Effect of Curtailment of Shear Wall in Bare Frame and Infilled Frame

Vikas Govalkar, P. J. Salunke, N. G. Gore

Abstract: The following report explores about concept of shear wall, bare frame and infilled structure. In past the high rise buildings structures offer some major advantages but also pose serious challenges to designers in seismic and wind loading and structure economically not feasible. Structural engineer added some other elements like braces, shear wall, dampers, and isolators to improve the performance of the structure, but structure still become uneconomically and it is also complex to design. Adding some other element is not sufficient solution to make structure economical. Now, to avoid this problem in this report talk about non structural element such as masonry wall, which are already exist elements in a structure. Structural engineer accepted that if the properties of infill wall or masonry wall considered in structural design it will helps to enhance the strength and stiffness of the structure. But in India infill wall is not considered as a structural element so here lot of research and development required regarding with consideration of infill wall in all point of view. In this report discussed about the effect of curtailment of shear wall in bare frame and infilled frame for this lot of literature survey are included regarding with this project. Some models are analysed in SADD Pro V8i such as Bare Frame, Infilled Frame, Bare Frame with shear wall, Infilled Frame with shear wall, and Bare Frame with curtailed shear wall and infilled with curtailed shear wall and get the result in terms of storey drift, bending moment, shear force and axial force. From this result understand the behavior of the structure in different condition and concluded that infilled frame structure are superior to the bare frame structure. Infill wall improve the strength and stiffness of the structure and reduce the storey drift. If shear wall provided in infilled structure then, it will help to reduce the bending moment and shear force in beam and column. It is not necessary to provide shear wall up to whole height of the structure. If shear wall are curtailed in Bare Frame and infilled Frame up to certain height then concluded that the Infilled frame gives better result Than the Bare frame.

Key words : Bare Frame, Diagonal strut, Infilled Frame, Shear wall.

I. INTRODUCTION

Most of the ancient times buildings, which do not fulfill the current seismic requirements, may suffer extensive damage or even collapse if shaken by severe ground motion. Therefore, the lot of research and development worked out in present to assess the seismic capacity of earthquake vulnerable building or earthquake damaged building for the future use. Due to this the structure becomes safer but cost of the structure is increased because lots of factors are included regarding with seismic condition in structural design to improve the strength of the structure and increase seismic capacity. The structural engineer added some other element like bracing, isolator, damper and shear wall to increase the strength and reduce cost of the structure. In structural design introducing or adding some other element is not sufficient solution to make an economical structure. If the structural engineer considered property of the non structural element in structural design along with other elements like bracing, isolator, damper, and shear wall gives better results. The non structural element which is already exists in structure but not considered in a structural design as a structural element like curtain wall. The curtain wall means partition wall which is made up of brick masonry therefore it is called as a masonry wall and also it is called as an infill wall. If the properties of the infill wall like density and modulus elasticity of brick masonry are considered in structural design, it will helps to improve the strength and stiffness of the structure. But in India infill wall is not considered as a structural element due to this, stiffness of infill wall is not estimated and not considered in design of structure. But nowadays the structural engineers and researchers are accepted that infill wall or masonry wall is effective in enhancing the strength and rigidity of the structure. But there is no any provisions for infill wall in IS code and also properties, advantages, disadvantages and limitation are not clearly define. So here necessity to required lot of research works and developments regarding with infill wall considering all point of views of structural designs. This can be done by making some models in the software like STADD ProV8i. Analyze these models in different condition such as bare frame model, RC frame with shear wall, RC frame with curtailed shear wall, Infilled frame, Infilled frame with shear wall, Infilled Frame with curtailed shear wall and calculate the storey drift, shear forces, axial forces, and moment forces. From this result understand the behavior of the structure.

II. DESCRIPTION OF STRUCTURAL MODEL

The floor plan of a typical public building is shown in fig 1. Thus, entire building space frame can be divided into a number of vertical frames with simple symmetrical plan having 6 bays (column to column distance 5m) in X-direction and 5 bays (column to column distance 4m) in Z-direction. The building is G+20 storey with ground storey height is 4m and floor to floor height is 3.35 m. The building is assumed to be located in a seismic zone III and ground floor acts as a soft storey or weak storey.

