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Seismic Evaluation of RC Asymmetric Building Consisting of Floating Column and Passive Device

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Abstract*: The abrupt slip on a fault that causes earthquakes causes the ground to tremble. Earthquakes have been happening frequently all around the planet over the past several decades. Nearly all earthquakes cause direct damage to the buildings, which results in the destruction of life and property. Due to lack of following structural guidelines which lead to collapse, so carried out modern seismic reduction techniques base isolation, shear wall, dampers, which helps in earthquake resistant structures for better performance during seismic events. The energy dissipation devices are easy to installed in existing or new building with low construction cost.So past studied has been done on fluid viscous damper, Tune mass damper, viscous damper with multi storied regular building. In present study comparing with fluid viscous damper in RC Asymmetric layout C & H shape having G+12storey building with consisting Floating column at alternative floor. Time-History analysis has been done by using two different earthquakes taken from PEER ground motion having high and low Pga value. To learn the analytical effects like change in Axial force, Bending moment of Floating column with fluid viscous damper at different location. Also, Optimization of Damper position has been carried out using parameters like storey displacement, storey drift, storey stiffness*

Keywords: Time-History analysis, Asymmetric Layout, Floating column, Fluid Viscous Damper

I. INTRODUCTION

From a very long time, natural forces have been always disturbing the living survival. Even though human being always trying to control the nature and coexist with it, from all other disasters, most destructive and hazardous disaster is earthquake. Earthquakes occur due to release in energy on the earth surface which creates seismic forces. They occur with different intensities, sometimes they are so trivial that they do not recognize but sometimes they are so strong due to which high storied structure may also collapse or cause major damage to infrastructure and kill thousands of people or the whole city may get destroyed in some fraction of time.

In order to minimize damage caused by earthquakes and other dangerous that could affect structures and infrastructures, such as severe winds, storms, hurricanes, and tsunamis, more and more energy dissipation devices and vibration-control systems are being utilized. With the use of seismic dampers, a structure is able to withstand high levels of input energy while minimizing dangerous deflections, stresses, and accelerations to nearby structures and inhabitants.

In viscous dampers, seismic energy is absorbed by silicone-based fluid passing between piston-cylinder arrangement which is inert, non-toxic, non-flammable, non-ageing and thermally stable.FVD works mainly on the principle of fluid flow via orifices. When the structure is subjected to external ground motions due to the earthquake, the piston inside the cylinder moves and pushes the viscous fluid via orifices, and the fluid passes from chamber 2 to chamber 1 with large velocity and gets transferred into kinetic energy.

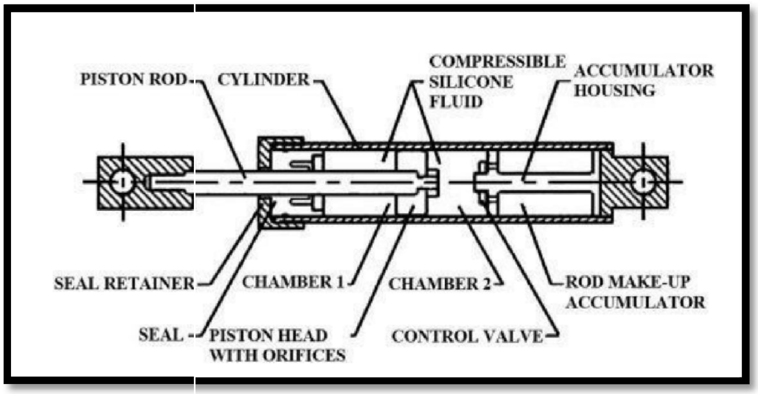

Figure. Fluid viscous Damper

Floating column is nothing but a vertical member or element that rests on a beam, but doesn't transfer load directly to the foundation. Generally, the columns rest on the foundation to transfer loads coming from slabs and beams, floating column acts as a point load on the beam and this beam transfers the load to the column below it, that beam is called a transfer beam.

II. OBJECTIVE OF STUDY

- To evaluate behavior of RC Asymmetric building with effect of floating column.
- To learn the impact of Fluid viscous damper on different plan layout building with and without floating column under seismic force.

III. METHODOLOGY

To learn the Effectiveness of Fluid viscous Damper with RC Asymmetric building with C-shape & H-shape of G+12 storey building considered. Optimization of damper location is carried out in building by providing dampers at various location. The work is carried out by providing Floating column at various locations.

