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Seismic Performance of Energy Dissipation Devices

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***Abstract*—The study for the behaviour of every multistoried building structure which is subjected to ground motion is common problem for construction. Earthquake has become a great concern for our country. Vibrations caused by earthquakes have led to collapse of structure and loss of precious human life and property. Recently dampers have become very popular for vibration control of structures because of their effective and economical design. This paper gives an idea about various researches carried out on multistoried buildings using dampers .Analysis is generally carried out using ETABS software.**

Keywords— Energy dissipation devices,viscous dampers, pall dampers.

I. INTRODUCTION

Strong earthquakes have occurred across the world in past. These earthquakes have caused severe damages to large-scale infrastructures. To protect structures from significant damage under severe earthquakes has become an important topic in structural engineering. Conventionally, structures are designed to resist dynamic forces through a combination of strength, deformability and energy.

The structures designed are vulnerable to strong earthquake motions. In order to avoid critical damages, structural engineers are working to figure out different types of structural systems that can withstand strong motions.

Serious efforts have been undertaken to develop the structural control concept into a workable technology and energy dissipation devices are installed in structures.

The concept of structural control is to absorb vibration energy of the structure by introducing supplemental devices. Various types of structural control theories and devices have been recently developed and introduced to large-scale civil engineering structures.

II .OBJECTIVE

To find the suitability of energy dissipation devices in structures

To check weather viscous damper or pall friction damper which is more suitable for a particular earthquake zone.

III . LITERATURE SURVEY

(Naziya Ghanchi and Shilpa Kewate 2015)
In this paper they did dynamic analysis of 25 floor rcc building with and without viscous dampers found that by adding viscous dampers in a building response of a structure get reduced by significant amount. It is seen that for response spectrum analysis in X and Y direction, the response of the structure such as the story drift and storey displacement reduces more as compare to the story shear. Reduction of story drift is around 29% to 30%, reduction of story displacement is around 20% to 23%, and reduction of story shear is around 0% to 2%.

(D.A.Chikhalekar and M.M.Murudi)
They studied about seismic performance of structure with fixed base ,base isolated structure and structure with viscous damper and found that response of the structure can be reduced by use of visous damper in structure the storey drift ,storey displacement are reduced.Base isolation techniques have been found reliable for seismic protection of multy storey structure.

(Ankit Jain and Dr.R.S.Talikoti 2016)
In this paper they insvigated about performance of High rise structure with dampers at different locations the study describes the results of a study on the seismic behavior of a structure (G+7) with and without damper.Analysis was done in E tabs software.
Seismic Performance of building can be improved by providing energy dissipating device (damper), which absorb input energy during earthquake.
After application of damper is much better when we provide same number of damper to bottom 7th stories.
Frame is safer when damper is provided up to Floor from base as compare with other arrangement.
With deployment of damper in the structures, base shear effectively reduce.

(Avtar PALL and R. Tina PALL , August 2004)
In this paper they studied about Pall Friction Dampers and its economical feasibility
in design of structures. Their low cost and maintenance free characteristics suggest wide application for new construction as well as for retrofit of existing buildings.
Public sectors, private sectors, developed and developing countries are all benefiting from this technology.
Pall Friction Dampers have been used for the seismic protection of more than 80 major building projects, including the Boeing Commercial Airplane Factory at Everett, WA – the world's largest building in volume.This offered savings of more than 50% over conventional retrofit scheme.

Jianxing Chen, Lianjin Bao

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In this paper they present an innovative method for the design of super high-rise building where Cantilever Truss Dampers are induced.
Time history analysis result shows that the structural dynamic responses, such as force and displacement, are virtually eliminated when VDs are applied. VDs dissipate nearly 2/3 energy induced by the minor earthquake.
The viscous damping ratio will be twice as structural intrinsic damping according to the energy theory. The investigation illustrates that viscous dampers work effectively to dissipate energy and the benefit can be realized

