Appendix 15.2: Noise & Vibration Guidance

BS 8233: 2014: Guidance on Sound Insulation and Noise Reduction for Buildings (BS 8233:2014)

BS 8233: 2014 provides recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings, or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including residential dwellings. It suggests that for steady external noise sources, during the day, an internal noise level of 35 dB $L_{Aeq,T}$ is appropriate for resting conditions within living rooms and bedrooms and a level of 40 dB $L_{Aeq,T}$ is applicable to dining rooms. During the night, an internal noise level of 30 dB $L_{Aeq,T}$ is recommended within bedrooms.

The recommended levels are based on the existing guidelines issued by the World Health Organisation (WHO) and assume normal diurnal fluctuations in external noise. It is also stated that '*Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by upto 5 dB and reasonable internal conditions still achieved.*'

For regular individual noise events with the potential to cause sleep disturbance it is stated that a guideline value may be set in terms of sound exposure level (SEL) or $L_{Amax,F}$. No further guidance is provided with respect to an appropriate criterion which may be adopted for the assessment of such events.

Recommendations for design criteria for external noise are also provided, in this regard it is stated;

> *'For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited'*

BS 8233:2014 also provides guidance on acceptable levels of noise for development types other than residential. For executive offices a range of 35dB to 40dB $L_{Aeq,T}$ is recommended and for staff / meeting rooms a design range of 35dB to 45dB $L_{Aeq,T}$ is presented. For reasonable listening conditions within a public building a range of 30 to 35dB $L_{Aeq,T}$ is recommended. For reasonable conditions for study and work requiring concentration the Standard advises a range of 35 to 50dB $L_{Aeq,T}$ and for reasonable speech or telephone communications a design range of 45 to 55dB $L_{Aeq,T}$ is recommended.

World Health Organisation (WHO): 1999: Guidelines for Community Noise

This is a wide ranging document describing the effects of community noise. It provides information about the effects of noise that may occur at certain levels of exposure. For dwellings, the critical effects of noise are taken to be sleep disturbance, annoyance and speech interference.

Indoor guideline values are provided for bedrooms with the aim of protecting against sleep disturbance, a guideline value of 30 dB L_{Aeq} for continuous noise and 45 dB L_{Amax} for single sound events is recommended. To enable casual conversation during the daytime an internal guideline noise level of 35 dB L_{Aeq} is provided.

With respect to external noise levels it is stated that:

> *"To protect the majority of people from being seriously annoyed during the daytime, it is recommended that the sound pressure level on balconies, terraces, and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor noise level should not exceed 50 dB L_{Aeq}."*

The external and internal ambient noise levels L_{Aeq} criteria in BS 8233:2014 is concordant with those contained within the WHO guidelines. Accordingly, for the purpose of this assessment, and in absence of any specific L_{AFmax} criterion being detailed within BS 8233:2014, the WHO 45dB L_{AFmax} criterion has been adopted.

With respect to the night-time L_{AFmax} noise levels, the WHO states:

> *"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than 10-15 times per night"*

On this basis, for the purpose of assessing night-time L_{AFmax} noise events, it is considered appropriate to adopt the 10th highest L_{AFmax} noise event occurring in a typical night-time (23:00 – 07:00) period.

The Design Manual for Roads and Bridges (DMRB): Volume 11: Environmental Assessment

Section 3 Part 7 of this document is that which is pertinent to noise and vibration and was published by the Department of Transport in 1993 with later amendments, the latest of which is November 2011. This document sets out procedures for undertaking the environmental assessment of new road schemes, including the assessment of noise impacts from road traffic. In particular, Section 3 Part 7 describes a method for assessing the severity of a noise impact, in terms of the number of people who will be bothered from any noise increase due to a new road scheme. In undertaking a DMRB assessment, the calculation of traffic noise levels uses the methodology contained within the Calculation of Road Traffic Noise (CRTN) (Ref 15.4)) document as described below.

Although the DMRB strictly applies to new road schemes, the principles of the approach contained within the document can also be applied to the assessment of noise from road traffic in general. The Proposed Development has the potential to affect road traffic noise levels along existing roads, hence the need for this assessment.

The DMRB assessment suggests that the magnitude of noise changes from a project should be classified into levels of impact. The February 2011 amendment to Section 3 Part 7 gives detailed consideration to how effect magnitude will be affected by whether a noise level change will occur in the short term (e.g. as a result of a sudden opening of a scheme), or whether the noise level

change would occur in the long term (e.g. gradually over time, such as that associated with natural traffic growth).

The two example classification scales contained within the DMRB are duplicated in Table A15.2.1 (short term) and Table A15.2.2 (long term).

Table A15.2.1: Classification of Magnitude of Noise Changes in the Short Term

Noise Change, $L_{A10, 18h}$, dB	Magnitude of Change
0	No Change
0.1 to 0.9	Negligible
1.0 to 2.9	Minor / Low
3.0 to 4.9	Moderate / Medium
5.0+	Major / High

Table A15.2.2: Classification of Magnitude of Noise Changes in the Long Term

Noise Change, $L_{A10, 18h}$, dB	Magnitude of Change
0	No Change
0.1 to 2.9	Negligible
3.0 to 4.9	Minor / Low
5.0 to 9.9	Moderate / Medium
10.0+	Major / High

The DMRB confirms that the above scales apply to the magnitude of change, (not the significance of effect). The significance of effect will depend upon both the magnitude of change and the sensitivity of the receiving environment.

