COMPARATIVE ANALYSIS OF AN IRREGULAR STRUCTURE WITH SHEARWALL AND WITHOUT SHEARWALL FRAME SYSTEM

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Abstract - *The main objective of the research work presented in this paper is to study the seismic behavior and to compare the results of buildings with reinforced concrete shearwall and without shearwall. Two buildings, one with shear wall and one without shear wall with the same plan and equal number of storeys are considered. A brief review of design concept is presented and need of shear wall, effect of earthquake are discussed. Response spectrum analysis has been done to both the buildings with shear wall and without shearwall with same plan. The storey displacements of both the buildings are obtained and compared to each other to meet the shear wall effect. The analysis and design of models are done according to IS codes in an eco friendly software ETAB 2015*

Key Words: **Etabs, Response spectrum, Shearwall, Stiffness, Story drifts**

1. INTRODUCTION

Shear walls are specially designed structural walls included in the buildings to resist horizontal forces that are induced in the plane of the wall due to wind, earthquake and other forces. They are mainly flexural members and usually provided in highrise buildings to avoid the total collapse of the highrise buildings under seismic forces. Shear wall has high in-plane stiffness and strength which can be used to simultaneously resist large horizontal loads and support gravity loads. Shear walls also provide lateral stiffness to prevent the roof or floor from excessive side sway.

1.1 MODEL CONFIGURATION

Three buildings with twenty five story irregular reinforced concrete building are considered in seismic zone IV. The beam length in (x) transverse direction are 5m, and beams in (y) direction are of length 5m. Figure 1 and 2 shows the plan and 3D view of the twenty five story building having 6 bays in x-direction and four bays in y-direction. Story height of each building is assumed 3m. .Beam cross section 300X450 mm and Column cross section is 450x600 mm.

