Comparative Study on Seismic Behavior of Different Shape of RC Structure with Help of Viscous Damper- A Review

Bharaw Kumar Yadav[1], Sandhya Sahani[2]

[1]*M.Tech, Civil Engineering, Suyash Institute of Information Technology, Gorakhpur, Uttar Pradesh*
[2]*Assistant Professor, Civil Engineering, Suyash Institute of Information Technology, Gorakhpur, Uttar Pradesh*

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Abstract - *Dampers are energy-dissipating devices that resist lateral forces occurring on a structure. Dampers are used to minimize column buckling and beam deflection while also increasing the structure's stiffness. During earthquakes, the damper is utilized to minimize vibration and deformation of RC framed structures. The purpose of this research is to evaluate the performance of several types of passive control devices for the specified RC frame construction. Sap 2000 is used to do a time history study on a G+9 storey RC framed structure with and without dampers. When RC framed buildings without dampers are compared to RC framed structures with dampers, the maximum absolute displacement, story shear, and storey drift values are higher in the case of RC framed structures without dampers. A large number of the RCC building constructed all over the country in the earth-prone area and In this review paper, we study a paper that is related to the seismic analysis of RCC buildings by using the different types the damper in the building. After studying all the research papers we gave the conclusion in this paper of the different shapes of the RCC building with different heights in the different seismic zone with the help of the vicious, mass damper.*

Key Words: Time history, Mass damper, Viscous damper, RCC building, Etabs, Irregular building

1. INTRODUCTION

Energy dissipation devices are the most common component of structural passive control systems. Damping is an effect that occurs inside or on an oscillatory system that reduces, limits, or maintains its oscillations. Damping is established in physical frameworks by techniques that separate the intensity stored in the oscillation. In the simplest terms, seismic earthquakes are defined by shaking and vibration on the surface of the earth caused by subsurface growth along a flat plane. Tremors are caused by seismic waves, which induce vibrations. Seismic waves are the most depressing. [1] The recent advancement in the use of passive energy absorption technologies for structural earthquake resistance. [2] On a shaking table, multi-story scale model building structures are evaluated using a regulated semi-active fluid damper control system. [3] The seismic effect of an 8-story RC building seismic energy dissipation device application in China is viscous damper, visco-elastic damper, and steel damper [4]. High-capacity friction dampers based on the rotating friction principle are installed in tall constructions. [5] Frictional dampers in single-story constructions prevent seismic action. [6] A viscous damper's seismic response was calculated using sophisticated damper theory. [7] To manage shock vibration, seismic vibration may be controlled by using fluid viscous dampers. [8] Viscous damper mathematical modeling and dynamic analysis The maintenance and application of any structure are thus jeopardized as the population grows. A quake-safe structure, according to conventional norms, can withstand the most severe shaking that might occur in that specific zone. Regardless, the most effective way for designing a shaking secure structure is to restrict the passings as well as the decimation of the fundamental component's functionality. From historical and recent records, the world has seen multiple devastating seismic earthquakes, increasing the number of people killed or injured as a result of basic crumple and structural damage.

1.1. Seismic Damper

A Seismic Damper is a mechanical device that distributes the kinetic energy of seismic waves traveling through a structure. The seismic damper is a technological advancement that significantly minimizes the vibrations in structures caused by earthquakes.

Type of damper

1. Viscous Damper.
2. Viscoelastic Damper.
3. Friction Damper.
4. Tuned Mass Damper (TMD).
5. Yielding Damper.
6. Magnetic Damper.

1.1.1. Viscous Dampers

The silicone-based fluid moving between piston-cylinder combinations absorbs seismic energy in viscous dampers. In seismic locations, viscous dampers are utilized in high-rise structures. It can work in temperatures ranging from 40 to 70 degrees Celsius. Vibrations caused by severe winds and earthquakes are reduced using a viscous damper.

