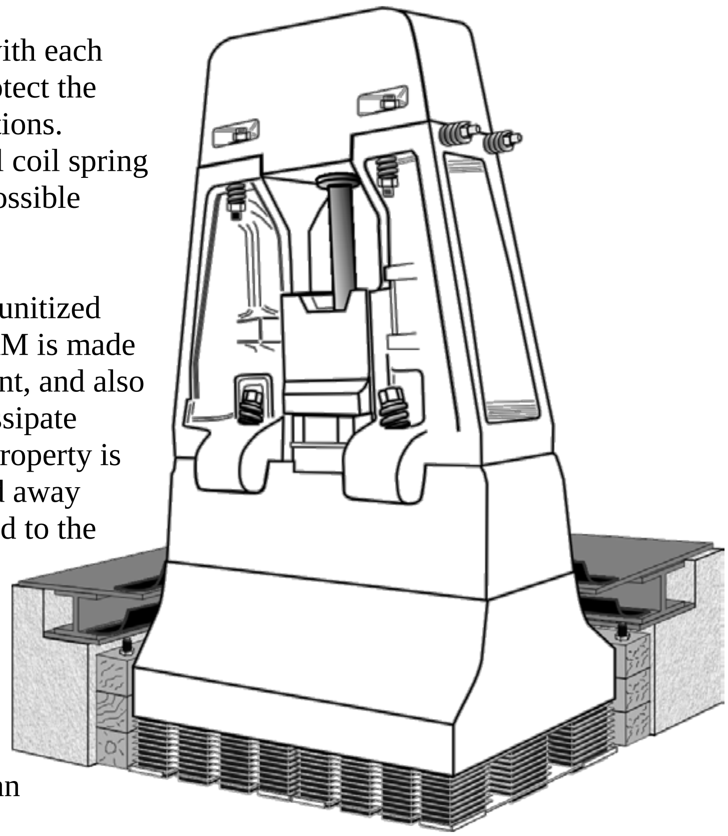
M/L Bulletin 710

Isolation Effectiveness of Vibro/Dynamics MRM Systems for Forging Hammers

MRM models provide significant vibration reduction compared to conventional timber and pad.



Forging hammers generate enormous shock forces with each blow. Soft, resilient isolation units are needed to protect the surrounding environment from the transmitted vibrations. Vibro/Dynamics has developed FSX and FSV model coil spring isolators with viscous damping to provide the best possible passive isolation effectiveness.

