Seismic Performance of RC Frame Structure Using Viscous Dampers

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Abstract- *Dampers are the energy dissipating devices which are used to resist lateral forces acting on the structure. Dampers are used to reduce the buckling of columns and deflection of beams and to increase the stiffness of the structure. Dampers are used to reduce the vibrations and deformation of RC framed structure during earthquake. At the time of earthquake multi storey building is damaged and large deformation occurred in multi storied building. The dissertation work is concern with comparative study of various arrangements of fluid viscous dampers used for multi storied R.C.C. building. Response Spectrum method is used to analyse seismic G+9 story building with double and BRB dampers. In response Spectrum method, earthquake load is applied in both X and Y direction. For the analysis purpose ETABS 2015 software is used by considering seismic zone V as per IS 1893:2002 (Part 1) code. Results of these analyses are discussed in terms of various parameters such as maximum absolute displacement, story shear, and time period. The comparison of these various parameters is done. From this comparison it is concluded that maximum, story shear, time period values are more in case of RC building without damper as compared to RC building with dampers.*

Keywords- Dampers, Conventional Building, High rise building, Seismic behaviour.

I. INTRODUCTION

Structural passive control system primarily includes energy dissipation devices. Damping is an impact inside or upon an oscillatory framework that has the impact of lessening, limiting or keeping its oscillations. In physical frameworks, damping is created by procedures that separate the least complex terms can be characterized as shaking and vibrations at the outside of the earth coming about because of underground development along a flat plane. The vibrations created by the tremors are because of seismic waves. Seismic waves are the saddest one. Multi story scale model building structures are tested in shaking table, it subjected to controlled semi active fluid damper controlled system. Viscous damper, Visco-elastic damper and steel damper are the seismic effect of 8-story RC building seismic energy dissipation device application in China. High capacity friction dampers are installed in tall structures based on rotational friction concept. The frictional dampers are resists the seismic response in single story structures. Fluid viscose damper desired to control the shock vibration.

II. TYPES OF DAMPERS

Viscous damper

In this kind of damper by utilizing viscous fluid inside cylinder vitality dispersed. Viscous dampers are utilized in towering structures in seismic zones. Viscous dampers decrease the vibrations prompted by both strong wind and seismic trembling. Viscose dampers are water driven gadgets that distribute the active vitality of seismic occasions and can be intended to permit free development just as controlled damping of structure to shield from wind stack, warm movement or seismic occasions. Available in appraisals up to 1000 KIP, seismic dampers are appropriate for extensive relocation and additionally substantial load applications for example scaffolds, structure, and huge structures. Figure 1 shows the Taylor device fluid viscous damper that installed in RC framed structures.

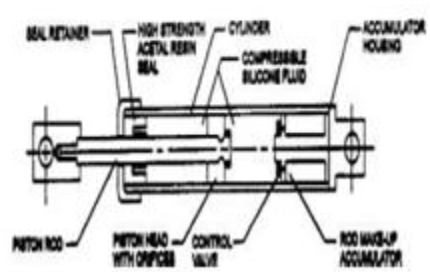

Fig. No. 1 Taylor device fluid Viscous dampers

Visco-elastic damper

Visco elastic dampers can be utilized in almost every industrial sector to reduce resonant vibrations. Applications incorporate energy production, process building and damping of individual machines or complete channelling frameworks. Dampers can be utilized to take care of vibration issues up to a strong direction of the most astounding conceivable of a metal housing loaded up with a viscous medium. Either the upper or lower plate is associated with the vibrating framework, while the other one must be mounted on a fixed abutment. Figure 2 shows the viscous elastic damper that installed in RC framed structures.

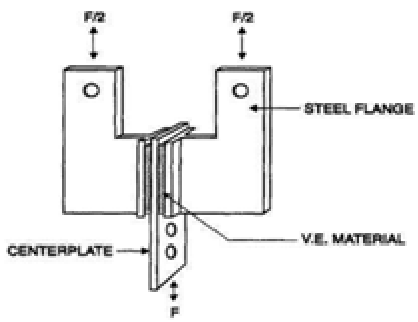

Fig. No. 2 Visco elastic dampers

Friction dampers

Friction provides another excellent mechanism for energy dissipation, and has been used for many years in automotive brakes to dissipate kinetic energy of motion. In the improvement of rubbing dampers, it is vital to limit stick-slip marvels to abstain from presenting high recurrence excitation. Furthermore, compatible materials must be employed to maintain a consistent coefficient of friction over the intended life of the device. The Pall device is one of the damper elements utilizing the friction principle, which can be installed in a structure in an X-braced frame as illustrated in the figure 3.