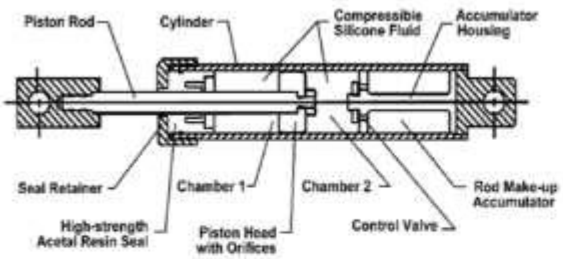

Figure-01: Viscous Damper

1.1.2. Visco-elastic Dampers

Visco-elastic dampers, which stretch an elastomer in conjunction with metal elements, are another form of the damper. The mechanical energy of the structure is dissipated by this form of damper, which converts it into heat. Several parameters, such as ambient temperature and loading frequency, have an impact on the damper system's function and, as a result, its efficacy.

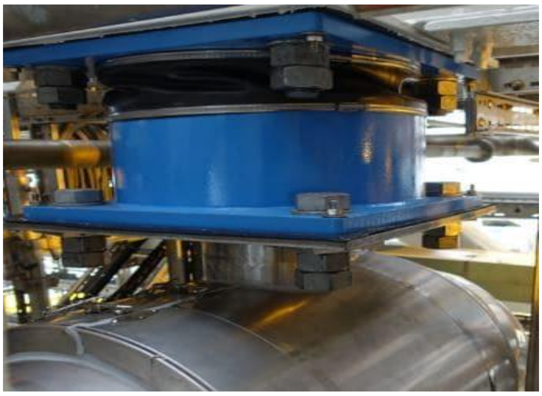

Figure-02: Visco-elastic Damper

1.1.3. Friction Dampers

A friction damper is made up of many steel plates moving in opposite directions against one other. Shims of friction pad material separate the steel plates. The energy is dissipated through friction between the surfaces that rub against each other in the damper. Surfaces made of materials other than steel can also be produced.

Figure-03: Friction Damper

1.1.4. Tuned Mass Damper (TMD)

When a significant lateral force such as an earthquake or high winds strikes, a tuned mass damper (TMD), also known as vibration absorbers or vibration dampers, is placed to a specified point in a structure, which reduces the amplitude of vibration to an acceptable level.

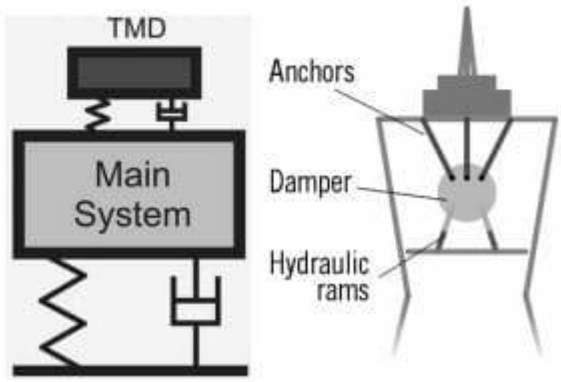

Figure-04: Tuned Mass Damper

1.1.5. Yielding Dampers

A yielding damper, also known as a metallic yielding energy dissipation device or a passive energy dissipation device, is made of easily yielded metal or alloy.

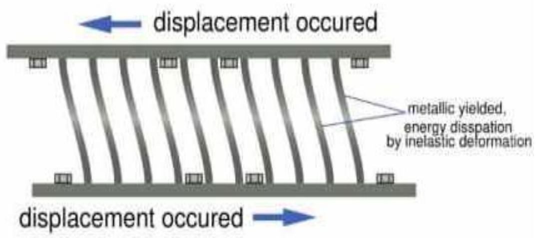

Figure-05: Yielding Damper

1.1.6. Magnetic Damper

Two racks, two pinions, a copper disc, and rare-earth magnets make up the Magnetic Damper. This sort of damper is neither costly nor temperature-dependent. Because magnetic damping is not a strength, it is effective in dynamic vibration absorbers with low damping requirements.

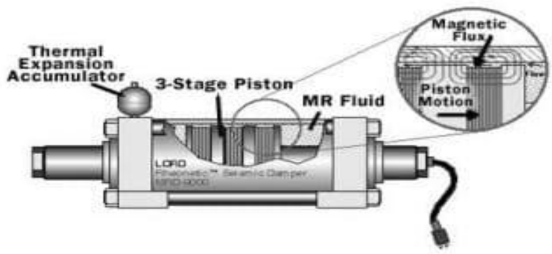

Figure-06: Magnetic Damper

2. LITERATURE REVIEW

We study the following paper which is related to the Seismic analysis of the RCC building by using the different types the damper.

