Effect of location of fluid viscous dampers on the seismic performance of the multi-storey building

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Abstract

Seismic waves affect the performance of the multi-storey structure by releasing stain energy and transfer the vibrations to the structure. These vibrations may cause damage to the structure and needs to be controlled. These vibrations can be controlled by the devices known as energy dissipation devices. Fluid viscous dampers are one of the energy dissipation devices which absorbs the vibrations produced by the seismic disturbance and avoid the vibrations to further cause any damage to the structure. This paper deals with the effect on the performance of a multi-storey structure by using fluid viscous dampers.

Keywords: Fluid viscous dampers, seismic waves, Time history.

Introduction

With the increase in population in the recent past, there has been a continuous demand of construction of multi-storey buildings. These multi-storey building are highly prone to seismic disturbances. So it involves a risk of loss of life as well as loss of property during the destruction caused by seismic waves. These waves move from the ground to the foundation and further from foundation to the structure. To avoid these vibration to cause a major destruction energy dissipation system is used which absorbs most of the energy of the waves and prevent the structure from any serious damage.

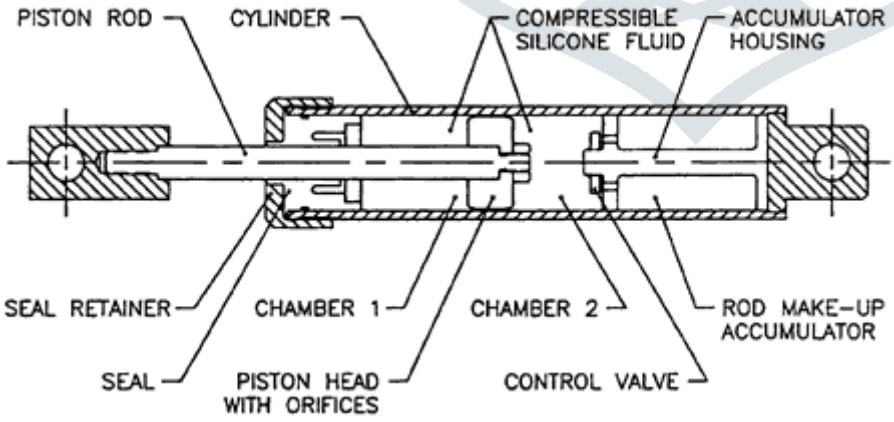


Fig 1: Showing Fluid Viscous Damper

The fluid viscous damper consists of a viscous fluid which absorbs the vibration caused by the disturbances. The vibration pushes the piston which further compresses the fluid and comes back to its position after the vibration passes.

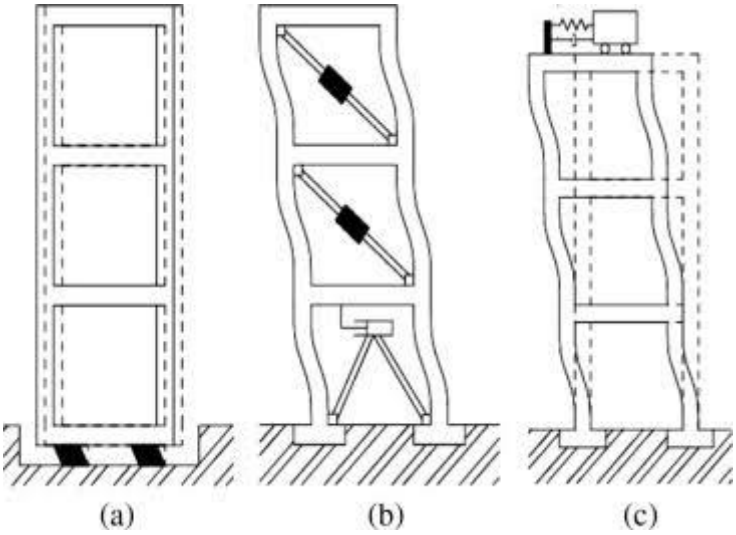


Fig 2: Showing the effect of the Fluid viscous damper on the structure.

The damper prevents the structure from moving during the seismic disturbances thereby making it safe for the living.

Structural Modeling and properties

Table 1: Showing properties of the structure.

Component	Details
Beam	300X450 mm
Column	300X300 mm
Slab	150mm
Grade of steel	Fe 500
Grade of concrete	M 30
Soil type	II
Seismic zone	V

Various models have been prepared by placing viscous dampers at different location to check the efficiency by using finite element method on ETABs.

Total 6 models were generated for analysis.