Analysis is done by Response Spectrum and Time-History Analysis with Two ground motion Loma Prieta & Kobe Earthquake using ETABS software. Study the essential Indian standard provision relating models and Results comparison of parameters like base shear, storey displacement, storey drift, storey stiffness, bending moment and axial capacity of column.

MODELING DETAILS

Table 1 Model Parameters

No of Story	G+12
Plan Dimension	35m x 40m
Length of Bays in X & Y direction	5m & 4m
Grade of steel	Fe500
Grade of Concrete	M30
Column dimension	500mm x 650mm
External wall thickness	230 mm
Ground storey height	3.5 m
Typical storey height	3 m

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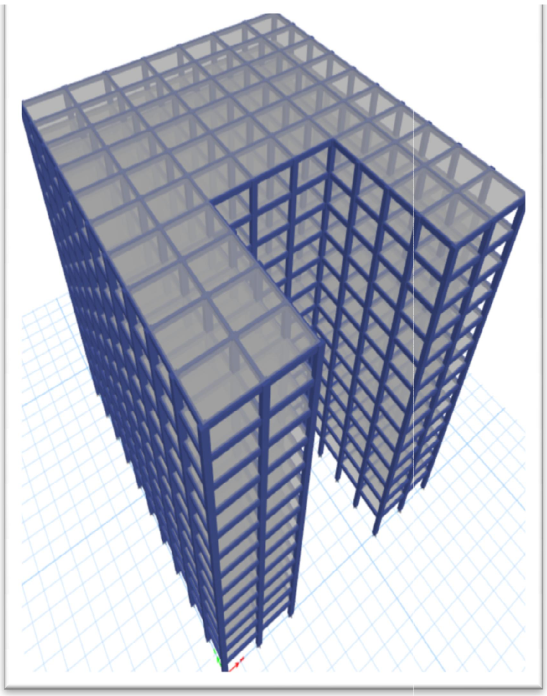

