Analysis of seismic behavior of multi-storied RCC building with fluid viscous dampers using Etabs

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Abstract: **In the present study fluid viscous dampers (FVD) are used to evaluate the response of RC buildings. The main task of a structure is to bear the lateral loads and transfer them to the foundation. Since the lateral loads imposed on a structure are dynamic in nature, they cause vibrations in the structure. In order to have earthquake resistant structures, fluid viscous dampers have been used. In present study G+7 Story buildings is compared with the seismic effect of structure with dampers and without dampers. In the present study the software ETABS 2017 have been used. Using response spectrum analyses the response of the RC building considered in the present study is evaluated and compared with and without FVD. This study investigates the influence of mechanical control on structural systems through strategically applying reliable dampers that can modulate the response of building.**

Index Terms: **Viscous Dampers, RCC Building, ETABS**

I. INTRODUCTION

Natural disasters are inevitable and it is not possible to get full control over them. The history of human civilization reveals that man has been combating with natural disasters from its origin but natural disasters like floods, cyclones, earthquakes, volcanic eruptions have various times not only disturbed the normal life pattern but also caused huge losses to life and property and interrupted the process of development. With the technological advancement man tried to combat with these natural disasters through various ways like developing early warning systems for disasters, adopting new prevention measures, proper relief and rescue measures. But unfortunately it is not true for all natural disasters. Earthquakes are one of such disaster that is related with ongoing tectonic process; it suddenly comes for seconds and causes great loss of life and property. So earthquake disaster prevention and reduction strategy is a global concern today. Hazard maps indicating seismic zones in seismic code are revised from time to time which leads to additional base shear demand on existing buildings.

The viscous fluid dampers (VFD) are the more applied tools for controlling responses of the structures. These tools are applied based on different construction technologies in order to decrease the structural responses to the seismic excitation. Though over the recent years heavy costs have been paid for accurate recognition of force of an earthquake in the research institutes of the world with the purpose of decreasing its damage, the increasing need for more research studies on the effects resulted from the earthquake is felt in the theoretical and laboratorial scales. Over the last fifty years, the earthquakes are categorized into two groups of near-field earthquakes and far-field earthquakes based on the distance of the place of recording the earthquake from the fault. Later, this definition was modified and other factors also influenced this categorization. Over the recent years, the research studies concentrated on the study of impacts of ground motion in the near-field earthquake on the structural performance.

A. Statement of project

Utility of building : Residential building
No of stories : G+7
Type of construction : R.C.C framed structure
Types of walls : Brick wall

B. Geometry Details

Height of building : 25m
Height of the floor : 3m

C. Description of Members used:-

Column Sizes: 1) Rectangular Columns = 230*530mm and 230mm*450mm.
Beam Sizes: 230mm*380mm and 230*450mm
Slab Thickness: 125mm
Grade of Concrete and Steel: M30; Fe 500 Steel