A.K. Sinha,Sharad Singh,February 2017
In this paper the results of the non-linear modal time history analysis conducted on a 12 story RC frame structure with and without friction damper(FD), represented using story responses and time history plots for various parameters, demonstrate that the story response of the structure in form of AMSD(Absolute Max. Storey Displacements) and AMSd(Absolute Max. Storey Drift) have been reduced considerably by use of dampers.
The time history plot of roof displacement shows considerable reduction by use of dampers against the building without supplemental damping. The effectiveness of dampers is evident in form of reduced storey responses and stress demands on structural elements and indicates the nature of the FD which is a displacement based damper.
The time history plot of roof acceleration, base shear and storey shear reveals that by use of dampers there is an overall increase in the value of these parameters which implies the ineffectiveness of FD in reducing the value of these parameters.
The increase forces in case of building with dampers has lower damaging effects on the structural members as these forces are considerably shared by the damper brace system.
The damping demand on structural members is reduced due to frictional damping and hysteretic damping by damper brace system. This indicates a lower hysteretic damping by structural members.
A lower hysteretic damping by structural members indicates that the structure shows less inelastic behaviour and remains within elastic limit preventing damage to structural members.
Even though the FDs have significantly reduced the responses, the damping demand of structure can be further reduced by optimum selection and installation of FDs at various critical locations.

Dejian Shen, Sen Que,Ling Song and Coungbin Huang 2010
In this paper,they analaysed the effect of viscous damper on seismic performance of steel-concrete hybrid structure for high-rise building . The result shows that viscous damper has little effect on dynamic properties of structure. The story lateral displacement, story drift rotation and damage of structure can be reduced effectively by viscous damper. The effect of the viscous damper on structure seismic performance is better with the increase of seismic intensity. Under the 7, 8 and 9 degree seismic seldom intensity, the story lateral displacement of the top floor decreases at 17.2%, 23.3%, 33.4% and the story drift rotation decreases at 20.8%, 27.2%, 44.7% respectively.
Mr. Ashish A. Mohite, Prof. G.R. Patil
In this paper a tuned mass damper (TMD) is placed on top of the structure and through it they study its effects on structural response due to time history analysis with and without the tuned mass damper (TMD) in a ETABS.
The seismic behaviour of 10th, 12th, 14th, 16th, 18th, and 21th storey building with tuned mass damper and without tuned mass damper was investigated. TMD is effective in reducing displacement and acceleration and, thereby, can be used for structures under earthquake. The study was aimed at tuned mass dampers in reducing structural (storey drift, storey displacement and base shear) of seismically excited 10th, 12th, 14th, 16th, 18th, and 21th storey building.

It has been found that the TMDs can be successfully used to control vibration of the structure.
For the regular building frame, 5% TMD is found to effectively reduce top storey displacement. The reduction of 10th storey building is 38.13, reduction of 12th top storey building is 36.36, reduction of 14th top storey building is 35.16, reduction of 16th top storey building is 33.34, reduction of 18th top storey building is 31.96, and reduction of 21th top storey building is 30.46. And base shear by about 2%.
Therefore, the TMD should be placed at top floor for best control of the first mode.
For the regular building, TMD with damping exponent (n) value 0.2 is found to be better than TMD with damping exponent value 0.5.
From analysis it can be seen that it is necessary to properly implement and construct a damper in any high rise building situated in earthquake prone areas

R. Kazi , P. V. Muley, P. Barbude 2015
In this paper they studied about structures with viscous dampers modelled and analyzed in E tabs results of there investigation shows that :
The response of structure can be dramatically reduced by using visco-elastic damper without increasing the stiffness of the structure.
They observed that, the acceleration can be reduced by substantial amount whereas displacement to a considerable amount.
Viscoelastic dampers are unique in combating the wind forces, for its visco-elastic material, whereas other dampers are suitable mostly for earthquake forces only.
The performance of visco-elastic damper devices is much better for the tall buildings with slender design.

CONCLUSION

The following conclusion can be drawn from the different literature surveys that :

1. Energy dissipation devices(dampers) helps in reducing the vibration of the structure as compared to normal structure without dampers.
2. The FVDs are capable of reducing both forces and displacements of the structure under seismic loads.

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