SEISMIC RESPONSE STUDY OF MULTI-STORIED REINFORCED CONCRETE BUILDING WITH FLUID VISCOUS DAMPERS

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Abstract:

The main aim of our study is to resist the vibrations in the structures from failure of building which are caused during the earthquake and to transmit the loads to the earth ground by which we gain strength and durable to the structure which acts due to the lateral loads. The dampers are introduced in the design of earthquake resistant structures by which it reduces the vibrations. There are different types of dampers in the earthquake resistant structures. The damper FVD250 is used in the analysis. The software used for the analysis is ETABS 2016. Using time history analysis and pushover analysis the results are compared with and without adding FVD. By the recent researches and recent examines the square columns are highly resistant against earthquake than that of rectangular columns in both the analysis done.th results are compared with the Base Shear for Time History.

Key words: **fluid viscous dampers, pushover analysis, time history analysis response spectrum curves, base reactions, storey maximum and average lateral displacements, base shear, Eigen values.**

1. INTRODUCTION

1.1 General

From the past decades the world is suffering from natural disasters like earthquakes which results to the severe damage to human life. Due to this many Historical structures, residential buildings turns to failure. Nowadays there is a lot of demand to the tall structures for residence as well as for commercial purposes.

To overcome these failures dampers are introduced in the structures which are very useful in reducing the vibrations in the structures caused during the earthquake from collapsing which turns into failure. The fluid Viscous Dampers are constructed with high technology and it acts as a tool in structures. The lateral load which emerges out from the structures is directly transferred to foundation using the dampers.

From the decades the research and studies are going on theoretically as well as practically to find out the solution for the failure of structures due to earthquake by which the divided into two categories namely nearly by occurring earthquakes and far occurring earthquakes which are measured based on the distance. The earthquake happens due to the vibrations taking place inside the earth ground due to some natural calamities. Many types of equipments are introduced to check the magnitude and amplitude of the earthquake. The recent earthquake that are caused heavy damage to the society are Gujarat Earthquake (2001),Nepal Earthquake(2015) killed nearly 9,000 people and injured nearly 22,000 according to Richter scale 7.3 was registered, Mexico earthquake (2017), Japan Earthquake (2017),Taiwan Earthquake(2018). These earthquakes are depends upon the faults in the seismic vibrations. To overcome this many measurements have been taken place.

1.2 DAMPING

Damping is defined as the energy of failure in the response with respect to the time period. Energy parameters which influences factors such as radiation of soil, materials, reinforcement etc. when the magnitudes are reduced the shape of the response curve do not change when subjected to damping.

1.3 IMPORTANCE OF DAMPING

The importance of damping is to reduce the vibrations in the structures which are caused during earthquake and to resist from collapsing the structure.

1.4 FLUID VISCOUS DAMPER

In viscous dampers the viscous fluid which is placed inside the cylinder, upon the process the energy is released. In case of setting up, flexibility and organization in their sizes with any other members is also acceptable .This damper has many of the advantages in terms of retrofitting and designing.

Viscous dampers types are linked in 3ways to the structure:
1. When they are fitted through diagonal braces.
2. Linking dampers through stern pericardial braces.
3. In foundation types or in the floor types these dampers are installed using seismic isolation.

