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Applications of Dampers for RCC Building to Reduce Seismic Risk

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Abstract: As known from very upsetting experiences, RCC buildings were heavily damage or collapsed during earthquake. This might be due to the lack of knowledge regarding the proper behaviour of supporting system of the building again dynamic effect. Past earthquake studies shows that the most of the RC buildings having such irregularities were severely damaged under the seismic ground motion. Several techniques are available today to minimize the seismic risk of the structure, dampers are one of them. The damper has become more popular to reduce seismic risk. Because of their safe effective and economical design, in this study an attempt has been made to study the effectiveness of damper for controlling seismic risk of the structure. The review includes different types of dampers as a vibration controls device, like tuned mass dampers, x-plate dampers, frictional dampers etc.

1. INTRODUCTION

Now-a-days in construction industries built-up for taller and lighter structure, Seismic safety of these structures is important. This types of structure more damages due to earthquake, resulting in increase loss of human life due to collapse of building. To reduce this seismic risk various types of structural control technology have been develop to solve the safety and functional problems for structures under the excitation of external force. In last few years in war footing step to research and development structural control system such as base isolation, shear wall, bracing, damping device.

Damping device - A flexible structural element of the damping system that dissipates energy due to relative motion of each end of the device. Damping devices include all pins, bolts, gusset plates, brace extensions, and other components required to connect damping devices to the other elements of the structure. Damping devices may be classified as either displacement dependent or velocity dependent, or a combination thereof, and may be configured to act in either a linear or nonlinear manner**.**

Damping system-The collection of structural elements that includes all the individual damping devices, all structural elements or bracing required to transfer forces from damping devices to the base of the structure, and the structural elements required to transfer forces from damping devices to the seismic force resisting system.

Displacement dependant damping device-The force response of a displacement dependent damping device is primarily a function of the relative displacement, between each end of the device. The response is substantially independent of the relative velocity between each end of the devices, and/or the excitation frequency.

Velocity- dependent Damping device:

The force displacement relation for a velocity dependent damping device is primarily a function of the relative velocity between each end of the device,

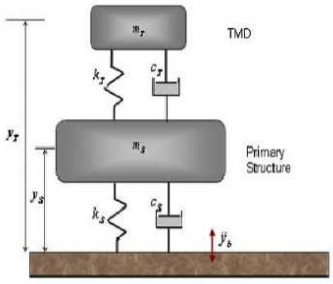
and could also be a function of the relative displacement between each end of the device.

Basic classification of damping system -

Passive control system, Active control system and Semi active control system are giving special importance on improvement of wind and seismic responses of RC buildings. Passive control systems do not require any power supply. Active control systems require external power supply and operate based on sensors which are attached within the structures. Semi active control systems are combination of both passive and active control systems which require external power supply and they operate based on sensors attached to within the structures. But when there is no power supply, passive control systems control the vibration of structures. The tuned mass dampers, frictional damper X- plate damper are commonly used as vibration control device.

Tuned mass damper- With the aim of developing such a simple control device, some studies have been undertaken in last couple of years. In these studies a simple type of Tuned Mass Damper (TMD) has been proposed. A tuned mass damper (TMD) is a passive energy dissipation device, consists of a mass, spring, and a damper, connected to the structure in order to reduce the dynamic vibrations induced by wind or earthquake loads. The soft storey will be made up of concrete and its columns, beams, and slab sizes will be smaller than columns, beams, and slab sizes other stories of the building1. The height, member sizes of

soft storey will be devised based on the principle of TMD i.e. the natural frequency of TMD (soft storey) should have same natural frequency as that of main building.



X-Plate damper-X-plate damper (XPD) is a metallic damper that is capable of sustaining many cycles of stable yielding deformation resulting in a high level of energy dissipation. XPD is also a hysteretic device because its energy dissipation depends primarily on relative displacement within the device and not on its relative velocities. XPD facilitates a constant strain over the height of device, thus ensuring that yielding occurs simultaneously and uniformly over full height of damper. The idea behind adding this device to structure is to enhance its energy dissipation capacity against environmental loads, providing an alternative to wind and conventional earthquake resistant design and retrofit. In order to use this device economically, optimization of locations in a structure is an important issue and has been studied by several researchers.

