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Analysis of RCC Structure with Viscous Damper under Seismic Loading

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Abstract*— Generally dampers are the energy dissipating devices which resist displacement of reinforced concrete building during earthquake. As a tall building keep becoming taller, they becoming more susceptible to dynamic excitations such as wind and seismic excitation. For the structure safety and occupants' comfort, the vibrations of the tall buildings are serious concerns for structural engineer. The damper helps the structure to reduce buckling of columns and beams also increases the stiffness of the structure. In this work a building with seventeen floors is analyzed with viscous damper at different levels and floors to reduce the vibrations and lateral sway of building. The building is analyzed according to their locations. Modelling, analysis and design of reinforced concrete structure shall be done in ETAB software to obtain the displacement, storey drift of building with different magnitudes of earthquakes.

***Keywords*— Viscous Damper, Seismic Analysis, RCC Building, ETAB**

I. Introduction

From recent years, many countries having experienced a number of destroying earthquakes, causes the increase in loss of nature and human beings due to structural collapse and damages to structure. The earthquake vibrations and the seismic waves are generates from the focus of the earthquake. Because of such type of structural damages, during seismic hazards clearly explains that the buildings or structures like residential buildings, public life-line structures, historical structures and industrial structures should be designed to seismic force design and very carefully to overcome from the earthquake hazards. Therefore, to protect such civil structures from significant damage one of the way is to increase the flexibility or stiffness of the structures. Hence many structural engineers uses the various approaches to protect the structural buildings from the destructive waves of earthquakes by increasing the strength of the structure so that structure does not collapse during earthquake. A number of techniques have been developed to reduce the structural response due to lateral excitations. Uses of damper is one of the most popular technique to reduce the vibrations formed from the focus of earthquake in tall structures. Dampers are the energy dissipating devices which are resist the displacement of structures by reducing the vibrations occurred from earthquake. Basic classification of damping systems are active damping systems, passive damping systems and semi active damping systems. Active and Passive are common techniques in vibration damping. Active vibration control system depends on the power source which requires power for operating the sensors, they can senses the vibrations whereas passive vibration control system are driven by the vibration itself, so does not require power source. Passive control system require minimum maintenance and installation is relatively simple.

II. Modelling

Modelling of the structure is done in ETABS. Method used for analysis is response spectrum analysis and damper used in structure is Fluid Viscous Damper FVD 250. The damper used for analysis are taylor devices from USA. The fluid used for damping is silicone oil, which is non-flammable, inert, non-toxic and stable for extremely long periods. In Viscous damper energy is reduced by pushing fluid in orifice and producing a damping pressure which creates a force and reduces the seismic excitations. The damping ratio for analysis is 5%. M25 grade of concrete and Fe 500 grade of Steel are used for all slabs and beams of the building whereas M40 is used for columns with same grade of Steel. Elastic material properties of these materials are taken as per IS 456-2000.

A. *Structural Elements –*
Column Sizes - 600mm*900mm and 600mm*1200mm
Beam Sizes - 230mm*600mm
Slab Thickness – 150mm

B. *Load Considerations –*
Dead Load - 1.5kN/m^2
Live Load – 2.0kN/m^2

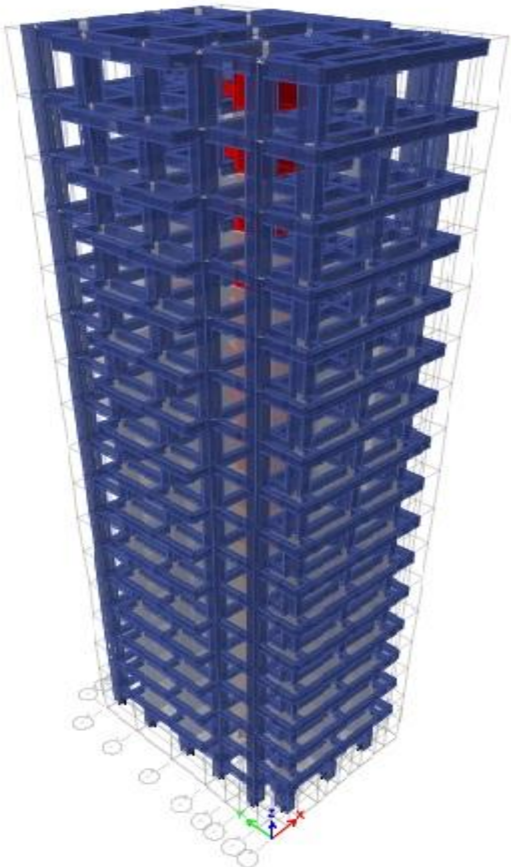


Fig. 1: Model Considered in ETABS

C. *Load cases –*

TABLE I
Load Cases

Name	Type
Dead	Linear Static
Live	Linear Static
EQ-x	Linear Static
EQ-y	Linear Static
wind-x	Linear Static
wind-y	Linear Static
RS-x	Response Spectrum
RS-y	Response Spectrum

