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Design Optimization of Shear wall in High Rise Building

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Abstract - *In past decades, shear walls are one of the most appropriate and important structural component in High Rise building. Therefore, it would be very interesting to study the structural response and their systems in High Rise Building structure. Shear walls contribute the stiffness and strength during earthquakes which are often neglected during design of structure and construction. This study shows the Optimization of shear walls in High Rise Building. In order to test, a G+40 storey building in seismic zone 2 was considered and analyzed for various parameters like base shear, storey drift, storey Displacement. Optimization of shear wall has been studied with the help of two models. For modeling and analysis of all the models, FEM based software ETABS 2018 were used. The analysis of all models was done by using Equivalent static method, Dynamics analysis and wind load Analysis. The comparison of results has been done based on same parameters like base shear, storey drift, lateral displacement & Base Shear.*

Key Words: Shear wall, storey Drift, Lateral Displacement, Base shear.

1. INTRODUCTION

The rapid growth of the urban population and high cost of land creates a pressure on available space specially in developing cities. Tall buildings are the today's necessitates today to fulfill these needs. As Designers' first choice is Shear wall as it resists the lateral loads such as wind or earthquake load and prevents buildings from damage. Shear wall is slender structure of having a large stiffness value, which resist lateral load and also resist the gravity load. Wind and seismic loads are the most common loads that shear walls are designed to carry. The distinguishing features are the much higher moment of inertia of the shear wall than a column and the width of the shear wall, which is not negligible in comparison with the span of adjacent beams Shear wall gives better performance when it is designed properly and placed at optimum location in the building plan

1.1 Objective

- To check the applicability of ductile design and detailing as per the code IS-13920-2016
- To check the applicability of minimum design lateral forces as per the code IS-1893-2016 at and IS-16700-2016
- Focus on the design optimization of vertical lateral load resisting member of shear wall.

1.2 Methodology

• Modeling & Analysis of a High rise Building With shear wall at different location for seismic loads and wind load.

• Comparison of Results and Graph of all models for storey displacement, storey drift, base shear, Storey shear.

• For Analysis Seismic zone 2 is considered.

• Optimization of shear wall in form of Reinforcement has calculated

2 MODELING AND ANALYSIS

Modelling a building involves the modelling and assemblage of its various load-carrying elements. The model must ideally represent the mass distribution, strength, stiffness and deformability. Modelling of the material properties and structural elements used in the present study is discussed below.

2.1 Building Description

Framed building located at Nagpur, Maharashtra, India (Seismic Zone II) is selected for the present study. The building is fairly symmetric in plan and in elevation.

Table -2.1 Building Description

Plan dimensions	33.35X20.25 m
Number of stories	G+40
Total height of building	147.6m
Height of each storey	3.6 m
Size of beams	230 X 500 mm (M40)

Thickness of shear wall	250 mm (M70/60/50/40)
Thickness of slab	200 mm (M40)
Partition walls	a) On floor 150 mm (AAC block, density 6kN/m3) Wall Load- 2kN/m2 on floor
Seismic Data (IS1893 Part1-2016)	
Seismic zone	II
Soil condition	Hard soil
Importance Factor	1.2
Response Reduction Factor	3 and 5
Damping of structure	0.05
Wind load (IS 875 Part3-2015)	
Wind speed	44 m/s
Risk Coefficient (K1)	1
Terrain, height and structure size factor (K2)	As per condition
Topography factor(K3)	1
Importance factor for cyclonic region (K4)	1
Live load (IS875 Part2-1987)	2 kN/ m2
Floor Finishing	2 kN/ m2
Material	M 70/60/50/40 Grade concrete &Fe 650 Rebar
Unit weights	Concrete = 25 kN/m3

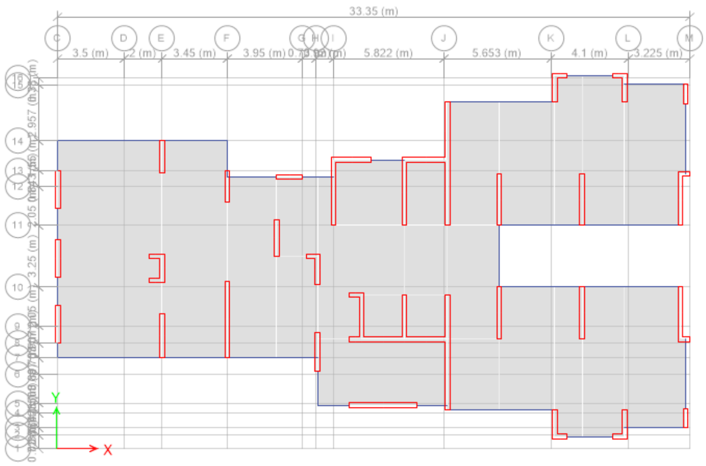


Fig 2.1 Typical floor plan of the selected building

2.2 Material Properties

Elastic material properties of these materials are taken as per Indian Standard IS 456: 2000.