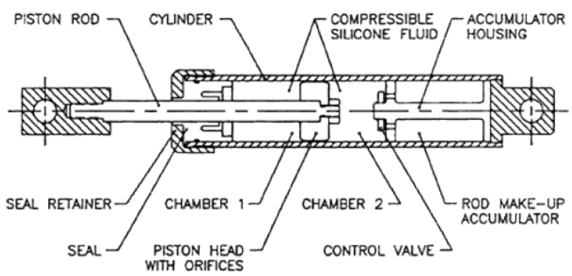


Fig 2: Longitudinal Section of Viscous Damper

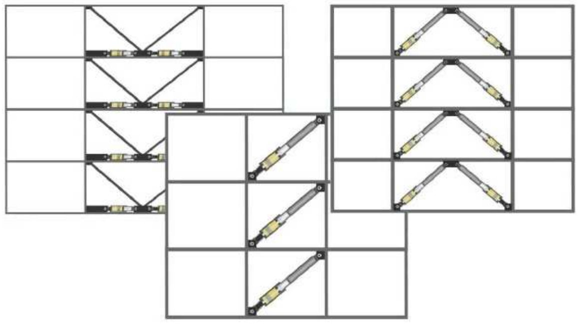


Fig3: Viscous Damper Installation Methods

2. OBJECTIVES

1. To evaluate the building with and without FVD by displacement.
2. To evaluate the building with and without FVD by Base Shear.
3. To evaluate the building with and without FVD by Pushover Analysis.
4. To evaluate the building with and without FVD by Time History Analysis.

3. METHODOLOGY AND ANALYSIS

The structural buildings are of four different types. The building is of 20 stories. the software ETABS 2016 is used for modelling and analysis of the building.

1. Square building with square columns (SBSC).
2. Square building with rectangular columns (SBRC).
3. Rectangular building with square columns (RBSC).
4. Rectangular building with rectangular columns (RBRC).

3.1 STRUCTURAL PARAMETERS

1. Columns sizes
    1. Square columns =800x800 mm
    2. Rectangular columns = 1000x400 mm
2. Beam sizes
    1. Beam = 600x400 mm
3. Slab size
    1. Slab thickness = 150 mm
4. Dead load = 1.5KN/m^2
5. Live load = 4KN/m^2
6. Frame load is nothing but dead loads = 5.25KN/m^2
7. Damping = 5
8. Z = 0.24
9. Soil Type = II
10. Grade M30 and steel Fe415

3.3 Models Description

3.3.1 Square buildings with Square columns (SBSC)

In this type of building which has square shape columns in the building having 6m of spacing between the columns and the floor to floor height is about three meter and the length of the structure is above 20 floors. The building has 8 rows in X direction and 8 rows in Y direction. The figures are shown below

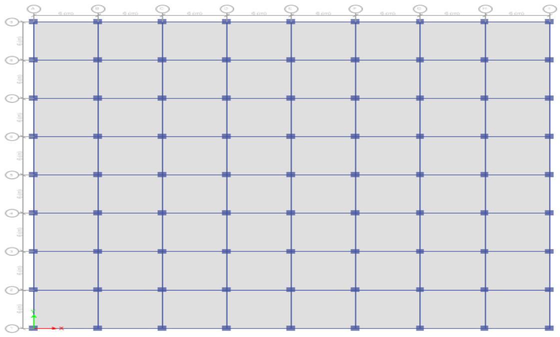


Fig. 3 Typical Building Plan

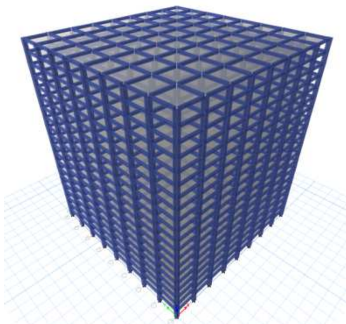


Fig. 4 Isometric view of Model

3.3.2 Rectangular building with square columns (RBSC)

In this type of building which has square shaped columns but it is a rectangular shaped building. In the building 6m of spacing is provided between the columns and the floor to floor height is three meters and the length of the structure is above 20 floors. The building has 10 rows in X direction and 5 rows in Y direction