Figure 1.1 C-Shape Layout

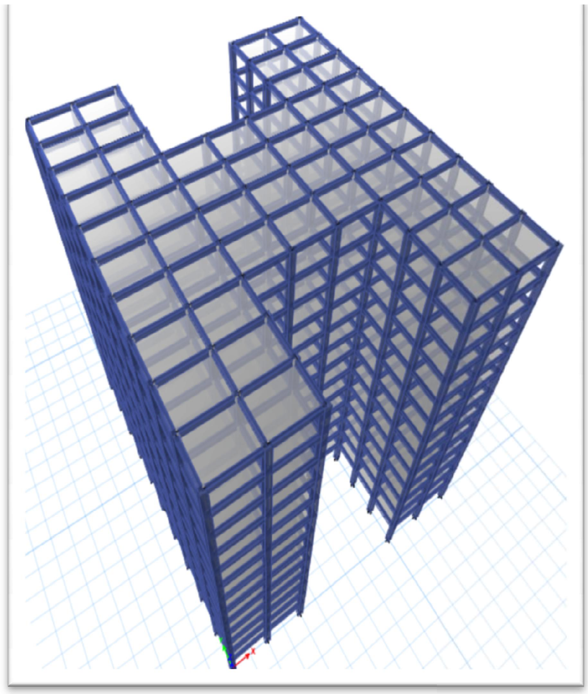

Figure 1.2 H-shape layout

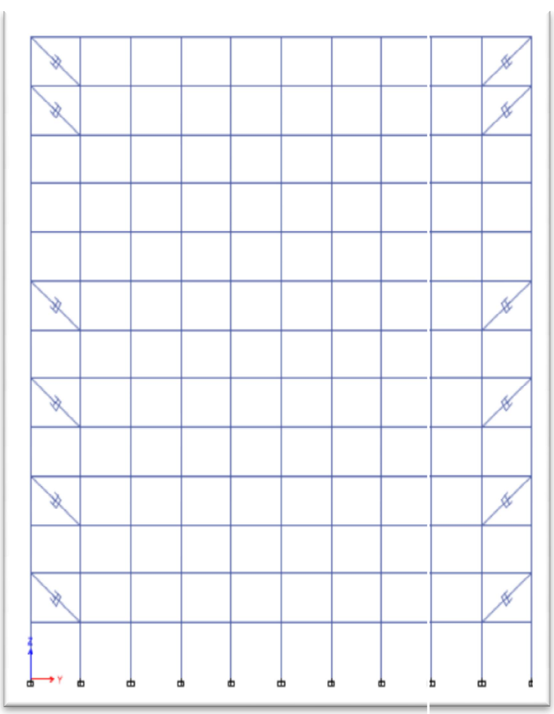

Figure 1.3C-Shape layout Damper position-1

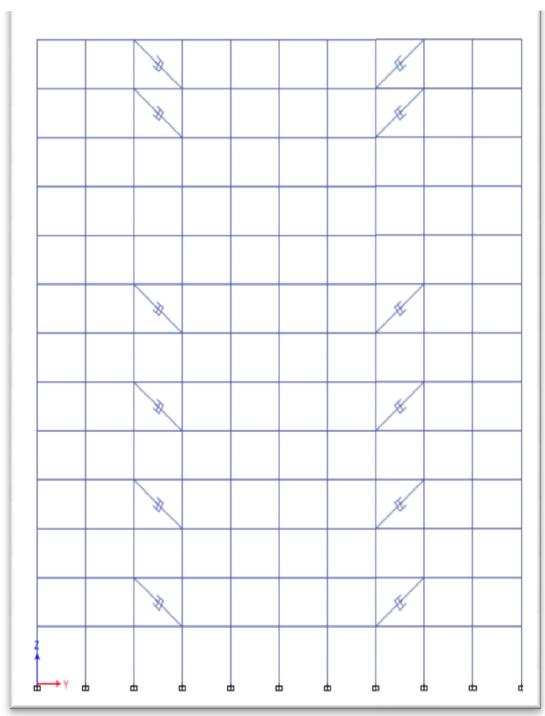

Figure 1.4 C-shape layout Damper position-2

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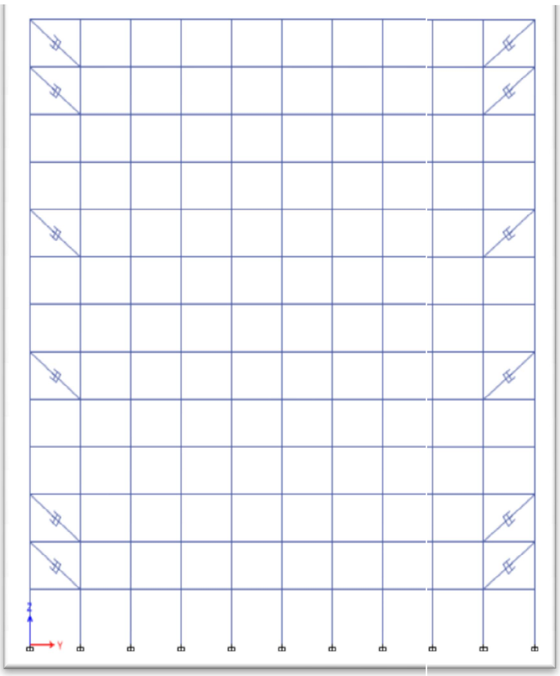

