

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

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In this paper, a fifteen-story reinforced concrete building with semi-active tuned mass damper (STMD) is modelled to calculate the seismic responses under the earthquake acceleration. Modelling of the structure is done by considering members connected by a rigid floor diaphragm such that it has three degrees of freedom at each floor, i.e., lateral displacements in two perpendicular directions and a rotation about the vertical axis for the third dimension. 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, based on the feedbacks of the structure. The responses of the structure equipped by semi-active tuned mass damper attached on the top floor of the building are compared with those of the building with passive tuned mass damper 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.

According to the complex mathematical formulation of the physical behaviour the MR damper, one cannot easily calculate the appropriate voltage to achieve the demanding force of the controller. Hence, in this paper fuzzy controller is employed to estimate the applied voltage of the MR damper directly using linguistic fuzzy rules. The inputs of the fuzzy controller are displacement and velocity of the top floor of the building and the velocity of the auxiliary mass. Fuzzy rules are contrived according to the physical intuition of the supervisor designing the controller. The mathematical model of the building structure equipped by STMD, the fuzzy controller and the semi-active MR damper is simulated on the SIMULINK environment of the MATLAB software (Figure 1).

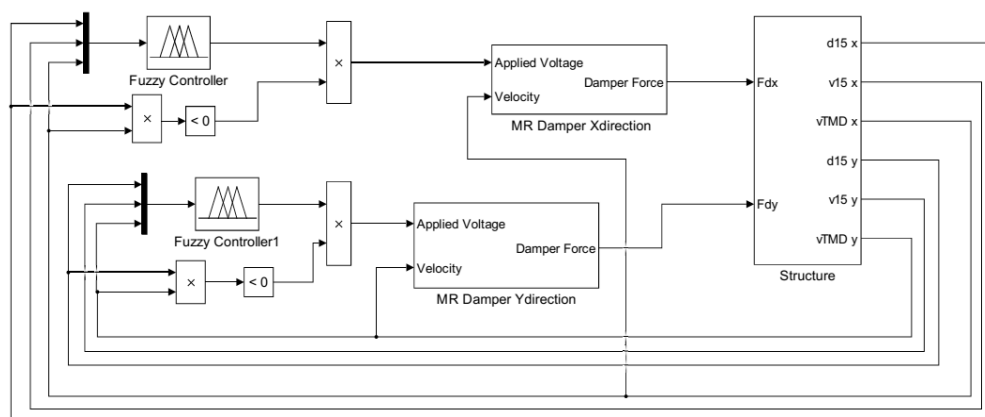


Figure 1. Simulated model of the fuzzy controller

The model is subjected to the El Centro earthquake excitation in both East-West (EW) and North-South (NS) directions. The results of the STMD by fuzzy controller is plotted and compared with the passive TMD and the uncontrolled structure under the same earthquake acceleration in Figure 2. As can be seen, the efficiency of the STMD in reducing the translational responses of the stories in comparison with TMD and uncontrolled structure is apparent. Also, the rotational response of the building is calculated to investigate the performance of the STMD. Each floor rotation is plotted in Figure 3. The STMD has a good performance in reducing the rotational response unlike the passive TMD.

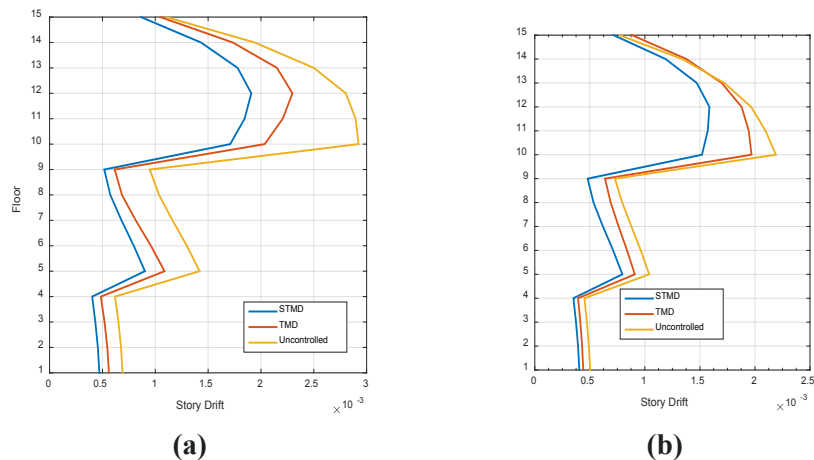


Figure 2. Story drift of the structure in (a) X direction (b) Y direction translations

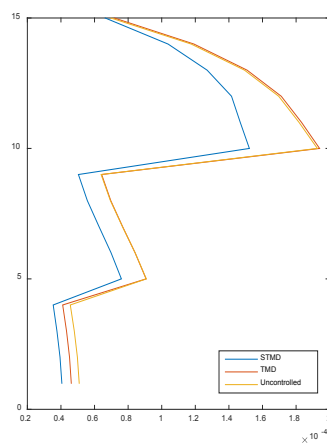


Figure 3. Story rotational response

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