A) Concrete:

Concrete with following properties is considered for study.

Characteristic compressive strength (fck) = 70/60/50/40 MPa

- ✓ Poisson Ratio = 0.3
- ✓ Density = 25 kN/m3
- ✓ Modulus of Elasticity (E) = 5000 x √ fck

  M70 = 41833 MPa

  M60 = 38729 MPa

  M50 = 35355 MPa

  M40 = 31622 MPa

Fck is the characteristic compressive strength of concrete cube in MPa at 28-day

B) Steel:

Steel with following properties is considered for study.

- ✓ Yield Stress (fy) = 650 MPa
- ✓ Modulus of Elasticity (E) = $2x10^5$ MPa

2.3 Analysis of Structure

A RCC medium rise building of G+40 stories with floor height 3.6m subjected to earthquake loading in Zone II has been considered. In this regard, ETABS software has been considered as tool to perform. Effect of shear wall on behavior of structural frames is analyzed. Storey displacements, story shear, story drift and base shear have been calculated to find out the effect in the building. Loading consideration Dead Load (DL) and Live load (LL) have been taken. Seismic load calculation has been done based on the IS 1893 (Part 1) (2016) approach. The loads combinations are applied to the selected frames are.

Load Combinations

Load Combination	LOAD FACTORS					
	D.L	L.L	WL X	WL Y	EQX	EQY
DL + LL	1.5	1.5	-	-	-	-
DL + LL + EQX	1.2	1.2	-	-	1.2	-
DL + LL - EQX	1.2	1.2	-	-	-1.2	-
DL + LL + EQY	1.2	1.2	-	-	-	1.2
DL + LL - EQY	1.2	1.2	-	-	-	-1.2
DL + EQX	1.5	-	-	-	1.5	-
DL - EQX	1.5	-	-	-	-1.5	-
DL + EQY	1.5	-	-	-	-	1.5
DL - EQY	1.5	-	-	-	-	-1.5
DL + LL + WLX	1.2	1.2	1.2	-	-	-
DL + LL - WLX	1.2	1.2	-1.2	-	-	-
DL + LL + WLY	1.2	1.2	-	1.2	-	-
DL + LL – WLY	1.2	1.2	-	-1.2	-	-
DL + WLX	1.5	-	1.5		-	-
DL – WLX	1.5	-	-1.5		-	-
DL + WLY	1.5	-	-	1.5	-	-
DL – WLY	1.5	-	-	-1.5	-	-
0.9DL + EQX	0.9	-	-	-	1.5	-
0.9DL - EQX	0.9	-	-	-	-1.5	-
0.9DL + EQY	0.9	-	-	-	-	1.5
0.9DL - EQY	0.9	-	-	-	-	-1.5
0.9DL + WLX	0.9	-	1.5		-	-
0.9DL – WLX	0.9	-	-1.5		-	-
0.9DL + WLY	0.9	-	-	1.5	-	-
0.9DL – WLY	0.9	-	-	-1.5	-	-

3. RESULTS & DISCUSSION

Table indicate the values of storey displacement, storey shear, base shear and storey drift for along X direction and Y direction as shown in Fig