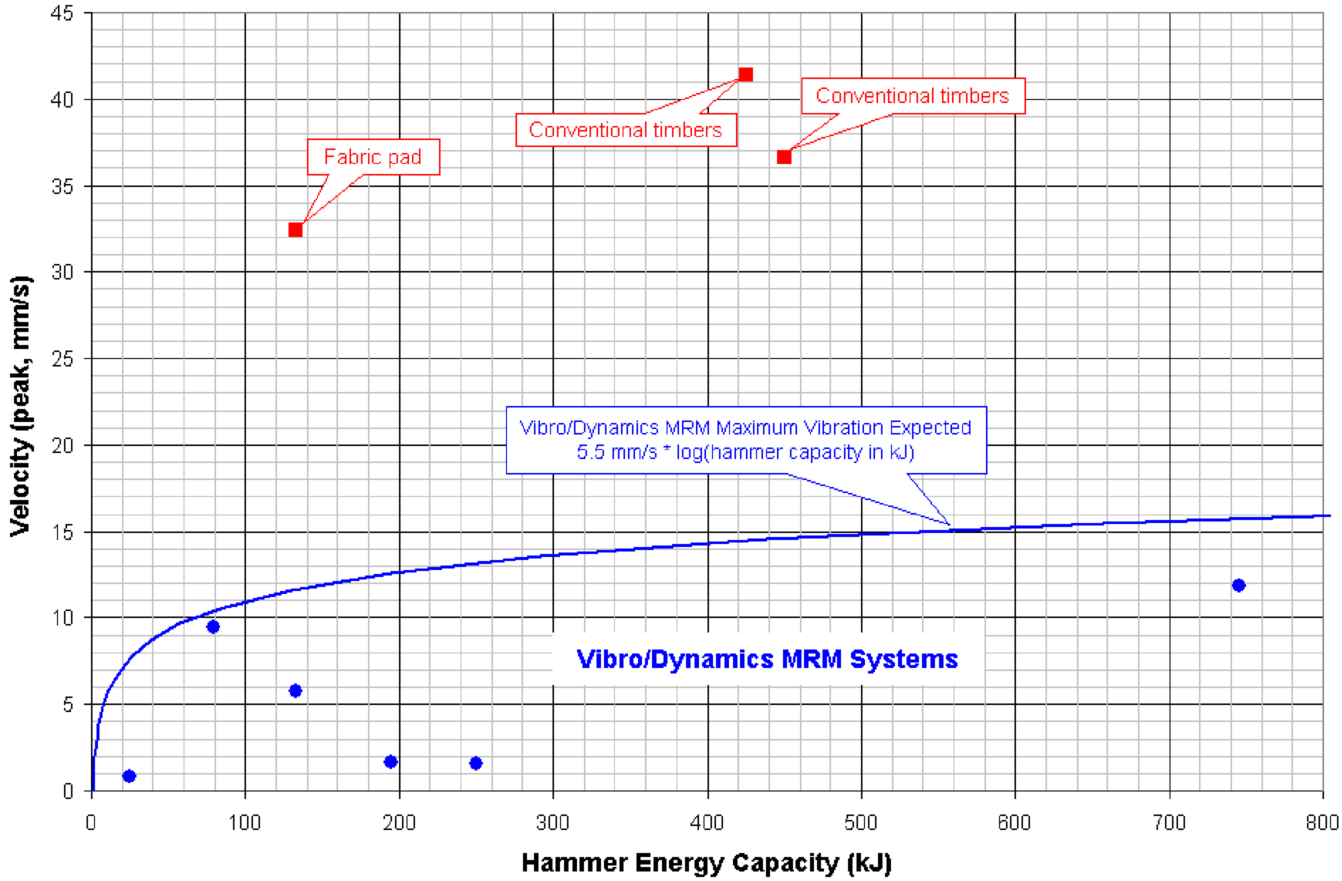
Vibro/Dynamics has also developed an economical, unitized elastomer based system, the MRM models. The MRM is made from a synthetic elastomer that is oil and heat resistant, and also very tough with significant damping. Elastomers dissipate energy in the form of heat when compressed. This property is known as hysteresis damping. The heat is conducted away from the elastomer parts by steel plates and dissipated to the surroundings. It is critical that all hammer isolation systems have sufficient damping to reduce the motion to near zero before the next hammer blow. The most important design feature of the MRM system is the stiffness of the system. Softer isolation systems transmit less peak force to the foundation. The MRM system is much softer than timbers and pad material.

Coil spring isolators with viscous fluid damping can achieve 80-95% vibration reductions compared to traditional timber foundations. However, coil spring isolators are expensive due to the need to add a damping device with thick fluid. The fluid is susceptible to leaking and contamination in the harsh environment of forging plants. The springs can also be damaged by scale and debris. Fatigue of the springs and damper often require repair and fluid replacement. Installations using coil springs typically require the addition of a large, expensive concrete or steel inertia mass to limit the machine motion because the springs are very soft. The disadvantages of the coil spring system are eliminated in the Vibro/Dynamics MRM system.

MRM systems have been praised by operators and nearby office workers and residential neighbors for significantly reducing vibration levels compared to timber and pad systems. Operators that work on both timber and MRM installed hammers credit MRM Systems for significantly reduced muscle fatigue. Because it is difficult to quantify these subjective claims of effectiveness, Vibro/Dynamics has analyzed several hammer installations covering a range of hammer capacities.

Figure 1 presents a summary of the measured vertical floor velocity near eight hammers. In cases where it was not possible to get a measurement at a 10m distance from the hammer center, the value was extrapolated from all the data points taken. The MRM system transmits less vibration to the surrounding floor than conventional timber and pad materials. In the case of the 133 kJ hammer, the reduction when mounted on the MRM system, as compared with a competitive fabric pad material, was 83%, installed in the same location doing the same work (see Figure 2). Figure 1 shows the typical vibration reduction using the MRM system is 60% to 80% when compared to traditional timber or competitive pad systems.

Figure 1: Measurement of Vertical Floor Velocity 10m from Die Forging Hammer versus Hammer Capacity.



Ordinances specifying maximum vibration often cite peak velocity levels. Typically, vibration readings are taken with an accelerometer. The acceleration measurement is then integrated to get velocity. Many sources claim peak particle velocity levels in excess of 13mm/s (0.5 inch/s) at 12-20 Hz are harmful to common building construction.[1] As Figure 1 shows, the floor vibrations at only 10m from the hammer, when installed on MRM systems, are below this damaging threshold.