[1] Kasai [2008] The author employed a variety of dampers in this study, including viscous dampers, steel dampers, and visco-elastic dampers. The paper's principal finding is that when compared to a frame without dampers, average inter-story drift and shear forces of columns may be decreased by approximately half. The viscous dampers have a greater displacement control effect than the other types of dampers, especially during moderate and large earthquakes. The force-displacement curves of dampers are highly full, and they may dissipate a lot of energy. Under mild earthquakes, the ratio of actual damping forces to predicted damping forces demonstrates that the initial damper parameter design is correct.

[2] Hejazi, et al [2009] "Earthquake Analysis of Reinforced Concrete Framed Structures with Viscous Dampers" is a paper published in the journal Earthquake Engineering. The following conclusion may be formed based on the current study: A set of computer tools has been presented for the study of reinforced concrete framed structures with viscous damper elements. When seismic responses of structures without an energy dissipation system are compared to seismic responses of structures with suggested viscous damper components, it is clear that the use of damper devices efficiently reduces structural reaction when earthquakes are excited. (In the case of a three-story building, the reduction is 80%). The best design of damper parameters is determined by evaluating the influence of the damper damping coefficient on the structure's response and selecting appropriate damper characteristics for the intended structural design based on the effect of damper devices on seismic load reduction.

[3] Benita et al [2017] In this study the seismic response of the building is analyzed when it is connected with various passive dampers and subjected to the earthquake of intensity 6 Storey benchmark building is modeled and analyzed using SAP2000. The Time History Analysis method is used for dynamic analysis. After the analysis results for passive dampers are obtained and compared and the results are as follows. The RCC building without the masonry wall is analyzed without a passive damper and its displacements are 79.6mm, 22.5mm, and 22.1mm when subjected to El Centro 1940, Northridge, and Imperial Valley. The Displacement results obtained after the connection of dampers show 55% displacement reduction for VED, displacement reduction for 73% friction damper, and displacement reduction for VISCOUS FLUID DAMPER 79%. Inter-Storey drifts are within the permissible limit for all the passive dampers. The value of the Base shear for the Bare frame with the Friction damper is higher when compared to the Viscous Fluid Damper, a Visco-elastic damper.

[4] Rakesh, Savita [2018] This study explains the behavior of dampers on the structural system under the performance of dynamic loads from which the following conclusion can be drawn, based on the result, i. The analysis shows that the period of structure increases when the Tuned Mass Damper and Viscous Fluid Damper are mounted because these frequencies of structure reduce when compared with a bare frame of the RCC structure. As the frequency of structure reduces the dynamic effect on the building also reduces. The value of response spectrum acceleration under time history analysis there is a reduction of about 17.0% of model Tuned Mass Damper and 27.0% of model Viscous Fluid Damper as compared to the model without any damper in X direction after applied time history data. Similarly, in The value of response spectrum acceleration under time history analysis, there is a reduction of about 11.0% of model Tuned Mass Damper and 19.0% of model Viscous Fluid Damper as compared to the model without any damper in the Y direction after applying the time history data. The value of response spectrum velocity under time history analysis there is a reduction of about 9.0% of model Tuned Mass Damper and 19.0% of model Viscous Fluid Damper as compared to the model without any damper in the X-direction. And the reduction of about 8.0% of model Tuned Mass Damper and 23.0% of model Viscous Fluid Damper as compared to the model without any damper in the Y direction. On observing the base acceleration value under time history analysis, there was a reduction of 2% in model TUNED MASS DAMPER and about a reduction **of** 7.68% in model with VISCOUS FLUID DAMPER in the X direction for the same coefficient of damping for both. The value of base displacement under time history analysis there is a reduction of about 3.0 % of model Tuned Mass Damper and 12.0% of model Viscous Fluid Damper as compared to the model without any damper in the X-direction. Similarly, The value of base displacement under time history analysis there is a reduction of about 2.54% of model Tuned Mass Damper and 13.27% of model Viscous Fluid Damper as compared to the model without any damper in the Y direction. After comparing all models it has been observed that the Viscous Fluid dampers gave a maximum reduction in responses (Base Shear, Displacement, Velocity, Acceleration) with compare to the TUNED MASS DAMPER model for the same damping coefficient.

