Control Seismic load using Energy Dissipation in Structures

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***Abstract*: Seismic waves are waves of energy that travel through the Earth's layers, and are a result of earthquakes, volcanic eruptions, magma movement, large landslides and large man-made explosions that give out low-frequency acoustic energy. Many other natural and anthropogenic sources create low-amplitude waves commonly referred to as ambient vibrations. The determination of seismic risk is the foundation for risk mitigation decision-making, a key step in risk management. Large corporations and other enterprises (e.g., local governments) analyze their 'portfolio' of properties, to determine how to best allocate limited funds for structural strengthening of buildings, or other risk reduction measures such as emergency planning. In this work we have considered a novel approach for the reduction and early detection of the seismic load and energy dissipation.**

***IndexTerms*: Energy Dessipation, Accelerometer, Building, Earth Layers, Seismic load.**

I. INTRODUCTION

The foundation of the risk mitigation from the seismic is determination of risk, main step of the risk management, huge companies and other firms (foe an example, local government bodies) observe their portfolio of the belongings, to solve the problem of allocation of scares resources for functional strengthening of the buildings, or other methods of emergency plotting. In the measurement of the risk of every facility in the potential of the portfolio guards the life and losses of economic type not only because of the structural damage, other factors so considered are tools, contents and business communication are concentrated.

The seismic risk is frequently fixing by the use of the seismic structural computer programs which make the use of seismic hazard tools and mixes them with the non-defined weaknesses poles etc. The end result provides the chances for the economic losses or uncertainties, for an instance the HAZUS computer program. For variant type of buildings, the results of such tools is used, the seismic risk is vary from building to building and is dependent on its particular configuration and circumstances. Segmentation of the paper as under,

II. OBJECTIVE

The main objective of this work is to introduce seismic load and vibrations in structure engineering to reduce the dynamic response of structures under extreme loads and increasing the system reliability and ensuring human comfort during everyday life. And to achieve this, we propose a methodology to reduce Seismic loads and wind vibrations by using of an amplifier in conjunction with a nonlinear damper for vibration suppression and determination of optimal parameters of a passive control system device for optimum and effective outcomes. Through this proposed work we can increase the ability to balance the required damping for various size damper, ability to different amplification factor with different size of damper and maximize the sensitivity of dampers.

III. MOTIVATION

The most attractive aim of the structural engineers is the seismic protection. On the way to conserve the lives and mitigate the losses to build the framework in the circumstances of the earthquake of very immense rate. For some type of the framework, absence of damage is very crucial, like as:

- Buildings which house high jeopardy constituents and resources (atomic amenities, some biochemical plants, etc.);
- significant connections and bridges;
- Significant public structures (hospitals, emergency control centres, energy and communication distribution centres, etc.);
- constructions which are significant for the nation-wide defence;
- constructions which house expensive mechanisms and microelectronic apparatus;
- Galleries and significant and imaginative memorials.

IV. LITERATURE REVIEW

Vamvatsikos. D & Cornell C. A (2002) [1], in there study considered the incremental dynamic analysis for the better assessment of the vulnerability and also its various related concerns. IDA is being used for the prediction of the performance and responses of the structure. In the analysis the ground motion I being considered for the evaluation which actually are structural models and intensity of the ground models is highly related to some factors of the scale. Factor responses are generated in the form of the curves with respect to the motion are being generated. Large number of analysis of past of non-linear time is generated by IDA.

M. S. Kircil et al., (2006) [2], considered the RC frame of the structure in mid-rise for analysing the fragility of the structure in the city of Istanbul. The sample structure are generated using the seismic design of Turkey, where the 3, 5, and 7 flored buildings are being considered as the sample structure. For analysing the IDA 12 different ground motions are being considered. The analysis id being done for gathering the data about the yielding and collapse of the building. Different curves of fragility are then drawn using the above capacities.

Nikolay & Ryan (2008) [3], the bearing system of friction pendulum is being used for which different lab setups are being used. For the better evaluation of the work the freedom systems are being in different degrees like single for which they are being considered with and also without isolation base. Accelerometer is being used for the better response creation of the free and also for the forced vibrations. Shake table is being utilized for the purpose of testing.

Luigi Petti et al (2013) [4], considered the evaluation of the seismic nature of the structures having the isolated base and also having the friction pendulum slide bearing tools which actually subjected to event faults which are quite near while considering the motion components of the vertical ground. The non-linear dynamic analysis where the seismic events which are near faults are considered for the better analysis of the vertical components.

