INTRODUCING A NEW TUNED MASS DAMPER SYSTEM

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ABSTRACT

Tuned mass dampers (TMD) are effective and reliable structural vibration control devices commonly attached to a vibrating primary system for suppressing undesirable vibrations induced by winds and earthquake loads. This paper introduces a newly developed semi pendulum TMD system. The proposed device is composed of a specific configuration of rolling parts which provide a long natural period for the device along with providing the appropriate force transmission or energy dissipation capacity for the system. The effectiveness of the device has been shown by a simple experimental prototype of the device. The proposed system can be utilized for various structural bodies such as buildings, bridges, etc. It can also be used for both new and existing systems to improve their seismic performance for retrofitting purposes. It can be concluded that the proposed device is a proper substitute for the conventional TMD systems in long-period as well as shorter-period structures to mitigate the seismic/wind induces vibrations in a more efficient way in terms of the overall size and/or energy dissipation capacity.

INTRODUCTION

The tuned mass damper (TMD) systems have been a major means for the vibration control of civil engineering structures(Housner, et al., 1997). They have been successfully installed in different structures from high rise buildings to long bridges such as the CN Tower (535 m) in Canada, the John Hancock Building (sixty stories) in Boston, Center-Point Tower (305 m) in Sydney, and also the largest one in the Taipei 101 Tower (101 stories, 504 m) in Taiwan, in order to reduce the vibrations due to earthquakes and wind.

The natural frequency of the TMD is tuned in resonance with the first vibration mode of the primary structure, so that a large amount of the structural vibrating energy is transferred to the TMD and dissipated viaits out-of-phase motion with the primary structure (Soong and Constantinou, 1994). Consequently, the safety of the structure is enhanced. In other words, a TMD is a kind of dynamic secondary system implemented on a primary structure whereas its natural frequency is tuned to be very close to the dominant frequency of the primary structure. In such a situation a large reduction in the dynamic responses of theprimary system can be achieved.

Single or Multiple TMDs may be designed in different kinds including Tuned Liquid Column Dampers (TLCD), LiquidColumn Vibration Absorbers (LCVA), etc(Chang, 1999). However, one common type of such devices is the pendulum type TMD such as what we have on the Taipei101.

In the Taipei 101 which is 509 meters tall, the key features of the Structural Systemare 8 steel composite steel-concretesupercolumns (8'xlO'), 8 outrigger trussesin both directions (every 8 storeys),