**Study of tuned mass dampers with piezoelectric stack energy harvester attached to** **an undamped primary structure under harmonic base excitation**

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**Abstract.**

Energy harvesting from vibration suppression devices, specially tuned mass dampers with piezoelectric stack energy harvester (TMD-PSEH), has become a growing need in recent years. This paper studies the optimal design of TMD-PSEH attached to an undamped primary structure under harmonic base excitation. For this purpose the governing equations for the system of undamped primary structure with TMD-PSEH are obtained. Then an equivalent replacement is proposed to reduce those governing equations to the ones with TMD in order to use the well-known Den Hartog’s results to desig optimal tuning and damping ratios of TMD-PSEH in closed form. The system responses, including mechanical displacement, magnification factors, voltage, instantaneous and average output powers are analytically determined. Numerical examinations of the TMD-PSEH attached to an undamped primary structure with the obtained optimal parameters are caried out. It is shown that not only the vibration of the primary structure is effectively reduced, but also a large amount of the harvested energy can be captured, especially in the main resonance domain.

**Keywords:** tuned mass damper, energy harvesting, piezoelectric stack, undamped primary structure, harmonic base excitation, equivalent replacement