論 文 の 内 容 の 要 旨

論文題目　Development of a New Compact Tuned Roller Mass Damper System

（ローラーを用いた新型コンパクト同調マスダンパーの開発）

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This dissertation introduces and studies a new compact type of passive Tuned Mass Dampers (TMD) system. The dynamic performance of the proposed system has been evaluated through a comprehensive set of numerical as well as experimental analyses.

Three sets of experimental models have been studied. Each model has been improved by resolving the problems confronted in the previous model(s). These problems and challenges have been analyzed followed by the solutions proposed to them.

The preliminary experimental tests include a set of shaking table tests which have been done in order to achieve an initial understanding of the performance of the proposed system. The results have been compared to those of the uncontrolled and conventionally-controlled structures.

Based on the lessons learnt from the preliminary experimental tests, the framework of the third experimental model has been established. The final experimental tests include a comprehensive set of 130 shaking table tests which have been performed with different sinusoidal and earthquake base excitations and structural models in order to analyze the performance of the proposed TMD system under different conditions compared to conventionally-controlled systems as well as uncontrolled structures.

Experimental results show good performance of the proposed system especially in resonance condition which is the target purpose for application of the TMDs. The performance under other base excitations and primary structural cases show acceptable performance and robustness of the proposed TMD system. It was also understood that the proposed system shows the highest performance in case the natural period of the system and the structure fall into the same period range as for the base excitation(s). This may be utilized for design purposes.

In the next stage, the entire 130 individual final experimental tests have been numerically modeled through an explicit dynamic time-history analysis scheme. Results have been verified with the corresponding experimental results in all 130 cases including the uncontrolled structures, and the structures controlled with the Translational TMD (TTMD) and with the proposed TMD. The numerical and experimental results have shown good agreement.

Subsequently, the numerical modeling of a realistic building example has been proposed in order to give a realistic image of the advantages of the proposed TMD system. A 20-story building structure has been considered. The structure has been resonated while controlled separately with the application of the proposed TMD as well as the TTMD. The maximum story drift ratios have been compared to those of the uncontrolled structure. Results show the positive effect of both control systems compared to the uncontrolled structure in resonance condition. However, the TTMD has generally shown a better performance.

The proposed new TMD system is an effective device for mitigating the unwanted seismic structural responses. It shows effective performance especially in resonance condition. The structures controlled either by the TTMD or the proposed TMD have generally shown a better performance than the uncontrolled structures. Yet, the effect of the proposed TMD is generally lower compared to conventional TTMD systems. Nevertheless, the proposed system has exclusive advantages.