Calculation of Road Traffic Noise (CRTN) 1988

Published by the Department of Transport and the Welsh Office in 1988, this document sets out standard procedures for calculating noise levels from road traffic. The calculation methods use a number of input variables, including traffic flow volume, average vehicle speed, percentage of heavy goods vehicles, type of road surface, site geometry and the presence of noise barriers or acoustically absorbent ground. CRTN predicts the $L_{A10,18hour}$ or $L_{A10,1hour}$ noise level for any receptor point at a given distance, up to 300m, from the road.

A guide to Measurement and Prediction of the Equivalent Continuous Sound Level L_e, 1978

In 1978, the Noise Advisory council (NAC) set up a working group to prepare a report for practitioners with the appropriate technical background who need to measure or predict environmental noise. It presents general procedures to be followed for the measurement and prediction of L_{eq} from a number of different sources.

The report provides a method for calculating the Leq noise level from the combined effect of a number of events (e.g. vehicle pass-bys) with their own single event noise exposure level (L_{AX}, commonly referred to as the SEL). In addition, the report presents a method for determining the

L_{AX} at a distance of 10m from the nearside edge, for heavy and light vehicles travelling at different speeds.
Combining the use of these of these ANC prediction methods provides a means of determining the L_{eq} from a road traffic source, for example where the number of pass-by events fall outside the range valid for calculations in accordance with CRTN.

BS 5228: Noise and Vibration Control on Construction and Open Sites - Part 1: Noise: 2009 + A1 2014 (BS 5228-1)

This Standard sets out techniques to predict and assess the likely noise effects from construction works, based on detailed information on the type and number of plant being used, their location, and the length of time they are in operation. The noise prediction method is used to establish likely noise levels in terms of the $L_{Aeq,T}$ over the core working day.

This Standard also documents a database of information, comprising previously measured sound power levels for a variety of different construction plant undertaking various common activities.

Example criteria are presented for the assessment of the significance of noise effects. Such criteria are concerned with fixed noise limits and ambient noise level changes. With respect to fixed noise limits BS 5228 discusses those included within Advisory Leaflet 72: 1976: Noise Control on Building Sites (Ref 15.12). These limits are presented according to the nature of the surrounding environment, for a 12-hour working day. The presented limits are:

- 70dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise; and
- 75dB(A) in urban areas near main roads and heavy industrial areas.

The standard goes on to provide methods for determining the significance of construction noise levels considering the change in the ambient noise level brought about by the construction work. Two example assessment methods are presented, these are the ABC method presented within the following table and the 5dB(A) change method as described within the following paragraph.

Table A15.2.3: Example Threshold of Significant Effect at Dwellings – ABC Method

Assessment Category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq,T}$)		
	Category A[A)]	Category B[B)]	Category C[C)]
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends[D)]	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
NOTE 1: A significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the Category appropriate to the ambient noise level.			
NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total L_{Aeq} noise level for the period increases by more than 3 dB due to the site noise.			
NOTE 3: Applied to residential receptors only			
A) Category A: threshold values to use when ambient levels (when rounded to the nearest 5 dB) are less than these values.			
B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.			
C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.			
D) 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays			

With respect to the 5dB(A) change method, the guidance states:

> *'Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5dB $L_{Aeq,\ T}$ or more, subject to lower cut-off values of 65dB, 55dB and 45dB $L_{Aeq,T}$ from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect'.*

BS 5228: Noise and Vibration Control on Construction and Open Sites - Part 2: Vibration: 2009 +A1 2014 (BS 5228-2)

This standard provides recommendations for basic methods of vibration control relating to construction and open sites. The legislative background to vibration control is described and guidance is provided concerning methods of measuring vibration and assessing its effects on the environment.

Guidance criteria are suggested for the assessment of the significance of vibration effects; such criteria are provided in terms of Peak Particle Velocities (PPV) and are concerned with both human and structural responses to vibration. Those applicable to human perception and disturbance are presented within the table below.

Table A15.2.4: Guidance on Effects of Vibration Levels

Vibration Level (PPV)	Effect
0.14 mms^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mms^{-1}	Vibration might be just perceptible in residential environments.
1.0 mms^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mms^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

The standard goes on to present guidance criteria applicable to the vibration response limits of buildings in terms of the component PPV, these are presented within the table below.

Table A15.2.5: Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial	50 mm/s at 4 Hz and above	50 mm/s at 4Hz and above
Unreinforced or light framed structures Residential or light commercial	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1: Values referred to are at the base of the building. NOTE 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

It should be noted that the values presented within the above table are applicable to cosmetic damage only. It is stated within BS 5228-2 that minor damage is possible at vibration magnitudes which are greater than twice those given in the table.