Figure 1.5 H-Shape layout Damper position-1

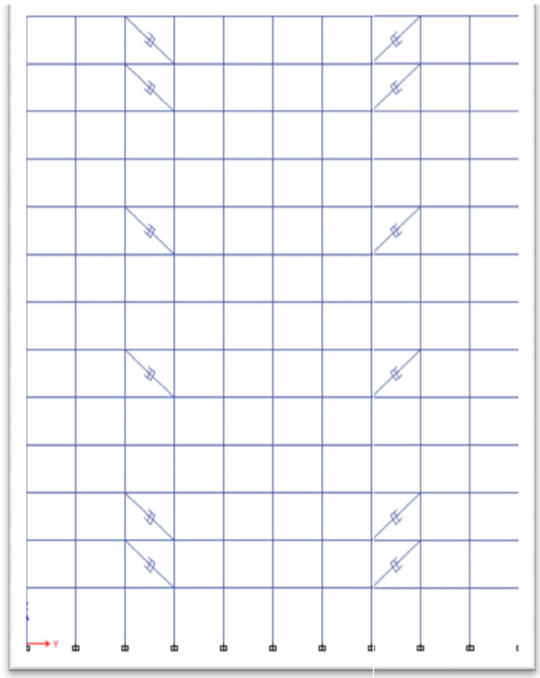

Figure 1.6 H-shape layout Damper position-2

IV. RESULTS AND DISCUSSIONS

1. Storey Displacement (mm)

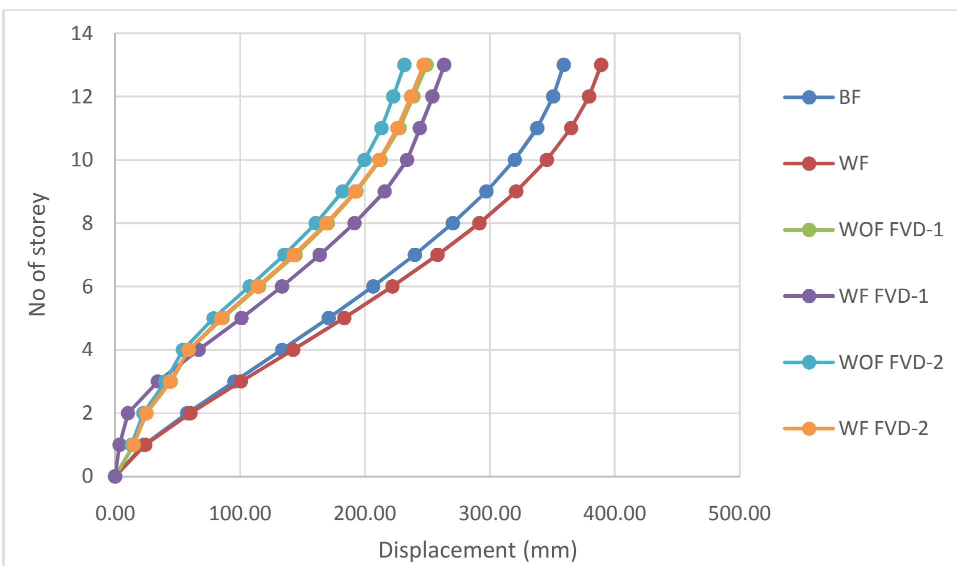

Figure1.6 Maximum Storey Displacement for C-Shape

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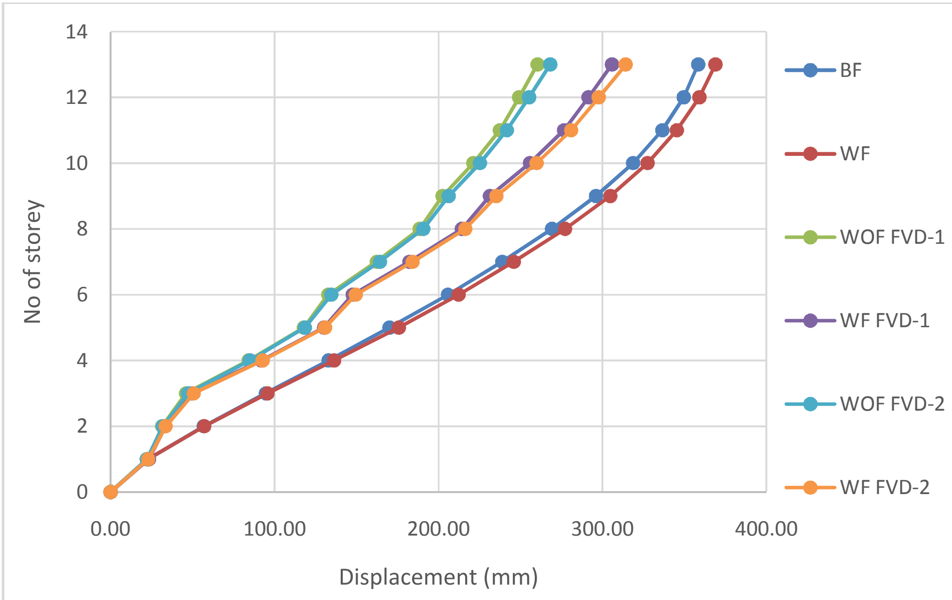

