PAPER REF: 3829

VIBRATION CONTROL OF SINGLE FLOOR SEISMICALLY EXCITED STRUCTURE USING ACTIVE MASS DAMPER

Abdul Qadir Bhatti[1(*)], Humberto Varum[2]
[1,2]INational University of Sciences and Technology (NUST), Islamabad, Pakistan
[2]Department of Civil Engineering, University of Aveiro, Portugal
[(*)]*Email:* aqbhatti@ua.pt, bhatti-nit@nust.edu.pk

ABSTRACT

The purpose of this paper is to dampen the vibrations using active mass damper (AMD) flexible structure has been tested using Shake Table by linear cart. The active and passive mass properties has been discussed. An observer based state-feedback card controller was used for one floor AMD using MATLAB/SIMULINK modelling. Several laboratory experimental setup using AMD, general system description, model, parameters, and comparison of data obtained by Pakistan earthquake occurred on Oct 8, 2005 has been discussed.

INTRODUCTION

Structures are vulnerable to Earthquakes and dynamic loading and they must be properly evaluated in design, as they greatly affect stability. The devastating earthquake recorded in Kashmir Oct 8, 2005 of magnitude 7.6 having a depth of 10 km, killed more than 87,000 people and 138,000 people were seriously injured (Bhatti A.Q et al., 2011a). Control devices such as Tuned mass dampers have been used in real structures, the most widely used controller for use in tall buildings is the Linear Quadratic Regulator, LQR. (Dyke S, 1996; Fujino Y et al. 1996).

This paper discusses the control of single floor seismically excited structures using active mass damper. The controller was design for active and passive cases the purpose was to minimize the vibration present in a building like single floor structure by applying a state feedback control law to control the motion of the mass (Bhatti AQ 2005). Shake Table Testing was done for strong motion data of Oct 8, 2005 earthquake and the observed damping was compared for passive and active cases. The modelling of the system as well as the observer and control design has been applied on 46 cm x 46 cm shake table using real time earthquakes. The top stage of the shake table is driven by a powerful actuator that allows it to achieve the scaled ground motion. Finally the procedure to run the controller on actual experimental setup has been discussed

RESULTS AND CONCLUSIONS

The mathematical model of the experimental setup is shown in Fig. 1. The results from the shake table tests are shown in Fig. 2. The objective of dampening the vibrations in the building-like structure for Seismic Excitation was met. As can be seen from the previous figures, the controller was successful in regulating the motion of the cart on the floor, and hence that of the structure, when driven by the shaker using an impulse response or in the case of seismic excitation for Kashmir Earthquake Oct, 2005. Scaled Seismic excitation of any

resource can be implemented to the model provided the source is authentic and scaled properly. The control method used is efficient for seismic excitation in a single story structure.

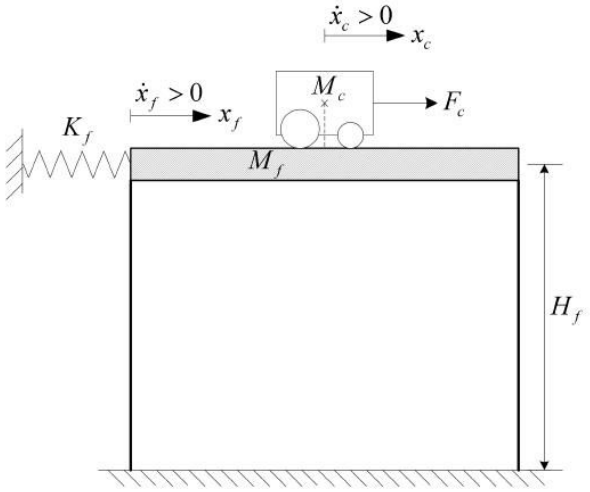

Fig.1 - Simplified Model with AMD

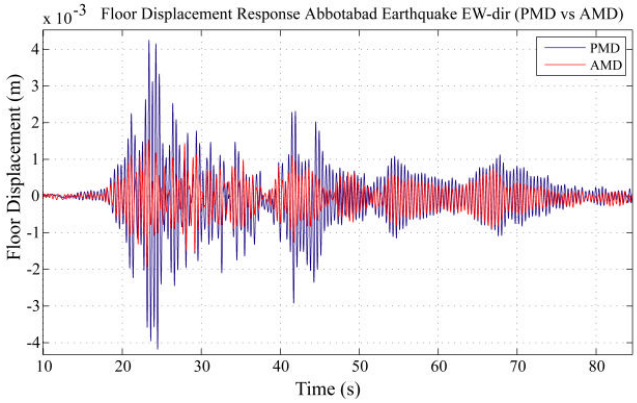

Fig.2 - Floor Displacement when subjected to Seismic excitation by Shake Table PMD Vs AMD

ACKNOWLEDGMENTS

The authors gratefully acknowledge the funding by Higher Education Commission (HEC) Pakistan under Grant No. 20-1149/R&D/08/2557

.

REFERENCES

[1]-Bhatti A. Q. Effective Force Testing: A Method of Seismic Simulation for Structural Testing Using Electromagnetic Structure, Master Thesis Paper Department of Built Environment, Tokyo Institute of Technology Japan, 2005, Volume 9, Feb, 2005, pp 181-185

[2]-Bhatti A.Q, Hassan SZ, Rafi Z, Khatoon Z, Ali Q Seismic Hazard Analysis of Islamabad Pakistan. Journal of Asian Earth Sciences, 2011a 42 (3):468-478

[3]-Fujino, Y., Soong, T.T. and Spencer Jr., B.F.: Structural Control: Basic Concepts and Applications, Proc. ASCE Struct. Cong., Chicago, Illinois, pp. pp. 361-370 (1996).

[4]-Duke, S.J., Dyke, S.J., Spencer Jr., B.F., Quast, P., Sain, M.K., Kaspari Jr., D.C. and Soong, T.T. Acceleration Feedback Control of MDOF Systems," ASCE., J. Engrg. Mech., 1996, vol. 122, pp. 907-917.