

A NEW APPROACH FOR TUNING ATMD IN ORDER TO IMPROVE SEISMIC RELIABILITY INDEX OF STRUCTURE

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ABSTRACT

Active structural control systems are used to protect structures against seismic excitations. One of the difficulties in the design of structures considering protective systems is the explicit consideration of uncertainty about the structural model and the potential variability of future excitations (Jensen and Sepulveda, 2011). According to the uncertain nature of the earthquake phenomena, tuning of an active structural control system for a specific seismic record may not necessarily lead to the optimum performance (Soleymani and Khodadadi, 2013).

The tuned system must be fitted for a wide range of seismic excitations. In this paper, a new approach for tuning an ATMD system designated for a tall building is proposed. For this purpose, an 11-stories structure located in vicinity of a certain fault with a characteristic magnitude is considered. According to the assumed site hazard; 1000 physically-based ground motion record is generated. The ground motion records are clustered based on their spectral features. As a result; a representative record is constructed by employing the cluster centers. The constructed record is used for tuning procedure. Results reveal that this method of tuning arises the seismic reliability index; comparing with the other well-known approaches. The robustness of the proposed approach is analyzed with more details.

INTRODUCTION

Tuned mass damper is one of the oldest yet most effective systems presented for attenuating amplitude of the transmitted vibrations to the structures from wind or earthquake excitations (Pourzeynali et al., 2007). Not only, this system is reliable, but also it is very simple and affordable. These advantages make this system a popular one among the structural control systems. On the other hand, optimal performance of this system is limited to a very limited frequency range (Wongprasert and Symans, 2004). This limitation can be resolved by adding a force actuator to this system and widen the operating frequency range by this mean. The TMD system accompanied with an actuator whose force is controlled via a feedback control system is called active tuned mass damper (ATMD) system.

Due to uncertain nature of seismic excitations, reliability of the ATMD system during occurrence of earthquake in a certain geographical region is a concern which should be considered. Some works have been done on the reliability of the systems equipped with active control systems in recent years e.g. Battainiet al.