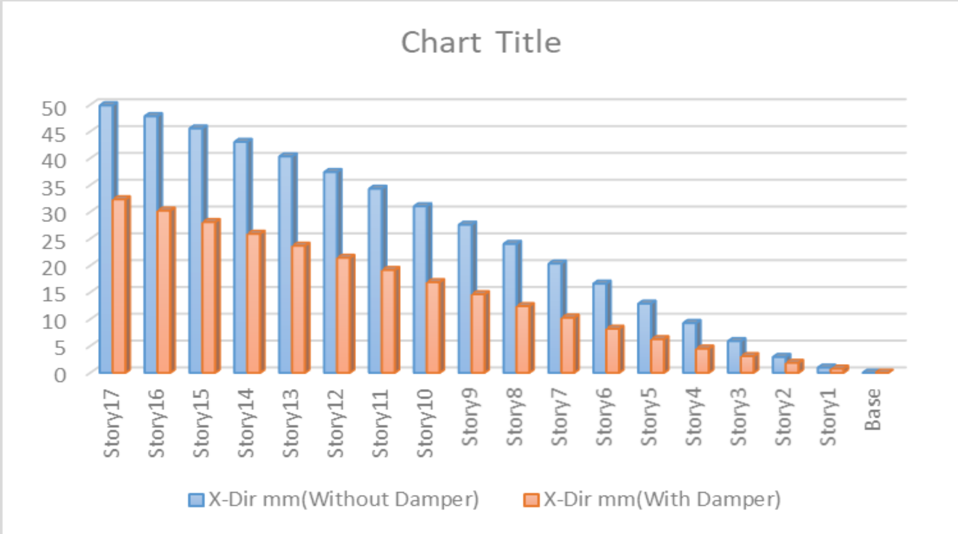
D. *Seismic Properties From IS1893(Part1):2002-*
Zone Factor (Z) – 0.36
Soil Type – II
Damping ratio – 5%
Importance Factor (I) – 1

III. Results and Discussion

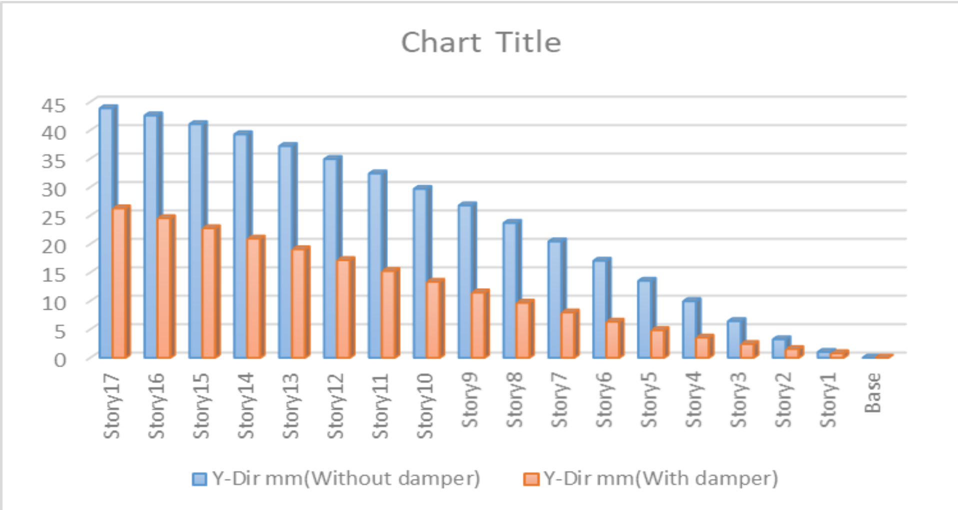
1. Displacement –

A) The graph 1 shows the displacement in structure for response spectrum analysis in X-Direction (RSX) with damper and without damper. The maximum displacement without damper for top storey is 49.87729mm and maximum displacement with damper is reduced to 32.3507mm.