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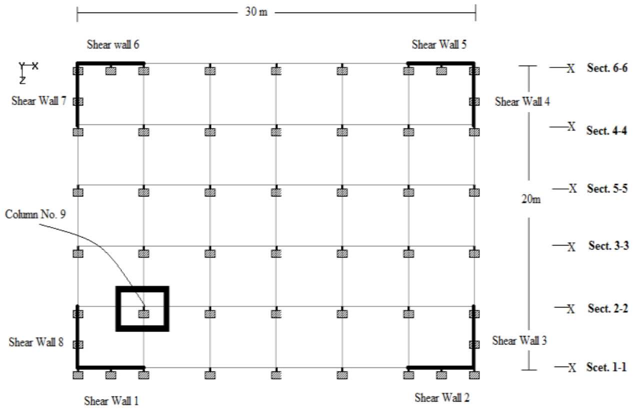


Fig.1 Plan of typical public building

It has total 12 models with different features. As per literature survey, the location of the shear wall affects the result of analysis of the building. The shear wall located in each corner of the building in both directions gives better results. Therefore, in some models shear wall provided at each corner of the building in both directions and also in this analysis in some models, here considered infill wall or masonry wall as a structural element. The geometric and material properties of the equivalent diagonal strut are required for conventional braced frame analysis to determine the increase stiffness of the infill frame. Therefore, by using equivalent diagonal strut method to covert the infill wall (without opening) into equivalent diagonal strut which is provided in both X and Z direction in models.

III. PRELIMINARY DATA

1) Type of structure = Multi-storey rigid jointed frame
2) Zone = III
3) Layout = as shown in fig.
4) Number of stories = twenty one (G+20) as shown in fig.
5) Ground storey height = 4 m.
6) Floor to floor height = 3.35 m
7) Parapet wall =150 mm thick including plaster
8) Wall thickness =230 mm thick including plaster
9) Total depth of the slab =150 mm
10) Size of all columns = 800 × 300 mm
11) Size of all beams = 600 × 230 mm
12) Size of all shear walls in X direction = 5000 × 200 mm
13) Size of all shear walls in Z direction = 4000 × 200 mm
14) Size of all infill wall which is equivalent to diagonal strut = 1000 × 230 mm
15) Unit weight of concrete is assumed 25kN/m^3
16) Unit weight of brick masonry is 20kN/m^3
17) Weight of floor finish (FF) = 1kN/m^2
18) Weight of terrace water proofing (TWF) = 1.5kN/m^2
19) Live load on floor = 4kN/m^2
20) Live load on roof = 1.75kN/m^2
21) Elastic modulus of masonry wall =13800MPa
22) Elastic modulus of concrete = 21718MPa
23) Type of soil = hard soil.

A. Equivalent Diagonal Strut

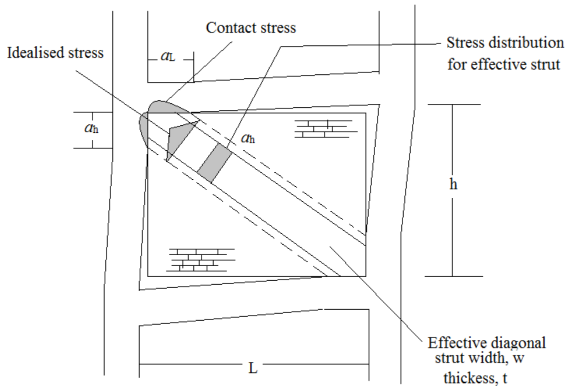


Fig.2 Equivalent diagonal strut

The geometric and material properties of the equivalent diagonal strut are required for conventional braced frame analysis to determine the increased stiffness of the infilled frame. The geometric properties are of effective width and the thickness of strut. The thickness and material properties of strut are similar to infill wall. The width of diagonal strut depends on the length of contact between wall and the columns, α_h, and between the wall and beams, α_L in (Fig. 2.) The proposed range of contact length is between one-fourth and one –tenth of the length of panel. The following equations are proposed to determine α_h and α_L, which depends on relative stiffness of the frame and infill, and on the geometry of the panel.

$$\alpha_h = \frac{\pi}{2}\sqrt[4]{\frac{E_f I_c h}{2E_m t \sin 2\theta}}$$

$$\alpha_L = \pi\sqrt[4]{\frac{E_f I_b h}{E_m t \sin 2\theta}}$$

Where,

h = height of masonry infill panel, cm.
L = length of infill panel, cm.
t = thickness of infill panel and equivalent strut, cm.
E_f = modulus of elasticity of frame material, MPa
E_m = modulus of elasticity of infill material, MPa
I_c = moment of inertia of column, cm4.
I_b = moment of inertia of beam, cm4.
θ = angle whose tangent is the infill height-to-length aspect ratio, radians.

