COMPARITIVE ANALYSIS OF A MULTISTOREY BUILDING USING VISCO ELASTIC DAMPER IN TWO DIFFERENT COUPLING MECHANISMS

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Abstract - *In this work, the seismic analysis of a multistoried apartment building in Delhi is carried out by introducing visco elastic damper in two different types of mechanism. A comparative study between structural models with both type of mechanisms are also made. Delhi is the third earthquake prone city in India and hence the structures must be constructed to withstand the seismic effect. Thus to control the seismic performance, it is necessary to install dampers. The models are analysed using ETABS. The result shows the reduction in seismic response of multistoreid building by using the viscoelastic dampers. Response Spectrum method of analysis is used.*

Key Words: Visco-elastic damper; hybrid coupled mechanism; Brace type mechanism; Response spectrum, ETABs

1. INTRODUCTION

1.1 Genaral

Nowadays, high rise buildings are constructed with coupled shear wall in high seismic zones. Use of dampers can reduce the seismic response of the structure by increasing the damping effect. Damping plays important role in design of multistoried structure, which reduces the response of the structure. There are many different types of dampers in use. In this study visco elastic dampers are used to evaluate the response of building. During earthquake, this dampers can add more distributed damping in all lateral modes of vibration.

In this work the seismic characteristic of a 14 storied apartment building under construction in Delhi is analysed by introducing visco elastic damper. Delhi is the third earthquake prone city in India and hence the structures must be constructed to withstand the seismic effect. Thus to control the seismic performance, it is necessary to install dampers. The building is modelled using the software ETABs. Here, visco elastic dampers are provided to check the seismic performance of the structure. Finite element analysis was carried out using the software ETABS version 9.7.2.

1.2 Visco-elastic dampers

The effect of earthquake forces and wind forces depends on the height and profile of the building and also the location. The concept of seismic behaviour control has been taken as an important factor in the design of structures. VE dampers dissipate energy through shear deformation when loaded. The most important characteristic is that the properties are functions of the excitation frequency and the environmental temperature. The VCD consists of multiple layers of visco elastic material, placed between layers of steel plate which are anchored at alternating ends to the coupled RC walls. These VCD elements replace some of the RC coupling beams in coupled wall buildings to provide added distributed damping. During the event of an earthquake, the fuse elements inside the damper activates, limiting the forces transmitted to the adjacent RC walls and preventing tearing in the VE material due to large shear deformations. The VCDs are easily inspected following a major seismic event, and can be readily repaired or replaced.

2. BUILDING DETAILS

The structure considered is a G+13 apartment building located at Delhi, India. The building is chosen such that it is located in high seismic zone. Building has a typical plan and has a typical storey height of 3m. Beams and columns are modelled as frame elements and slabs are modelled as shell elements. Shearwall is modelled with piers.

Table -1: Model Details

Element Name	Size(mm)
Beam	230x500
Column	230x600
Slab	120

3. ANALYSIS OF STRUCTURES

3.1. Model Details

For analysis, different configurations were taken. Plan layout of the structure is shown in figure 1. Different configurations are shown in figure 2,3,4 and their descriptions are mentioned in Table 2.

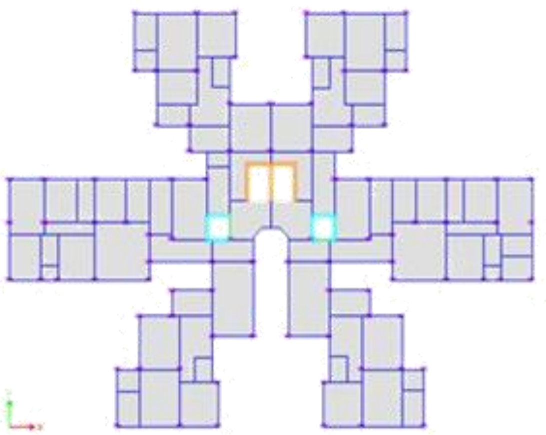

Figure 1. Plan layout of structure without damper(bare structure)