Larger capacity hammers can be expected to produce more vibration. Figure 3 compares the floor acceleration waveform of a large hammer installed on a conventional timber foundation and an even larger hammer installed on an MRM system. Note that the larger hammer on the MRM system is generating 75% less floor response (10-12 dB less) than the smaller, timber mounted hammer. The two hammers being compared are within the same facility, so the soil and floor conditions are similar.

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Figure 2: Measurement of Vertical Floor Acceleration 10m from 133kJ Die Forger

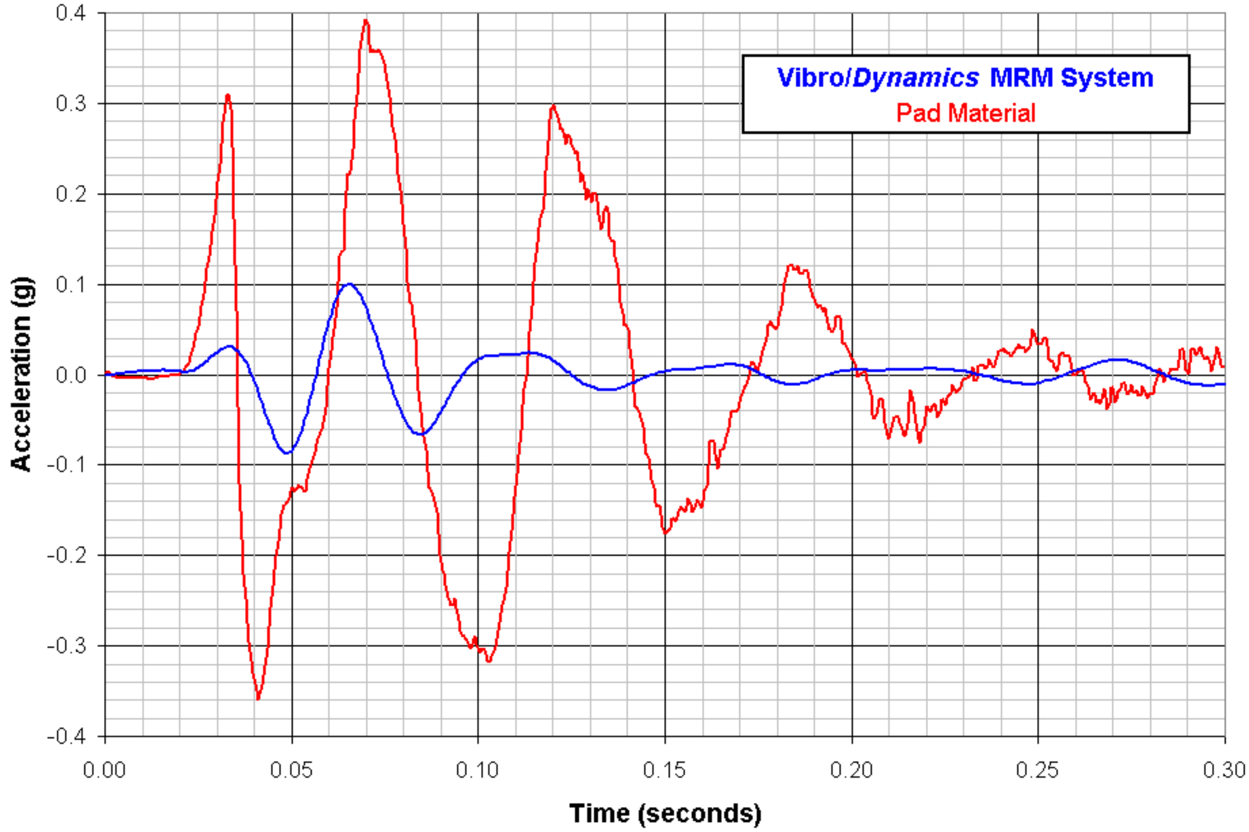


Figure 3: Measurement of Vertical Floor Acceleration 25m from Two Large Die Forgers