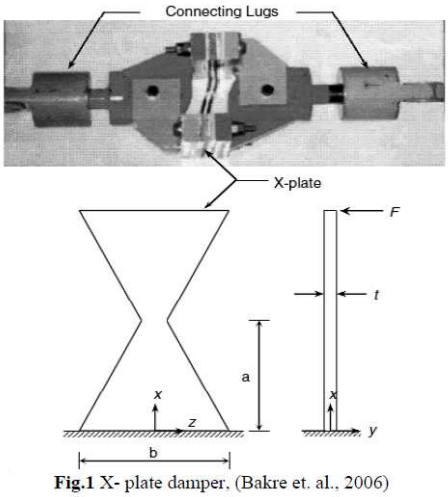


Fig.1 X- plate damper, (Bakre et. al., 2006)

MODELLING OF SQUARE BUILDING WITH XPD

Friction Dampers: Friction dampers work based on the mechanism of solid friction for dissipation of vibration energy. Mualla an Borislav, have investigated the performance of a friction damper installed in a single storey steel frame subjected to seismic loading. Experimental and numerical results show that the friction damper can improve the dynamic response of innovative structures as well as the existing building compared to the conventional design. The effectiveness of bidirectional frictional forces for the analysis of piping system when subjected to earthquake ground motion with friction supports was given by Jangid and Patil. The slotted bolt connection type friction damper was investigated on the seismic retrofitting of the structure by Robert Levy et al.. The conceptual design of three storey steel frame building of seismic retrofitting of existing building using friction damper was investigated by Lee et al. and Tabeshpour & Ebrahimian.

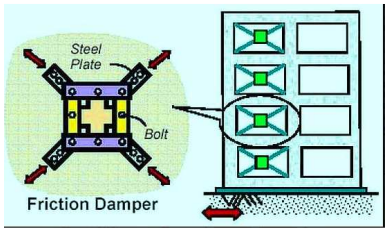


Fig-friction damper

2. LITERATURE REVIEW

1) S.N. Khante, and B.P.Nirwan, has studid that Mitigation of Response of Asymmetric Building using Passive Tuned Mass Damper. In present scenario, most of the buildings are often constructed with irregularities such as soft storey, torsional irregularity, vertical and plan irregularity. Past earthquake studies shows that the most of the RC buildings having such irregularities were severely damaged under the seismic ground motion. Torsional effects may significantly modify the seismic response of buildings and cause collapse of structures. These effects occur due to different reasons, such as non uniform distribution of the mass, stiffness and strength and torsional components of the ground movement. The concept of structural control is now widely accepted and has been frequently implemented in construction. Among the numerous passive control methods available, tuned mass damper (TMD) is one of the simplest and most reliable systems for reducing dynamic response of structure. The mechanism involved in mitigating the vibration consists in the transfer of the vibration energy to the TMD, which dissipates it by damping. In order to increase the efficiency of a TMD, it is necessary to define its optimum parameters.

2] Bharadwaj Nanda And K. C. Biswal has studid that (2o11) Application of Tuned Liquid Damper for controlling structural vibration due to earthquakes

excitations Current trends in construction industry demands for taller and lighter structures, which are also more flexible and having quite low damping value. This increases failure possibilities and also, problems from serviceability point of view. Several techniques are available today to minimize the vibration of the structure, out of which concept of using of Tuned Liquid Damper (TLD) is a newer one. The TLDs have been used to control the wind induced structural vibration. However, the seismic effective of TLD remain an important issue for the study. In this study, an attempt has been made to study the effectiveness of Tuned Liquid Damper (TLD) for controlling seismic vibration of the structure. Finite element elements are used to model the structure and the liquid in the TLD

3) Thakur V.M., Pachpor P.D (2012), has studid that Seismic Analysis of Multistoried Building with TMD (Tuned Mass Damper**)**

Damper (TMD) is a passive control device which absorbs energy & reduces response of vibration. It is attached to vibratory system. TMD is considered to have same damping ratio as that of main structure. The effect of TMD with optimum parameters (frequency ratio & mass ration) given by Sadek, F (1997), is studied. In this paper TMD is used as soft story which is considered to be made up of RCC, constructed at the top of the building.

4) Nitendra G Mahajan and D B Raijiwala (2011) has studid that seismic response control of a building installed with passive dampers,Seismic response control using passive dampers is most cost effective, satisfied the architectural requirement of opening and recent technique to control the vibrations of structures arising due to dynamic loading. This study investigates the influence of mechanical control on structural systems through strategically applying reliable dampers that can modulate the response of building. SAP2000 nonlinear time history analysis program was applied to investigate the effects on building such as normalized base shear, tip displacement, normalized acceleration and energy dissipation of damper element by varying different important parameters namely Earthquake time histories, location of dampers, damping coefficient, damper stiffness, no of story of building.

5) Vajreshwari Umachagi1, Katta Venkataramana, G. R. Reddy, Rajeev Verma(2013) has studied that applications of dampers for vibration control of structures: an overview,Dampers have become more popular recently for vibration control of structures, because of their safe, effective and economical design. This paper presents an overview of literature related to the behavior of dampers on seismically affected structures. The review includes different types of dampers like metallic dampers, viscoelastic dampers, frictional dampers etc.

CONCLUSIONS

Recently, use of seismic control systems has more but selecting effective damper and applied it into a building is essential for reducing seismic risk 0f RC building. The controlling device reduces damage and also increasing the structural safety, serviceability and prevents the building from collapse during the earthquake. This paper attempts to provide an overview of different types of dampers, and highlight some of the recent developments. The investigation carried out by various dampers and finely finds out seismic performance of RC building.

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