Table-3.1 Storey displacement (mm) along X direction

X-Direction							
		Case-1			Case2		
Storey	Load Case	Static Analysis	Responce Spectra	Wind	Static Analysis	Responce Spectra	Wind
Terrace	EQX/Respose-X/Wind-X	128	95	210	77	57	210
40	EQX/Respose-X/Wind-X	126	93	206	75	56	206
39	EQX/Respose-X/Wind-X	123	92	203	74	55	203
38	EQX/Respose-X/Wind-X	121	90	199	72	54	199
37	EQX/Respose-X/Wind-X	118	88	196	71	53	196
36	EQX/Respose-X/Wind-X	115	86	192	69	52	192
35	EQX/Respose-X/Wind-X	112	84	188	67	50	188
34	EQX/Respose-X/Wind-X	109	82	184	66	49	184
33	EQX/Respose-X/Wind-X	106	80	180	64	48	180
32	EQX/Respose-X/Wind-X	103	78	175	62	47	175
31	EQX/Respose-X/Wind-X	100	76	171	60	45	171
30	EQX/Respose-X/Wind-X	97	73	166	58	44	166
29	EQX/Respose-X/Wind-X	93	71	161	56	43	161
28	EQX/Respose-X/Wind-X	90	68	156	54	41	156
27	EQX/Respose-X/Wind-X	87	66	151	52	40	151
26	EQX/Respose-X/Wind-X	83	63	146	50	38	146
25	EQX/Respose-X/Wind-X	79	61	140	48	37	140
24	EQX/Respose-X/Wind-X	76	58	135	45	35	135
23	EQX/Respose-X/Wind-X	72	56	129	43	33	129
22	EQX/Respose-X/Wind-X	68	53	123	41	32	123
21	EQX/Respose-X/Wind-X	64	50	117	39	30	117
20	EQX/Respose-X/Wind-X	61	47	111	36	28	111
19	EQX/Respose-X/Wind-X	57	45	105	34	27	105
18	EQX/Respose-X/Wind-X	53	42	99	32	25	99
17	EQX/Respose-X/Wind-X	49	39	92	29	23	92
16	EQX/Respose-X/Wind-X	45	36	86	27	22	86
15	EQX/Respose-X/Wind-X	42	33	79	25	20	79
14	EQX/Respose-X/Wind-X	38	31	73	23	18	73
13	EQX/Respose-X/Wind-X	34	28	66	21	17	66
12	EQX/Respose-X/Wind-X	31	25	60	18	15	60
11	EQX/Respose-X/Wind-X	27	22	54	16	13	54
10	EQX/Respose-X/Wind-X	24	20	47	14	12	47
9	EQX/Respose-X/Wind-X	20	17	41	12	10	41
8	EQX/Respose-X/Wind-X	17	15	36	10	9	36
7	EQX/Respose-X/Wind-X	14	12	30	9	7	30
6	EQX/Respose-X/Wind-X	11	10	24	7	6	24
5	EQX/Respose-X/Wind-X	9	8	19	5	5	19
4	EQX/Respose-X/Wind-X	6	6	14	4	3	14
3	EQX/Respose-X/Wind-X	4	4	10	3	2	10
2	EQX/Respose-X/Wind-X	3	2	6	2	1	6
1	EQX/Respose-X/Wind-X	1	1	3	1	1	3

Similarly results for Storey displacement (mm) along Y direction

Table 3.3 Storey shear along X direction

X-Direction							
		Case-1			Case2		
Storey	Load Case	Static Analysis	Respoance Spectra	Wind	Static Analysis	Respoance Spectra	Wind
Terrace	EQX/Respose-X/Wind-X	134	228	86	80	137	86
40	EQX/Respose-X/Wind-X	287	446	252	172	268	252
39	EQX/Respose-X/Wind-X	433	612	417	260	367	417
38	EQX/Respose-X/Wind-X	572	734	582	343	441	582
37	EQX/Respose-X/Wind-X	704	822	746	422	493	746
36	EQX/Respose-X/Wind-X	829	886	909	498	532	909
35	EQX/Respose-X/Wind-X	948	937	1072	569	562	1072
34	EQX/Respose-X/Wind-X	1061	981	1234	637	589	1234
33	EQX/Respose-X/Wind-X	1168	1025	1395	701	615	1395
32	EQX/Respose-X/Wind-X	1268	1069	1556	761	641	1556
31	EQX/Respose-X/Wind-X	1363	1116	1716	818	669	1716
30	EQX/Respose-X/Wind-X	1452	1164	1875	871	698	1875
29	EQX/Respose-X/Wind-X	1536	1212	2034	922	727	2034
28	EQX/Respose-X/Wind-X	1615	1258	2192	969	755	2192
27	EQX/Respose-X/Wind-X	1688	1303	2349	1013	782	2349
26	EQX/Respose-X/Wind-X	1757	1344	2504	1054	807	2504
25	EQX/Respose-X/Wind-X	1821	1383	2658	1092	830	2658
24	EQX/Respose-X/Wind-X	1880	1419	2811	1128	851	2811
23	EQX/Respose-X/Wind-X	1935	1453	2962	1161	872	2962
22	EQX/Respose-X/Wind-X	1986	1486	3112	1191	892	3112
21	EQX/Respose-X/Wind-X	2032	1519	3260	1219	912	3260
20	EQX/Respose-X/Wind-X	2075	1553	3407	1245	932	3407
19	EQX/Respose-X/Wind-X	2114	1588	3552	1269	953	3552
18	EQX/Respose-X/Wind-X	2150	1623	3696	1290	974	3696
17	EQX/Respose-X/Wind-X	2182	1659	3839	1309	996	3839
16	EQX/Respose-X/Wind-X	2212	1696	3980	1327	1017	3980
15	EQX/Respose-X/Wind-X	2238	1731	4120	1343	1038	4120
14	EQX/Respose-X/Wind-X	2261	1765	4258	1357	1059	4258
13	EQX/Respose-X/Wind-X	2282	1797	4393	1369	1078	4393
12	EQX/Respose-X/Wind-X	2300	1828	4526	1380	1097	4526
11	EQX/Respose-X/Wind-X	2316	1858	4657	1390	1115	4657
10	EQX/Respose-X/Wind-X	2330	1888	4784	1398	1133	4784
9	EQX/Respose-X/Wind-X	2342	1921	4909	1405	1152	4909
8	EQX/Respose-X/Wind-X	2352	1957	5031	1411	1174	5031
7	EQX/Respose-X/Wind-X	2360	1999	5148	1416	1199	5148
6	EQX/Respose-X/Wind-X	2367	2047	5262	1420	1228	5262
5	EQX/Respose-X/Wind-X	2372	2102	5369	1423	1261	5369
4	EQX/Respose-X/Wind-X	2376	2159	5470	1426	1295	5470
3	EQX/Respose-X/Wind-X	2380	2216	5563	1428	1330	5563
2	EQX/Respose-X/Wind-X	2382	2268	5652	1429	1361	5652
1	EQX/Respose-X/Wind-X	2383	2306	5740	1430	1383	5740
0	EQX/Respose-X/Wind-X	2384	2310	5741	1430	1386	5741