The following equation to determine the equivalent or effective strut width w, where the strut is assumed to be subjected to uniform compressive stress

$$W = \frac{1}{2}\sqrt{\alpha_h^2 + \alpha_L^2}$$

L_d = Diagonal length of strut = $\sqrt{h^2 + L^2}$
A = Cross-sectional area of diagonal strut = w × t
And stiffness of infill is $\frac{AE_m}{L_d}\cos^2\theta$
$\theta = \tan^{-1}\frac{h}{L}$

IV. Model Considered For Analysis

To study the effect of the curtailment of the shear wall in bare frame and Infilled frame, for that total 12 models are developed and analysis in standard computer program like STADD PRO V8i.

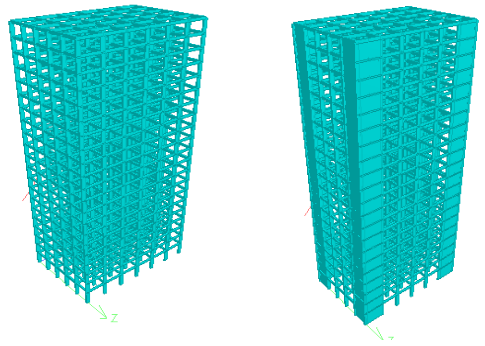


Fig.3 Bare Frame and Bare Frame with Shear Wall

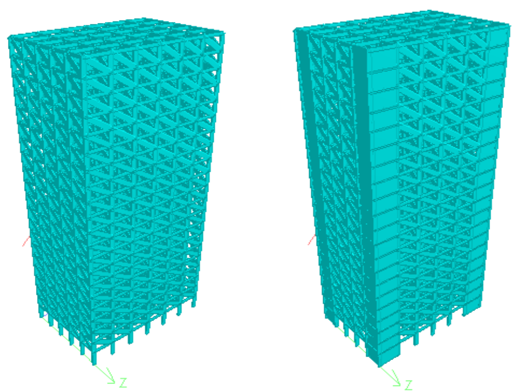


Fig.4 Infilled Frame and Infilled Frame with Shear Wall

In which Model 1,2,7 and 8 are shown in figure 3 and 4, where shear wall are provided in model 2 and 8 up to G+20. Next in remaining models shear wall are curtailed at different levels. From this different condition all models are identify by their names which is given below.

MODEL 1: Bare Frame (G+20)
MODEL 2: Bare Frame (G+20) with Shear Wall up to (G+20)
MODEL 3: Bare Frame (G+20) with Shear Wall up to (G+14)
MODEL 4: Bare Frame (G+20) with Shear Wall (G+12)
MODEL 5 Bare Frame (G+20) with Shear Wall up to (G+10)
MODEL 6 Bare Frame (G+20) with Shear Wall up to (G+8)
MODEL 7 Infilled Frame (G+20)
MODEL 8 Infilled Frame (G+20) with Shear Wall up to (G+20)
MODEL9: Infilled Frame (G+20) with Shear Wall (G+14)
MODEL 10 Infilled Frame (G+20) with Shear Wall up to (G+12)
MODEL 11 Infilled Frame (G+20) with Shear Wall up to (G+10)
MODEL 12 Infilled Frame (G+20) with Shear Wall up to (G+8)

V.ANALYSIS OF THE BUILDING

Analyses has been performed as per IS 1893 (part-1) 2002 for each model using STADD Pro V8i (computer and structures) software. Lateral load calculation and its distribution along the height is done. The seismic weight is calculated using full dead load plus 50% of live load. Wind load calculation done as per IS 875. The results obtained from analyses are compared with respect to the following parameters

LOAD COMBINATION (used in STADD Pro V8i)