Shah. N. N &Tande. S. N (2014) [5], in his study stated that the seismic analysis is not able to evaluate the all type of the building structure while the detailed non-linear dynamic analysis can be considered for almost all type of the buildings. Considering the ELF which actually is capable of considering the seismic forces for the regular sized buildings where the regularity is being defined by the height of the building and also as per the seismic score I and II, while the type of analysis like linear analysis based on the history of time can be better used for the both types of buildings as regular and irregular as well considered in the seismic zones IV and V.

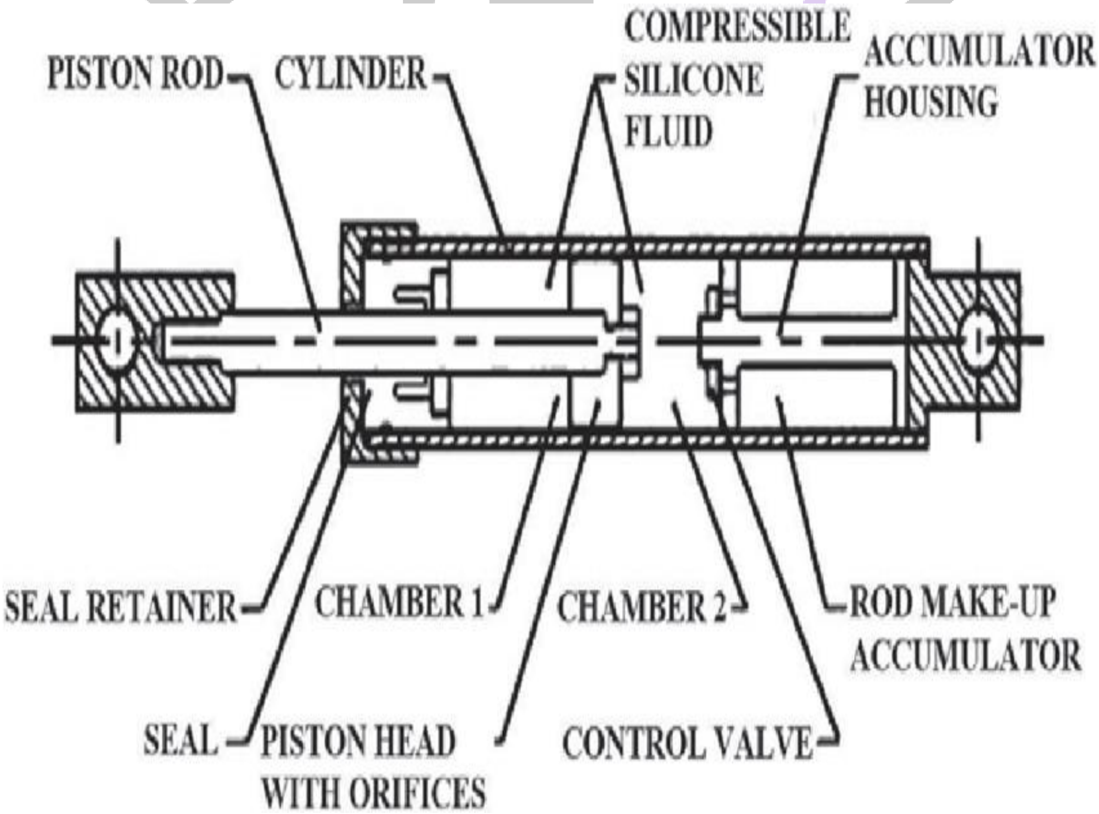
Bakhshi. A &Mostafavi. S.A. (2014) [6], the structural performance of the isolation system of the base are better explained and usefulness of the same for which various probabilistic techniques are being used for generating the fragility curves. For the analysis of the technique author considered three different structures having 2-D reinforced concrete structure and the height of the structure considered is of 3, 7, 12 floors. Lead Rubber Bearing (LRB) isolators which are completely based on FEMA 356 guidelines is being used for the rehabilitation of the strutures.

V. PROPOSED METHODOLOGY

Today, it is common in structural engineering to use control systems to decrease structures' responses and control the inner and external excitations. Devicesmay be categorized as passive, active or semi-active. Recently, they have come to be measured successful system devices in growing the confrontation of buildings by restraining the excitation produced by an earthquake or wind, particularly in giant structures and deferral bridges.

Active or semi-active dampers with unstable damping under the vocal excitation have researched. Thus, such dampers are not feasible to use due to of its heavy cost for installation and powering.

