Effect of Different Percentages of Damping on Multistorey Buildings with Shear Wall

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Abstract— One of the important measures to decrease the seismic forces on the structure is by damping. The basic principle of seismic modification is to modify the response of the building to permit the dissipation of vibration energy. The present study demonstrates the effect of different percentages of damping on a multistorey building with shear wall, we will get a clear idea how the damping affects on base shear, storey displacements and storey drifts. For the present study we have analyzed the building on Etabs 9.7.0, and the building is having a shear wall. The study has been carried out for the Zone V and on soft soil and for different percentages of damping as specified in IS 1893-2002.

Key words: Damping, Dampers, Shear Wall, Percentage of Damping, Multistorey Building, Fluid Viscous Damper, Viscoelastic Damper, Friction Damper

I. INTRODUCTION

The steady decrease of the successive amplitudes of vibration of a structure by the dissipation of vibration energy is known as damping. The energy dissipation concept allows seismic energy into the building and the capacity of the structure to absorb this energy is made high through appropriate devices. By adding suitable damping mechanisms into the lateral load resisting systems, the earthquake energy is dissipated as the structure sways back and forth due to seismic loading and helps in lowering the overall displacements of the structures. Therefore, to achieve reduction in response, a practical solution is to supplement the damping of the structure with a mechanical damping system external to the building structure.

II. DAMPING SYSTEMS

Damping systems are classified as follows Active System, passive system and semi active system.

A. Active System:

In active control system, external source of power controls the actuators that apply forces to the structure in one order. These forces can be used to both add and dissipate energy in the structure. In this system signals sent to the actuators are function of the response of the system measured with sensors. Active mass damper is one of the example of active system.

B. Passive System:

In this system outside source of energy is not required. Often there is disrupt in the power supply to a structure after few seismic shocks due to earthquake ground motion. This system develops mechanical forces within themselves in response to the motion of the structure. Tuned Mass Dampers and Tuned Liquid Dampers are examples of passive system.

C. Semi Active System:

It is the combination of both active and passive systems.

III. DAMPING DEVICES

Dampers (Energy Dissipation Devices) are mechanical systems to dissipate a large portion of the earthquake input energy.

A. Fluid Viscous Damper:

This form of damper dissipates energy by applying a resisting force over a finite displacement through the action of piston forced through a fluid filled chamber acting as a completely viscous, shock absorber. Such type of damper is preferred as it has long life, has greater flexibility and also can be installed in existing structures.

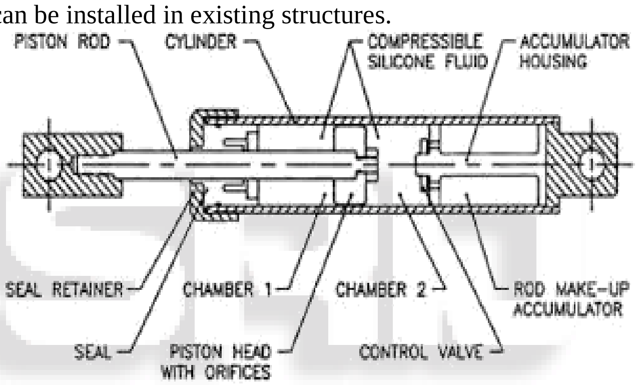

Fig. 1: Typical Fluid Viscous Damper

B. Viscoelastic Dampers:

In these systems energy is absorbed by utilizing the controlled shearing of solids. The Viscoelastic materials are usually bonded to steel and dissipate energy when sheared. The materials also exhibit restoring force capabilities.

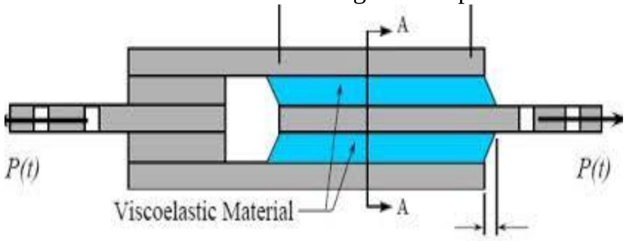

Fig. 2: Typical Viscoelastic Damper

C. Friction Dampers:

In these systems, the friction surfaces are clamped with prestressing bolts. The main feature of this system is that almost perfect rectangular hysteretic behaviour is exhibited. These systems are referred to as displacement dependent systems, since the amount of energy dissipated is proportional to the displacement.

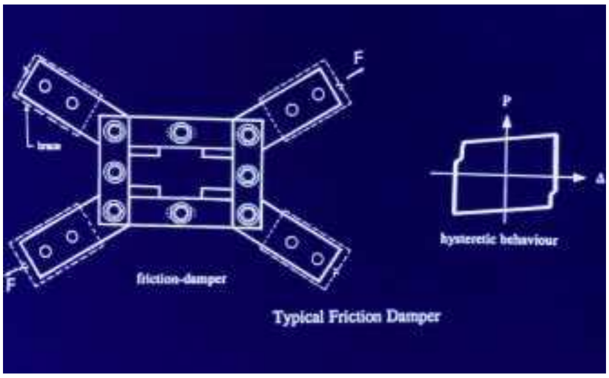

Fig. 3: Typical Friction Damper

IV. STUDY PARAMETERS:

1) Type of building: Multi Storied Building.
2) Zone: V
3) Type of soil: Soft soils
4) Plan of the Building: 16mX16m.
5) Each Bay Size: 4m
6) Height of Buildings: 60m
7) Floor to floor height: 3mts.
8) Beams: 0.5mX0.5m
9) Columns: 0.6mX0.5m
10) Slab thickness: 0.15m.
11) Shear Wall thickness: 0.3m.
12) Live load: $3kN/m^2$.
13) Dead load of wall as UDL: 14kN/m
14) Materials: M40 and Fe415.
15) Damping: 0%, 2% 5%, 7%, 10%, 15%, 20%, 25%, 30%
16) Seismic analysis: Response Spectrum Method as per IS: 1893 (Part 1):2002.