1) DL-(Self Weight)
2) DL-(Member Weight i.e. Wall Load)
3) DL-(Floor Weight i.e. Slab Load)
4) LL
5) WIND-X
6) WIND-Z
7) SEISMIC-X
8) SEISMIC-Z
9) 1.5 (DL+LL)
10) 1.2(DL+LL+WIND-X)
11) 1.2(DL+LL+WIND-Z)
12) 1.2(DL+LL-WIND-X)
13) 1.2(DL+LL-WIND-Z)
14) 1.2(DL+LL+SEISMIC-X)
15) 1.2(DL+LL+SEISMIC-Z)
16) 1.2(DL+LL-SEISMIC-X)
17) 1.2(DL+LL-SEISMIC-Z)
18) 1.5(DL+WIND-X)
19) 1.5(DL+WIND-Z)
20) 1.5(DL-WIND-X)
21) 1.5(DL-WIND-Z)
22) 1.5(DL+SEISMIC-X)
23) 1.5(DL+SEISMIC-Z)
24) 1.5(DL-SEISMIC-X)
25) 1.5(DL-SEISMIC-Z)
26) 0.9(DL)+1.5(SEISMIC-X)
27) 0.9(DL)+1.5(SEISMIC-Z)
28) 0.9(DL)-1.5(SEISMIC-X)
29) 0.9(DL)-1.5(SEISMIC-Z)

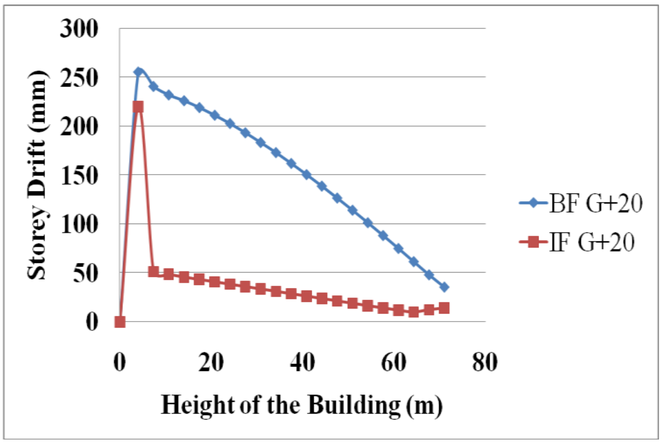
VI. RESULT AND DISCUSSION

Here standard computer program software used for analysis like STADD ProV8i. All required data provided in software and analyzed total 12 models, so get the result in terms of storey drift, bending moment, shear force and axial force. To understand the effect of curtailment of shear wall in bare frame and infilled frame for that the results are divided in to sub parts such as 1) storey drift in all models 2) bending moment and shear force in beam 3) Axial force in column. These subparts are described briefly in further section.

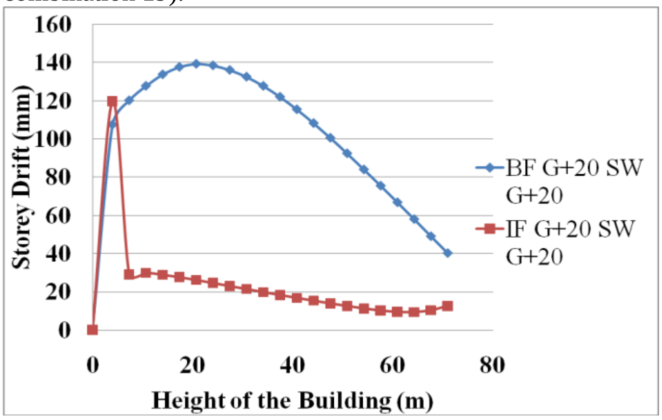
A. Storey Drift

After analyzed all models in STADD ProV8i get the results in terms of storey drift of the models, first of all consider model 1 "BARE FRAME (G+20)" because, it is a basic or traditional structure in which no other element are included or considered in structure for improving the performance of the building, so the results of the Bare frame (G+20) can compare with the results of the other models. The storey drifts at each floor height of the model 1 (i.e. Bare Frame (G+20) with all load combination) get from software, from this result understand that the load combination 19 and 21 shows maximum storey drift. So here storey drift of load combination 19 in all models can considered as a benchmark to state the comparative statement and prepared the graphs. Thus from the results six comparative graph in between bare frame and infilled frame are described in below.

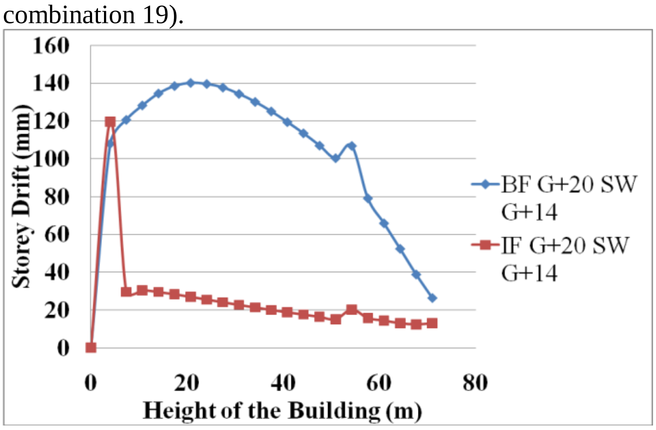
1) Graphical representation of storey drift between Bare Frame (G+20) and Infilled Frame (G+20) (Considered load combination 19)



