

**Energy Dissipation System In Multistorey Building Using Viscous Damper**Dipak Patel<sup>1</sup>, Vishal B Patel<sup>2</sup>, Anshu Arya<sup>3</sup><sup>1</sup> P.G. Student, Department of Structural Engineering, Parul University, Vadodara, Gujarat, India<sup>2</sup> Assistant Professor, Department of Structural Engineering, BVM Engineering College, V.V.Nagar, Gujarat<sup>3</sup> Associate Professor, Department of Civil Engineering, Parul University, Vadodara, Gujarat, India

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**Abstract** — The structure which are present in higher earthquake zone area are liable to get damaged or collapsed, hence to increase the safety of these structure few retrofitting techniques are done. This paper investigates the response of multi-storey structures under simulated earthquake loads with viscoelastic dampers and consequently, evaluations are made as to how the damping systems affect the seismic response of these structures with respect to deflections and accelerations. This paper concentrates on the effects of damper's locations within the multistory building having mass irregularity. The time history analysis is performed for dissipation system incorporated in building. The seismic event of BHUJ is taken in the analysis, which we can considered as extreme seismic event in INDIA. The main aim of the study is to compare the results of incorporated damper at different locations such as at corner, at middle in the reinforced concrete (RC) building.

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**Keywords-** Mass irregularity, Viscous Damper, Time history, ETABs.

**I. INTRODUCTION**

In recent years considerable attention has been paid to research and development of structural control devices with particular emphasis on mitigation of wind and seismic response of buildings. Many vibration-control measures like passive, active, semi-active and hybrid vibration control methods have been developed. Passive energy dissipation systems utilize a wide range of materials and technologies as a means to enhance the damping, stiffness and strength characteristics of structures. Dissipation may be achieved either by the conversion of kinetic energy to heat or by the transferring of energy among vibrating modes. The first mechanism incorporates both hysteretic devices that dissipate energy with no significant rate dependence, and viscoelastic devices that exhibit considerable rate dependence. Hysteretic devices operate on principles such as yielding of metals and frictional sliding and viscoelastic devices operate on deformation of Visco-elastic solids or fluids. A third classification consists of re-centering devices that utilize either a preload generated by fluid pressurization or internal springs, or a phase transformation to produce a modified force-displacement response that includes a natural re-centering component.

Viscoelastic fluid damper construction varies considerably from each other and from the viscoelastic solid damper counterparts, mathematical models suitable for overall force-displacement response have a similar form. In general, the devices are both frequency and temperature dependent, and in some cases amplitude dependence is also evident. The Viscous dampers are passive energy dissipation device which is added to structure to increase the effective stiffness of new and existing buildings. They are very robust material and energy is transferred by piston and absorbed or vanishes by silicone-based fluid flowing between the piston-cylinder arrangement. The damping force of viscous damper is given by

$$F=CV^\alpha$$

Where, F – The damping force.

C - The damping coefficient.

V - Velocity of Piston.

$\alpha$  – Velocity Exponent.