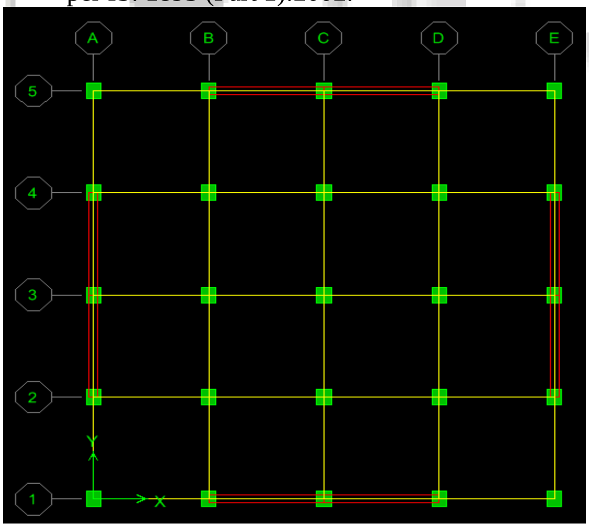

Fig. 4: Plan of the Building

V. RESULTS

Damping Percentage (%)	BASE SHEAR (kN)	MAX. STORY DISPLACEMENTS (mm)	MAX. STORY DRIFT (mm)
0	14259	71.67	1.451
2	6240	31.41	0.642
5	4058	22.41	0.457
7	4024	19.95	0.411
10	3590	17.89	0.366
15	3167	15.61	0.320
20	2743	13.40	0.273
25	2544	12.31	0.250
30	2343	11.14	0.227

Table 1: Results of Various Damping Percentages

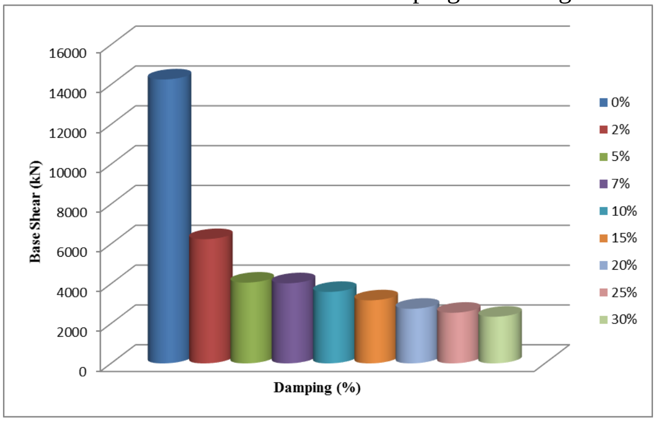

Fig. 5: Base Shear Vs Damping Percentage

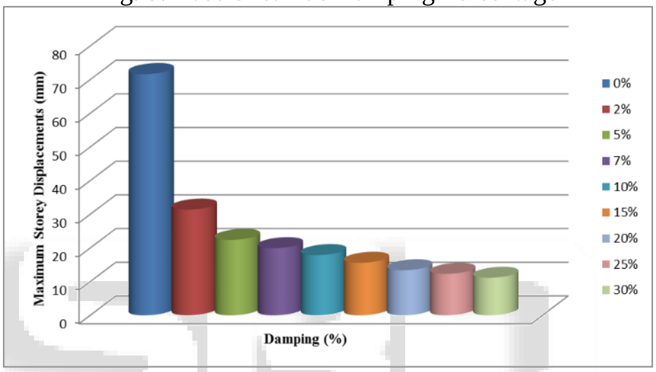

Fig. 6: Maximum Storey Displacements Vs Damping Percentage

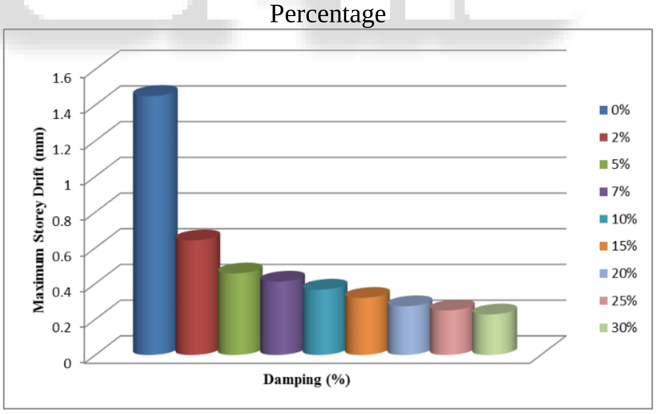

Fig. 7: Maximum Storey Drift Vs Damping Percentage

VI. CONCLUSIONS

- From the study it is clear that base shear is maximum for 0% damping and least for 30% damping, which corresponds that by increasing damping percentage seismic forces are greatly reduced.
- Maximum damping that is 30% gives least storey displacements where as 0% gives maximum storey displacements.
- Minimum storey drift is also for 30% damping whereas maximum for 0% damping.
- By interpreting the results we can conclude that by giving higher percentage of damping we can

greatly reduce the base shear, lateral displacements and lateral drifts.

- For economic reasons we can provide damping in the range of 5% to 15% as it gives satisfactory results.

The more damping a building possesses, the sooner it will stop vibrating--which of course is highly desirable from the standpoint of earthquake performance. Today, some of the more advanced techniques of earthquake resistant design and construction employ added damping devices like shock absorbers to increase artificially the intrinsic damping of a building and so improve its earthquake performance.

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