

# Vibration Control of Long Span Balcony in a Church Using Two 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.

Upon having the construction of a new church near completion, walking induced vibration was perceived on a long span balcony. DEICON conducted on-site measurements and identified the first two natural frequencies of the balcony. In addition, the participating mass and the damping ratio of mode 1 of the balcony was evaluated. Tuned damping was used to abate walking-induced vibration of the balcony.



Two tuned mass dampers (TMDs) with the nominal moving mass of 1400 lb (~600 Kg) each, both tuned to the first natural frequency of the balcony, were designed and built. The depth and height of the TMDs were chosen so that they fit within two existing W14x61 beams; see Figures 1 and 2. The remaining parameters of the TMDs namely their tuning frequency and damping ratios were selected based on the measured dynamic attributes of the balcony.

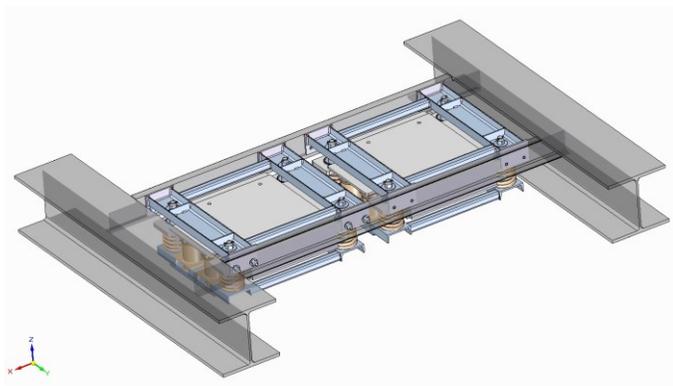


Figure 1 Installation scheme

The blue traces in Figure 3 present the power spectral densities (PSDs) and time traces of the measured acceleration at two locations close to the edge of the balcony, in response to a heel drop at the center edge of the balcony, with the TMDs operational. The red traces

show the measured data acquired in a similar fashion as that of blue traces except with the TMDs operational.



Figure 2 Installed TMDs

## Increase in Structural Damping of the Balcony

The extent of damping without and with the TMDs operational are also identified by fitting decaying exponentials to their heel drop response traces.

The TMDs increased the structural damping of the balcony from 2% to 11%; more than 5 fold increase.

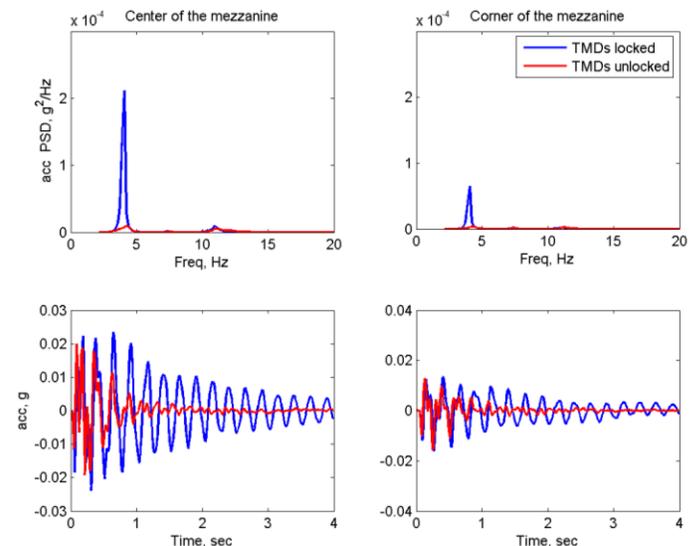


Figure 3 Power spectral densities and time traces of the measured vibration of the balcony at two locations without and with the TMDs operational