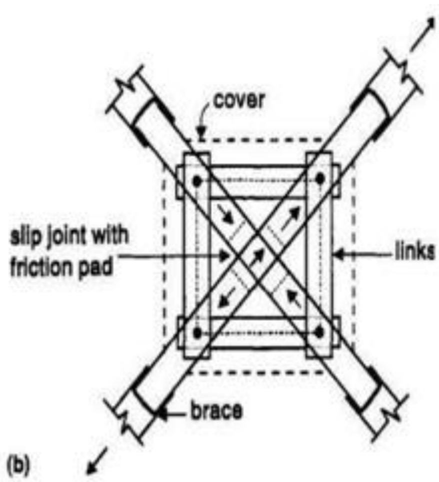

Fig. No. 3 Friction damper

Metallic dampers

Metallic dampers are typically using steel. They are intended to distort so much when the building vibrates during an earthquake that they can’t came back to their unique shape. This lasting disfigurement is called inelastic deformation, and it utilizes a portion of the seismic earthquake intensity which goes into the building. Figure shows the metallic damper that is installed in RC framed structures.

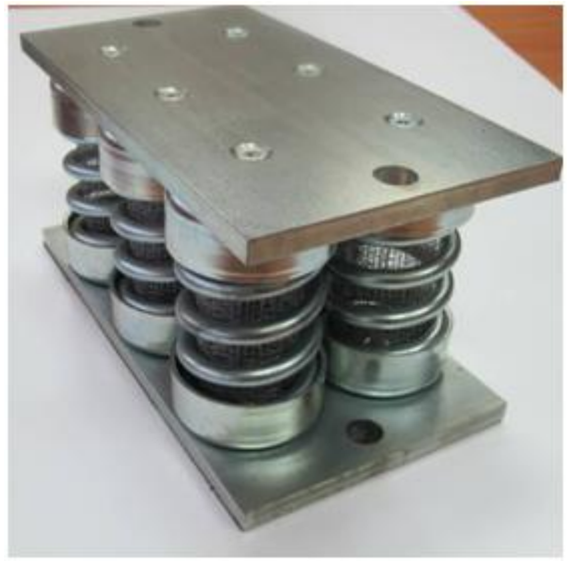

Fig. No. 4 Metallic damper

III. OBJECTIVES OF THE WORK

The objectives of present work are:-

1. To compare response of the RC structure for double bracing damper, and BRB Dampers.
2. To study of Dynamic analysis results in terms of story displacements, Storey drift, Base shear, mode participation etc.
3. To study the effect of Dampers on structure.

IV. MODELLING AND ANALYSIS

It involves modelling and analysis of G+9 with double damper and with BRB damper. The plan and loading is kept same for all the structures.

Building Configuration

i. Plan Dimensions – 20 m X 15 m
ii. Story Height – 3.5 m
iii. Column Size – 230 mm X 700 mm
iv. Beam Size – 230 mm X 600 mm
v. Slab Thickness – 125 mm
vi. Wall Thickness – 230 mm
vii. Parapet Height – 1.2 m

viii. Damper type – FVD
ix. Damper Mass – 45 Kg
x. Damper weight – 250 kN

Earthquake force data:

i. Earthquake load for the building has been calculated as per IS 1893(par 1) : 2005
ii. Zone factor – 0.36
iii. Seismic zone – V
iv. Importance factor (I) – 1
v. Reduction factor (R) – 5

