



## Control of Base Isolated Benchmark using Combined Control Strategy with Fuzzy Algorithm Subjected to Near-Field Earthquakes

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## Abstract

The Purpose of control structure against earthquake is to dissipate earthquake input energy to the structure and reduce the plastic deformation of structural members. There are different methods for control structure against earthquake to reduce the structure response that they are active, semi-active, inactive and hybrid.

In this paper two different combined control systems are used first system comprises base isolator and multi tuned mass dampers (BI & MTMD) and another combination is hybrid base isolator and multi tuned mass dampers (HBI & MTMD) for controlling an eight story isolated benchmark steel structure. Active control force of hybrid isolator is estimated by fuzzy logic algorithms. The influences of the combined systems on the responses of the benchmark structure under the two near field earthquake (Newhall & Elcentro) are evaluated by nonlinear dynamic time history analysis.

Applications of combined control systems consisting of passive or active systems installed in parallel to base-isolation bearings have the capability of reducing response quantities of base-isolated (relative and absolute displacement) structures significantly. Therefore in design and control of irregular isolated structures using the proposed control systems, structural demands (relative and absolute displacement and ect) in each direction must be considered separately.

Keywords: Base Isolated benchmark structure, Multi Tuned Mass Dampers, Hybrid Isolators, Nearfield Earthquake, Fuzzy Algorithm

## **1. INTRODUCTION**

The response reduction of structures to dynamic loadings like earthquake and wind loads has been a subject of study for many decades. Therefor there is a need to use structural control method for decreasing response and damage in structures. Structural control methods are divided into several categories including passive, active, semi-active and hybrid control systems [1]. Passive systems have been extensively used because of easy application, high reliability and low cost. One of these inactive systems is base isolator Although the response quantities of a fixed-base building are reduced substantially through base isolation, the base displacement may be excessive, particularly during near-field ground motions [1]. So using other complementary system to improve the seismic behavior of asymmetric base isolated structure is required

Tuned mass damper (TMD) is one of the oldest passive control devises which was first used by Frahm [r]. Following him, many studies were done for determining optimum parameters of TMD and also MTMD for decreasing the structural response. However, passive systems have some deficiencies like limited control.

Active control force in a hybrid base isolator can be generated by different control algorithms. In the last few years, application of smart control algorithms like fuzzy has been increased. Because of its ability to handle nonlinearities, independency on mathematical model and its inherent robustness. Structural control with hybrid base isolator through FLC has attracted the extensive attention of researchers during the recent years Tsai [4] Investigated effect of mass dampers to reduce lateral displacement of or-story base isolated structure. He noticed that mass dampers have very little effectiveness in reducing the structural response