MODELLING OF REINFORCE CONCRETE BUILDING WITH ASYMMETRIC PLAN EQUIPPED BY SEMI-ACTIVE TUNED MASS DAMPER USING FUZZY CONTROLLER

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ABSTRACT

In this paper, a fifteen-story reinforced concrete (RC) building with asymmetric plan equipped by semi-active tuned mass damper (STMD) is modelled to evaluate the seismic responses under the earthquake acceleration. Modelling of the structure is done by considering members connected with a rigid floor diaphragm such that has three degrees-of-freedom at each floor, i.e., lateral displacements in two perpendicular directions and a rotation about the vertical axis of the third dimension. A MATLAB program has been developed to calculate the building structural mass, stiffness and damping matrices based on the number of stories, the plans' geometry and loadings, each column's location and specifications and the damping ratio of the structure. A fuzzy controller is employed to control the applied voltage of a semi-active magneto-rheological (MR) damper working parallel with the tuned mass damper attached on the top floor of the building, based on the feedbacks of the structure. The responses of the structure equipped by STMD are compared with those of the building with passive tuned mass damper (TMD) and the uncontrolled structure. The results showed an appropriate performance of the fuzzy controller in reducing the both translational and torsional responses of the RC building structure under the earthquake excitation.

INTRODUCTION

Nowadays modelling of structures with or without controller devices based on appropriate methods is one of the major concerns of the building designers to predict the behavior of the structures precisely. The location of the columns and other members bearing the shear forces of the stories e.g. shear walls or braces and the non-uniform loadings on the story can cause asymmetrical problem in the planar of the building stories due to the divergence of the mass center from the stiffness center of the structure. As this divergence is increased, the torsional responses of the structure cannot be ignored because of the undesirable effects on the members. Many researchers investigated the asymmetrical problems in the buildings and represented and developed various methods to analyze the structure responses over the torsional displacements (Tso and Dempsey 1980, Hejal and Chopra 1989, Ueng et al. 2000, Rafezy and Howsonb 2009, Yiu et. al 2014). In such situations the members have to design with considering the torsional stresses that can be lead to use sizable cross sections and increasing consumption of materials. In this paper a semi-active tuned mass damper with fuzzy controller is presented to control the building structure system with asymmetric plan to reduce the lateral and torsional responses under the earthquake excitation applied on the building base level in both East-West (EW) and North-South (NS) directions.