Similarly results for Storey shear along Y direction

Table 3.5 Story Drift (%) along X direction

X-Direction							
		Case-1			Case2		
Storey	Load Case	Static Analysis	Respoance Spectra	Wind	Static Analysis	Respoance Spectra	Wind
Terrace	EQX/Respose-X/Wind-X	0.07%	0.05%	0.10%	0.04%	0.03%	0.10%
40	EQX/Respose-X/Wind-X	0.07%	0.05%	0.10%	0.04%	0.03%	0.10%
39	EQX/Respose-X/Wind-X	0.07%	0.05%	0.10%	0.04%	0.03%	0.10%
38	EQX/Respose-X/Wind-X	0.07%	0.06%	0.10%	0.04%	0.03%	0.10%
37	EQX/Respose-X/Wind-X	0.08%	0.06%	0.11%	0.05%	0.03%	0.11%
36	EQX/Respose-X/Wind-X	0.08%	0.06%	0.11%	0.05%	0.04%	0.11%
35	EQX/Respose-X/Wind-X	0.08%	0.06%	0.11%	0.05%	0.04%	0.11%
34	EQX/Respose-X/Wind-X	0.08%	0.06%	0.12%	0.05%	0.04%	0.12%
33	EQX/Respose-X/Wind-X	0.09%	0.07%	0.12%	0.05%	0.04%	0.12%
32	EQX/Respose-X/Wind-X	0.09%	0.07%	0.13%	0.05%	0.04%	0.13%
31	EQX/Respose-X/Wind-X	0.09%	0.07%	0.13%	0.05%	0.04%	0.13%
30	EQX/Respose-X/Wind-X	0.09%	0.07%	0.13%	0.06%	0.04%	0.13%
29	EQX/Respose-X/Wind-X	0.10%	0.07%	0.14%	0.06%	0.04%	0.14%
28	EQX/Respose-X/Wind-X	0.10%	0.07%	0.14%	0.06%	0.04%	0.14%
27	EQX/Respose-X/Wind-X	0.10%	0.07%	0.15%	0.06%	0.04%	0.15%
26	EQX/Respose-X/Wind-X	0.10%	0.08%	0.15%	0.06%	0.05%	0.15%
25	EQX/Respose-X/Wind-X	0.10%	0.08%	0.16%	0.06%	0.05%	0.16%
24	EQX/Respose-X/Wind-X	0.10%	0.08%	0.16%	0.06%	0.05%	0.16%
23	EQX/Respose-X/Wind-X	0.10%	0.08%	0.16%	0.06%	0.05%	0.16%
22	EQX/Respose-X/Wind-X	0.11%	0.08%	0.17%	0.06%	0.05%	0.17%
21	EQX/Respose-X/Wind-X	0.11%	0.08%	0.17%	0.06%	0.05%	0.17%
20	EQX/Respose-X/Wind-X	0.11%	0.08%	0.17%	0.06%	0.05%	0.17%
19	EQX/Respose-X/Wind-X	0.11%	0.08%	0.17%	0.06%	0.05%	0.17%
18	EQX/Respose-X/Wind-X	0.11%	0.08%	0.18%	0.06%	0.05%	0.18%
17	EQX/Respose-X/Wind-X	0.11%	0.08%	0.18%	0.06%	0.05%	0.18%
16	EQX/Respose-X/Wind-X	0.10%	0.08%	0.18%	0.06%	0.05%	0.18%
15	EQX/Respose-X/Wind-X	0.10%	0.08%	0.18%	0.06%	0.05%	0.18%
14	EQX/Respose-X/Wind-X	0.10%	0.08%	0.18%	0.06%	0.05%	0.18%
13	EQX/Respose-X/Wind-X	0.10%	0.08%	0.18%	0.06%	0.05%	0.18%
12	EQX/Respose-X/Wind-X	0.10%	0.08%	0.18%	0.06%	0.05%	0.18%
11	EQX/Respose-X/Wind-X	0.09%	0.08%	0.18%	0.06%	0.05%	0.18%
10	EQX/Respose-X/Wind-X	0.09%	0.07%	0.17%	0.06%	0.04%	0.17%
9	EQX/Respose-X/Wind-X	0.09%	0.07%	0.17%	0.05%	0.04%	0.17%
8	EQX/Respose-X/Wind-X	0.08%	0.07%	0.16%	0.05%	0.04%	0.16%
7	EQX/Respose-X/Wind-X	0.08%	0.07%	0.16%	0.05%	0.04%	0.16%
6	EQX/Respose-X/Wind-X	0.07%	0.06%	0.15%	0.04%	0.04%	0.15%
5	EQX/Respose-X/Wind-X	0.07%	0.06%	0.14%	0.04%	0.03%	0.14%
4	EQX/Respose-X/Wind-X	0.06%	0.05%	0.12%	0.04%	0.03%	0.12%
3	EQX/Respose-X/Wind-X	0.05%	0.04%	0.11%	0.03%	0.03%	0.11%
2	EQX/Respose-X/Wind-X	0.04%	0.03%	0.09%	0.02%	0.02%	0.09%
1	EQX/Respose-X/Wind-X	0.03%	0.02%	0.06%	0.02%	0.01%	0.06%
0	EQX/Respose-X/Wind-X	0.01%	0.01%	0.03%	0.01%	0.01%	0.03%