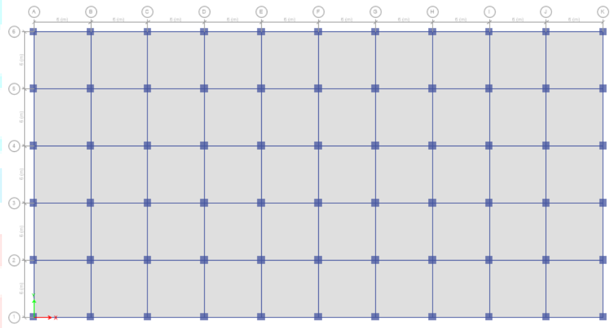


Fig. 5 Typical Building Plan

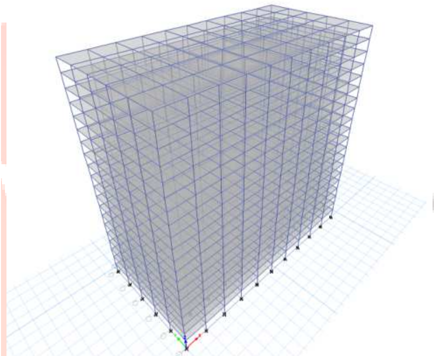


Fig. 6 Isometric view of Mode

3.4 Modelling of dampers

3.4.1 SBSC with added dampers

In this type of building the dampers are added to the structural building which helps in reducing vibrations caused during earthquake. The building is provided with 6m of spacing between the columns and the floor to floor height is three meters and the length of the structure is above 20 floors. The building has 8 rows in X direction and 8 rows in Y direction.

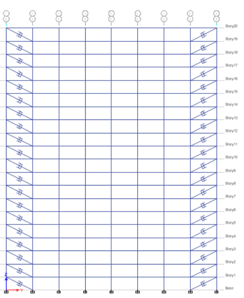


Fig7: SBSC among FVD at Outside Corners Elevation.

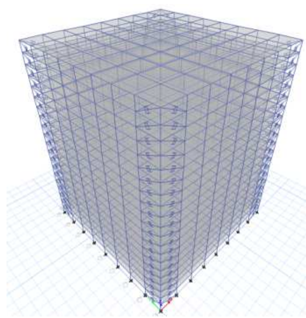
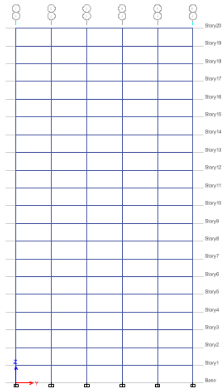


Fig8: SBSC among FVD on Outside Corners Isometric View.

3.4.2 RBSC with added Dampers

In this type of building the dampers are added to the structural building which helps in reducing vibrations caused during earthquake. The building is provided with 6m of spacing between the columns and the floor to floor height is three meters and the length of the structure is above 20 floors. The building has 10 rows in X direction and 5 rows in Y direction.



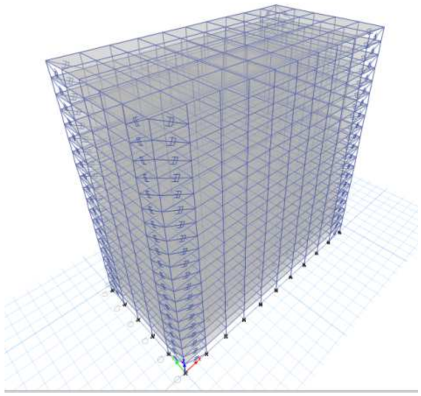


Fig9: SBSC among FVD at Outside Corners Elevation. **Fig10: SBSC among FVD on Outside Corners Isometric View.**

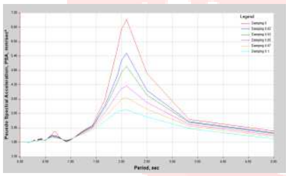
4 RESULTS AND DISCUSSIONS

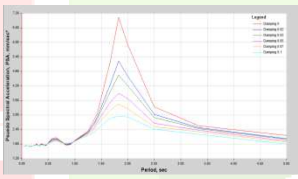
In this section, the results of all the models have been discussed. The following five parameters of buildings are compared.

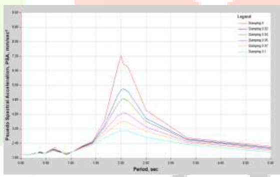
1. Base reactions.
2. TH response spectrum curve.
3. Modal participating mass ratios.
4. Modal periods and frequencies.
5. Storey Maximum and Average Lateral Displacements.

