

Floor Vibration Control Using Tuned Mass Dampers

A tuned damping solution was developed to mitigate walking induced vibration of joist framed floors in twenty five rectangular, trapezoidal, and irregular shaped rooms in an educational establishment. The make-up of the floors was concrete on metal deck, supported by open-web bar joists. The floors came in various sizes (from 800 to 1200 sq. ft.) and shapes with the first resonant frequencies in the 6.5-7.5 Hz range.



Figure 1 The education establishment

Following the measurement of vibration and finite element analysis of the floors, fifty tuned mass dampers (two for each room) were designed, manufactured and installed to effectively address the vibration challenges of the first structural modes of the floors they were designed for. The TMDs were appended to the vibrating structure (underneath the floors) at locations where they could most effectively couple with their target mode(s). Figure 2 shows two of the TMDs appended underneath the floor of one of the classrooms. The TMDs were tuned to the first resonant frequencies of the floor of the room they were intended for, ranging from 6 to 7.5 Hz.

The TMDs effectively absorbed oscillatory energy of the structure and dissipated it internally, lowering the vibration due to walking to an acceptable level. The blue trace in Figure 3 presents the response of the floor to a heel drop perturbation without the TMDs operational (TMDs locked). The black traces depict the same measurements when the TMDs were brought online (TMDs unlocked).

Tuned mass dampers (TMDs) are tuned damping devices commonly used for dampening the vibration of a structure at a particular resonant frequency. TMDs come in various configurations. The commonality between all of them is their make-up which includes an inertia element (mass) suspended by an energy dissipating (damping) device and a restoring (resilient) element.



Figure 2 Two TMDs appended underneath one of the floor of one of the classrooms

Clear from this figure, tuned mass dampers effectively dampened the first structural mode they were designed for and tuned to, dissipating its vibration. The floor vibration of the other rooms were damped as effectively as the one presented in this technical note.

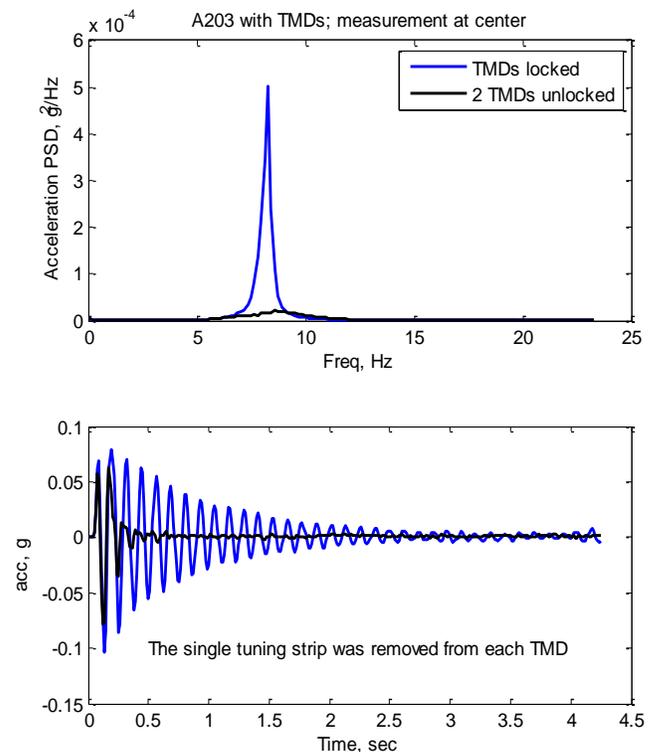


Figure 3 Power spectra and time traces of the floor acceleration measured without and with the TMDs