Similarly results for Story Drift (%) along Y direction

Table 3.7 Seismic base Shear (KN)

Seismic Base shear					
LOAD CASE	STATIC BASE SHEAR(kN)		DYNAMIC BASE SHEAR (kN)		Min Vb (Cl.7.2.2)
	R=3	R=5	R=3	R=5	0.7xW
X- Direction	2206	1323	2206	1323	1820
Y- Direction	1720	1032	1719.6	1032	1820

Table 3.8 Wind base Shear (KN)

Wind Base Shear	
LOAD CASE	STATIC BASE SHEAR(kN)
X- Direction	5410.0
Y- Direction	9439.0

3.1 Comparison of Results

RCC G+40 building is analyzed. Parameters like Storey displacement, storey shear, storey drift and base shear is calculated. Graphical representation of data is discussed in this chapter.

3.2 Graphical Representation For Storey Displacement

- The maximum displacement in longitudinal and transverse direction is considered and graphical representation of data is shown in Fig

Fig 3.1 Storey displacement along X-direction

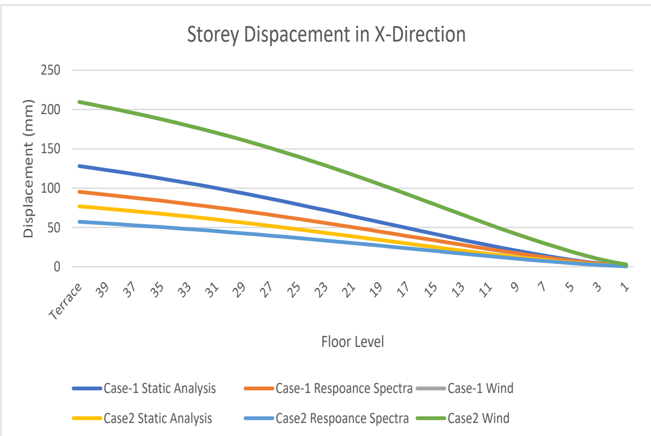
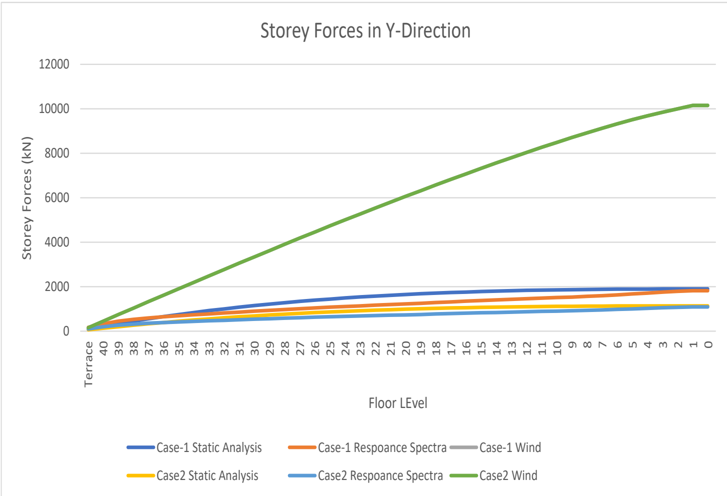