4. Time History

4.1 Response Spectrum Curves







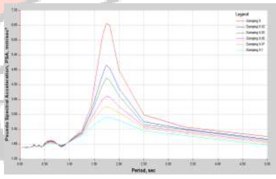


Fig 12.SBSC without FVD **fig.13 SBSC with FVD** **fig14.RBSC without FVD** **fig.15 RBSC with FVD**

4. Base reactions

Load Case/Combo	FX kN	FY kN	FZ kN	MX KN-m	MY kN-m	MZ kN-m
Dead	0	0	145416.724	2617501	-2617501	0
Live	0	0	61560	1108080	-1108080	0
EQ X 1	-4762.2697	0	0	0	-132733	85720.854
EQ Y 2	0	-4762.2697	0	132733.3411	0	-85720.854
WIND X 1	-8551.11	0	0	-5.19E-02	-125897	145020.41
WIND X 2	8551.11	0	0	5.19E-02	125897.32	-145020
WIND Y 1	0	-6556.28	0	125897.32	5.19E-02	-145020
WIND Y 2	0	6556.28	0	125897	-5.19E-02	145020
TH-X Max	3265.12	0.0000212	0	0.0000154	41568.2365	36987.369
TH-X Min	-2987.87	-0.0000205	0	-0.0000101	-37065.23	-54698.36
TH-Y Max	0.0001	3265.12	0	37065.23	0.0002	54698.36
TH-Y Min	-0.0001	-2987.87	0	-41568.2365	-0.0002	-36987.369
PUSH X Max	17346.55	0	0	0.00000133	33338.82	0
PUSH X Min	0	-8.615E-07	0	0	0	-29234.23
PUSH Y Max	0	13369.21	0	0	0	294.2323
PUSH Y Min	-0.000003035	0	0	-33338.82	-0.000001928	0

Table 1.Base reactions of SBSC without FVD

Load Case/Combo	FX kN	FY kN	FZ kN	MX KN-m	MY kN-m	MZ kN-m
Dead	0	0	137967.03	1655604	-3725110	0
Live	0	0	61560	738720	-1662120	0
EQ X 1	-2694.881	0	0	0	-75091.9756	32338.572
EQ Y 2	0	-1988.5795	0	55411.11	0	-53691.646
WIND X 1	-5741.36	0	0	-6.15E-07	89754.12	65852.54
WIND X 2	5741.36	0	0	6.15E-07	89754.12	-65852.54
WIND Y 1	0	-10774.87	0	199521.9	8.00E-02	-325147.07
WIND Y 2	0	10774.87	0	-199521	-8.00E-02	325147
TH-X Max	2282.44	0.0002	0	0.0002	38744.22	21369.29
TH-X Min	-1752.07	-0.000055	0	-0.0002	-31225.50	-27112.96
TH-Y Max	0	3120.20	0	39665.88	0.0000016	85721.23
TH-Y Min	0	-2003.22	0	-45587.11	-0.0000015	-58741.02
PUSH X Max	11237.32	0	0	0	408.9704	0
PUSH X Min	0	0	0	-320112	0	-219.1085
PUSH Y Max	0	21605.61	0	0	0	55635.08
PUSH Y Min	0	0	0	-36502.39	0	0

Table 2.Base reactions of SBSC with FVD

Load Case/Combo	FX kN	FY kN	FZ kN	MX KN-m	MY kN-m	MZ kN-m
Dead	0	0	146434.4359	1757213	-3953730	0
Live	0	0	61560	738720	-1662120	0
EQ X	-4922.2025	0	0	0	-137189	59066.4295
EQ Y	0	-4671.672	0	130206.808	0	-126135
WIND X 1	-6123.45	0	0	0	-89564.12	130207.32
WIND X 2	6123.45	0	0	0	89564.12	-130207.32
WIND Y 1	0	-13674.77	0	21874.63	8.98E-06	-356841.14
WIND Y 2	0	13674.77	0	-21874	8.98E-06	356841
TH-X Max	2963.77	0.0002	0	0.0002	43156.88	21697.32
TH-X Min	-1874.21	-0.0001	0	-0.0002	-35115.74	-34925.67
TH-Y Max	0.0001	2639.32	0	33982.25	0.0001	63113.85
TH-Y Min	-0.0001	-1856.22	0	-41736.36	-0.0001	-49332.33
PUSH X Max	22983.23	0	0	0	333.9764	0
PUSH X Min	0	0	0	0	0	-193.9677
PUSH Y Max	0	16566.37	0	0	6.089E-07	44721.88
PUSH Y Min	0	0	0	-34443.82	0	0

