Using Steel Triangular Plate Energy Dissipater & Tapered Steel Energy Dissipater Devices for Safety of Building in Seismic Zone

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Abstract— The metallic dampers are more common. These dampers are often created by some parallel steel plates. And in combination with a bracing system, they undertake the role of absorption and energy dissipation. This part of bracing can acts as a fuse in structure. And by focusing on nonlinear behavior prevent non-linear behavior and damage in other major and minor structure parts. X-shaped metal dampers have a significant performance. These dampers have a high lateral stiffness, in addition to providing damping. So, they were entitled as Added Damping & Stiffness (ADAS). Seismic Analysis of G+15 story building is carried out with and without metallic dampers using Etabs V16. Two models of same parameters of G+15 story building are analyzed. One without dampers and another with Triangular and Tapered Plate energy dissipaters. The comparison between two buildings having G+15 storey. In one building we are using dissipaters such as steel triangular plate energy dissipater and tapered steel energy dissipater, while another one is usual. The height of each storey should be consider 3m. With a different loading condition how to behave a storey is to be analyze.

Key words: Seismic Analysis, ETABS, Energy Dissipater

I. Introduction

The primary objective of adding energy dissipation devices to building structures is to dissipate energy during an earthquake, and to substantially reduce the seismic response of the gravity-load- resisting structure. However, the major of above-mentioned dampers only adopt one energy dissipation mechanism, and provide much confined damping force and ability of energy dissipation. In order to increase the effect of damper, the idea of amplifying the deformations and the force in passive control devices was utilized, such as toggle energy dissipation brace and composite damper.

In order to avoid such critical damages, structural engineers are working to figure out different types of structural systems that are robust and can withstand strong motions. Alternatively, some types of structural protective systems may be implemented to mitigate the damaging effects of these dynamic forces. These systems work by absorbing or reflecting a portion of the input energy that would otherwise be transmitted to the structure itself. In such a scenario, structural control techniques are believed to be one of the promising technologies for earthquake resistance design. 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.

In general, the control of the building response to seismic has been done by increasing the stiffness of the building by increasing the member sizes or by introduction shear walls in excess of what is normally required for strength. In high seismic zones, increasing the member sizes has an additional disadvantage as it increases the mass of the building, leading to higher base shear. In such a situation, it is usually more optimal solution to increase the damping rather than the building stiffness. The purpose of using damper is to increase the damping ratio of the structure which is subjected to lateral loads and decrease the total structural response.

II. Aim & Objectives

The primary objectives of this project can be summarized as follows:

1) Increasing the stiffness of the first storey such that the first storey is at least 30% as stiff as the second storey.
2) Specialization of general optimization based framework for the design of each of the selected protective system.
3) Establishment of meaningful performance indices to measure the improvement in the seismic structural performance.

III. Literature Review

Vijay Chachapara, Sharadkumar Purohit and P. V. Patel [1] A three storey shear building with Viscous and VE damper subjected to four earthquake excitations (El Centro, Kobe, Loma Prieta, Northridge) is considered and solved using numerical method Newmark – Beta through MATLAB. Response quantities like Displacement, Velocity, Acceleration, Interstorey Drift and Damper force are extracted. It is found that both Viscous and VE damper are quite effective in controlling the response of the building under all the earthquake excitations considered. Reduction in interstate drift ranges between 32% to 54%, displacement between 38% to 58%, velocity between 27% to 55% and acceleration between 13% to 56% for building with viscous damper under four type of earthquake excitations. Building with VE damper subjected to various earthquake excitations shows reduction in interstorey drift ranges between 22% to 73%, Displacement 30% to 73%, Velocity between 23% to 75% and acceleration between 15% to 51%.Damper force ranges between 383.83 KN to 1881.08 KN for Viscous and VE damper under various earthquake excitations.

Vajreshwari Umachagi, Katta Venkataramana, G.R. Reddy, Rajeev Verma [2] 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. Recently, use of seismic control systems has increased but choosing best damper and installing it into a building is very important for reducing vibration in structures when subjected to seismic loading. The controlling devices reduce damage significantly by increasing the structural safety, serviceability and prevent the building from collapse during the earthquake. Therefore many researches are being carried out to find the best solution. This paper attempts to provide an overview of different types of seismic response control devices, and highlights some of the recent developments. The experimental and analytical investigations carried out by various researchers clearly demonstrate that the seismic control method has the potential for improving the seismic performance of structures.

Dr. Imad H. Mualla [3] This paper presents the development, testing and application of a novel, worldwide patented friction damper system developed by in order to control the vibration in structures and buildings due to earthquakes or strong winds. The capability of the dampers to dissipate energy has been extensively studied and tested in previous research both experimentally and numerically, as well as in several finalized projects around the world. This paper also presents a study on the parameters that govern the performance of a friction damping system for base isolation of structures. The device is designed to dissipate seismic input energy and protect buildings from structural and non-structural damage during strong vibration.