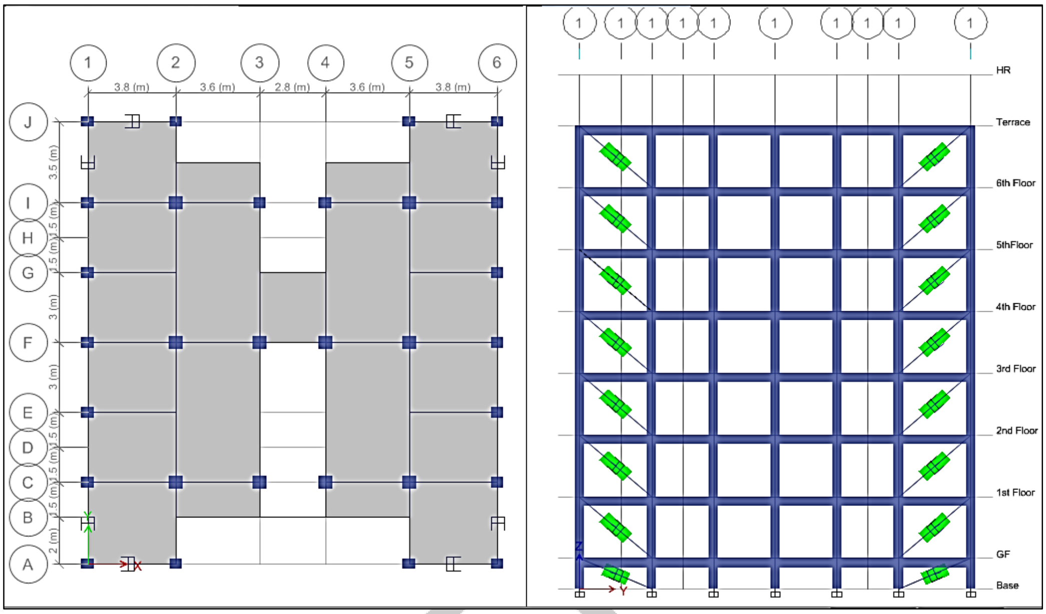


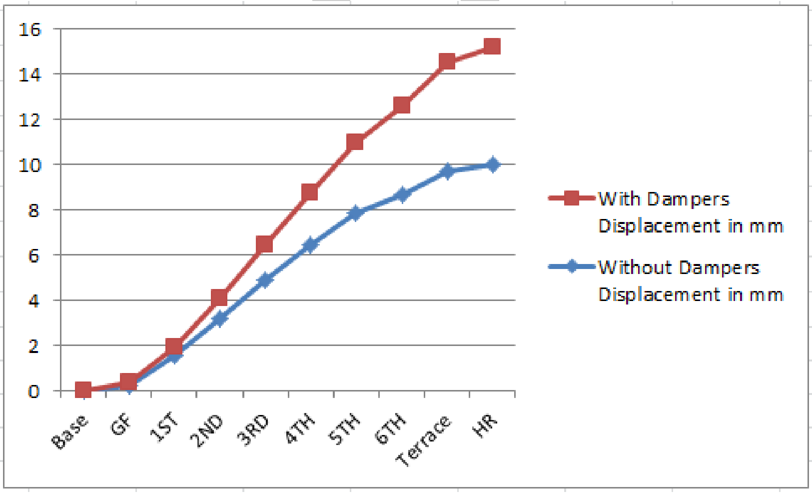
Figure 1: model considered in ETABS

II. RESULTS AND DISCUSSION

A. Story wise Displacement Variation

Table 2: Story wise Displacement Variation

Story	Without Dampers	With Dampers
Base	0	0
GF	0.2353	0.1558
1ST	1.5531	0.3949
2ND	3.2062	0.8725
3RD	4.885	1.5285
4TH	6.4677	2.296
5TH	7.8567	3.1189
6TH	8.6552	3.9554
Terrace	9.6986	4.8025
HR	10	5.2



Graph 1: Story wise Displacement Variation.

B. Base Reactions

Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. Calculations of base shear (V) depend on:

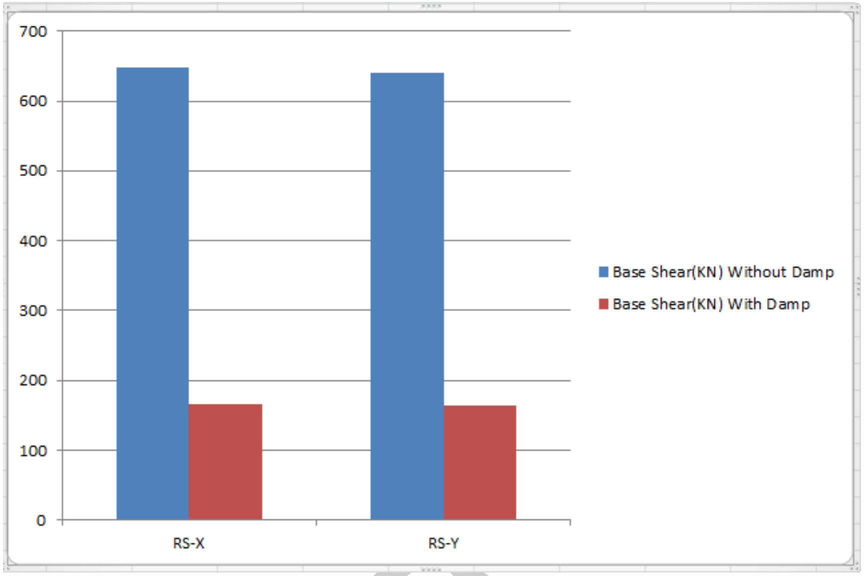
- Soil conditions at the site
- Proximity to potential sources of seismic activity (such as geological faults)
- Probability of significant seismic ground motion
- The level of ductility and over-strength associated with various structural configurations and the total weight of the structure
- The fundamental (natural) period of vibration of the structure when subjected to dynamic loading..