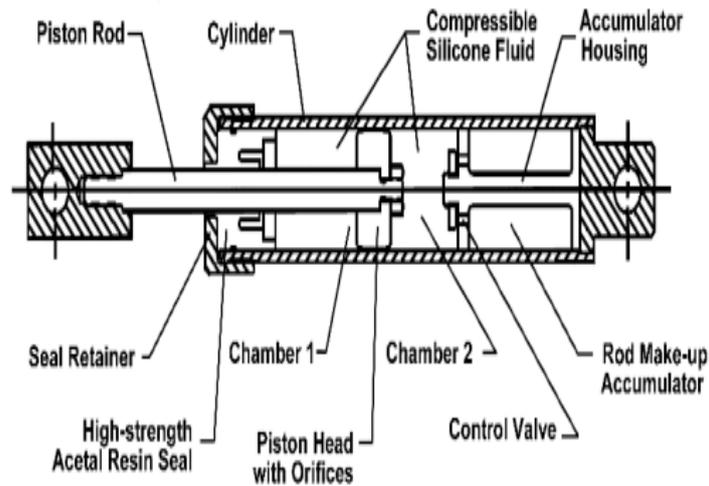


Fig 1 Viscous Dampers

## II. REGULAR AND IRREGULAR STRUCTURES

According to the Indian standard, the structure is structurally specified in regular or irregular form. In a regular structure there is no significant imbalance in planning, vertical configurations, or lateral force resistance systems. In irregular structure, according to IS-1893 (Part 1) 2002 has such important constraints like plan irregularities and vertical irregularities. To perform well in the earthquake, there are few main features in a building, i.e simple and regular configuration, and sufficient lateral strength, stiffness and ductility. The failure of the structure mainly depends on the discontinuity in the mass of the structure, stiffness and geometry of the building. Mostly due to vertical irregularity structure possesses failure. To overcome this failure we use isolation system in the building which decouples the superstructure from substructure by which the structure resist the lateral force and gain adequate stability.

## III. STRUCTURAL PROPERTIES AND MODELING

A G+10 multi storey building with the plan dimensions of 30m x 30m have been adapted in the present work with 5 bays in both longitudinal and transverse directions respectively. The storey height of building up to 1st storey is 3m and above all storey is 3.5m.

Table 1 Detail of the Building

Building	Details
Beam	350mm x 500mm
Coloumn	550mm x 550mm
Slab	150mm
Grade of Steel( fy )	Fe 415
Grade of concrete (	M-25
Live load (1st floor)	10 kN/m <sup>2</sup>
Live load (up to 11th floor)	4 kN/m <sup>2</sup>
Floor finish	1.5 kN/m <sup>2</sup>
Soil type	II
Zone	V

**There are 4 models is taken in the analysis :**

- 1) Building with Fixed base
- 2) Building with Viscous Damper
- 3) Building with Viscous Damper at middle
- 4) Building with Viscous Damper at corner