Table 3.Base reactions of RBSC without FVD

Load Case/Combo	FX kN	FY kN	FZ kN	MX KN-m	MY kN-m	MZ kN-m
Dead	-0.000002684	-0.000001488	165291.0832	2975239	-2975239	0.00002152
Live	-0.000002167	-0.000001229	60975.1162	1097552	-1097552	0.00001688
EQ X 1	-3469.7299	0	6.106E-07	0.00001083	-216125	62455.1375
EQ Y 1	-3469.7299	0	6.106E-07	0.00001083	-216125	62455.1375
WIND X 1	1541.6987	0	0	0	2614.8741	-25887.5698
WIND X 2	-1541.6987	0	0	0	-2641.8741	25887.5698
WIND Y 1	0	2087.5547	0	-1754.55	0	17540.7452
WIND Y 2	0	-2087.5547	0	1754.55	0	-17540.7452
TH-X Max	1936.88	0	0	0.00000988	28321.9821	51236.1985
TH-X Min	-3106.5697	0	0	-0.0000095	-36554.3922	-27665.5211
TH-Y Max	0	1677.5264	0	33720.02	0	21939.6653
TH-Y Min	0	-2368.114	0	-29365.33	0	-36987.3212
PUSH X Max	0	0	0	0	316.7451	0
PUSH X Min	-563.39	0	41.3698	-10.30	-1125.36	0
PUSH Y Max	0	0	0	-339.9588	0	0
PUSH Y Min	0	-2456.08	-369.21	0	-693.21	44220.33

Table 4.Base reactions of RBSC with FVD

4.3 Modal participating mass ratios.

Table5: SBSC – MPMR values without FVD

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	2.1	0.2071	0.586	0	0.2071	0.586	0
Modal	2	2.1	0.586	0.2071	0	0.7931	0.7931	0
Modal	3	1.914	0	0	0	0.7931	0.7931	0
Modal	4	0.685	0.00001075	0.0965	0	0.7931	0.8896	0
Modal	5	0.685	0.0965	0.00001075	0	0.8897	0.8897	0
Modal	6	0.626	0	0	0	0.8897	0.8897	0
Modal	7	0.394	0.0073	0.0284	0	0.897	0.9181	0
Modal	8	0.394	0.0284	0.0073	0	0.9254	0.9254	0
Modal	9	0.362	0	0	0	0.9254	0.9254	0
Modal	10	0.269	0.0063	0.0134	0	0.9316	0.9387	0
Modal	11	0.269	0.0134	0.0063	0	0.945	0.945	0
Modal	12	0.247	0	0	0	0.945	0.945	0

Table 6: RBSC – MPMR values without FVD

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	2.143	0	0.789	0	0	0.789	0
Modal	2	2.045	0.7944	0	0	0.7944	0.789	0
Modal	3	1.936	0	0	0	0.7944	0.789	0
Modal	4	0.697	0	0.0995	0	0.7944	0.8885	0
Modal	5	0.668	0.0956	0	0	0.89	0.8885	0
Modal	6	0.632	0	0	0	0.89	0.8885	0
Modal	7	0.397	0	0.036	0	0.89	0.9245	0
Modal	8	0.385	0.0356	0	0	0.9256	0.9245	0
Modal	9	0.363	0	0	0	0.9256	0.9245	0
Modal	10	0.27	0	0.0198	0	0.9256	0.9444	0
Modal	11	0.263	0.0196	0	0	0.9451	0.9444	0
Modal	12	0.248	0	0	0	0.9451	0.9444	0

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	1.825	0.0557	0.6669	0	0.0557	0.6669	0
Modal	2	1.825	0.6669	0.0557	0	0.7227	0.7227	0
Modal	3	1.368	0	0	0	0.7227	0.7227	0
Modal	4	0.555	0.0048	0.1187	0	0.7275	0.8413	0
Modal	5	0.555	0.1187	0.0048	0	0.8462	0.8462	0
Modal	6	0.399	0	0	0	0.8462	0.8462	0
Modal	7	0.296	0.0002	0.0441	0	0.8463	0.8903	0
Modal	8	0.296	0.0441	0.0002	0	0.8904	0.8904	0
Modal	9	0.206	0	0	0	0.8904	0.8904	0
Modal	10	0.197	0.0152	0.0077	0	0.9056	0.8982	0
Modal	11	0.197	0.0077	0.0152	0	0.9134	0.9134	0
Modal	12	0.147	0.0057	0.007	0	0.9191	0.9204	0