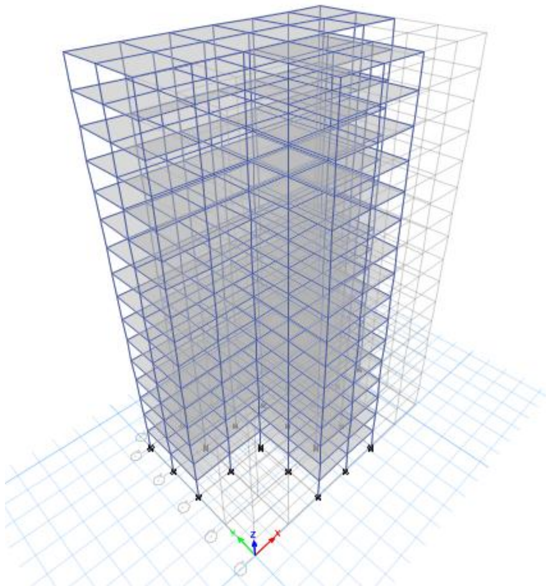

Fig 1.1:Building1

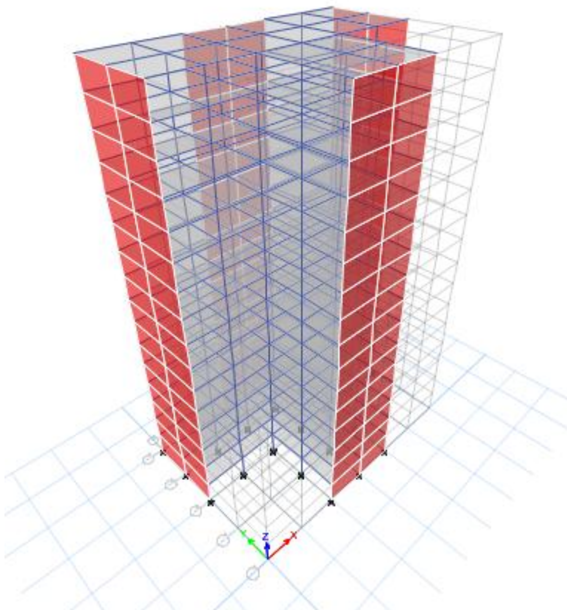

Fig 1.2: Building 2

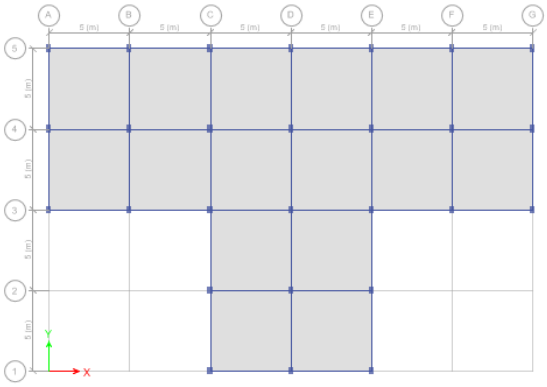

Fig 1.3: Plan of Building 1

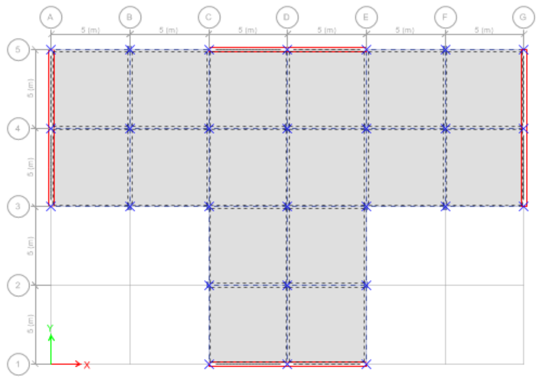

Fig 1.4: Plan of Building 2

1.2 TIME PERIOD

IS-1893-2016 defines different Sa/g values for different values of approximate time period (T). The fundamental natural period (Ta) is taken for moment resisting frame building without brick infill panels as $T_a = 0.075h^{0.75}$, Where, h = Height of the building in m.

Table 1.1 : Time period of Building 1 and 2.

Time Period	Building 1	Building 2
Global x	1.36	1.36
Global y	1.36	1.36

1.3 DESIGN BASE SHEAR

The design base shear of a building can be calculated by using the code IS-1893-2002

$V_b = A_h * W$

Where A_h=design horizontal seismic coefficient

W= seismic weight

The Design horizontal seismic coefficient (Ah) is a function of peak ground acceleration (z), Importance Factor (I), Response Reduction Factor (R) and Design acceleration coefficient (Sa/g) for different types of soil normalized corresponding to 5 % damping.

$$A_h = \frac{Z\, I\, S_a}{2Rg}$$

Sa/g values for medium soil according to IS-1893- 2002

For medium soil sites

$$S_a/g = \begin{cases} 1+15T; & 0.00 \le T \le 0.10 \\ 2.50 & 0.10 \le T \le 0.55 \\ 1.36/T & 0.55 \le T \le 4.00 \end{cases}$$

Table -1.2: Design base shear for Building 1 and 2 for Equivalent static load

Design base shear	Building 1	Building 2
Global X (KN)	1446.7803	1647.0879
Global Y(KN)		

1.4 STIFFNESS

Table 1.3: Story stiffness in X direction for equivalent static loads

Story	WSW	SW
Story16	132277.4	187991.8
Story15	167319.7	377524
Story14	181776.7	537931.6
Story13	189805	673683.4
Story12	194962.2	790872.1
Story11	198647.5	895566
Story10	201527.2	993981.3
Story9	203968.3	1092718
Story8	206198.3	1199485
Story7	208374.8	1324445
Story6	210619.1	1482909
Story5	213034.4	1701258
Story4	215715.6	2032255
Story3	218778.2	2602282
Story2	222673.5	3831757
Story1	255598	8020847
Base	0	0