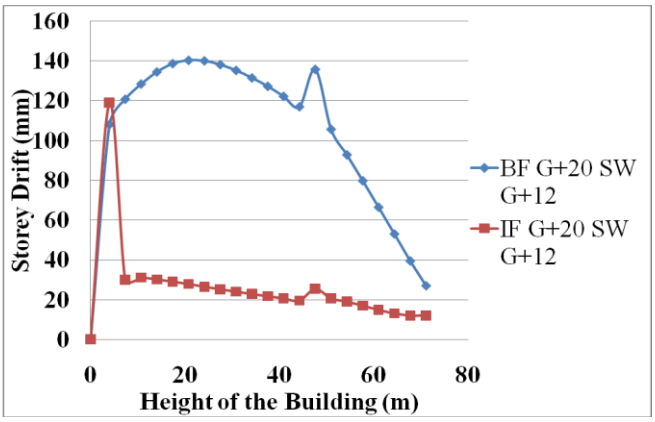
2) Graphical representation of storey drift between Bare Frame (G+20) with Shear Wall (G+20) and Infilled Frame (G+20) with Shear Wall (G+20) (Considered load combination 19).



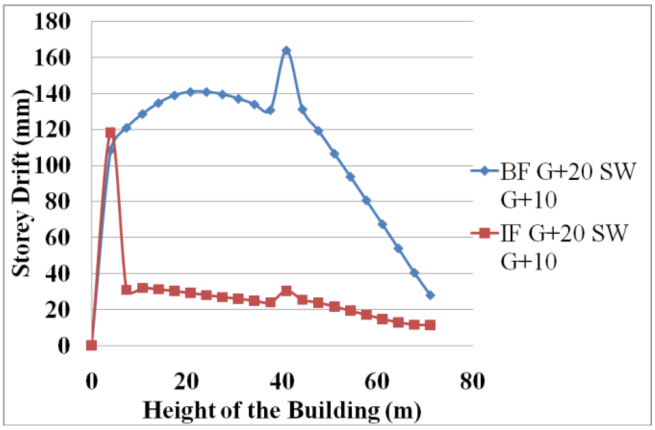
3) Graphical representation of storey drift between Bare Frame (G+20) with Shear Wall (G+14) and Infilled Frame (G+20) with Shear Wall (G+14) (Considered load combination 19).



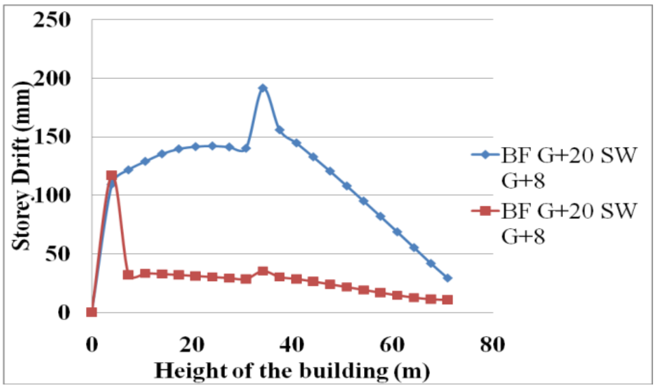
4) Graphical representation of storey drift between Bare Frame (G+20) with Shear Wall (G+12) and Infilled Frame (G+20) with Shear Wall (G+12) (Considered load combination 19).



5) Graphical representation of storey drift between Bare Frame (G+20) with Shear Wall (G+10) and Infilled Frame (G+20) with Shear Wall (G+10) (Considered load combination 19).



6) Graphical representation of storey drift between Bare Frame (G+20) with Shear Wall (G+8) and Infilled Frame (G+20) with Shear Wall (G+8) (Considered load combination 19).



B. Bending Moment and Shear Force in Beam

In this report the entire building space fame can be divided into number of vertical frames with simple symmetrical plan, so as per plan the building frame divided into total six sections (sect. 1-1, sect 2-2, sect 3-3, sect 4-4, sect 5-5, and sect 6-6) as shown in fig 1, then consider sect 2-2. From this section select the second floor beams in X direction (beam no. 168, 176, 187, 198, 209, and 220.) and get the bending moment and shear force of the load combination 19 for selected beam in all models from STADD Pro V8i software.