Model 1: Multi-storey building without dampers

Model 2: Multi-storey building with dampers at corners

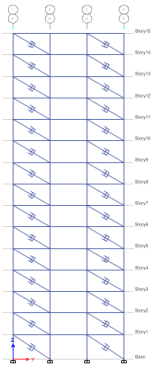
Model 3: Multi-storey building with dampers in middle

Model 4: Multi-storey building with dampers placed at I Shape

Model 5: Multi-storey building with dampers placed at H Shape

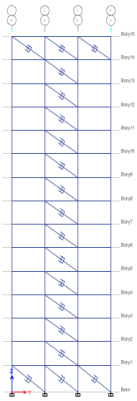
Model 6: Multi-storey building with dampers placed at O Shape

Model 1

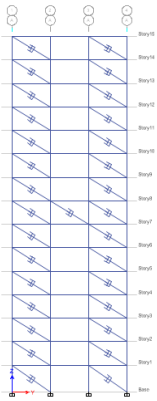


Model 2

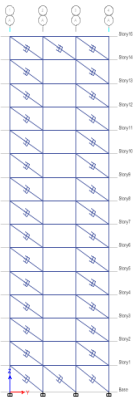
Model 3



Model 4



Model 5



Model 6

Results and discussion

The models are generated on ETABs and time history is applied for the analysis.

Storey stiffness and storey drift is analysed for the models and graphs have been made accordingly.

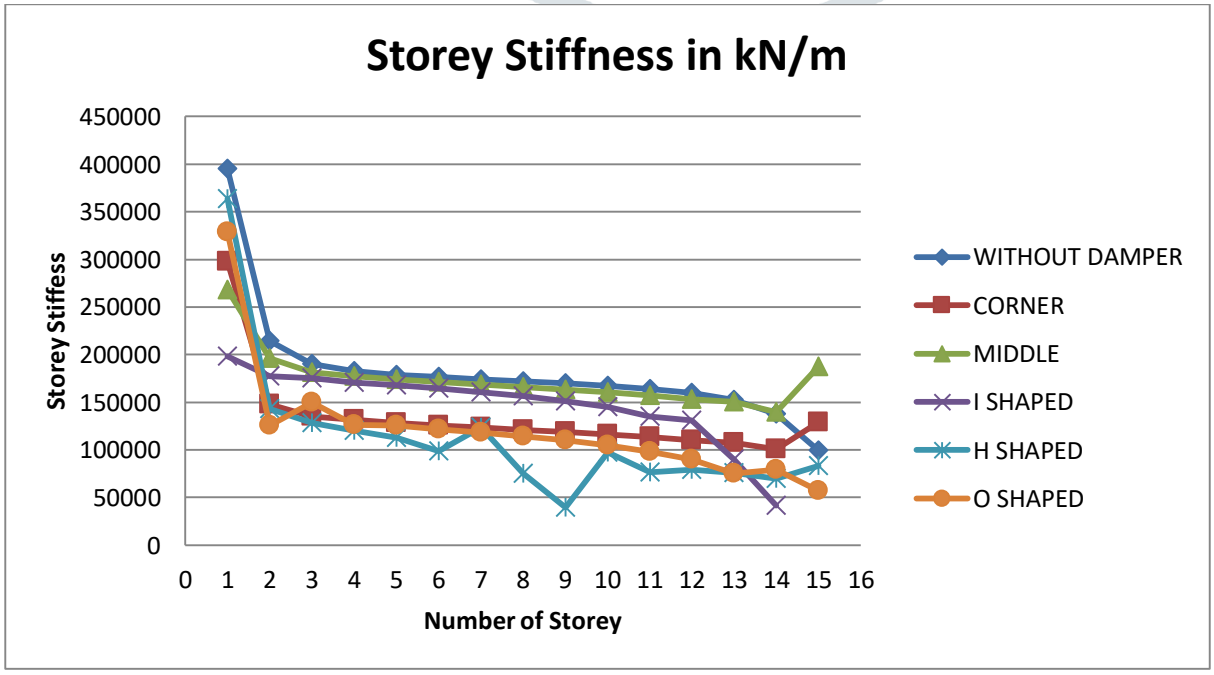


Fig 3: Graph showing the stiffness of the structure at different floors.