Table 1.4: Story stiffness in Y direction for equivalent static load

Story	WSW	SW
Story16	129177.7	160514.6
Story15	192264.7	323631.1
Story14	225783.7	463290.6
Story13	246907.2	583234.7
Story12	261631.3	688386.6
Story11	272780.9	783759.1
Story10	281880.2	874597
Story9	289855.7	966631.1
Story8	297335	1066735
Story7	304792.3	1184172
Story6	312628.6	1333091
Story5	321223	1538099
Story4	330968.4	1848706
Story3	342486.9	2384278
Story2	358979.2	3544876
Story1	469095.2	7593219
Base	0	0

1.5 MAXIMUM STORY DISPLACEMENT

Table 1.5: Max displacement in X Direction

Story	WSW	SW
Story16	86.282	17.568
Story15	84.519	16.201
Story14	81.805	14.817
Story13	78.247	13.418
Story12	73.964	12.011
Story11	69.068	10.605
Story10	63.665	9.211
Story9	57.851	7.844
Story8	51.717	6.52
Story7	45.345	5.258
Story6	38.807	4.093
Story5	32.172	3.033
Story4	25.496	2.087
Story3	18.83	1.283
Story2	12.216	0.648
Story1	5.698	0.212
Base	0	0

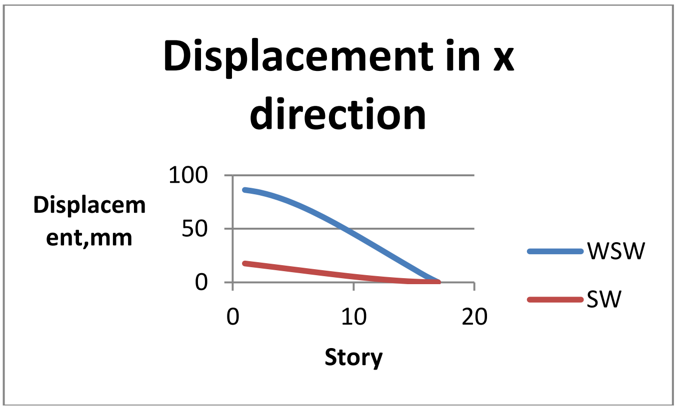

Chart 1: Displacement in x direction

Table 1.6: Max displacement in Y Direction for equivalent static load

Story	WSW	SW
Story16	59.659	19.459
Story15	57.864	17.937
Story14	55.512	16.395
Story13	52.658	14.84
Story12	49.378	13.276
Story11	45.743	11.715
Story10	41.822	10.169
Story9	37.68	8.655
Story8	33.378	7.189
Story7	28.974	5.794
Story6	24.52	4.49
Story5	20.064	3.301
Story4	15.652	2.252
Story3	11.322	1.37
Story2	7.112	0.681
Story1	3.084	0.217
Base	0	0

