Vibration Control of a Concrete, Cantilever Pier 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.

Grant Street Pier, the focal point for "The Waterfront" development in Vancouver, WA is an attractive, triangular, post-tensioned concrete deck overhanging the water by 90 feet providing an expansive view of Columbia River. A cable system and 80-foot-tall mast supports the deck.

Since the pier is intended for visitors walking on it as well as special events such as weddings, a substantial finite element vibrational analysis was performed by the designers to understand how the structure reacts to a variety of dynamic loading scenarios. The structure's low fundamental frequency (1.2 Hz) combined with low damping made it prone to movements that may not be acceptable for human comfort. DEICON designed and fabricated a pair of 11,000 lb tuned mass dampers which were installed in cavities within the concrete deck, close to the tip of the pier.

Figure 1 Grant Street Pier

Figure 2 shows one of the TMDs in place inside its cavity and the other one being lowered into its cavity. Upon the completion of installation the cavities were covered with their access hatches and decking wood.

The blue traces in Figure 3 present the power spectral densities (PSDs) and time traces of the measured acceleration at the tip of the pier, in response to a heel drop at the same location, measured prior to the installation of the TMDs. The red traces in Figures 2 show the measured data acquired in a similar fashion to those of blue traces except with the TMDs installed.

Figure 2 One TMD installed in its cavity and the other one being lowered into its corresponding cavity

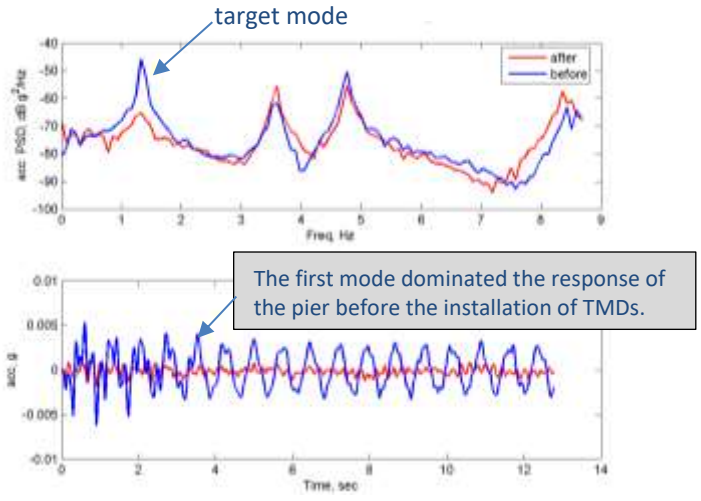

Figure 3 Power spectral densities and time traces of the acceleration measured a the tip of the Pier without (red traces) and with (red traces) the TMDs

With the tuned mass dampers installed and fine-tuned, the structure's response met standard industry acceleration guidelines.