The power dissipation system is the tool designed and tested to dissipate the huge quantity of the energy.Viscous and hysteretic are two most common energy dissipation system, thus viscoelastic, electro-inductive and by friction damping systems are some more dissipation system. The shape of Viscous dampers devices is of a cylinder that containing a high viscosity liquid, as sketched in Figure:



The doings of this is very easy: in the duration of earthquake, the force which was generated due to of friction in the plates was transferred to the dampers, which makes the fluid in the dumpers to move in the fourth direction via the small holes of the dampers. The pace of the seismic energy is wholly dependent on the pace of liquid via the holes of the dampers.

The following expression shows the force emitted by the viscous damper:

$$F = C \times V^{\propto} \quad \text{Eq. 1}$$

Where:
F- force in the damper;
V-relative velocity between the ends of the damper;
C- Damping coefficient depending on the diameter and area of the holes;
α– Characteristic value of the fluid viscosity. The value of can vary between 0.1 and 1.8 [9].

For the maximization of the end results, the value which is equal to 0.1 should be used. The value of C is dependent on the amount of the energy which is dissipated from the flow of liquid.

The main features of viscous dampers are presented:

- High damping constants;
- No requirement of high maintenance (Alga);
- The life span of the building in which the viscous is installed is less than the life of the viscous (Taylor, Devices);
- Foe any type of the application the dampers are highly versatile, regardless of the building's architecture.
- The deformation of the structure and reduction of the stress is allowed by such devices, diminishing the losses in thefunctional structure and non- structural components in between of the seismic action (Taylor, et al.).

Involvement reflects that this dissipation system can diminish about half percentage of the accelerations and movement in relation of floors [7] [8].

Energy Dissipation and Amplification factor

A primary view for the diminishing the structural radiations in the building is to suitable alternate damping tools into the structure. This theory takes the benefits of the structure's own movement to generate relative action within the damping devices. In the reaction, those tools are expected to be generated with full focus on the dissipation of the energy. If the connected movement of the damper can be enlarged for the small structural motion, a large damping power can be attained.

Optimum Parameter of Damper

Focusing on a nonlinear damping coefficient in a damper, a maximum-damping coefficient can be gotten as follows:

$$f_d(t) = C.u^o \quad \text{Eq. 2}$$
$$f_d(t)/u^o = C(t) \quad \text{Eq. 3}$$
$$C = f(u, u^o) \quad \text{Eq. 4}$$

Where fd (t) is the damping force, C is the optimum-damping coefficient, u is the position of stroke in viscous dampers and u° is velocity of the stroke in the damper.

VI. RESULT AND DISCUSSION

With this optimization, it is intended to determine which values provide better results, and the influence of these parameters on the performance of the viscous dampers in the structure in study are interpreted. The results of this analysis (displacement and force) are shown in Fig. 4.4

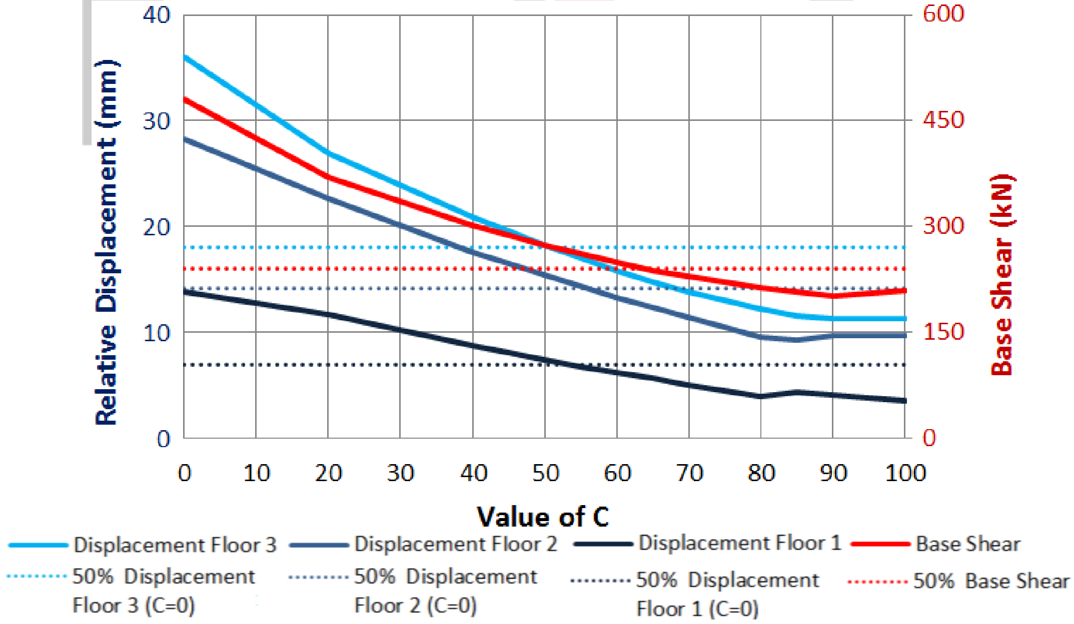


Fig. 2 Maximum relative displacement of the three floors and base shear force of structure according to the value of C used in the dampers.

