Seismic Analysis of I Shaped and Plus Shaped Building with and without damper

Prof. G.C Jawalkar[1], Ms. Mariya Royali[2]

[1]Prof. Ganesh C. Jawalkar, Department of Civil Engineering, N.B.N. Sinhgad College of Engineering, Solapur
[2]PG Student Ms. Mariya Royali, Department of Civil Engineering, N.B.N. Sinhgad College of Engineering, Solapur

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Abstract - *Earthquakes are the largest natural hazard in damaging the structures. The structural response control is necessary to create the safer structures against earthquakes.*

The fluid viscous dampers (FVD) 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.

Key Words: Seismic Analysis, Damping, Dampers, I Shaped Building, Plus Shaped Building, Fluid Viscous Dampers, Displacement, base Shear.

1. INTRODUCTION

Increase in population in urban areas leads to increase in high rise buildings. In the present years earthquakes are the main natural hazards in damaging the structures. Earthquake cause ground vibration due to the sudden release of energy. The devastative effects of the recent earthquakes such as Northridge earthquake (1994), Kobe earthquake (1995), and Taiwan earthquake (1999) on the buildings of the cities adjacent to fault, and with regard to the close location of many of the cities of India to the active faults indicate the significance of the research. 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. The retrofitting of an existing building is a dominant task in decreasing seismic risk. The aim of improving the capacity of building leads to invention of new techniques for earthquake resistant structures. There are a number of passive energy dissipating devices in use, such as metallic dampers, friction dampers, viscous fluid damper and visco-elastic dampers to tackle with damaging seismic forces.

1.1 Dampers

Dampers are the devices used to absorb or dissipate the structure's vibration from theearthquake and to increase the structure's damping and stiffness. Dampers system are designed and manufactured to protect structure integrity, control structural damage and prevent resident injury through the absorption of seismic energy and reduction of structural deformation.

The fluid viscous dampers (FVD) 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.

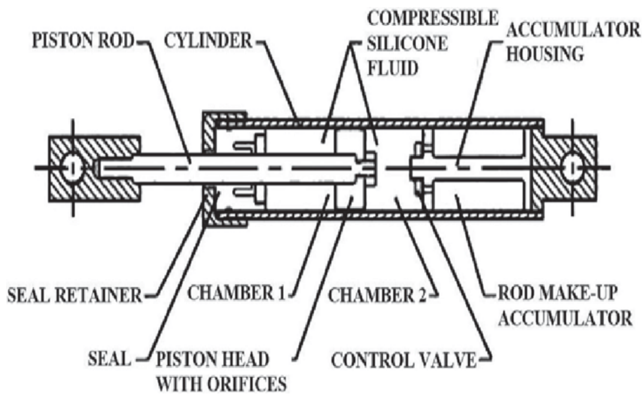


Fig-1 Longitudinal Section of Fluid Viscous Damper

1.2 Seismic Analysis

Seismic analysis is a major tool in earthquake engineering which is used to understand the response of buildings due to seismic excitations in a simpler manner. In the past the buildings were designed just for gravity loads and seismic analysis is a recent development. It is a part of structural analysis and a part of structural design where earthquake is prevalent.

There are different types of earthquake analysis methods. Some of them are as follows:

1) Equivalent Static Analysis
2) Response Spectrum Method

1.3. Methodology and Modeling

Aim: To compare the seismic response of multi-storey building of varying heights, with and without the use of viscous dampers, using seismic coefficient method.

Methodology: I Shaped and Plus Shaped Buildings of 9 Storeys are considered. The modeling of these buildings is done and fluid viscous dampers are applied on corners of building. Seismic analysis is carried out using seismic coefficient method. Thereafter, both the models are compared for displacement and base shear.