Figure1.7 Maximum Storey Displacement for H-Shape

2. Storey Drift (Unitless)

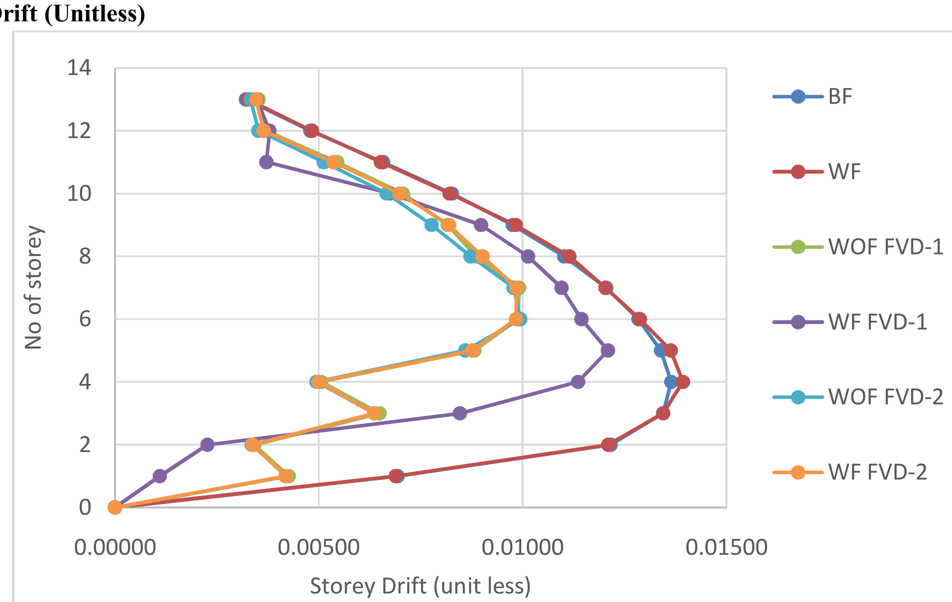

Figure1.8 Storey drift of C-Shape layout

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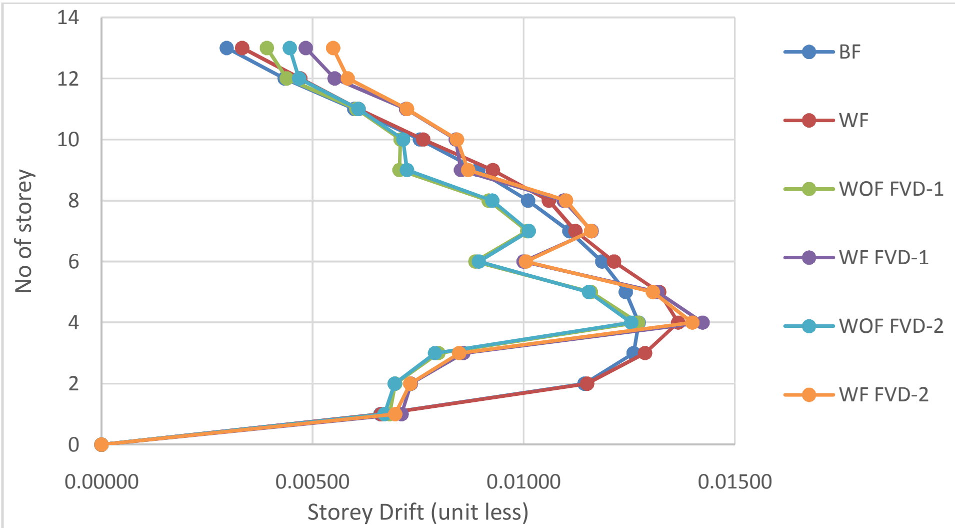

Figure 1.9 Storey drift of H-Shape layout

3. Storey Stiffness

Table 2. Storey stiffness of C-Shape Layout

G+12 Storey C Shape Building Storey Stiffness (kN/m)						
	WITHOUT DAMPER		DAMPER POSITION-1		DAMPER POSITION-2	
STOREY	BF	WF	WOF FVD-1	WF FVD-1	WOF FVD-2	WF FVD-2
12	740294	748692	1462770	1130745	1476452	1420446
11	1096328	1084738	659114	1416217	663502	650949
10	1166734	1163043	1353828	354862	1360618	1356730
9	1175104	1164620	1244502	1405073	1250295	1235582
8	1171748	1141664	1211025	1212964	1216310	1180450
7	1171057	1137850	1206787	1172421	1211259	1170169
6	1174158	1168220	1223578	1195709	1228620	1217850
5	1178790	1170232	1316546	1208650	1320731	1311985
4	1187286	1156499	1673235	1218843	1680144	1642436
3	1208389	1172726	713895	1331424	713522	758580
2	1260399	1258137	2623806	1889144	2634957	2635495
1	1410669	1416840	1694665	2427672	1697133	1694013
G.F.	2092003	2108165	3559131	2918923	3574539	3583625