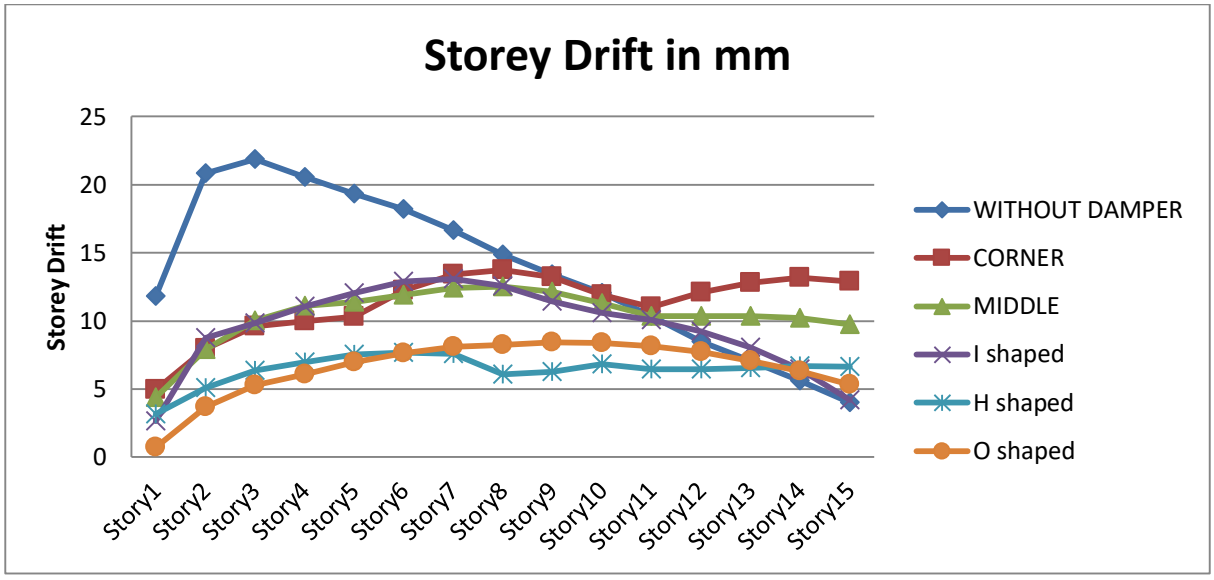


Fig 4: Graph showing storey drift of the structure at different floors.

Conclusion

1. The stiffness changes with the change in the arrangement of the fluid viscous dampers. It increases most for the middle and corner placed dampers as compared to other arrangements at the top storey of the structure.
2. The maximum story drift is found to decrease about 37% for corner arranged dampers, 43% for middle arranged dampers, 40% for I shaped dampers arrangement, 65% for H shaped arranged dampers and 61% for O shaped arranged dampers as compared to the structure with no dampers.

Refereces

1. S. P. D, A. Cinitha, P. K. Umesha, and N. R. Iyer, "Enhancing the Seismic Response of Buildings with Energy Dissipation Methods – An Overview," *J. Civ. Eng. Res.*, vol. 4, pp. 17–22, 2014.
2. J. Marko, D. Thambiratnam, and N. Perera, "Influence of damping systems on building structures subject to seismic effects," vol. 26, pp. 1939–1956, 2004.
3. L. Mathew and C. Prabha, "EFFECT OF FLUID VISCOUS DAMPERS IN MULTI-STOREYED BUILDINGS," vol. 2, no. 9, pp. 55–60, 2014.
4. P. Sajjan and P. Biradar, "STUDY ON THE EFFECT OF VISCOUS DAMPER FOR RCC FRAME STRUCTURE," pp. 31–36, 2016.
5. M. D. Symans *et al.*, "Energy Dissipation Systems for Seismic Applications : Current Practice and Recent Developments," vol. 134, no. 1, pp. 3–21, 2008.
6. C. Engineering and C. Engineering, "Comparative Study on Seismic Response of RC Structure Using Viscous Dampers and Viscoelastic Dampers," vol. 3, no. 8, pp. 1468–1478, 2014.
7. S. Infanti, J. Robinson, and R. Smith, "Viscous Dampers for High-Rise Buildings," *World Conf. Earthq. Eng.*, 2008.
8. J. M. Londoño, S. A. Neild, and D. J. Wagg, "Using a damper amplification factor to increase energy dissipation in structures," *Eng. Struct.*, vol. 84, pp. 162–171, 2015.
9. S. S. Tezcan and O. Uluca, "Reduction of earthquake response of plane frame buildings by viscoelastic dampers," *Eng. Struct.*, vol. 25, no. 14, pp. 1755–1761, 2003.
10. W. Khan, S. Akhtar, and A. Hussain, "Non-linear time history analysis of tall structure for seismic load using damper," vol. 4, no. 4, pp. 1–5, 2014.