Table 3: Base Reaction of Building without Dampers

Load Case/Combo	**FX Kn**	**FY kN**	**FZ kN**	**MX kN-m**	**MY kN-m**	**MZ kN-m**
Dead	0	0	35668.4443	336151.404	-313882.310	0
Live	0	0	5762.2	53981	-50707.36	0
EQ-X	-809.5175	0	0	0	-14474.0344	7553.898
EQ-Y	0	-804.6322	0	14386.6859	0	-7080.7632
WX1	-518.2776	0	0	0	-7273.6768	4873.3263
WX2	518.2776	0	0	0	7273.6768	-4873.3263
WY1	0	-472.6698	0	6552.2489	0	-4159.4942
WY2	0	472.6698	0	-6552.2489	0	4159.4942
RSX max	647.6609	651.3254	0	10158.9945	10156.6524	8340.6261
RSY max	640.1158	643.7377	0	10040.6455	10038.3306	8243.4604

Table 4: Base Reaction of Building with Dampers

Load Case/Combo	**FX kN**	**FY kN**	**FZ kN**	**MX kN-m**	**MY kN-m**	**MZ kN-m**
Dead	0	-2.2736	53053.5232	497050.645	-466871.004	-20.0075
Live	0	-0.6458	5706.1238	53449.2751	-50213.8897	-5.6827
EQ-X	-242.9181	0	0	0	-16513.5714	2246.2983
EQ-Y	0	-317.5418	0.1147	16576.2284	-1.009	-2794.3675
WX1	-133.8619	0	0	0	-7275.0407	1245.1126
WX2	133.8619	0	0	0	7275.0407	1245.1126
WY1	0	-157.8156	0.0379	6601.9016	-0.3334	-1388.7772
WY2	0	157.8156	-0.0379	-6601.9016	0.3334	1388.7772
RSX max	166.3044	218.4045	0.0689	10493.6024	10329.1012	2423.1263
RSY max	164.367	215.8601	0.0681	10371.3553	10208.7704	2394.8977



Graph 2 : Comparison of Base shears for Response Spectrum.

C. Modal Participating Mass Ratios

Table 5: MPMR Value of Building without Dampers

Mode	Period (sec)	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
1	0.632	0	0.8004	0	0	0.8004	0
2	0.628	0.7902	0	0	0.7902	0.8004	0
3	0.568	0.0003	0	0	0.7905	0.8004	0
4	0.204	0	0.0952	0	0.7905	0.8956	0
5	0.199	0.1015	0	0	0.892	0.8956	0
6	0.182	0.0001	0	0	0.8921	0.8956	0
7	0.115	0	0.0325	0	0.8921	0.9281	0
8	0.109	0.0342	0	0	0.9264	0.9281	0
9	0.102	0.0004	0	0	0.9267	0.9281	0
10	0.079	0	0.0144	0	0.9267	0.9425	0

Table 6: MPMR Value of Building with Dampers

Mode	Period (sec)	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
1	0.373	0.6748	0	0	0.6748	0	0
2	0.364	0	0.6855	0	0.6748	0.6855	0
3	0.216	0.0003	0	0	0.675	0.6855	0
4	0.091	0	0.1887	0	0.675	0.8742	0
5	0.089	0.2086	0	0	0.8837	0.8742	0
6	0.062	0.0089	0	0	0.8925	0.8742	0
7	0.062	0	0.0169	0	0.8925	0.8912	0
8	0.05	0.0057	0	0	0.8983	0.8912	0
9	0.049	8.07E-07	0	0	0.8983	0.8912	0
10	0.039	0	0.0494	0	0.8983	0.9405	0

III. CONCLUSION

1. Displacement is compared for two models i.e,, without dampers & with dampers at top story of a high rise building in zone-3 in soil-II it is observed that 50% displacement is reduced when the dampers are provided at each elevation.
2. By providing the dampers the stiffness of the structure is increased and story shear is decreased with increase in height of structure.
3. The (G+7) stories frame structure is design with damper by using the ETABS software which having efficient result for frame structure over the fixed base structure than any other isolation system.
4. From analytical results, it is observed that viscous damper technique is very significant in order to reduce the seismic response of RC Structure as compared to building without dampers and control the damages in structure during strong ground shaking.

5. In damper system base reaction was found to be minimum for both external and internal column. Whereas in case of structure without dampers reaction was found more.

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