How vibration can be generated?

There are various methods to cause a structure to vibrate. The ideal vibration is dependent on the application and result required - high frequency at low stroke or high stroke at low frequency. Also you need to know of how much force and its direction to achieve the required result

For instances if you are testing products, it may be better to have a low frequency and high stroke when testing cartons for transport, however if testing electric circuit boards a high frequency at low stroke may be more appropriate.

To vibrate a structure, an engineer can use a simple cam, a reciprocating air cylinder or electric actuator, sound waves, or even a piezoelectric element, however the following are the more common methods currently used to obtain a controlled vibration of a machine or structure.

Crank mechanism

A simple crank and arm mounted onto the devise to be shaken. Commonly used to vibrate long conveyors, as the mass is usually high and 'G' forces relatively low this is suitable for high strokes and low frequency.

Eccentric shaft

By making a shaft "out of balance" the result is that the devise onto which is mounted will vibrate. The shaft usually mounted to the machine with a belt drive from a static mounted motor.

Rotary vibrators

There are many manufactures that make different types of rotary vibrators. Air or hydraulic driven turbines fitted with eccentric weights, vane type turbines as eccentric will induce vibration. Air driven balls, or rollers, running around a track also give an eccentric force. Motors, usually electric can be fitted with eccentric weights on one or both ends. When these are mounted onto a devise, it will vibrate. There are many manufactures of these rotary vibrators making the selection relatively easy.

Electromagnetic

By continually pulsing a coil or solenoid, which is mounted onto a devise, will induced vibration. To achieve the desired result with this system designers need to understand electrical service, both voltage and frequency, coil characteristics and electromagnetic fluxing, mechanical limitation of the system, and application restraints. Manufactures of electromagnetic units normally have a great deal of experience in how to design a suitable unit for duty requirements.

Pistons

A simple reciprocating piston will shake a devise. Piston vibrators are especially made for the high forces and frequencies that are required by the 'jack hammer' action often needed.

Each of the above have various advantages and problems all of which need to be examined in regard to the duty requirements before finalising the selection.

What needs to be considered in the application, selection, and design process?

The first consideration is to examine the product characteristics, how it will move under vibration, and clearly identify what is actually required to be achieved.

To build a vibratory machine the engineer needs to know what type of vibration is best for application, how much is required, and the direction to achieve the desired result. Then to be able to make the unit as light as possible, for the smallest drive, and still provide a rigid structure to be able to withstand the "G" forces required to perform the duty without the unit bending causing the structure to crack and break under load.

What is the connection between Diva's, Jericho, and mud flaps?

If you apply a vibrator directly to a structure or a machine you are vibrating with brute force, you are in effect forcing the structure to shake in relationship to the force applied.

An area often ignored, and sometimes misunderstood, is that all things, and their parts, have a natural frequency. This is the frequency at which they want to vibrate at, and will do so with very little force. Consider the opera singer who generates a sound at a frequency that matches a glasses natural frequency which can be at the other side of the room - keep it up long enough and the glass breaks. This idea was used in, biblical times, to bring the walls down at Jericho and is why that mud flap on the truck next to you at the lights shakes violently when idling but stops when the truck takes off.

When applying vibration to any structure consider the effect it may have on the surrounding equipment and how to control the vibration by isolating or altering the drive frequency to suit the environment. The mud flap needs a brace, a different mounting, or a change in weight to alter its natural frequency from the trucks idle frequency.

Many vibratory units utilise this feature to magnify the vibration of a unit allowing a smaller vibrator to be used. These are natural frequency units and tuned systems need to be treated as such, just like a musical instrument, any changes to their structure will change the natural frequency making it different to the drive frequency, hence the unit will no longer operate as it is out of tune.

Other things to consider.

A simple vibrator mounted to a hopper to assist with product flow, will over a week, (at only 20% on time) vibrate the hopper in excess of 50,000 times. With this many "blows" to the hopper it's best to get the installation correct or risk damage to the hopper or personnel.

Timing is also important; a contractor had a client with a hopper that stopped flowing. The client showed the contractor that all he had to do was knock the hopper to get it working again. The contactor duly fitted a vibrator only to complain that this did not solve the problem. The client had the advantage of knowing when to shake the hopper, and its possible that the vibration was in fact compacting the product, actually making the situation worse. Care needs to be taken to set the vibrator up for correct thrust and not to run it too long or ideally only turn it on if there is a flow problem.

Another common problem is apply vibration in a violent way to a structure in the hope it will solve the problem - beware as this is akin to shaking the baby to stop it crying - a very bad application of vibration.

Summary

Whilst vibration is a relatively simple action, and is indeed a part of our everyday life. The correct application and design of a suitable system can be very involved and is best left to the experts.

VIBCO are available to assist with your special application, regardless of size or complexity, and will confirm if vibration can be beneficial, and would be pleased to recommend the best course of action. As for vibrators for matting in the animal world, this is a completely separate field in which we do not have any expertise's, we can only suggest ways for shaking the building or structure for an outcome but not the individuals within it.