Thus, from this bending moment and shear force dia. can sort out the maximum positive and negative bending moment and also maximum positive and negative shear force for load combination 19, which are shown in table.

Table .1 Max +Ve Bending Moment in Bare Frame

LOAD COMBINATION 19							
Max +Ve BM		BF G+20	BF G+20 SW G+20	BF G+20 SW G+14	BF G+20 SW G+12	BF G+20 SW G+10	BF G+20 SW G+8
Beam No.	168	118.6	165.94	168.69	170.18	171.54	171.93
	176	99.78	117.19	116.02	114.92	113.21	110.74
	187	95.11	99.214	98.69	98.19	97.674	97.056
	198	95.11	99.214	98.69	98.19	97.674	97.056
	209	99.78	117.19	116.02	114.92	113.21	110.74
	220	118.6	165.94	168.69	170.18	171.54	171.93

Table .2 Maximum +Ve BM in Infilled Frame

LOAD COMBINATION 19							
Max -Ve SF		BF G+20	BF G+20 SW G+20	BF G+20 SW G+14	BF G+20 SW G+12	BF G+20 SW G+10	BF G+20 SW G+8
Beam No.	168	-91.7	-73	-71.9	-71.3	-70.74	-70.57
	176	-99.7	-92.4	-92.9	-93.33	-94	-94.9
	187	-101	-99.9	-100.2	-100.3	-100.6	-100.8
	198	-102	-104.8	-104.8	-104.3	-104.1	-103.8
	209	-104	-112.2	-111.8	-111.4	-110.7	-109.7
	220	-112	-131.7	-132.8	-133.4	-134	-134.1

Table .3 Maximum -Ve BM in bare frame

LOAD COMBINATION 19							
Max -Ve BM		BF G+20	BF G+20 SW G+20	BF G+20 SW G+14	BF G+20 SW G+12	BF G+20 SW G+10	BF G+20 SW G+8
Beam No.	168	-52.43	-59.75	-60.08	-60.51	-60.77	-60.89
	176	-51.32	-52.18	-52.25	-52.29	-52.33	-52.36
	187	-50.93	-51.43	-51.40	-51.37	-51.33	-51.27
	198	-50.93	-51.43	-51.40	-51.37	-51.33	-51.27
	209	-51.32	-52.18	-52.25	-52.29	-52.33	-52.36
	220	-52.43	-59.75	-60.08	-60.51	-60.77	-60.89

Table .4 Maximum -Ve BM in Infilled Frame

LOAD COMBINATION 19							
Max -Ve BM		IF G+20	IF G+20 SW G+20	IF G+20 SW G+14	IF G+20 SW G+12	IF G+20 SW G+10	IF G+20 SW G+8
Beam No.	168	-58.20	-55.09	-55.24	-55.45	-55.77	-56.24
	176	-57.49	-55.1	-55.36	-55.59	-55.92	-56.33
	187	-57.23	-54.68	-54.85	-55.03	-55.28	-55.59
	198	-57.02	-53.94	-54.05	-54.1	-54.37	-54.64
	209	-56.61	-52.79	-52.81	-52.87	-52.98	-53.19
	220	-60.05	-55.56	-55.56	-55.55	-55.53	-55.55

Table .5 Maximum +Ve SF in Bare Frame

LOAD COMBINATION 19							
Max +Ve SF		BF G+20	BF G+20 SW G+20	BF G+20 SW G+14	BF G+20 SW G+12	BF G+20 SW G+10	BF G+20 SW G+8
Beam No.	168	112.98	131.74	132.85	133.45	134.01	134.18
	176	104.98	112.29	111.85	111.42	110.76	109.78
	187	102.96	104.80	104.84	104.37	104.14	103.87
	198	101.80	99.96	100.21	100.39	100.61	100.89
	209	99.78	92.496	92.908	93.332	94	94.98
	220	91.77	73.017	71.909	71.303	70.747	70.572

Table .6 Maximum +Ve SF in Infilled Frame

LOAD COMBINATION 19							
Max +Ve SF		IF G+20	IF G+20 SW G+20	IF G+20 SW G+14	IF G+20 SW G+12	IF G+20 SW G+10	IF G+20 SW G+8
Beam No.	168	129.4	121.17	121.55	122.04	122.80	123.91
	176	128.7	122.92	123.35	123.84	124.51	125.37
	187	128.4	121.86	122.21	122.60	123.13	123.82
	198	128.0	120.45	120.68	120.96	121.38	122.00
	209	127.3	118.42	118.49	118.62	118.88	119.34
	220	128.5	119.33	119.36	119.37	119.39	119.47