Table 3 Storey stiffness of H-shape layout

G+12 Storey H Shape Building Storey Stiffness(kN/m)						
	WITHOUT DAMPER		DAMPER POSITION-1		DAMPER POSITION-2	
STOREY	BF	WF	WOF FVD-1	WF FVD-1	WOF FVD-2	WF FVD-2
12	690821	772801	850349	861921	847061	851329
11	1024751	988491	790456	746036	839225	789572
10	1084576	1063260	1154511	1144485	1147023	1137251
9	1092624	1061540	1194046	1171946	1188871	1166618
8	1094814	1029526	653325	579673	686791	615177
7	1095692	1024556	1222845	1158503	1216396	1151559
6	1097003	1074135	1228158	1205283	1225409	1202555
5	1103286	1074855	540911	509451	563745	533267
4	1115100	1049457	1295409	1224458	1294711	1223553
3	1135729	1062206	1326165	1249590	1332745	1255769
2	1185519	1169337	762251	729551	746620	713869
1	1335381	1329346	931448	935517	933388	937629
G.F.	2009438	2005157	2449715	2447014	2458478	2456445

4. Axial force and Bending moment.

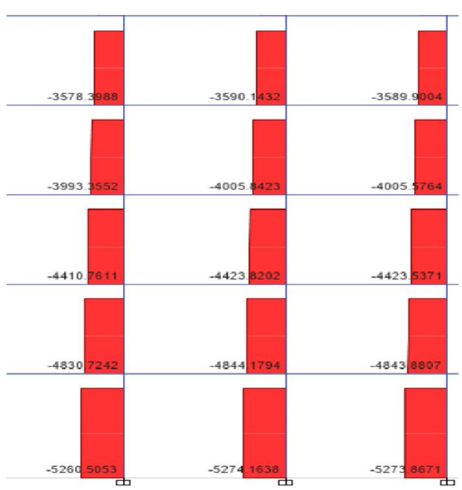

Figure 1.10 Without floating column

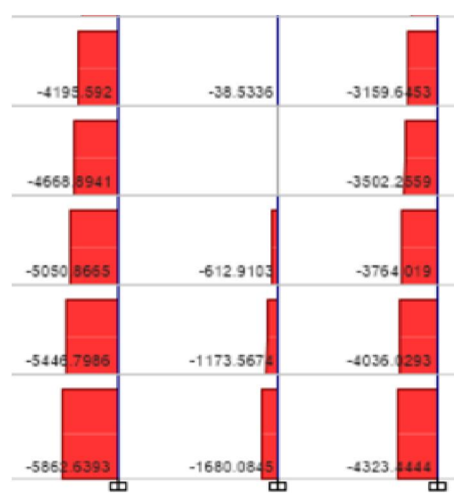

Figure 1.11 With floating column

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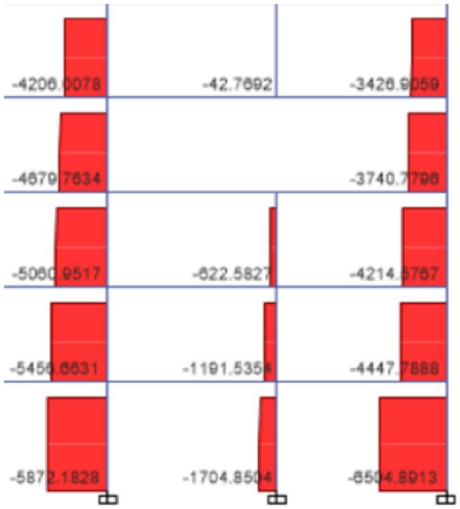