Fig 3.2 Storey displacement along Y-direction



OBSERVATIONS:-

- For easy comparison of the Storey displacement of the selected frames, plots of the storey displacement in transverse direction versus floor level in longitudinal direction are made, all imposed on the same graph. These are present in fig. 6.1 to fig. 6.2.
- Wind load case govern maximum displacement values in X and Y direction.
- In case1(R=3) and case2 (R=5) the displacement values are nearly same.
- Maximum Permissible limit is H/500 is 295.2 mm for wind and H/250 which is 590.4 mm for seismic.
- The displacement is inversely proportional to the stiffness.

3.3 Graphical Representation For Storey Shear

- The maximum storey shear in longitudinal and transverse direction is considered and graphical representation of data is shown in Fig

Fig 3.3 Storey forces along X-direction

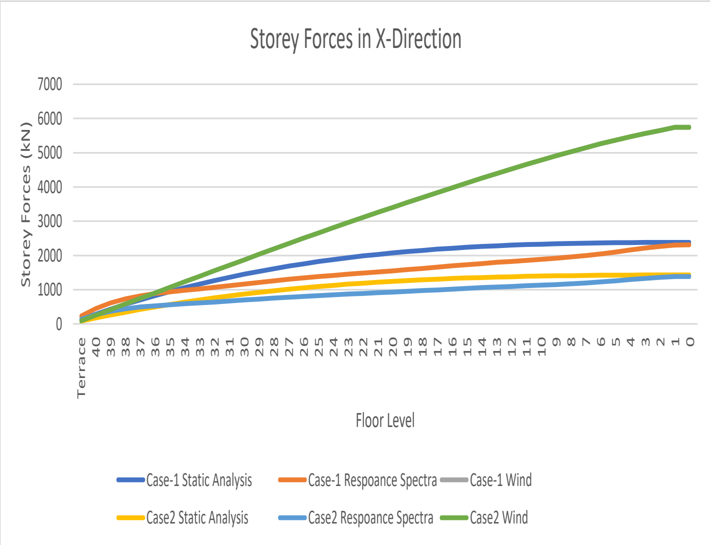
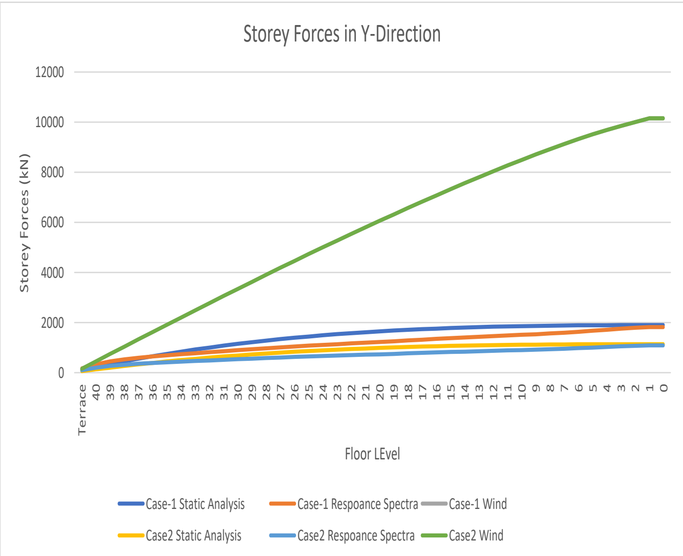


Fig 3.4 Storey forces along Y-direction



Observations:-

For easy comparison of the Storey shear of the selected frames, plots of the storey forces in transverse direction versus floor level in longitudinal direction are made, all imposed on the same graph. These are present in fig

.