Modeling of buildings:

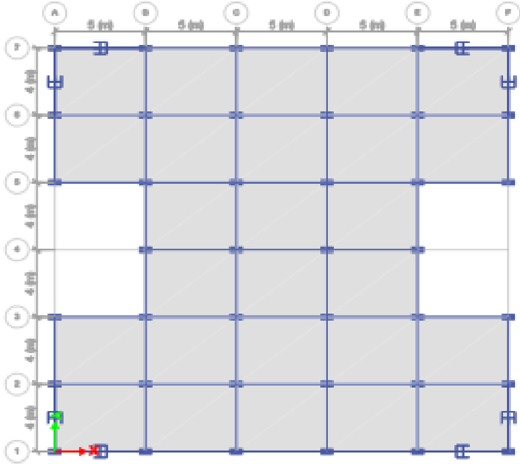


Fig -2: Plan of G+8 I Shaped Building

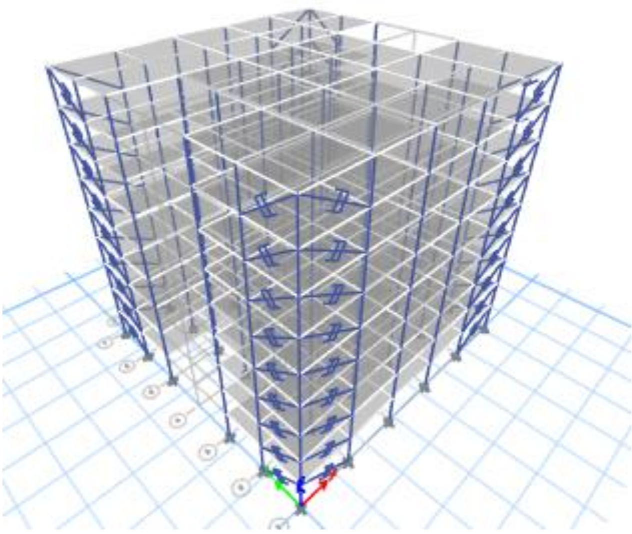


Fig -3: 3d view of G+8 I Shaped building

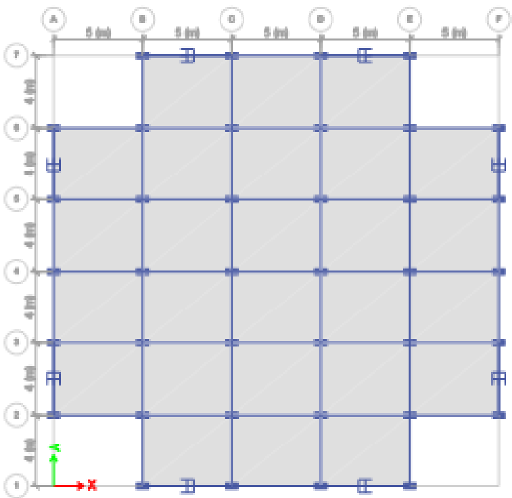


Fig -4: Plan of G+8 Plus Shaped Building

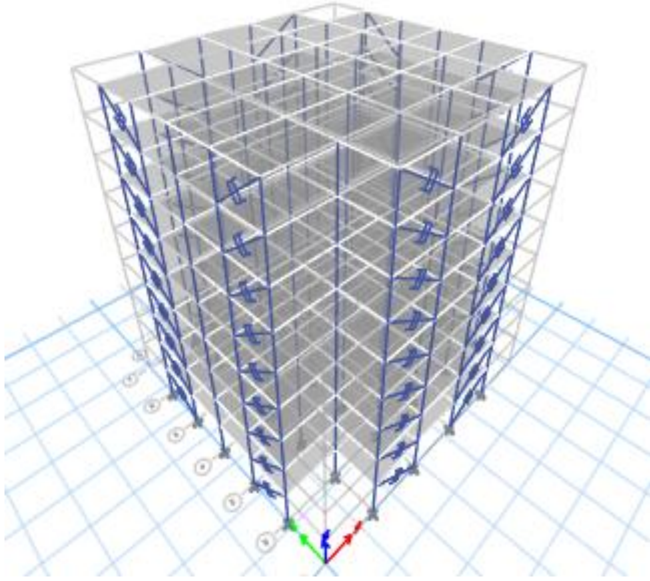


Fig -5: 3d view of G+8 Plus Shaped Building

2. RESULTS

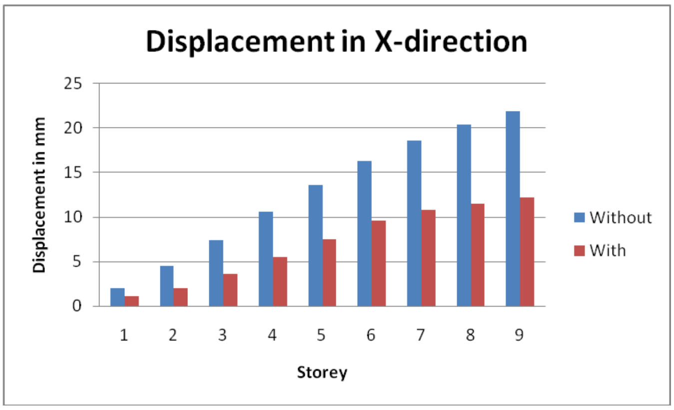
i. I Shaped Building

The I Shaped building has been analyzed for parameters like displacement and base shear and the result tables and graphs are as follows:

