

Monumental Staircase Vibration Abatement Using a Tuned Mass Damper-3

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.

To address the vibration of a monumental staircase in an office building, the structural engineer of the project incorporated a 500 lb tuned mass damper (TMD) into the design. DEICON designed, fabricated the TMD to be installed underneath the landing Figure 1 shows the tuned mass damper.

The dynamic attributes of the monumental staircase, namely the first natural frequency and damping ratio, were measured and used in tuning the tuned mass damper, targeting the first mode of vibration of the staircase.

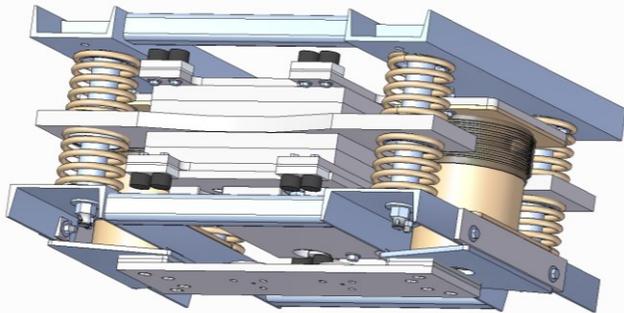


Figure 1 The solid model of the TMD

Figure 2 shows the images of the TMD installed in the cavity underneath the landing and the TMD itself.



Figure 2 The TMD installed in the cavity underneath the landing

The blue traces in Figure 3 depict the power spectral densities (PSDs) and time traces of the measured landing as well as step 7 accelerations without the TMD in place. The red traces in Figure 3 show the same measurements as those of blue traces, except with the TMD installed.

Comparison of the red and blue traces in Figure 3 clearly points to the effectiveness of the tuned mass damper in dampening its target mode, abating the vibration of the staircase.

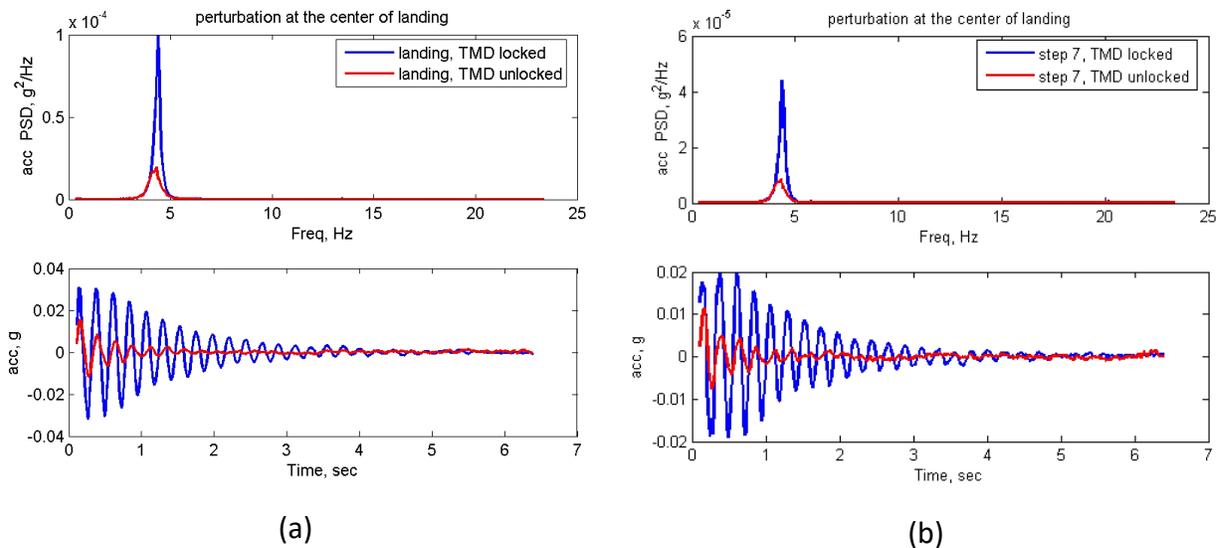


Figure 3 PSDs and time traces of landing (a) and tread 7 (b) acceleration measured with the TMD locked (blue traces) and unlocked and fine-tuned (red traces)