Table .7 Maximum -Ve BM in Bare Frame

LOAD COMBINATION 19							
Max +Ve BM		IF G+20	IF G+20 SW G+20	IF G+20 SW G+14	IF G+20 SW G+12	IF G+20 SW G+10	IF G+20 SW G+8
Beam No.	168	160.8	139.7	140.7	141.9	143.8	146.6
	176	159.4	144.8	145.8	147	148.6	150.7
	187	158.7	142.2	143	144	145.3	146.9
	198	157.9	138.8	139.3	140	141.1	142.6
	209	156.1	134	134.2	134.5	135.1	136.3
	220	156.2	133.9	134	134	134.1	134.3

C. Axial Force in Column

In this project for understand the effect of curtailment of the shear wall in bare frame and infilled frame; study the behavior of the column in all models. Total 12 models are analysed in STADD ProV8i and all models have same plan of building, therefore the position and numbers of columns are same in all plan of models which is shown in figure.

After analysis consider the column no. 9 shown in fig.1 from all models for load combination 19 and get the maximum axial forces of columns at every floor from software, which is given in table no 9 and 10.

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Table .8 Maximum -Ve BM in Infilled Frame

LOAD COMBINATION 19							
Max -Ve SF		IF G+20	IF G+20 SW G+20	IF G+20 SW G+14	IF G+20 SW G+12	IF G+20 SW G+10	IF G+20 SW G+8
Beam No.	168	-75.2	-83.58	-83.2	-82.71	-81.95	-80.85
	176	-76	-81.83	-81.4	-80.92	-80.24	-79.38
	187	-76.3	-82.89	-82.54	-82.15	-81.62	-80.94
	198	-76.6	-84.3	-84.07	-83.79	-83.37	-82.76
	209	-77.4	-86.34	-86.26	-86.13	-85.88	-85.41
	220	-76.2	-85.42	-85.39	-85.39	-85.36	-85.28

Table .9 Maximum axial force of Column no. 9 of bare frame

LOAD COMBINATION 19							
Maximum Axial force KN		BF G+20	BF G+20 SW G+20	BF G+20 SW G+14	BF G+20 SW G+12	BF G+20 SW G+10	BF G+20 SW G+8
(column no 9) Beam no.	22	7034.58	5665.39	5781.1	5871.9	6000.01	6171.43
	123	6665.06	5298.98	5416.68	5508.77	5638.39	5811.23
	236	6302.69	4955.45	5076.76	5171.21	5303.55	5478.81
	349	5945.54	4627.66	4754.22	4852.03	4988.15	5166.55
	462	5592.18	4313.67	4447.11	4549.21	4689.98	4871.77
	575	5242.41	4011.73	4135.63	4260.84	4406.88	4591.55
	688	4895.79	3720.19	3872.08	3985.04	4136.32	4322.55
	801	4551.97	3437.61	3600.87	3719.94	3875.97	4060.86
	914	4210.67	3162.69	3338.52	3463.63	3622.91	3801.72
	1027	3871.56	2894.32	3083.54	3214.06	3373.76	3539.55
	1140	3534.44	2631.48	2834.41	2968.83	3124.3	3264.87
	1253	3199.04	2373.3	2589.43	2725.05	2869.51	2981.46
	1366	2865.14	2118.99	2346.65	2479.05	2600.59	2690.32
	1479	2532.5	1867.84	2103.63	2226.41	2321.89	2392.94
	1592	2200.89	1619.23	1857.28	1959.23	2034.67	2090.48
	1705	1870.09	1372.57	1603.86	1682.12	1740.64	1783.9
	1818	1539.85	1127.32	1336.56	1396.56	1441.12	1473.98
	1931	1209.91	882.961	1060.06	1104.36	1137.2	1161.34
	2044	880.038	639.081	776.141	807.033	829.83	846.52
	2157	549.969	395.289	486.871	505.919	519.859	529.96
	2270	219.322	150.48	193.303	201.527	207.417	211.562

