CONTROL OF ASYMMETRIC PLAN BUILDINGS WITH ACTIVE TUNED MASS DAMPER USING GENETIC ALGORITHM

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ABSTRACT

The application of active tuned mass damper (ATMD) for the reduction of both the translational and torsional responses of asymmetric building in plan is discussed in the present paper. In the reality, most of the buildings with asymmetrical plan under earthquake have torsion that it will induced to increase the structural response. A multi-objective genetic algorithm to find the optimal control forces and other characteristics of active tuned mass damper. To analytically study, an eight story three-dimensional structure is considered as an example with an ATMD in two direction of the building on the roof. An LQR control algorithm is implemented to reduce the seismic responses of structures. The aim of the multi-objective function is to minimize the response of 8th story and the force of ATMD. Also, input variables are mass, damping and stiffness of the ATMD and the weighting matrix of LQR algorithm. The building is modeled as a structure composed of 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 with respect to a vertical axis for the third dimension. The results show that by using ATMD in both directions, in addition to reduction of structural response in the earthquake direction, there are a reduction in the perpendicular to the earthquake direction and torsion.

INTRODUCTION

Protection of large civil structures and human occupants from natural hazards like an earthquake and wind is very important and challenging. In order to protect buildings, a passive or active control is added to the system. Vibration control of civil engineering structures has drawn much attention during the last three decades. The various vibration control strategies, used to prevent structural damage in structure subjected to dynamic loads can be classified as active, passive, hybrid and semi-active control. To mitigate undesirable building motion under strong earthquakes and wind gusts, different structural control systems have been proposed and investigated (Soong, 1990; Connor &Laflamme, 2014). Active control methods are effective for a wide frequency range as well as for transient vibrations. Active control devices are always integrated with a power supply, real time controllers and sensors placed on the structure. The most commonly used active control device for civil engineering structures is the active tuned mass damper (ATMD). As (Li et al, 1992) commented, the high efficiency is the major advantage of ATMD, in which a relatively small mass can be used to reduce structural response. Meanwhile an active control force is applied to move this small mass