A16.1 Noise and Vibration – Introduction and Terms

1 Noise

1.1.1 Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 18 Hz to 18 kHz and over the audible range of 0dB (the threshold of perception) to 130dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear. To help understand the range of noise levels which may be encountered, an indication of the level of some common sounds on the dB(A) scale is given in Table 1.1 below.

Table 1.1: Indication of Noise Thresholds

dB(A)	Description
130	Threshold of pain
120	Jet take off at 50 metres
100	Maximum noise levels on an underground platform
80	Kerbside of a busy urban street
60	Busy general office
40	Residential area at night
20	Background in a TV and recording studio
0	Threshold of hearing

1.1.2 Furthermore, the perception of noise may be determined by a number of other factors, both acoustic and non-acoustic. In general, the effect of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

1.1.3 The most widely used weighting mechanism that best corresponds to the response of the human ear is the A-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90}, etc. according to the parameter being measured.

1.1.4 For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, eg $dBL_{A10,\ 5\ min}$ or $dBL_{A90,8hr}$.

1.1.5 The decibel scale is logarithmic rather than linear, and hence a 3dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3dB(A) of steady state noise is generally regarded as the minimum difference needed to perceive a change.

2 Vibration

2.1.1 Vibration is defined as a repetitive oscillatory motion. Vibration can be transmitted to the human body through the supporting surfaces, the feet of a standing person, the buttocks, back and feet of a seated person or the supporting area of a recumbent person. In most situations, entry into the human body will be through the supporting ground or through the supporting floors of a building.

2.1.2 Vibration is often complex, containing many frequencies, occurring in many directions and changing over time. There are many factors that influence human response to vibration. Physical factors include vibration magnitude, vibration frequency, vibration axis, duration, point of entry into the human body and posture of the human body. Other factors include the exposed persons experience, expectation, arousal and activity.

2.1.3 Experience shows that disturbance or annoyance from vibration in residential situations is likely to arise when the magnitude of vibration is only slightly in excess of the threshold of perception.

2.1.4 The threshold of perception depends on the frequency of vibration. The human body is most sensitive to vibration in the frequency range 0.5-80Hz, and especially sensitive to vibration in the range 4-8Hz. As with noise, a frequency weighting mechanism is used to quantify vibration in a way that best corresponds to the frequency response of the human body. For occupants within buildings, the appropriate standard is BS6472 (British Standards Institution, 2008).

2.1.5 BS6472 Part 1 advises the use of the estimated vibration dose value (VDV) from frequency weighted vibration measurements. The VDV value is used to estimate the probability of adverse comment which might be expected from humans experiencing vibration within buildings. Consideration is given to the VDV that an occupant would receive over the course of a 16 hour day or 8 hour night-time period. The vibration dose value provides a means of specifying the frequency dependent vibration level of a given duration as a single number.

2.1.6 BS6472 Part 2 gives guidance on human exposure to blast induced vibration in buildings. It is primarily applicable to mineral extraction blasting. It may be useful in assessing blasting associated with civil engineering works and demolition activity.

3 References

British Standards Institution (2008). Guide to Evaluation of Human Exposure to Vibration in Buildings, BS6472: 2008.