Table .10 Maximum axial force of Column no. 9 of Infilled frame

LOAD COMBINATION 19							
Maximum Axial force KN		IF G+20	IF G+20 SW G+20	IF G+20 SW G+14	IF G+20 SW G+12	IF G+20 SW G+10	IF G+20 SW G+8
(column no 9) Beam no.	22	6869.64	5084.89	5150.47	5228.56	5346.43	5517.31
	123	6336.33	4566.61	4631.08	4709.03	4827.2	4999.4
	236	6035.45	4284.29	4350.87	4431.69	4554.72	4735.33
	349	5694.75	3993.09	4063.47	4149.19	4280.54	4475.29
	462	5361.99	3723.21	3799.06	3891.72	4034.96	4249.94
	575	5030.23	3464.36	3547.42	3649.29	3808.52	4050.54
	688	4699.78	3213.51	3305.78	3419.57	3599.68	3875.95
	801	4370.5	2968.92	3027.82	3201.84	3408.69	3725.53

	914	4042.39	2729.81	2848.33	2996.74	3236.85	3595.09
	1027	3715.52	2495.7	2632.68	2805.6	3085.05	3458.14
	1140	3389.97	2266.2	2426.62	2629.88	2950.59	3271.18
	1253	3065.86	2040.94	2231.21	2470.6	2810.3	3026.35
	1366	2743.31	1819.54	2047.59	2325.99	2623.39	2745.46
	1479	2422.45	1601.65	1876.77	2176.51	2381.23	2444.24
	1592	2103.46	1387.03	1717.97	1985.41	2104.23	2132.66
	1705	1786.57	1175.62	1555.96	1743.96	1807.52	1816.7
	1818	1472.07	967.743	1359.24	1470.72	1507.04	1500.05
	1931	1160.26	764.094	1119.39	1179.78	1190.88	1184.9
	2044	850.908	564.978	851.781	879.895	880.155	872.069
	2157	543.723	371.711	561.11	575.42	569.97	561.455
	2270	228.983	173.694	259.467	256.72	249.498	242.221

VII. CONCLUDING REMARK

- When infill wall considered as a structural element in infill frame it will helps to reduce the storey drift drastically than the bare frame.
- Curtailment of the shear wall in bare frame and infilled frame does not affect to the storey drift results But in bare frame at top storey when shear wall curtailed the storey drift slightly increased while in infilled frame it is reduces.
- All infilled frame models not gives better results in weak storey where infilled wall not considered, but when shear wall provided in bare frame, storey drift of weak storey reduced at certain level and also same results shows in weak storey of infilled frame included with shear wall.
- It is observed that the +Ve and –Ve bending moment of the beam in bare frame is less as compare to infilled frame.
- shear wall provided in bare frame, the +Ve and -Ve bending moments increased at corner beams but in infilled frame +Ve and -Ve bending moments decreased at corner beams
- While the shear wall curtailed up to certain height the bending moment at corner beams still goes on increased. Opposite to this in infilled frame, when shear wall are provided then bending moment decreased at corner beams of the frame.
- The +Ve shear force maximum in infilled frame than bare frame and –Ve shear force is maximum in bare frame than the infilled frame.
- When shear wall curtailed in bare frame and infilled frame, the result shows approximately same in both models. It means the curtailment of the shear wall can be done in both cases.
- Shear wall can curtailed up to 50% of the height of the structure but practically shear wall must be provided more than 50% of the height of the structure. It is observed that in infilled frame shear wall can be provided less than 50% of the height of the structure.
- The axial force of the bare frame is maximum than the infilled frame. But when shear wall provided in bare frame and infilled frame it will help to reduce axial force significantly in bare frame and infilled frame. When shear wall curtailed at different levels it shows axial force also increased gradually in both case
- The infilled frame is superior to the bare frame. When shear wall provided and curtailed the infilled frame shows better results than the bare frame.

VIII. FUTURE SCOPE

In this project understand the behavior of the shear wall in infilled frame and bare frame and also observed that when shear wall curtailed at different levels in bare frame and infilled frame with different aspects such as properties of infill wall, behavior of the shear wall and infilled wall, behavior of the columns and beams in structure. These aspects to be well understood and should be considered during design structure. The above work can be further extended with comparison of different types of condition such as,

- Varying width of shear wall system.
- Change the position of the shear wall system.
- Shear wall provided with asymmetrical structure.
- Infill frame without soft storey.

The work done in the above project can be further continued for floors more than 20 and observe the behavior of these structural systems under seismic effect. Also experimental study on behavior of structure with different loading and other factors can be done for better understanding and develop better analysis and design procedure.

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