A study of the response for static and dynamic loading has identified the parameters which influence the response of a structure improved with the damping system. The numerical studies have demonstrated that the overall response is mainly affected by damper properties such as geometry, frictional sliding moment and the structural natural frequencies. Different damper systems are presented in this work. The dampers described are mainly used for vibration control of structures and base isolation of structures. The Damptech damper devices are easy to manufacture and implement in structures. The dampers are economical to manufacture due to the selection of material and its availability. In the unlikely situation of damage to a damper, it can easily be replaced or readjusted. The dampers have been installed in several buildings in Japan, Greece, India and Denmark.

M. S. Landge, Prof. P. K. Joshi [4] The dissertation work is concerned with the comparative study of various types of dampers used for multi-storey r.c.c. Building. Response spectrum method is used to analyse seismic behavior of g+7 storey building with and without 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 iv as per is 1893:2002(part 1) code. Results of these analyses are discussed in terms of various parameters such as maximum absolute displacement, absolute acceleration, absolute velocity, storey shear, storey drift. The comparison of these various parameters is done. The structure is analyzed with and without various types of dampers. Results of these analyses are discussed in terms of various parameters such as maximum absolute displacement, absolute acceleration, storey shear, storey drift. The comparison of these various parameters is done. From these comparison it is concluded that maximum absolute displacement, absolute acceleration, storey shear, storey drift values are more in case of rc building without damper as compared to rc building with dampers.

P. Vijay, P.R. Kannan Rajkumar and P.T. Ravichandran [5] The study investigates the effect of ViscoElastic (VE) dampers on the overall increase in damping ratio of RCC structure significantly and hence improving the global performance of dynamically sensitive structures. A parametric study is carried out on the proposed Hospital building located at Delhi using VE dampers. The building is chosen such that it is a life line structure and located in a highly seismic prone zone. The brace type damping mechanism has been modeled as a linear spring and dash-pot in parallel for the ViscoElastic damper. The earthquake events used in this study has been applied as response spectrum acceleration. A number of analyses were carried out to gain a comprehensive understanding of the effectiveness of strategic damper placement in this structure to achieve maximum damping ratio.

Gang Li and Hongnan Li [6] In this paper, a new idea for designing metallic damper is presented, i.e. metallic damper with “dual functions”, because they not only provide certain added stiffness to the building under normal use, but are also of good ability for seismic energy-dissipation. Also, quasi-static tests with these type of dampers are carried out. Furthermore, seismic responses of the structure with and without metallic damper are calculated and compared. The results show that the metallic dampers with “dual functions” not only provide certain added stiffness under normal application, but also are of good ability for seismic energy dissipation.

In normal cases, the RC structures are calculated following simplified procedures. Although traditional empirical methods remain adequate for ordinary design of RC members, the development of computer technology and the finite element method have provided efficient means for analyzing more complex systems. To obtain more exact structural story-drifts and evaluate the effectiveness of structural vibration reduction with the DFMDs, a three-dimensional frame model is established with the ADPL language in the ANSYS program. In this paper, the DFMD is presented utilizing the new idea of the force and steel plane being on one plane. Model and prototype test are carried out respectively, and test clearly reveal the properties of DFMD from its large and stable hysteresis curves. The DFMD is of not only provide certain stiffness, but also are of good ability of dissipating the energy. The design procedure and install method of actual building with DFMDs are introduced. The dynamic analysis of this building with and without DFMDs is carried out individually. The results presented that the DFMD is an effective dissipator, and it is feasible that calculate the response of the structure with dampers utilizing the software ANSYS.

Mahmoud Bayat and G.R. Abdollahzade [7] This study implements the commercial package PERFORM 3D.V4, information regarding the seismic hazard, passive control system and nonlinear structural response. The ADAS devices significantly increase the resistance of the structure components to the dynamic loads and they are effective in reducing the seismic response of the structures. The benefits of the energy dissipaters have been clearly demonstrated by these comparative data and the improvement in performance of structures during earthquake excitation have been proved. In addition, the considerable effect of the ADAS dampers in absorbing hysteretic energy is illustrated. The passive control system absorbs the vibrations automatically without the need of an electrically controlled system. Passive control systems are generally low in cost and effective for support of buildings subjected to dynamic vibrations. It will allow practicing engineers to design and use cost-effective seismic dampers in the preliminary design phase effectively, letting them explore the cost factors by comparing different building seismic performance objectives throughout design.

IV. Problem Formulation

Research is currently underway. Analysis will be done by using ETAB model for different floors of building. The comparison between two buildings having G+15 storey. In one building we are using dissipaters such as steel triangular plate energy dissipater and tapered steel energy dissipater, while another one is usual. The height of each storey should be consider 3m. With a different loading condition how to behave a storey is to be analyze.

V. Research Methodology

The proposed work is planned to be carried out in the following manner

1) Study of Research Papers.
2) Study of Limit State Design Method.
3) Study of various types of dissipaters.
4) Preparation of ETAB models for G+15 storey building.
5) Preparation of Comparative results on the basis of Design.

VI. Conclusion

Our project involves the study of effect of metallic energy dissipaters in high rise building for seismic excitations. Study of review papers has been carried out in this article. Study of Limit state design method and types of dampers will be studied with etabs modeling and analysis of G+15 story building with and without energy dissipaters. So this work will be the part of our next article.

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