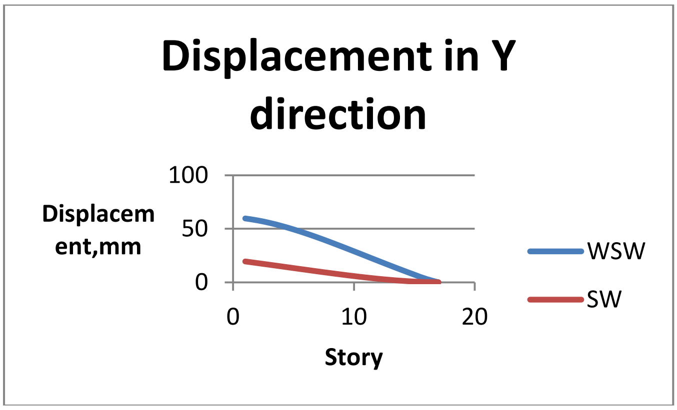

Chart 2: Displacement in Y direction

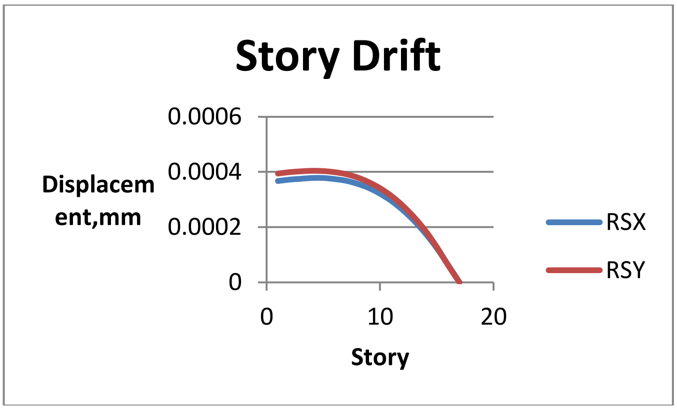

Chart 3: Story drift of building with shear wall due to response spectrum

1.6 STORY DRIFT

Table 1.7: Story drift of building with shear wall due to response spectrum

Story	RSX	RSY
Story16	0.000367	0.000394
Story15	0.000372	0.000399
Story14	0.000375	0.000402
Story13	0.000378	0.000404
Story12	0.000378	0.000403
Story11	0.000374	0.000399
Story10	0.000368	0.000392
Story9	0.000357	0.00038
Story8	0.000342	0.000363
Story7	0.000321	0.000341
Story6	0.000295	0.000313
Story5	0.000262	0.000278
Story4	0.000223	0.000236
Story3	0.000177	0.000187
Story2	0.000124	0.000128
Story1	6.30E-05	6.20E-05
Base	0	0

Table 1.8: Story Drift of building without shear wall due to response spectrum

Story	RSX	RSY
Story16	0.000493	0.000471
Story15	0.000787	0.000638
Story14	0.001016	0.000781
Story13	0.001187	0.000891
Story12	0.001322	0.000974
Story11	0.001435	0.001038
Story10	0.001536	0.001087
Story9	0.00163	0.001125
Story8	0.001716	0.001157
Story7	0.00179	0.001185
Story6	0.001858	0.001212
Story5	0.00192	0.001236
Story4	0.00198	0.00126
Story3	0.002044	0.001283
Story2	0.002103	0.001284
Story1	0.001895	0.001014
Base	0	0

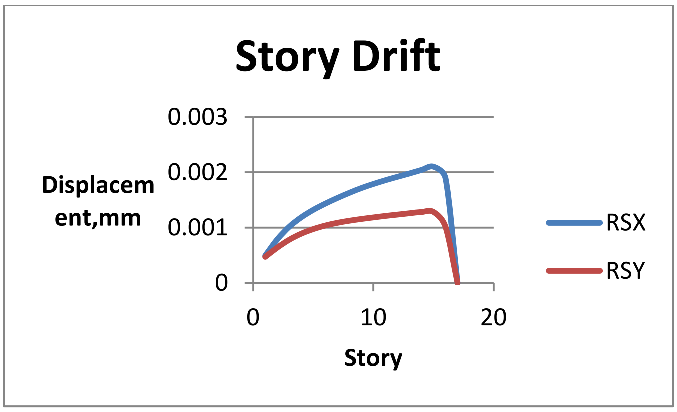

Chart 4: Story drift of building without shear wall due to response spectrum

3. CONCLUSIONS

By analyzing the buildings with shear wall and without shear wall we conclude that the maximum displacement at top story occurs in the building with no shear wall i.e. with a displacement of 59.659 mm in Y direction while in the building with shear wall the displacement is19.459 mm in the Y direction. While in X direction the displacements are shown in Table 1.5. This shows us that the minimum displacement occurs in the building with the shear wall.

The stiffness in building without shear wall is most as compared to buildings with shear walls as shown in Table 1.3 and 1.4.

Also the story drifts are found to be maximum in the building without shear wall as compared to building with shear wall which we can deduce from tables 1.7 and 1.8.

The result of the analysis concludes that the building with shear wall is much safer as compared to a building without shear wall.

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