Figure 1.12 With floating column& FVD

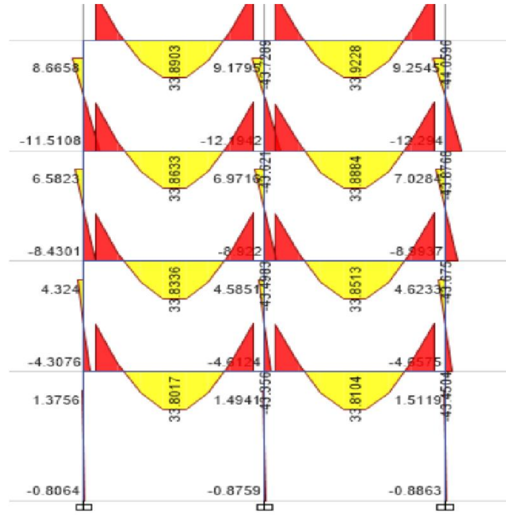

Figure 1.13 Without floating column

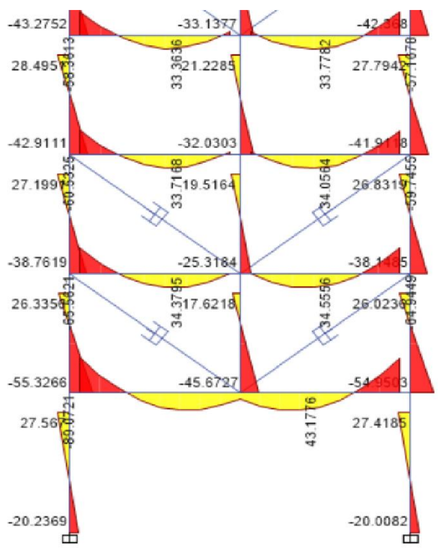

Figure 1.14 With floating column

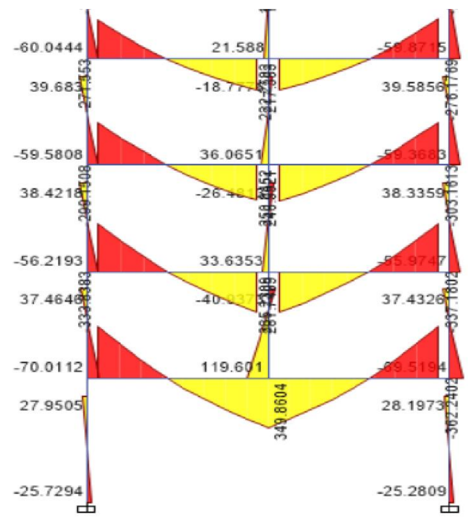

Figure 1.15 With floating column& FVD

V. CONCLUSION

C-Shape (G+12 Storey)

- Storey displacement increased by 3 to 8% in with Floating column as compared to Bare Frame, But Greatly decreased by Adding FVDs at different position, Hence FVD-2 gives better response up to 5% to 56% as compared to With Floating column models in Kobe earthquake.
- After Providing Floating column, Storey Stiffness reduced up to 2 to 6% as compared to Bare Frame and greatly extent up to 5 to 66% while adding FVD-2 in building.
- Time period reduction is up to 15% by providing FVD-2 position building.
- Bending moment decreased up to 25% after FVDs in building as compared to With Floating column storey.
- Storey Drift achieved peak response at 3rd storey by 3% in With Floating column as compared to Bare Frame, hence adding Damping System, FVD-2 decreased up to 60% better than With Floating column models in Kobe earthquake.

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H-Shape (G+12 & G+15 Storey)

- Storey displacement rose by 2 to 15% in With Floating column as compared to Bare Frame. When adding FVDs at various positions, the storey displacement fell significantly. As a result, FVD-1 responds better to the Kobe earthquake is up to 3% to 48% as compared to With Floating column models.
- When floating columns were added, storey stiffness decreased by 2 to 6% when compared to Bare Frame and significantly increased by 5 to 52% when FVD-2 was added to buildings.
- Time period reduction is up to 11% by providing FVD-1 position in building.
- Bending moment decreased by 22% after FVDs in building as compared to With Floating column storey.
- With the addition of a Damping System, Storey Drift increased peak response at the 5th storey in With Floating column as compared to Bare Frame up to 7%. As a result, FVD-1 dropped up to 4 to 33% better than with floating column models during the Kobe earthquake.

Optimization of Damper Location

- FVD-2 reduced Storey displacement and Storey drift better as compared to FVD-1 in Kobe earthquake in C shape G+12 storey building as compared to H-shape.
- Also, FVD-2 gives better response in G+12 storey is increased by stiffness in C & H shape building at particular floating column storey.
- FVD-2 reduced better time periods & Frequencies in with and without floating column models in C shape as compared to FVD-1 in H-shape.
- So, Optimized Damper location is FVD-2 in internal bays gives all over greater responses to control all parameters in high pga (Kobe) earthquake.

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