Table7: SBSC – MPMR values with FVD

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	1.814	0	0.7059	0	0	0.7059	0
Modal	2	1.743	0.7114	0	0	0.7114	0.7059	0
Modal	3	1.339	0	0	0	0.7114	0.7059	0
Modal	4	0.542	0	0.1305	0	0.7114	0.8364	0
Modal	5	0.524	0.1261	0	0	0.8375	0.8364	0
Modal	6	0.381	0	0	0	0.8375	0.8364	0
Modal	7	0.287	0	0.0447	0	0.8375	0.8812	0
Modal	8	0.276	0.0451	0	0	0.8825	0.8812	0
Modal	9	0.194	0	0	0	0.8825	0.8812	0
Modal	10	0.193	0	0.0228	0	0.8825	0.904	0
Modal	11	0.182	0.0234	0	0	0.9059	0.904	0
Modal	12	0.146	0	0.0124	0	0.9059	0.9164	0

Table 8: RBSC – MPMR values with FVD

4.4 MODAL PEROIDS AND FREQUENCIES

Table9: SBRC modal periods And frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigen value rad²/sec²
Modal	1	2.1	0.476	2.9924	8.9543
Modal	2	2.1	0.476	2.9924	8.9543
Modal	3	1.914	0.522	3.2819	10.771
Modal	4	0.685	1.459	9.1686	84.0631
Modal	5	0.685	1.459	9.1686	84.0631
Modal	6	0.626	1.597	10.035	100.7004
Modal	7	0.394	2.539	15.9553	254.5714
Modal	8	0.394	2.539	15.9553	254.5714
Modal	9	0.362	2.763	17.3584	301.3155
Modal	10	0.269	3.723	23.3915	547.1642
Modal	11	0.269	3.723	23.3915	547.1642
Modal	12	0.247	4.048	25.4357	646.9764

Table 10.RBSC modal frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigen value rad²/sec²
Modal	1	2.143	0.467	2.9317	8.5947
Modal	2	2.045	0.489	3.0728	9.4422
Modal	3	1.936	0.516	3.245	10.5302
Modal	4	0.697	1.435	9.0155	81.2791
Modal	5	0.668	1.497	9.4055	88.4631
Modal	6	0.632	1.582	9.9426	98.8545
Modal	7	0.397	2.517	15.8156	250.1333
Modal	8	0.385	2.598	16.3267	266.5621
Modal	9	0.363	2.751	17.2861	298.8109
Modal	10	0.27	3.701	23.2527	540.689
Modal	11	0.263	3.807	23.9193	572.1346
Modal	12	0.248	4.039	25.3764	643.9593

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigen value rad^2/sec^2
Modal	1	1.825	0.548	3.4433	11.8564
Modal	2	1.825	0.548	3.4433	11.8564
Modal	3	1.368	0.731	4.5941	21.1056
Modal	4	0.555	1.802	11.3209	128.1637
Modal	5	0.555	1.802	11.3209	128.1637
Modal	6	0.399	2.509	15.7664	248.5779
Modal	7	0.296	3.376	21.2141	450.0368
Modal	8	0.296	3.376	21.2141	450.0368
Modal	9	0.206	4.844	30.4373	926.4271
Modal	10	0.197	5.068	31.8411	1013.854
Modal	11	0.197	5.068	31.8411	1013.854

Table9: SBRC modal periods And frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigen value rad^2/sec^2
Modal	1	1.814	0.551	3.463	11.9922
Modal	2	1.743	0.574	3.6051	12.9969
Modal	3	1.339	0.747	4.6937	22.0304
Modal	4	0.542	1.847	11.6021	134.6098
Modal	5	0.524	1.908	11.9858	143.6599
Modal	6	0.381	2.628	16.5092	272.5545
Modal	7	0.287	3.482	21.876	478.5586
Modal	8	0.276	3.621	22.7501	517.5686
Modal	9	0.194	5.145	32.3277	1045.08
Modal	10	0.193	5.17	32.4871	1055.411
Modal	11	0.182	5.481	34.441	1186.179
Modal	12	0.146	6.857	43.0822	1856.08