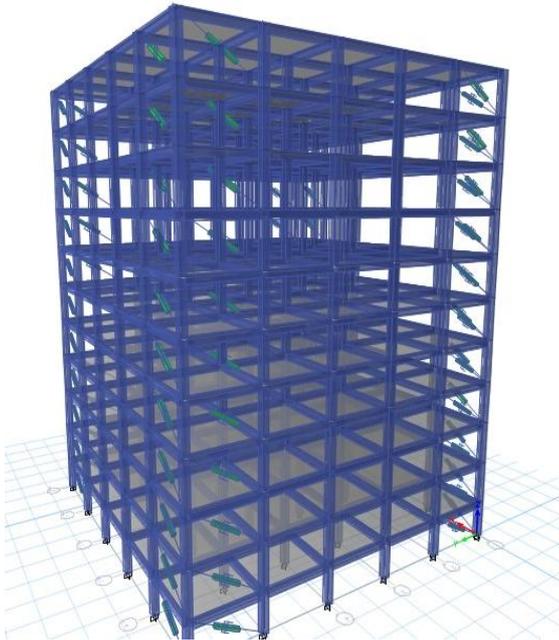


Fig-2 Building with Viscous Damper at corner

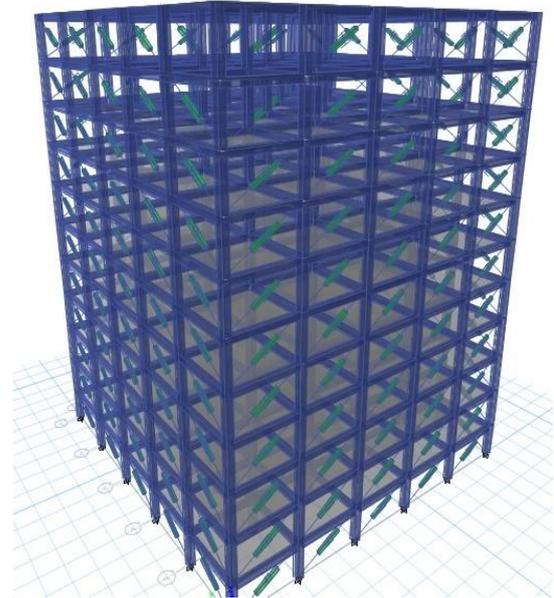


Fig-3 Building with Viscous Damper

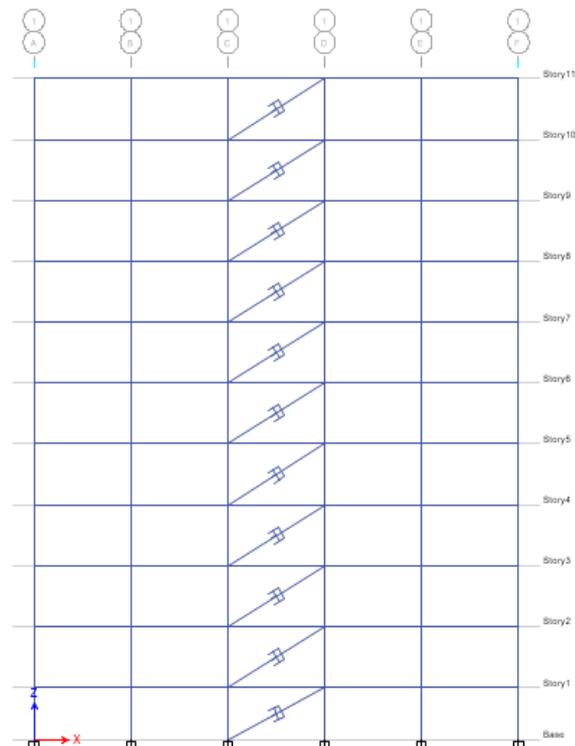


Fig-4 Building with Viscous Damper at middle

#### IV. RESULTS OF ANALYSIS

All figures show the response of the building such as (Time period, Base shear, Story drift, Story displacement) incorporated with the damper at different locations such as at corner, at middle and in whole building, under the seismic excitation of BHUJ.

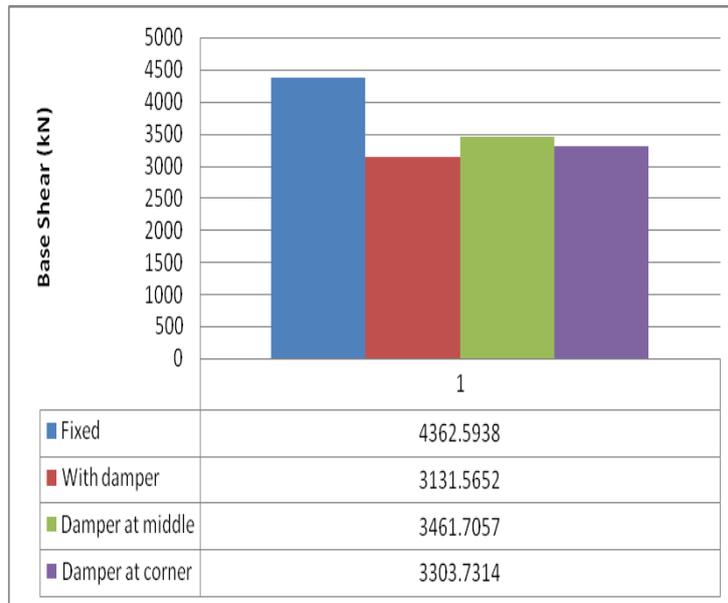


Fig – 5 Base shear

From fig.5 it is concluded that the base shear reduces in all case of damper but when we place it in all building it gives better result. It reduces the base shear around 30%. But damper at corner also give satisfactory result in terms of base shear it reduces upto 25%.