- Wind load case govern maximum storey shear values in X and Y direction.
- In case1(R=3) and case2 (R=5) the storey shear values are nearly same

3.3 Graphical Representation for Storey Drift

- The maximum Storey Drift in longitudinal and transverse direction is considered and graphical representation of data is shown in Fig

Fig 3.5 Storey drift along X-direction

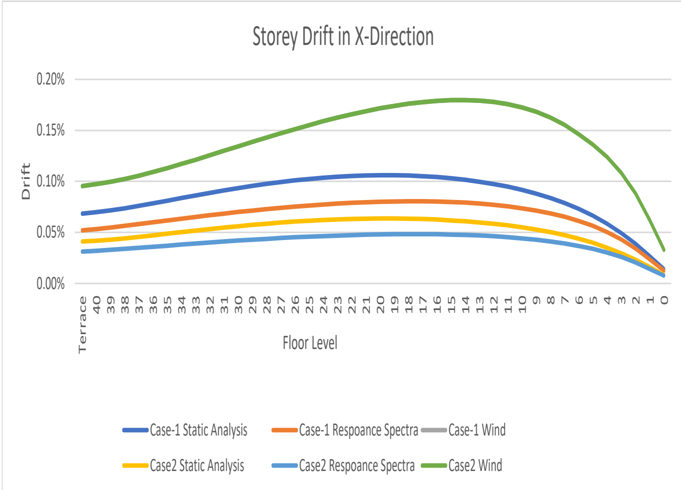
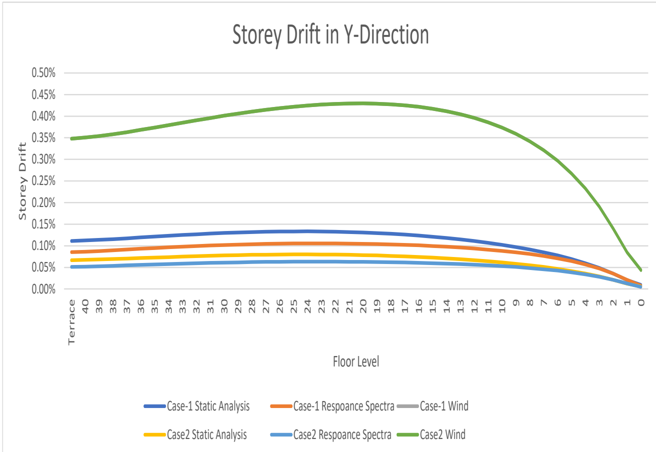


Fig 3.6 Storey drift along Y-direction



Observations:-

- For easy comparison of the Storey drift of the selected frames, plots of the storey drift in transverse direction versus floor level in longitudinal direction are made, all imposed on the same graph.
- Wind load case govern maximum storey drift values in X and Y direction.
- In case1 (R=3) and case2 (R=5) the storey drift values are nearly same.
- Maximum Permissible limit for storey drift for seismic behaviour is 0.004 times (i.e.0.4%) the

storey height but due to wind force storey drift governs the maximum value.

3.4 Graphical Representation for Base Shear

The Base Shear in longitudinal and transverse direction is considered and graphical representation of data is shown in

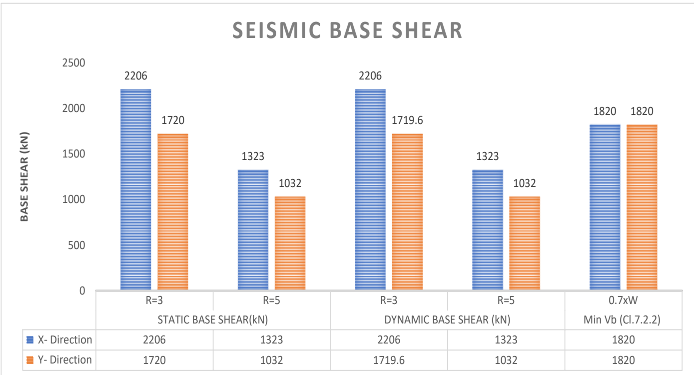


Fig 3.7 Seismic base shear

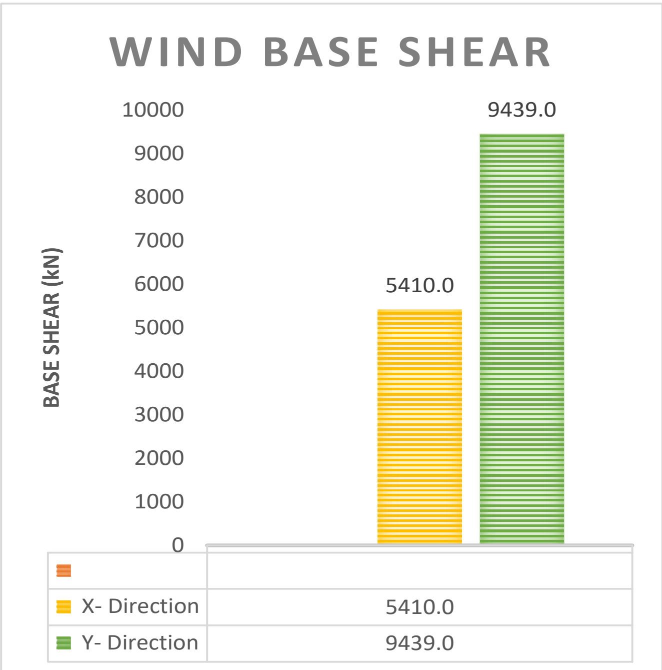


Fig 3.8 Wind base shear

Observations:-

- Plots of the base shear in longitudinal and transverse versus are made, all imposed on the same graph. The base shear is directly proportional to weight of structure.
- From the above graphs base shear profiles it is observed that minimum shear occurs in case 2.
- Wind load case govern maximum base shear values in X and Y direction.

