Isolation System for an Industrial Process Equipment Subject to Random Vibration

The support structure of a massive, 110,000 lb, industrial process equipment, subject to random perturbation, is isolated from the vibration of the equipment itself. The isolators used in the random vibration isolation system are made up of low-stiffness springs paired with viscous dampers. Motion control schemes were incorporated into the isolation system to manage the lateral excursion of the equipment.

Eight isolators each consisting of a bank of four springs paried with one viscous damper, distributed around the equipment, made up the isolation system. The sitffness of the springs and their placement locations around the equipment were selected to prevent the rocking of the isolated equipment. Figure 1 shows a portion of the equipment and three of the isolators.

> **Random vibration** is caused by perturbations with no particular pattern (regularity). Random perturbations like shock excitations, have broadband spectra. An isolated system subject to random perturbation vibrates at the natural frequencies created by the isolation system. Lowering these frequencies and introducing damping to the isolators allow for more gentle release of vibration energy to the support structure, resulting in more effective isolation.

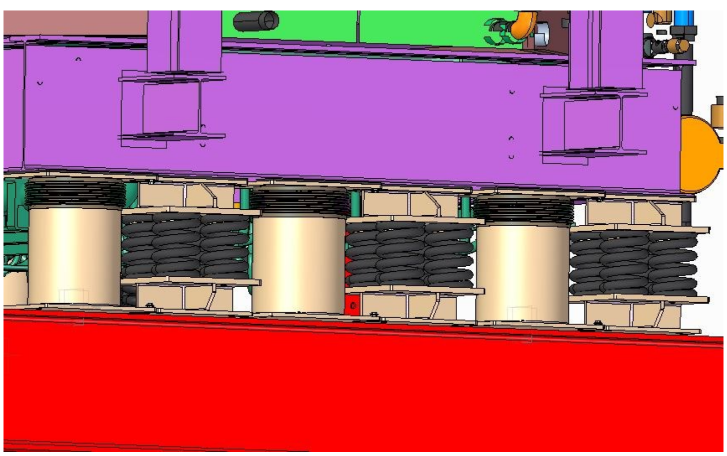

Figure 1 A portion of the isolated process equipment

Figure 2 shows the time traces and frequency spectra (in terms of power spectral densities) of the measured accelerations across one of the isolators, in vertical (z) and lateral (y) directions.

Comparison of the blue traces (top of the isolator) and red traces (bottom of the isolator) shows that the isolators are effectively lowering the transmitted vibration from the process equipment to its support structure.

> With their broadband spectra random perturbations, introduce energy into the isolated object at all frequencies including the natural frequencies of the isolated system, causing the system to resonate. In vibration isolation applications with random perturbation as the main source of agitation, damping should be added to the isolation systems to quiet the resonance and enhance the isolation. The effectiveness of isolation is further increased by lowering the natural frequency of the isolation systems via softening the isolators. As such, an ideal isolation system for shock and random vibration isolation should be soft and damped. The down side of having soft isolators is the excessive motion of the isolated object. Adequate excursion space as well as motion management schemes are to be incorporated into such systems to address the potential, occasional excessive motion.

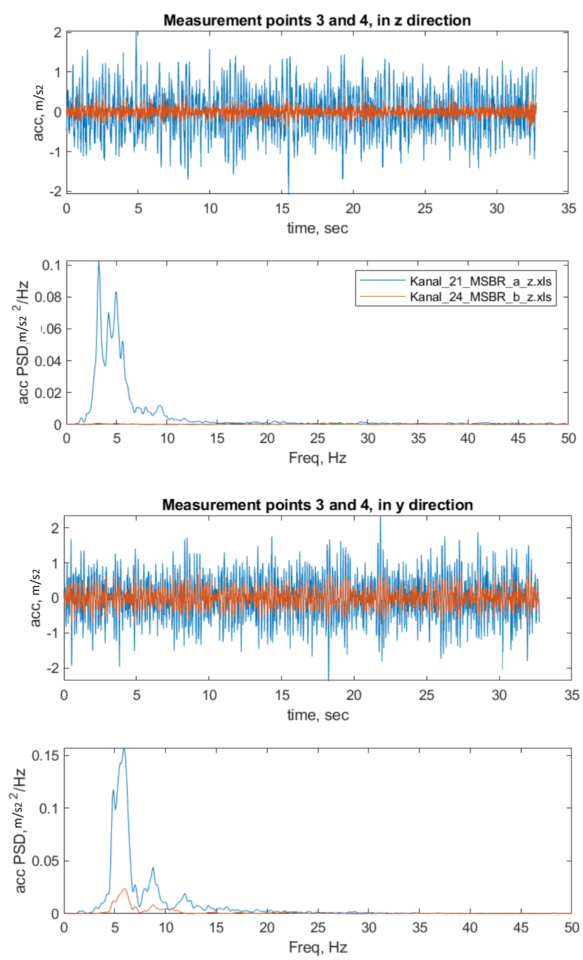

Figure 2 Measured accelerations across one of the isolators, in vertical (Z) and lateral (Y) directions