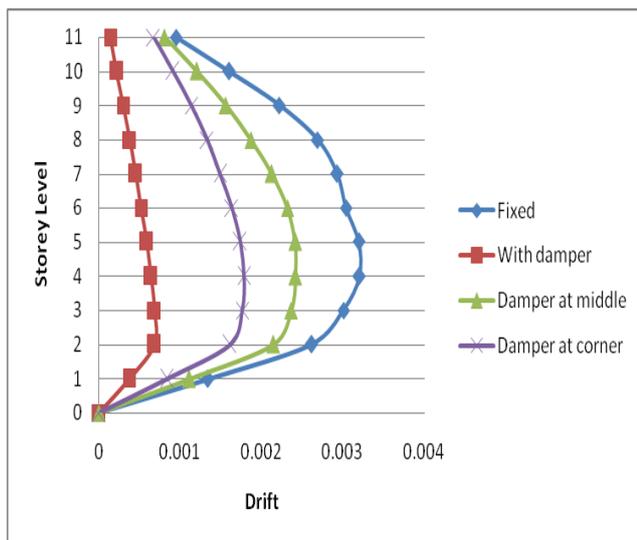


Fig 6 Story Drift In X-Direction

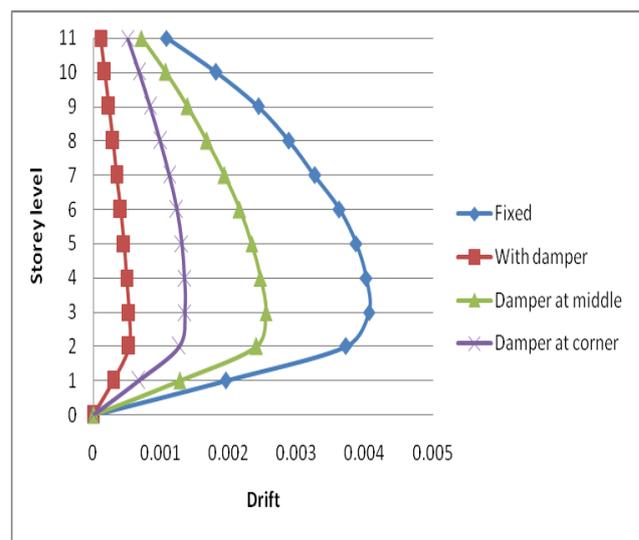


Fig 7 Story Drift In Y-Direction

From figure 6 and 7 it observed that at story level 2 story drift increases in all model because of mass irregularity exist in the building but after that it is decreasing gradually upto the top floor and give very effective result.

Figure 8 and 9 shows the displacement of all stories, at top level it goes decreasing very fairly in all system, but in case of damper in all building top displacement decreases from 117mm to 25mm.

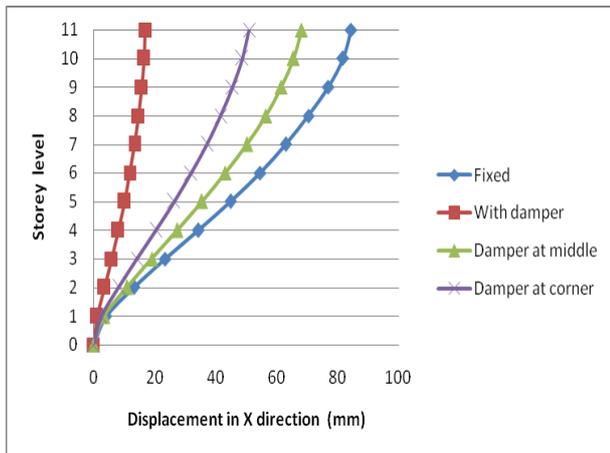


Fig - 8 Story Displacement in X-direction

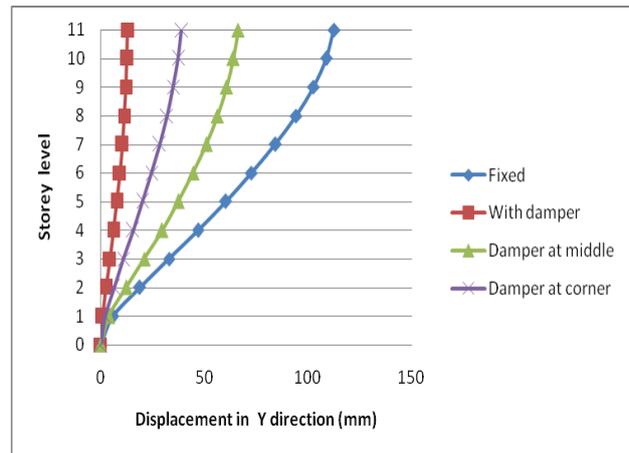


Fig - 9 Story Displacement in Y-direction

## V. CONCLUSION

Under the dynamic analysis of building using BHUJ seismic event, it concluded that the viscous dampers proves more relevant in seismic prone areas when we place it in all frames, but the damper at corner also gave satisfactory result and provide good rigidity to the structure specially in case of story displacement and drift

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