Etab Models

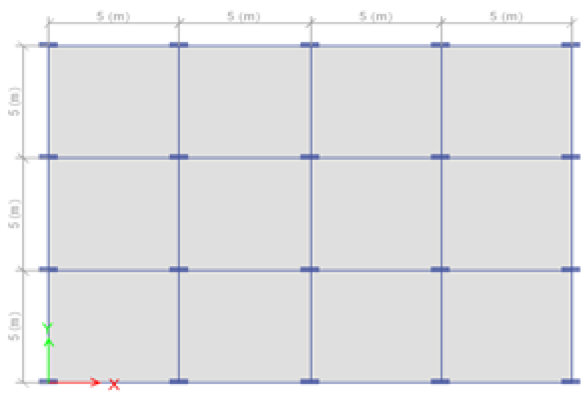

Fig.5 Plan of Building

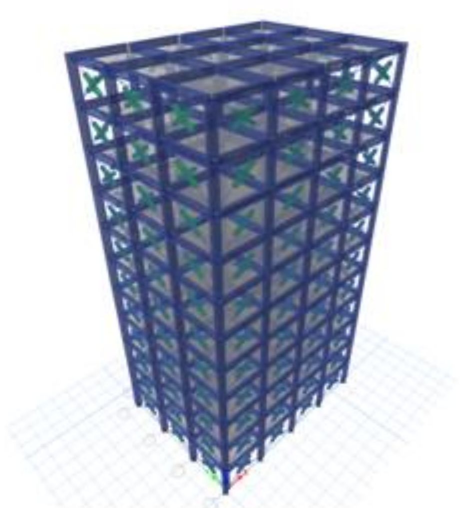

Fig. 6 3D of G+9 Double Dampers

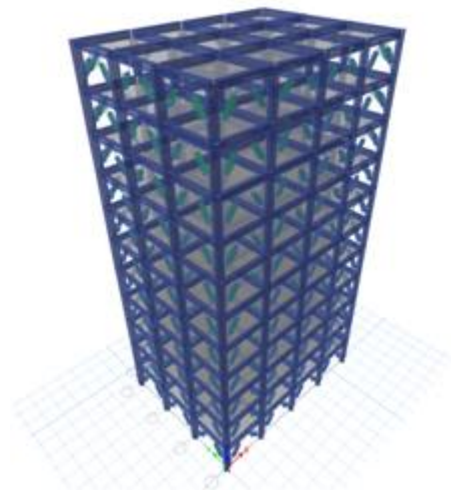

Fig. 7 3D of G+9 BRB Dampers

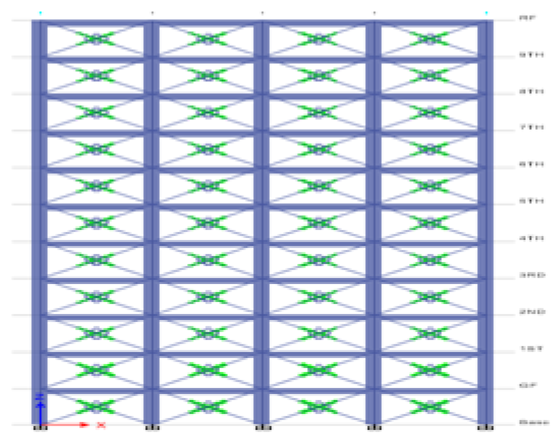

Fig. 8 Elevation of G+ 9 Double Dampers

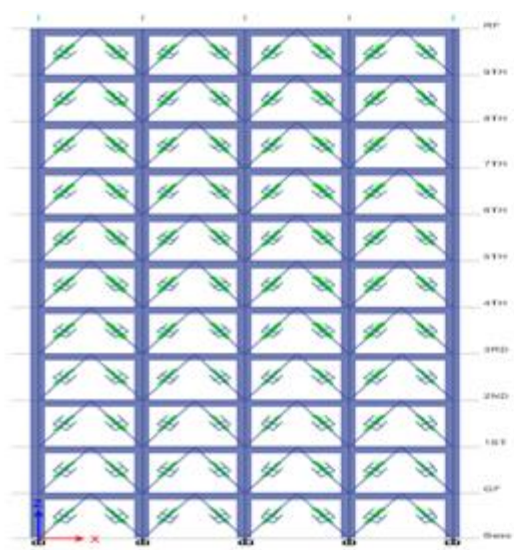

Fig. 9 Elevation of G+ 9 BRB Dampers

V. RESULT AND DISCUSSION

Comparative dynamic analysis results are

TIME PERIOD (Second) G+9

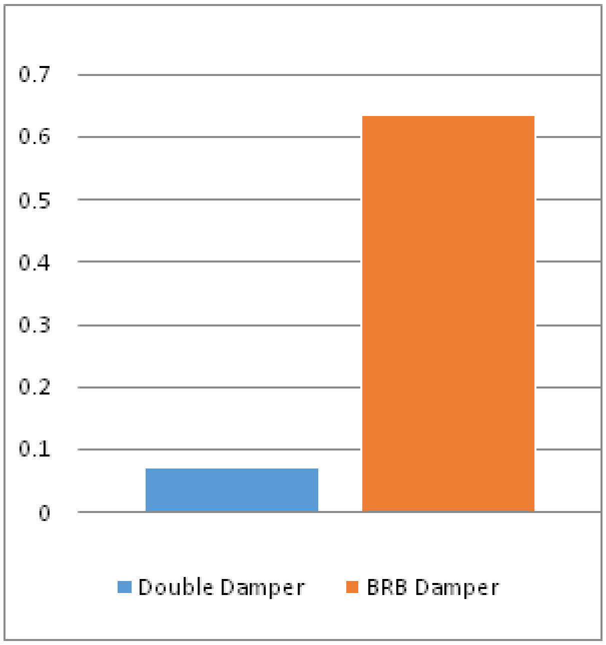

Fig. 10 TIME PERIOD G+9

MAXIMUM STORY DISPLACEMENT (mm) G+9

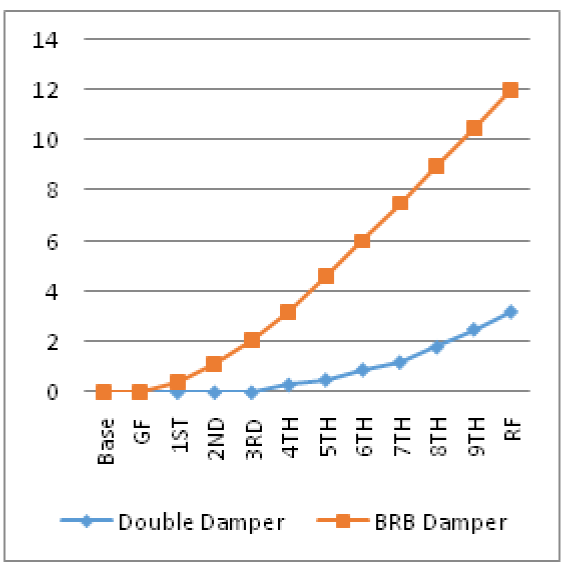

Fig. 11 MAXIMUM STORY DISPLACEMENTS G+9

STORY SHEARS (kN) G+9

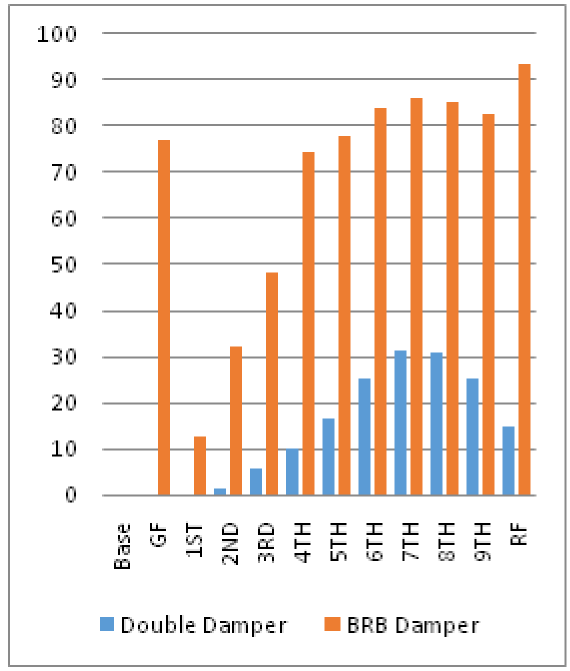

Fig. 12 STORY SHEARS G+9

VI. CONCLUSION

In this study, FVD (Fluid Viscous Damper) with different arrangement are used to reduce seismic response of the structure subjected to earthquake load. The dimensions ten story building are 20 m long and 15 m wide. The overall height is 14 m and 35 m respectively. The proposed building located in seismic zone V the material properties are concrete compressive strength fck 30 N/mm2 and fy 415 N/mm2 for the dynamic analysis the response spectrum analysis method is used. The design of super structure is checked with story displacement, story shear, time period, using ETABS software. Fluid viscous damper are installed in U1 and U2 direction at all story only along periphery of structure with double and BRB arrangement. It is found that all the damper arrangements are effective in reducing seismic response of the structure.

In the comparison of results of structure with damper and without damper it is concluded:

- The reduction in time period ranges 69 % to 97 % for damper structures less than that of uncontrolled structure.
- The reduction in maximum story displacement ranges 60 % to 90 % for structures with damper.
- Story shears for structures with damper about 30 % to 85 % less than that of uncontrolled structure.

The response can further reduced by different arrangement of damper. From above it can be conclude that the fluid viscous damper devices' with different arrangements perform a vital role in reducing and controlling the seismic response of the structure as compared to conventional structure.

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