Table 10.RBSC modal frequencies

4.5 Storey Maximum and Average Lateral Displacements

Table11: Stories at max Displacement at Push X

Storey	SBSC		SBRC		RBSC		RBRC	
	No damp	FVD	No damp	FVD	No damp	FVD	No damp	FVD
Storey 20	149.8	18.2	145.2	23.5	223.2	20.1	149.3	31.4
Storey 19	142.5	17.8	139.1	22	212.2	19	145.2	29.3
Storey 18	136.9	16.3	135.1	19.9	201.3	17.9	139.1	27.6
Storey 17	132.7	15.2	130.2	18.2	195.2	16.9	135.7	25.5
Storey 16	130.8	14.9	123.4	16.7	189.3	15.2	130.3	23.1
Storey 15	125.1	13.2	109.8	15.2	185.2	13.7	125.4	19.4
Storey 14	121.6	12.6	103.6	13.6	179.5	12.9	119.7	17.6
Storey 13	116.5	11.2	100.2	11.2	171.3	11.5	111.2	15.2
Storey 12	111.6	10.8	97	9	165.2	10.6	102.5	13.1
Storey 11	106.8	9.2	92	7.9	159.6	9.5	99.6	13.7
Storey 10	100.6	8.5	86	6.1	150	8.5	94.8	11.9
Storey 9	106.6	7.8	81.2	5.7	146.4	7.9	93.6	9.8
Storey 8	102.7	6.1	73.6	4.8	141.7	6.3	90.3	8.3
Storey 7	98.5	5.3	71.3	3.6	132.8	5.3	84.7	7
Storey 6	87.9	4.2	69.1	2.5	126.7	4.4	81.2	5.4
Storey 5	74.1	3.3	54.3	1.9	102.3	3.1	73.6	4.2
Storey 4	65.3	2.2	43.3	1.2	84.8	1.9	61.9	2.5
Storey 3	50.9	1.1	29	0.6	61.9	1.1	50	1.3
Storey 2	31.8	0.3	15.6	0.1	34.2	0.2	27.9	0.2
Storey 1	10.3	0	6.1	0	11.2	0	9.3	0
Base	0	0	0	0	0	0	0	0

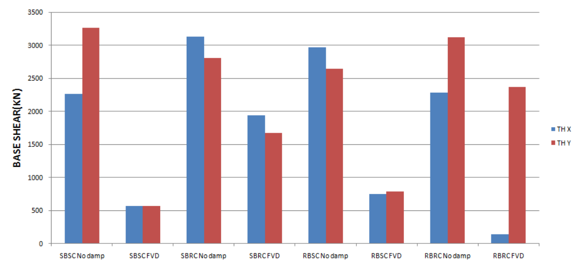
Table12: Stories at max Displacement at Push Y

