismic force more as compared to other models.
- In case of RCC framed structure the lateral displacement is very high. It is observed that in presence of shear wall the displacement at top reduces by approx 40% in case of static analysis and 47% in case of response spectrum analysis in both RCC and composite column buildings. Also the building with composite column reduces the displacement by approx 20% as compared to RCC building.
- Hence the composite column building in presence of shear wall counters the seismic effect more efficiently.
- Storey-drift is the relative displacement, it means the drift of one level relative to the level below. It is observed that the drift at top is reduced by 13%

in presence of shear wall in case of static analysis and 23% in case of response spectrum analysis.

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