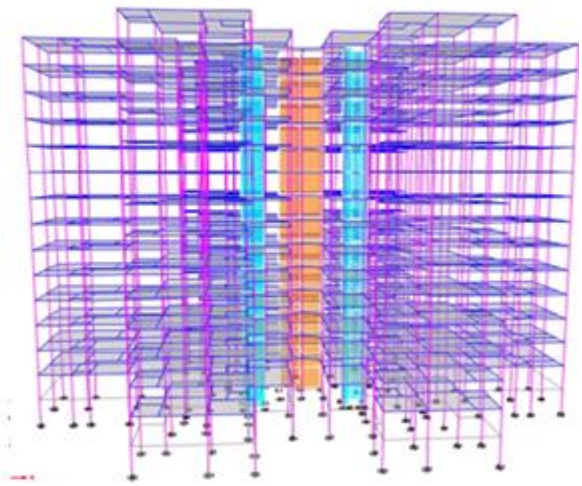

Figure 2. 3D view of structure without damper(bare structure- R)

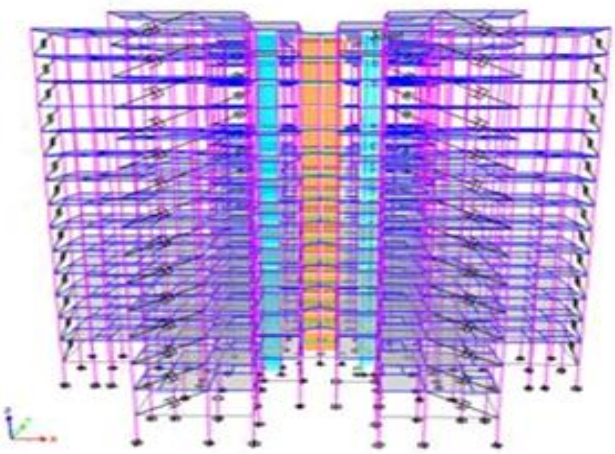

Figure 3. 3D view of structure with brace type damper mechanism (Configuration- A)

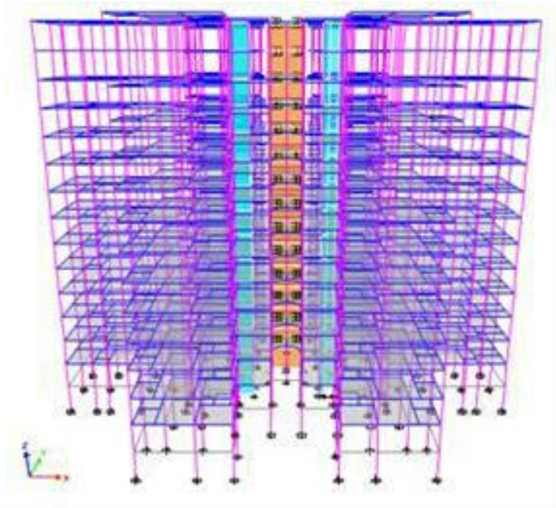

Figure 4. 3D view of structure with hybrid coupling mechanism (Configuration- B)

Table 2. Configuration details

Name	Description
R	Ordinary shearwall structure without damper taken as reference structure
A	Structure with brace type damper mechanism
B	Structure with hybrid coupling mechanism where damper is provided in lieu of coupling beam

Response spectrum analysis is carried out with damping ratio of 5%. Seismic parameters considered are shown in Table.3.

Table 3. Seismic Parameters considered

Seismic zone	IV
Zone factor	0.24
Soil type	medium
Importance factor	1.5
Response reduction factor	5

3.2. Damper details

The damper properties are selected with reference to literature papers by R Kazi, P V Muley, P Barbude[3] and M L Lai[7]

Table 4. Damper details

Damper used	Viscoelastic damper
Stiffness	20000kN/m
Damping coefficient	10000kNs/m

4. RESULTS AND DISCUSSION

Each configuration has been analysed using Etabs 2015 version 9.7.2. The results are obtained for the most critical load condition. Results are obtained on the basis of response spectrum analysis result for each configuration A and B with reference to that of bare structure R.

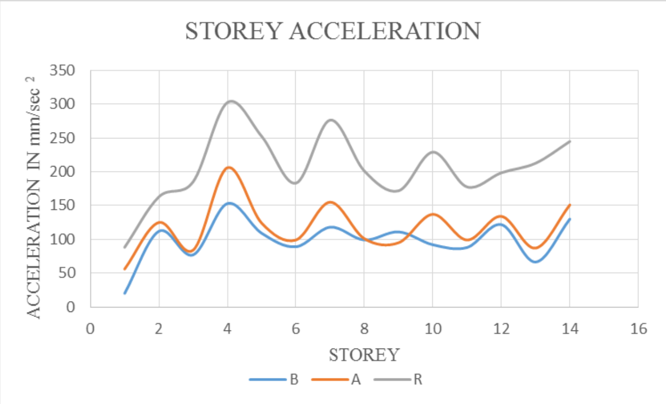

Chart 1. Storey acceleration for earthquake.