4. CONCLUSIONS

- The result of storey displacement, storey shear, storey drift and base shear of high rise building is nearly same for case 1(R=3) and case2(R=5).
- Wind load case as compared to seismic load governs maximum storey displacement, storey shear, storey drift and base shear of high rise building and hence the design is done by taking wind effect only so that the ductile detailing is avoided.
- Building with shear wall is found to be very effective in increasing building performance.
- Wind base shear of the shear wall increases with increase in mass and stiffness of self-weight of shear wall.
- Shear wall frame increases the lateral stiffness of the building, thereby reducing displacement in all storey levels.
- Shear wall are found to be most effective in increase the stiffness.

REFERENCES

1) Saurabh Mishra, V.K. Singh, "Optimization of Location of Shear Wall in Irregular Multi Storey Building" International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE) ISSN: 2456-1290 Volume-ss3, Issue 4, April 2018

2) L.Rahul, M.Akbar, M.Sriraman, "Design Optimization and Earthquake Analysis Of Shear Wall in High Rise Building", Journal of Xi'an University of Architecture & Technology ISSN No : 1006-7930

3) Gangisetty Sri Harsha, Dr. H. Sudarsana Rao," Shear Wall Analysis & Design Optimization in High Rise Buildings", International Journal of Engineering and Research Technology. ISSN No : 2277-9655

4) M.Pavani, G.Nagesh Kumar, Dr. Sandeep Pingale," Shear wall Analysis and design Optimization in case of high rise building using ETABS", International Journal of Scientific & Engineering Research ISSN: 2229-5518, Volume 6, Issue 1, January-2015

5) S Kasliwal N. A. and Rajguru R. S," Effect of Numbers and Positions of Shear Walls on Seismic Behavior of Multistoried Structure", International Journal of Science, Engineering and Technology Research (2016). Volume 5.

6) Vinayak Kulkarni, Swapnil Cholekar, Hemant Sonawadekar, "Effect of Openings of Shear Wall in High Rise Buildings", Int. Journal of Applied Sciences and Engineering Research Issue 4, (2014), ISSN 2277 – 9442

7) Anshuman S, Dipendu Bhunia and Bhavin Ramjiyani," Solution of Shear Wall Location in Multi-Storey Building," International Journal of Civil and Structural Engineering (2011) ISSN 0976 – 4399

8) Siamak Tala Tahari, Mahdi Rabiei, "Shear wall layout optimization of tall buildings using Quantum Charged System Search", Front. Struct. Civ. Eng., https://doi.org/10.1007/s11709-020-0660-1

9) Ali Kaveh and Pooya Zakian," Optimal Seismic Design of Reinforced Concrete Shear Wall-Frame Structures", KSCE Journal of Civil Engineering (2014) 18(7):2181-2190, DOI 10.1007/s12205-014-0640-x,pISSN 1226-7988, eISSN 1976-3808

10) Men Jinjie, Shi Qingxuan,He Zhijian, "Optimal Design of Tall Residential Building with Shear wall and with Rectangular layout" International Journal of High Rise Buildings Volume 3 Number 4..

11) Ravikanth Chittiprolu And Ramancharla Pradeep Kumar ," International Journal of Education and applied research(2014) Vol. 4, Issue Spl-2, ISSN: 2348-0033

12) Sanisha Santhosh, Linda Ann Mathew," seismic analysis of Multi-Storey buildings with shear walls of different shapes", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 6 Issue 06, June – 2017.

13) Tarun Magendra, Abhyuday Titiksh and A.A. Qureshi," Optimum Positioning of Shear Walls in Multi-storey Buildings", International Journal of Trend in Research and Development, Volume 3(3),ISSN: 2394-9333

14) Nakul Khanna, Jagdish Chand, "optimum Structural Design for high rise buildings", International Journal of Innovation Technology and exploring Engineering.ISSN:2278-3075,Volume-8 issue-8 June,2019

15) M. S. Aainawala and Dr. P. S. Pajgade "Design of Multi-storeyed R.C.C. Buildings with and without Shear Walls" International Journal of Engineering Sciences & Research Technology (2014) ISSN: 2277-9655.