Using a fluid viscous damper with a variable damping coefficient from previous equation Listed, it is expected that the damping performance become more uniform and therefore can increase energy dissipation in the system when comparing to the performance of a system with a linear damping coefficient. To compare the results of these damping systems (a Linear, a Non-linear, an Active system), a single degree oscillator is considered and analysed in a time-history analysis program. The results are compared between the three same structures (oscillator with same damping and stiffness property) with different damping systems.

Evaluation and comparison of how structure responses are controlled by an active control system versus a linear or non- linear system. According to the damped energy plot in Fig. 3, the energy loss, which is calculated by multiplying damping force to the displacement vector, is greater in non-linear passive control system than other systems. Since the value of maximum damping force in all three cases (i.e. active control, passive control with linear behaviour and passive with non-linear behaviour) were equal, it can be concluded that the only reason for having more energy loss is the non-linearity characterization of the damper.

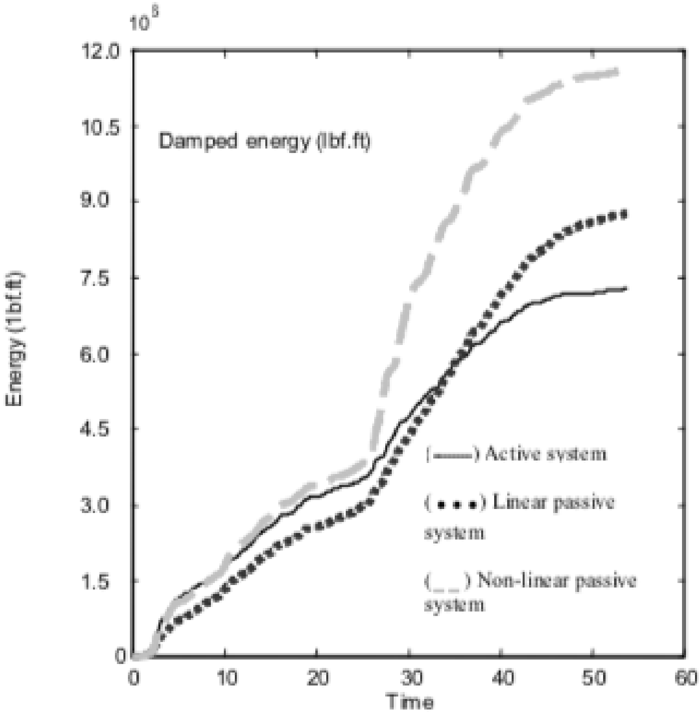


Fig. 3 Maximum relative displacement of the three floors and base shear force of structure according to the value of C used in the dampers.

It was necessary to define a satisfactory level of stresses and displacements reduction, because in theory for a more sophisticated damper, better results are obtained. So the goal of this study is to reduce 50% the values of maximum relative displacements between floors and base shear force of structure. In the design of these devices, the parameters K, α and C, must be defined. For a better optimization of the results, it was chosen an α parameter of 0.1. The value of K, corresponding to the spring stiffness must be a high value, however, this value should not be too high, or it will cause convergence numerical problems. In this case, a value of K=1.000.000, was adopted.

VII. CONCLUSION

In order to optimize the solution, by maximizing the seismic performance of the structure, it was concluded that the distribution of energy dissipation with optimum parameters and the building should be in accordance to the evolution of displacements in height. More powerful dampers should be condensed with amplification factor and where the displacements are higher, reducing at the same time, the displacements and the base shear force.The energy indulgence system are tools specially made and tested to disperse huge quantities of the energy. The most usual energy disperse system are the viscous ones (power relative to the speed of distortion) and the hysteretic (power relative to movement), thus there are also the viscoelastic, electro-inductive and by friction damping systems. Viscous discouragements strategies contain of a cylinder which contains the high viscosity of the liquid.

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