BARRY CONTROLS

DEFENSE & INDUSTRY
Antivibration

Q: What is the difference between base mounting and center of gravity (CG) mounting?

A: A base mounted system has isolators positioned or installed under the base, like the legs of a table. This system is shown schematically in Figure 1 below, where the zigzag lines represent the isolators, and the rectangle represents the mass or payload. Rotation or rocking is reduced by aligning the unit CG with the elastic center of the isolators. This is often referred to as CG mounting.

Presuming equal load distribution and isolator stiffness, either isolation system will translate under vertical excitation. However, when the system is excited horizontally, two natural frequencies result from a base mounted system because the CG of the unit is not in line with the elastic center (see Definitions) of the isolators. A transmissibility curve illustrating this horizontal vibration output is shown below as Figure 1:

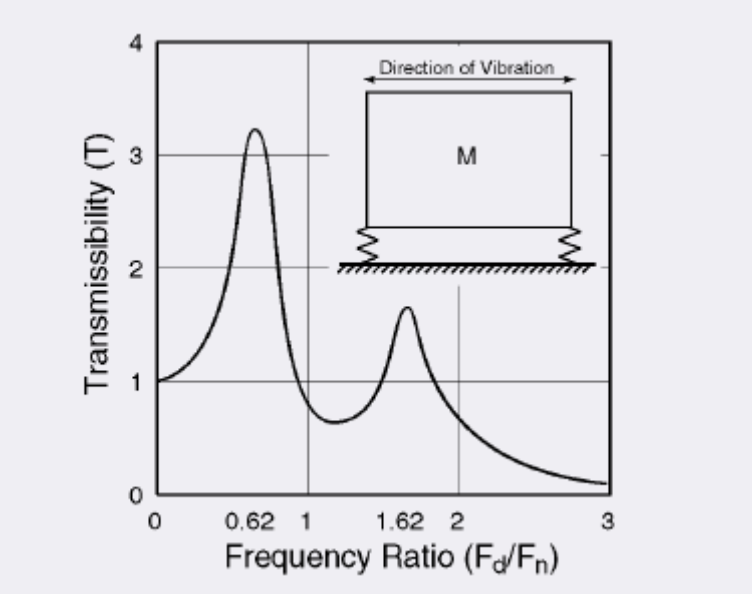

Figure 1

The two natural frequencies include a lower mode where the unit rocks or rotates about a point well below the system elastic center and a higher mode where the unit rocks at a point near the CG. These modes are lower and higher than a natural frequency resulting from pure translation and no rocking. Two other natural frequencies will occur if the unit is rotated horizontally 90º from the first position. This presumes the mass moments of inertia and/or mount spacing are different.

The approximate frequencies of these modes can be determined as a function of isolator stiffness and unit dimensions from Figure 2 below.

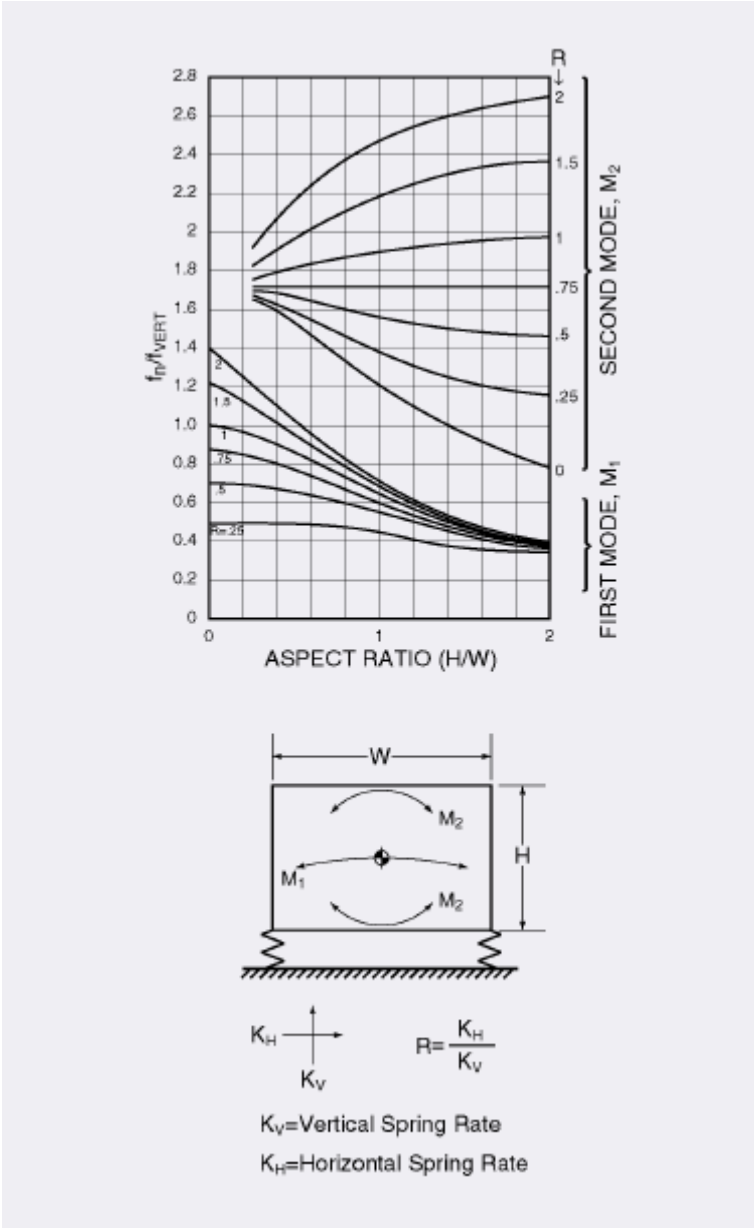

Figure 2

These curves assume that the equipment is solid, of uniform mass and that the isolators are attached to the extreme corners. This would result in equal load distribution on the isolators.

The equipment can be made to translate without rotation or rocking by lining up the unit CG with the elastic center of the isolators. This can be accomplished by moving the isolators up instead of installing them at the base as shown in Figure 3. In this case, Figure 2 may be applied by letting H/W = 0, which results in only one mode of vibration, that of translation. A second mode can then only be excited by torsion.

Figure 3

This can also be accomplished by leaving the isolators at the base and adding high mounted stabilizing isolators.

So, why would one system be used instead of the other? As stated above, base mounting is very common and is probably the easiest and most cost effective to install. And rocking may not be a detriment to the performance of the isolation system in terms of its relatively high excursions and isolation effectiveness.

If high excursions can not be accommodated, and/or isolation effectiveness is critical, a CG mounted system may be necessary. These are also common for optical or gyroscopic systems that are precisely aligned and can not tolerate rocking or angular motion. However, there must be space and attachment features available for high mounted isolators.

Another way to accomplish this is by focusing the isolation system. This will be discussed in another FAQ.