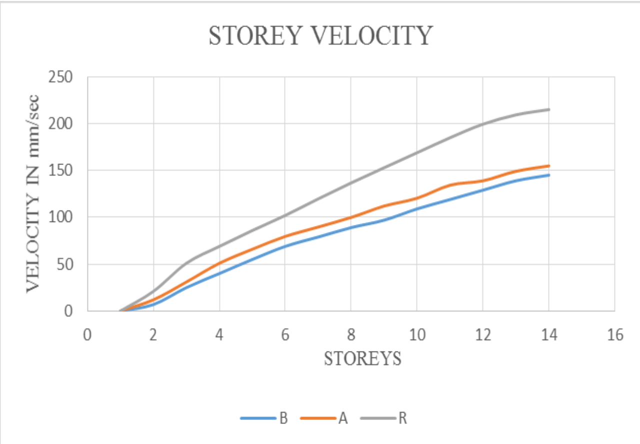

Chart 2. Storey velocity for earthquake

Chart 3. Storey displacement for earthquake

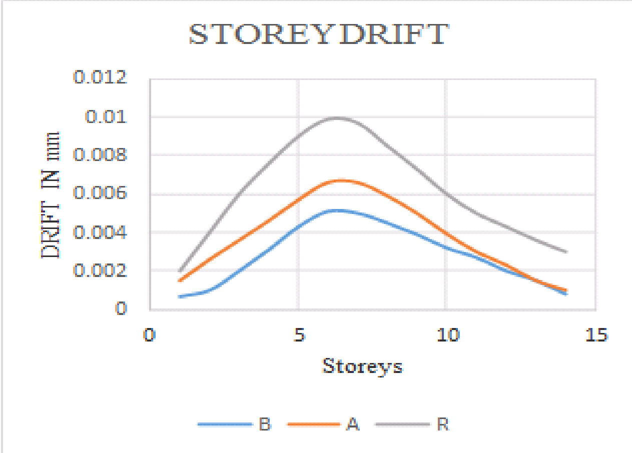

Chart 4. Storey drift for earthquake.

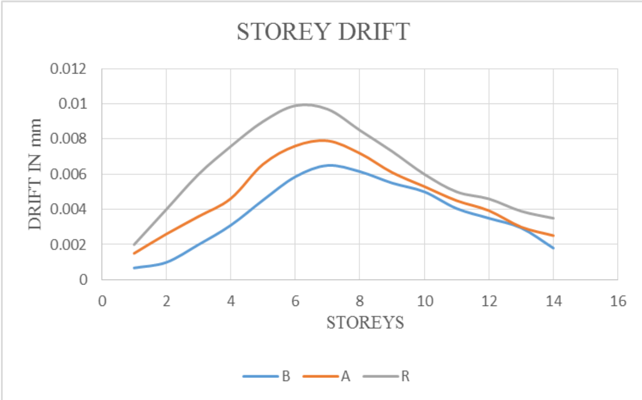

Chart 5. Storey drift for wind.

Table 5. Average reduction in storey drift

Configuration	Due to earthquake (%)	Due to wind (%)
A	33.713	22
B	47.5	37.45

Table 6. Average reduction in storey displacement

Configuration	Due to earthquake (%)
A	42.55
B	36.67

5. CONCLUSIONS

From the results obtained on the basis of response spectrum analysis for each configuration A and B with reference to that of bare structure R, following conclusions were made:

1. The results of this study show that, the response of structure can significantly be reduced by using

viscoelastic damper with hybrid coupling mechanism than with brace type mechanism.

2. Thus, for multistory building, hybrid coupling mechanism is more effective than brace type mechanism and thus can reduce the number of dampers.

3. Chart 4 and 5 shows that the acceleration and velocity were reduced.

4. Table 5 shows that the use of viscoelastic damper can reduce storey drift not only due to earthquake but also due to wind.

5. The percentage reduction in storey response is more in case of hybrid coupling mechanism than that of brace type mechanism for multistorey building.

6. The results show that it is effective to use viscoelastic dampers in multistory building at high risk zone.

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