from which $A = 4f^2 X$

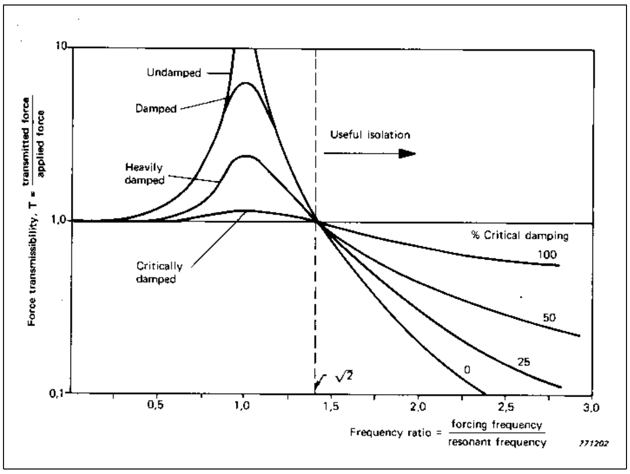
A similar set of equations relate the three RMS values.

Displacement, X may be measured in m., mm. or m. (microns). Velocity, V, may be measured in $m.s^{-1}$, or $mm.s^{-1}$ .Acceleration, A, is measured in $m.s^{-2}$.

Vibration Isolation

A vibrati on isolator is a spring or mount which reduces the transmission of the vibration to the sturcture at freque ncies $2^{1/2}$ x natural frequency of spring or mount. The transmissibiltiy (T) is given by
$T = 1/ (1 -[f/f_r]^2)$

where f is the driving frequency
and f_r is the natural frequency of mount (isolator)
.



Springs and mounts may be simply sized by their static defection under load. The natural frequency of the loaded mount is given by:

$f_r = 15.8/d^{1/2}$ where d is the static deflection in mm and f_r the natural frequecy of the loaded mount.

More Complex Vibrations, and Vibration Spectra. More complex vibrations may be thought of as being built from a combination of simple sinusoidal vibrations, and represented by a frequency spectrum. The frequency spectrum of a single frequency vibration with a sinusoidal waveform is a single line. Vibrations with a **harmonic** waveform, ie one which repeats itself exactly, have a line spectrum, in which the frequency components are integer multiples of the fundamental frequency defined by the period of the waveform. Such a series of lines is often called a Fourier series, after the French mathematician J.B.Fourier (1768-1830) who showed that any repetative function can be broken down (ie analysed into) a series of sinusoidal functions. The waveform of a **random** vibration never repeats itself and has a continuous frequency spectrum, ie one in which the lines have moved infinitesimally close together. This continuous spectrum may be analysed into octave or one-third octave bands, exactly as for sound signals.The spectrum of a single **transient** vibration is also a continous spectrum, with, usually, higher levels at the lower frequencies and with the levels reducing at higher frequencies. **Repeated transients** produce a line spectrum in which the line spacing is determined by the repetition rate, but where the shape of the spectrum is determined by the waveform of the transient. Examples include the vibration produced by rotating machines such as fans, pumps and motors, and reciprocating machines such as engines.

THE EFFECTS OF VIBRATION ON PEOPLE

Depending upon the level, and a variety of other factors, vibration may affect people’s comfort and well-being, impair their efficiency at performing a variety of tasks. or even at very high levels become a hazard to their health and safety. The best known example of the harmful effects of vibration is the White Finger syndrome (also known as Reynaud’s disease) in which prolonged use of hand-held equipment, such as chain saws, in very cold conditions. produces loss of sensation in the fingers. The vibration produced by the various forms of transportation (e.g. road traffic, trains and aircraft) is of great interest for a variety of reasons. First of all. there is concern about the safety and efficiency of the driver or operator subjected to vibration; secondly, there is the effect of vibration levels on the comfort of passengers; and thirdly, there is often great concern amongst members of the public about vibration produced in buildings. including domestic dwellings adjacent to roads or railway lines or near to air routes. A great variety of industrial machinery produces vibration which is experienced by people at work. Particular sources which can cause vibration to be experienced by the occupants of nearby buildings and thus often give rise to concern amongst members of the public include heavy-duty air compressors, forge hammers, pile driving and quarry blasting operations.

FACTORS INVOLVED IN HUMAN RESPONSE TO VIBRATION

The assessment of human response to vibrati on is made difficult by the fact that there are a large number of factors involved, and because of the great differences between individuals. The main physical factors determining the response to a vibration are the amplitude (or intensity) and frequency, and also the duration (exposure time), point of application and direction of the vibration. Amongst the configurations which are of interest are the transmission of vibration from the floor through the feet of the standing person and from the seat via the buttocks and possibly the head (through the headrest) of the seated person. In these cases the vibration may be transmitted and felt throughout all parts of the body, and it is the whole body response which will be required. In other cases the vibration may be applied and sensed at a particular part of the body - the vibration produced in the fingers and hands by power tools being a good example. In this particular case it is the response of the hand-arm system which is important.

As far as vibration transmission is concerned. the human body may be thought of as a complex mass-spring system. It therefore has a complicated frequency response which includes resonances associated with either the whole body or various parts of the body such as the head or the shoulder girdle. These frequencies may vary greatly for different people. Different parts of the body are therefore most sensitive to different frequencies of vibration. Therefore there is not only a difference in individual sensitivity to vibration, but also a