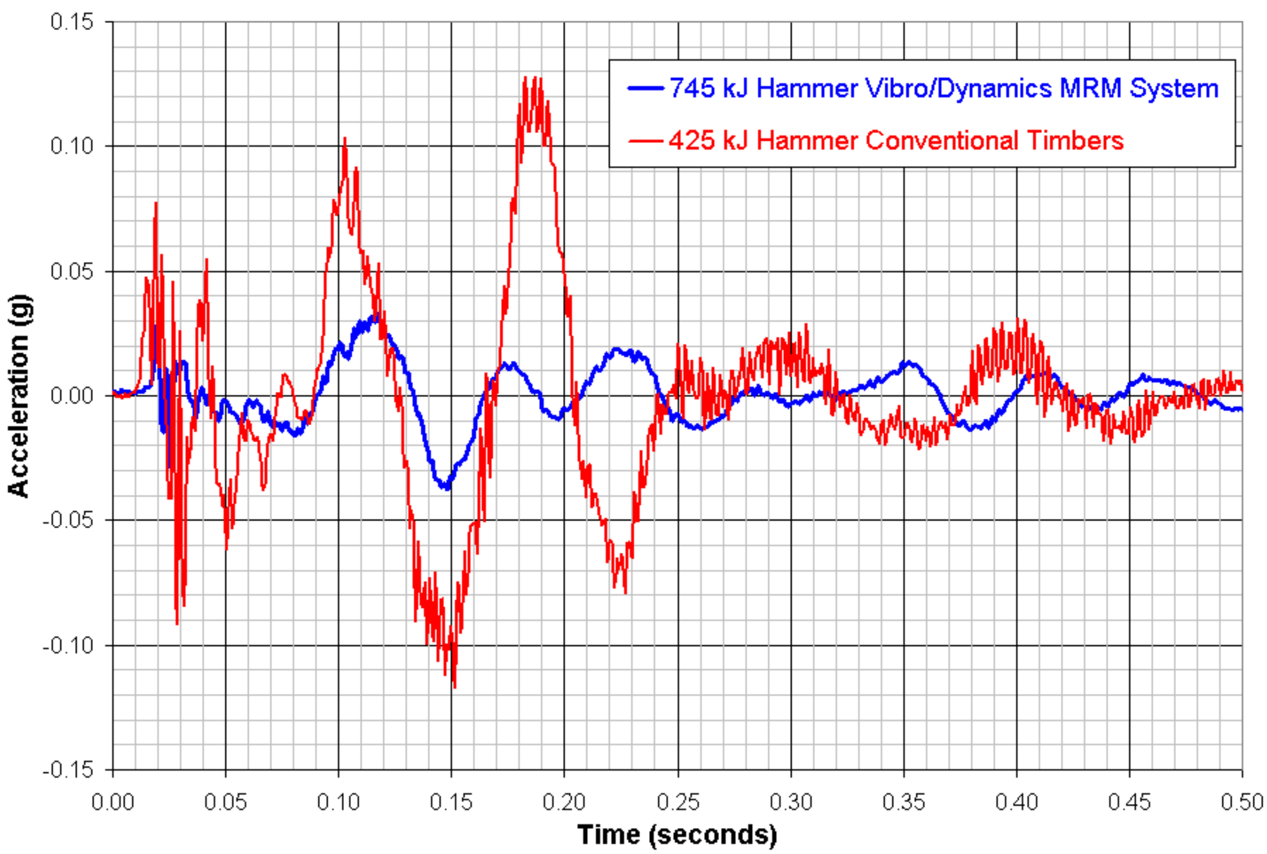
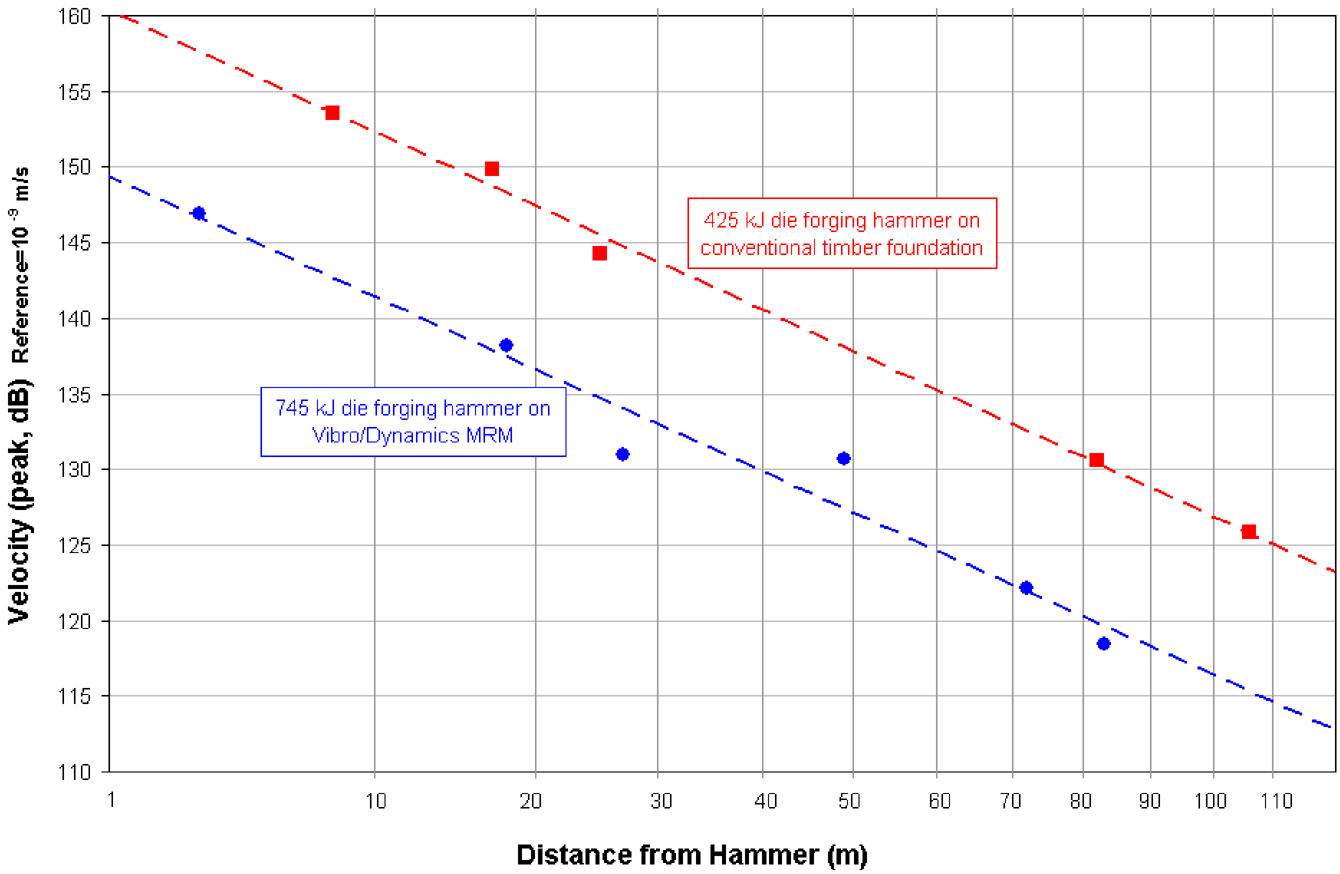


