Vibration Control of an Overlook Using Tuned Mass Dampers

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.

Hunter's Point South Park is a breath-taking waterfront park located on the edge of the East River, in Western Queens, NY. The focal point of the park is Hunter's Point South overlook, a beautiful cantilevered platform that offers unobstructed views of the New York skyline.

The Overlook's rather low fundamental frequency (3.5 Hz) combined with very low damping ratio of less than 1% made it prone to objectionable vibration. DEICON designed and fabricated a pair of rather small 500 Kg (1100 lb) tuned mass dampers which were installed in cavities within the structure, close to the tip of the overlook.

Figure 1 Hunter's Point South overlook

Figure 2 shows the locations of the TMDs, marked in red, and one of the TMDs in place inside its. Upon the completion of installation the cavities were covered with their access hatches and decking wood.

Figure 3 depict the power spectral densities (PSDs) as well as time traces of the acceleration measured by one of the accelerometers placed at the tip of the overlook with the TMDs operational (the red traces) compared to the corresponding 'before' measurements of with no TMDs (the blue traces).

Comparison of the blue PSD traces of the untreated overlook with the red PSD traces of the overlook treated with the TMDs, shows that the TMDs have introduced a sizeable amount of auxiliary damping into the first mode of the structure at 3.5 Hz. The damping ratio of the 3.5 Hz mode of the overlook with the TMDs operational is estimated as 4.5%; the estimation is done by fitting an exponential decay, shown by the black/dotted lines on Figures 3, to the time traces of accelerations measured after the TMDs were commissioned.

(a) (b)

Figure 2 The locations of the TMDs (marked in red) close to the tip of the overlook (a) and one of the two TMDs placed in its cavity (b)

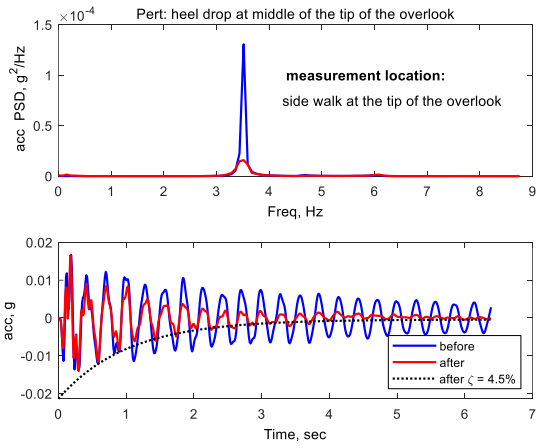

Figure 3 Acceleration PSDs and time responses measured at the tip of the overlook without (blue) and with (red) TMDs with heel drop perturbing the structure at two locations

Compared to the 0.9% damping ratio of the untreated structure, measured before the installation of the TMDs, tuned damping *increased the damping of the target mode of the overlook by more than 4 folds from 0.9% to 4.5%*.