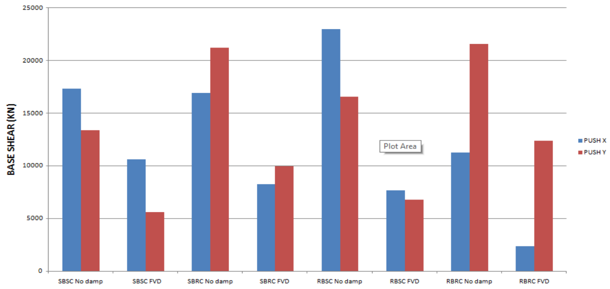
Storey	SBSC		SBRC		RBSC		RBRC	
	No damp	FVD	No damp	FVD	No damp	FVD	No damp	FVD
Storey 20	84.6	73.6	140.2	185.6	145.3	75.6	152.3	259.7
Storey 19	82.3	72.1	132.2	178.2	139.7	73.2	146.1	251.3
Storey 18	80.1	70.3	125.2	176.1	132.8	69.5	141.2	241.3
Storey 17	78.2	68.9	123.3	173.2	130.5	65.4	135.4	235.4
Storey 16	76.9	67.2	120.3	170.9	126.2	62.1	130.6	229.4
Storey 15	75.6	66.1	111.3	166.2	123.4	59.7	123.6	223.1
Storey 14	74.2	64.2	109.6	163.2	112.3	55.3	111.2	216.8
Storey 13	73.6	62.3	107.3	160.2	109.8	53.4	106.4	213.4
Storey 12	72	58.8	106.5	153.6	103.5	50.2	99.8	211.7
Storey 11	70.3	55.4	102.3	152.8	101.9	47.3	95.6	200.5
Storey 10	66.4	52.7	98.6	149.8	100	45.6	88.7	190.9
Storey 9	64.5	46.9	95.6	126.2	92.5	41	84.6	170.3
Storey 8	60	40.2	90.3	109	85.6	39.8	79.2	140.5
Storey 7	58.1	33.2	87	95.2	82.6	37	72.1	125
Storey 6	52.8	25.6	74.6	70.3	72.3	28.7	64.5	96.3
Storey 5	42.3	19.5	65.2	53	64.5	15.5	50	65.2
Storey 4	32.5	13.6	51	34.2	50.2	10.3	40.9	46.5
Storey 3	25	7.8	37.5	15.3	35.3	5.9	28.4	25
Storey 2	15.6	3.2	22.3	7.6	23.6	2.3	15.2	9.6
Storey 1	5.9	0	7.6	0	8.6	0	5.6	0
Base	0	0	0	0	0	0	0	0

4.6 BASE SHEAR

The results are compared with Base Shear for time history due to TH-X are 76.69% for SBSC, 55.24% for SBRC, 75.71% for RBSC lastly 90.36% for RBRC.

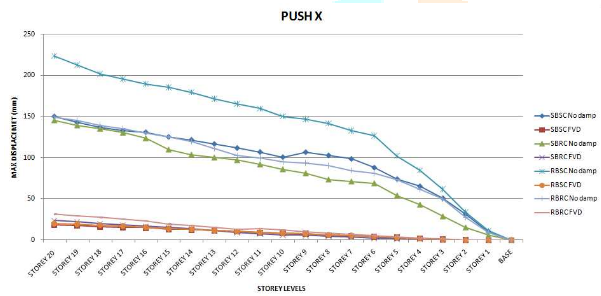
The results are compared with Base Shear for time history due to TH-Y are 75.87% for SBSC, 61.63% for SBRC, 70.17% for RBSC lastly 30.82% for RBRC.

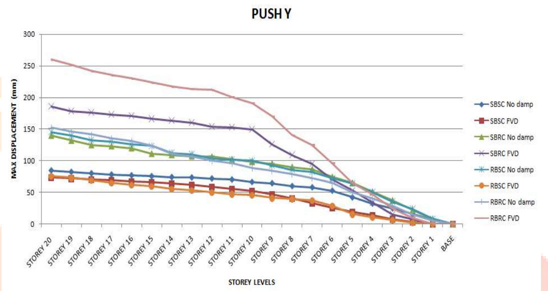




Storey Max or Average Displacements

The results are compared with storey max or average displacements due to PUSH X and PUSH Y. the displacements values are 93.73% for SBSC, 92.71% for SBRC, 95.35% for RBSC lastly 89.64% for RBRC. The results which we got are acceptable. The graphs are shown above





6.1 CONCLUSIONS

The results of different types of analysis have been tabulated and the analysis results are discussed below

1. From the analysis results it is found that the building with square columns are more economical and efficient than the building with Rectangular columns.
2. The Eigen values are increased to 70-80% when FVD 250 is applied.
3. The storey max displacement is up to 80% when FVD 250 is applied.
4. The Base Shear in time history is nearly 80% when FVD 250 is applied.

6.2 RECOMMNEDATIONS

1. The damper of higher level of FVD 500 or more can be used for the structures.
2. The analysis can be done for irregular plan buildings..
3. Other types of dampers in different zones can be analysed to check their efficiency in reducing the vibrations

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