B) The graph 2 shows the displacement in structure for response spectrum analysis in Y-Direction (RSY) with damper and without damper. The maximum displacement without damper for top storey is 43.88692mm and maximum displacement with damper is reduced to 26.26982mm.



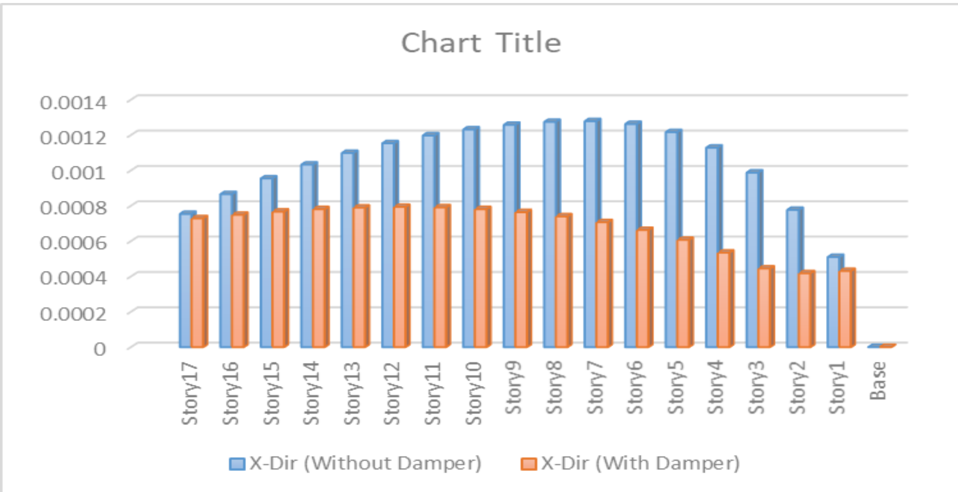
Graph. 1: Displacement with and without damper in X-Direction



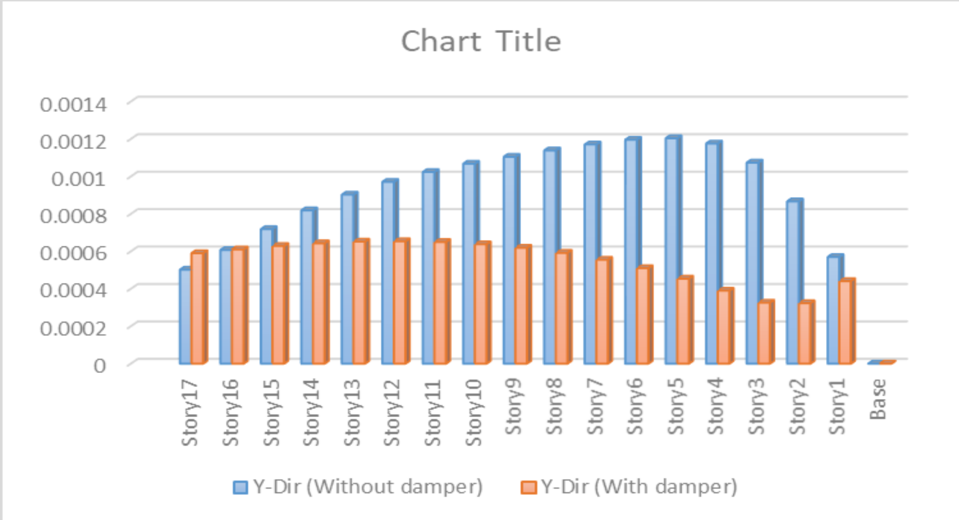
Graph. 2: Displacement with and without damper in Y-Direction

2. STOREY DRIFT –

The graph 3 shows the storey drift in structure for response spectrum analysis in X-Direction with damper and without damper. The storey drift without damper is 0.001279 and story drift with damper is reduced to 0.00079.



Graph. 3: Drift with and without damper in X-Direction



Graph. 4: Drift with and without damper in Y-Direction

The graph 4 shows the storey drift in structure for response spectrum analysis in Y-Direction with damper and without damper. The storey drift without damper is 0.001204 and storey drift with damper is reduced to 0.00065.

IV. Conclusions

The displacement of the structure is reduced by 57% by using fluid viscous damper FVD250 for response spectrum analysis.
The displacement for top storey is reduced by 65% by using fluid viscous damper FVD250 for response spectrum analysis.
The storey drift is reduced by 65% by using fluid viscous damper FVD 250 for response spectrum analysis.

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