a. Displacement

Displacement in mm (X-direction)			
Storey	Without Damper	With Damper	Percentage Reduction %
1	2.01	1.07	46.46
2	4.49	2.04	54.55
3	7.37	3.62	50.84
4	10.56	5.47	48.15
5	13.6	7.51	44.79
6	16.33	9.56	41.43
7	18.63	10.83	41.85
8	20.4	11.5	43.59
9	21.86	12.2	44.19

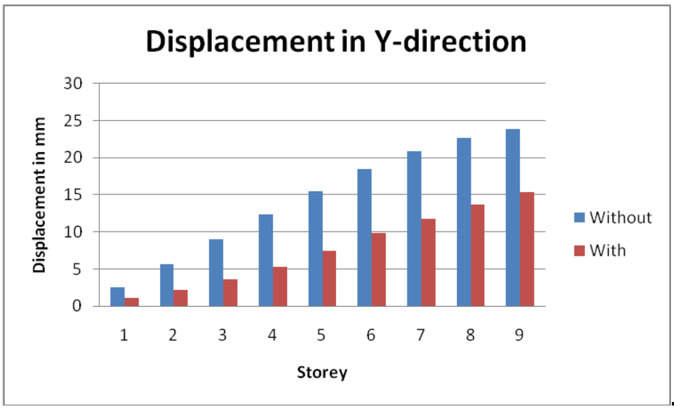
Table 1: Displacement in X-direction



Graph 1: Displacement in X-direction

Displacement in mm (Y-direction)			
Storey	**Without Damper**	**With Damper**	**Percentage Reduction %**
1	2.58	1.09	57.62
2	5.6	2.11	62.38
3	8.96	3.58	60
4	12.34	5.25	57.41
5	15.54	7.42	52.2
6	18.43	9.81	46.76
7	20.87	11.73	43.77
8	22.71	13.64	39.93
9	23.83	15.37	35.52

Table 2: Displacement in Y-direction

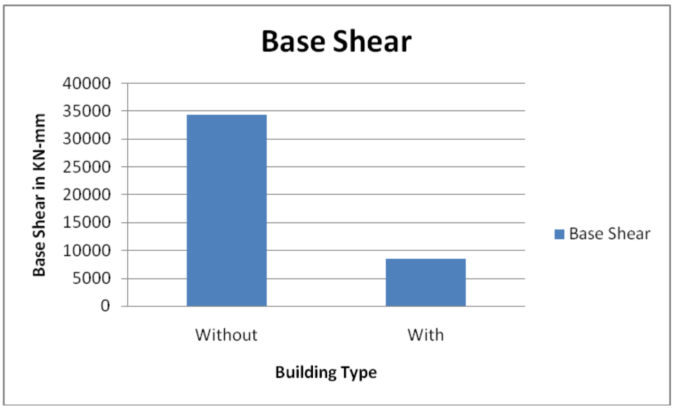


Graph 2: Displacement in Y-direction

b. Base Shear

Base Shear in KN-mm		
Without Damper	**With Damper**	**Percentage Reduction %**
34435.83	8554.014	75.15

Table 3: Base Shear



Graph 3: Base Shear

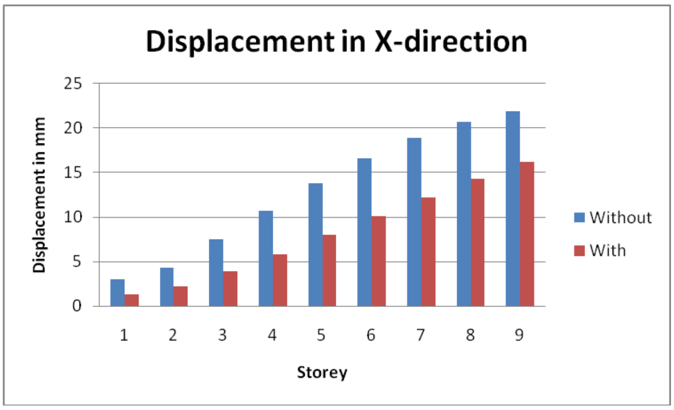
ii. Plus Shaped Building

The Plus Shaped building has been analyzed for parameters like displacement and base shear and the result tables and graphs are as follows:

a. Displacement

Displacement in mm (X-direction)			
Storey	**Without Damper**	**With Damper**	**Percentage Reduction %**
1	2.97	1.34	54.88
2	4.34	2.24	48.38
3	7.47	3.86	48.32
4	10.7	5.83	45.51
5	13.78	7.96	42
6	16.55	10.12	38.85
7	18.88	12.25	35.11
8	20.67	14.29	30.86
9	21.92	16.2	26.09

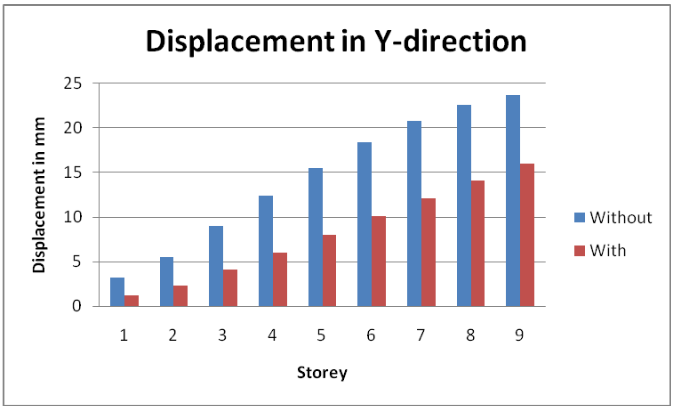
Table 4: Displacement in X-direction



Graph 4: Displacement in X-direction

Displacement in mm (Y-direction)			
Storey	**Without Damper**	**With Damper**	**Percentage Reduction %**
1	3.21	1.25	61.07
2	5.54	2.34	57.74
3	8.99	4.06	54.87
4	12.36	5.98	51.56
5	15.53	8.03	48.3
6	18.39	10.09	45.09
7	20.8	12.12	41.72
8	22.6	14.1	37.61
9	23.69	16.01	32.4

Table 5: Displacement in Y-direction

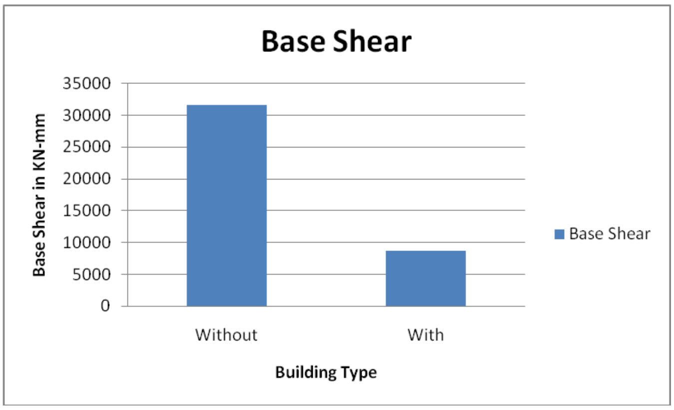


Graph 5: Displacement in Y-direction

b. Base Shear

Base Shear in KN-mm		
Without Damper	**With Damper**	**Percentage Reduction %**
31695.16	8713.901	72.5

Table 6: Base Shear



Graph 6: Base Shear

3. CONCLUSIONS

In the present study, the I Shaped and Plus Shaped Buildings with and without dampers are compared and the following conclusions can be drawn from it:

1. I Shaped and Plus Shaped Buildings with dampers placed at corners are having lower values of displacement and base shear as compared to buildings without dampers.

2. The values of percentage reduction for displacement goes on decreasing from bottom storey to top storey in both the building models except in Storey 2 of I Shaped building.

3. The Base Shear is reduced up to 75.15% and 75.5% in I Shaped and Plus Shaped Buildings respectively after the application of dampers.

4. When dampers are applied to the buildings, there is an average reduction of about 50-70 % in displacement and base shear in both the building models.

5. The shape of the building model influences the structural response of building.

6. Structures with dampers can be used for high rise buildings for gaining strength and stability in high seismic zone

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