Figure 4 shows the vibration measured at several distances from the two hammers. The ground vibration decays with distance from the hammers. Plant personnel and neighbors of the plant have noted the improved isolation of the MRM system. Testimonies and a more complete case history of the larger hammer can be found at: http://www.vibrodynamics.com/english/cases/CH-Kropp.pdf

Figure 4: Measurement of Vertical Floor Velocity from Two Die Forgers at Various Distances



In conclusion, the MRM system is a durable, affordable, and efficient alternative to timbers, pads, and viscous damped coil spring isolators. The MRM system has been successfully installed on hammers as small as 7 kJ (5500 ft-lb) and as large as 745 kJ (550,000 ft-lb).

Contact Vibro/Dynamics Sales or Engineering staff to learn more:
http://www.vibrodynamics.com/english/contact.htm

Reference conversions:
9.81 m/s^2 = 1g = 386 in/s^2
1 kJ = 738 ft-lbf
1m = 39.4 in = 3.28 ft
Decibel velocity conversion: $V_{dB} = 20 \log (\text{Velocity} / 10^{-9}\ \text{m/s})$ The SI standard conversion is listed here, some American industries and the U.S. Navy use 10^{-8} m/s as the reference level.

[1]The U.S. Bureau of Mines has done extensive research concerning damaging levels of seismic vibration, see RI 8507 (Siskind, et al 1980). See also standards ISO4866, BS7385, DIN4150, AASHTO R-8-96. Human full-body exposure levels are discussed in ISO2631-2 (ANSI S3.18).

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