[5] Puneeth, Praveen [2018] The following is the conclusion of the paper research by all authors: According to the findings, the presence of a viscous damper in a structure reduces building displacement and drift. The displacement of the bare frame model without a damper is 29.0 mm, and the narrative drift is 0.00181 mm, according to the data. The displacement and narrative drift derived from the model with the inclusion of a viscous damper is 10.73 mm and 0.00055 mm, respectively. As can be seen, the displacement values grow as the building rises in height. When viscous dampers are applied to the structure, the displacement value of the structure is decreased by around 60% to 85%, according to the comparison. The maximum drift in the structure under seismic loading is reduced when a viscous damper is installed. When compared to the base model, the story drift at mid-stories is reduced by 70% when a viscous damper is used in the structure. The drift value at the top and bottom stories is reduced by around 60% to 80% when a viscous damper is applied to the structure. The bare frame model has a base shear value of 1291.18 kN, whereas the model with a viscous damper has a base shear value of 1487.82 kN. Because of the weight of the damper supplied to the structure, the difference is minimal when looking at the sheer value. According to the research, introducing viscous dampers to the structure affects its behavior under seismic loads. As can be seen, these viscous damper devices play an important function in decreasing and managing the structure's seismic reaction.

[6] Jigar et al [2018] The study's major goal is to determine the best strategy for improving the seismic performance of a structure with dampers. The following conclusions are drawn from the analytical results: When considering storey displacement in an RCC structure with beam-column frame model R9 (i.e. dampers on the 3rd, 4th, and 5th floor), the displacement is reduced by 17.3 percent and 22.9 percent in the X and Y directions, respectively. In the X-direction, the displacement increases to 24.8 percent for model R2 and 4.9 percent for model R3, whereas the displacement increases to 11.7 percent for model R2 and 4.8 percent for model R3 in the Y direction. This demonstrates that dampers are successful in reducing displacement when installed on the bottom level and continue to increase when they are installed on the top floor. When dampers are installed on the 3rd, 4th, and 5th floors of an RCC structure with a beam column frame, the structure's storey drift is decreased by 59.6% in the X direction and 71% in the Y direction. When dampers are installed in all storeys, storey drift increases by 120.6 percent and 176 percent in the X and Y directions, respectively. As a result, dampers on the bottom storey are installed to reduce storey drift. When dampers are installed in the bottom storey, the base shear increases by 3.83 percent, but the X and Y directions are reduced by 13.14 percent and 25.87 percent, respectively, when dampers are installed in all stories. When dampers are installed at all levels, the structure becomes more flexible, minimizing the base shear. When the damper is just installed on the lowest storey, there is only a 3.8 percent increase in base shear. When dampers are installed on the 3rd, 4th, and 5th levels, the structure's time in the first mode is decreased by 7.9%. As a result, the use of dampers in the structure's bottom floor period can be decreased. The presence of dampers in the bottom storey is favorable for lowering storey displacement, storey drift, and structure period, as shown by the above analytical results.

[7] Vibha et al [2019] Based on the results and discussion the following conclusions are made. Up to 44% reduction in storey displacement was observed when Fluid Viscous Damper is provided till 10th floor in a zigzag pattern while the reduction is up to 54% when Fluid Viscous Damper are provided in all external corner in a zigzag pattern. The storey drifts decreased up to 78% when FVD is provided till the 10th floor in a zigzag pattern. Also, it decreases up to 65% when VFD is provided in all external corners in a zigzag pattern. Around 40% reduction in the period was observed when FVD is used. It is observed that model B with aspect ratio 1 with dampers provided in a zigzag pattern in all external corners gives a satisfactory result as compared with other models. Model D with an aspect ratio of 1.5 with dampers provided in a zigzag pattern in all external corners also gives good results.

3. CONCLUSION

After studying all papers which are given in the literature review, the following conclusions are come out, The value of the torsion decrees which is arising in the L shape building, and the value of the torsion in the L shape building is less as compared to the T shaped building. By using the viscous damper we found that the value of the base shear and storey displacement decreases as compared to the normal building. By using the viscous damper, reduction in the base shears, storey drift with increasing the number of the floor. The period is also found to be reduced as compared to that of the bare frame with the addition of dampers of about 25%. The bending moments in beams and axial forces in columns are greatly reduced with the addition of dampers.

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