Document 6.2

The West Midlands Rail Freight Interchange Order 201X
Technical Appendix 13.2 - Standards and Guidelines
Regulation 5(2)(a)
Resound - July 2018

West Midlands Interchange

Four Ashes Ltd

Technical Appendix 13.2: Standards and Guidelines

A13.2.1 British Standard 5228

Part 1 of British Standard (BS) 5228: 2009+A1: 2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites (including Amendment 1)*, titled *Noise*, sets out a method for predicting, assessing and controlling noise levels arising from a wide variety of construction and related activities and sets out tables of sound power levels generated by a wide variety of construction plant to facilitate such predictions.

Noise levels generated by a construction site will depend upon a number of variables, the most significant of which are:

- the amount of noise generated by plant and equipment being used at the development site, generally expressed as a sound power level;
- the periods of operation of the plant at the development site, known as the "on-time";
- the distance between the noise source and the receptor, known as the "stand-off";
- the attenuation due to ground absorption or barrier screening effects; and
- the reflection of noise due to the presence of hard vertical faces such as walls.

The prediction method set out in Part 1 of BS5228 takes account of each of these variables, and provides typical source emission levels for a range of construction plant undertaking specific construction activities.

The predicted construction noise levels have been assessed against criteria derived using the "ABC Method" as described in Section E.3.2 of BS5228, which states:

> *"Table E.1 shows an example of the threshold of potential significant effect at dwellings when the site noise level, rounded to the nearest decibel, exceeds the listed value. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5dB. This is then compared with the site noise level. If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect."*

Table E.1 of BS5228 is reproduced here as Table A13.2.1.

Table A13.2.1: Threshold of significance effect at dwellings

Assessment Category and Threshold Value period (L_{Aeq})	**Threshold Value, dB**		
	Category A[(A)]	**Category B[(B)]**	**Category C[(C)]**
Night-time (23:00 to 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

Notes:

[(A)] Category A: threshold values to use when ambient noise levels (rounded to the nearest 5dB) are less than these values.

[(B)] Category B: threshold values to use when ambient noise levels (rounded to the nearest 5dB) are the same as Category A values.

[(C)] Category C: threshold values to use when ambient noise levels (rounded to the nearest 5dB) are higher than Category A values.

[(D)] 19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays

There are further notes to the table in BS5228, which state:

> *"Note 1: A potential significant effect is indicated if the L_{Aeq} 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 3dB due to site noise.*
>
> *Note 3: Applied to residential receptors only."*

For the purposes of this assessment, the criteria set out in Table A13.2.1 have been applied at each receptor, based on the measured ambient noise levels. The period of construction works affecting a given receptor has been factored into the significance of any exceedances of the identified criteria, as described in the standard.

Part 1 of BS5228: 2009+A1:2014 sets out an example of thresholds that might be adopted in instances where construction noise leads to impacts that can not be mitigated in other ways so that the noise insulation is required, or in the worst cases, temporary rehousing is appropriate. The thresholds are shown in Table 13.2.2.

Table A13.2.2: Noise levels associated with the determination of eligibility for noise insulation, façade $L_{Aeq,T}$

Time	Relevant Time Period	Averaging Time, T	Noise Insulation Trigger Level dB $L_{Aeq,T}^{(A)}$	Temporary Rehousing Trigger Value dB $L_{Aeq,T}^{(A)}$
Monday to Friday	07:00 to 08:00	1 hour	70	80
	08:00 to 18:00	10 hours	75	85
	18:00 to 19:00	1 hour	70	80
	19:00 to 22:00	3 hours	65	75
	22:00 to 07:00	1 hour	55	65
Saturday	07:00 to 08:00	1 hour	70	80
	08:00 to 13:00	5 hours	75	85
	13:00 to 14:00	1 hour	70	80
	14:00 to 22:00	1 hour	65	75
	22:00 to 07:00	1 hour	55	65
Sunday and Public Holidays	07:00 to 21:00	1 hour	65	75
	21:00 to 07:00	1 hour	55	65
Note: $^{(A)}$ - All noise levels are predicted or measured at a point 1 m in front of the most exposed of any windows and doors in any façade of any eligible dwelling				

The trigger values shown in Table A13.2.2 will not apply where the ambient noise level is greater than the noise insulation trigger value. In such cases, where the ambient noise level in the absence of construction noise exceeds the relevant noise insulation trigger value shown above, then:

- the ambient noise level shall be used as the construction noise level required to trigger insulation, and
- the ambient noise level +10dB shall be used as the temporary rehousing trigger value.

The predicted or measured noise level exceeds the noise trigger value for noise insulation at the property for at least ten days out of any period of 15 consecutive days or alternatively for 40 days in any six-month period

Part 2 of BS5228: 2009+A1: 2014, titled *Code of practice for noise and vibration control on construction and open sites Part 2: Vibration*, relates to vibration that may be impulsive, such as that due to hammer-driven piling; transient, such as that due to vehicle movements along a railway; or continuous, such as that due to vibratory driven piling. The primary cause of community concern generally relates to building damage from both construction and operational sources of vibration, although the human body can perceive vibration at levels that are substantially lower than those required to cause building damage.

Part 2 of BS5228 indicates that vibration might be just perceptible at 0.14 mm/s (peak particle velocity or ppv) in the most sensitive situations for most vibration frequencies associated with construction. The standard goes on to note that at 0.3 mm/s vibration might be just perceptible in residential environments, at 1.0 mm/s vibration in residential environments is likely to cause complaint although it can be tolerated if prior warning and explanation has been given to the residents and at 10 mm/s vibration is likely to be intolerable for any more than a very brief exposure.

Damage to buildings associated solely with ground-borne vibration is not common and although vibration may be noticeable, there is little evidence to suggest that they produce cosmetic damage such as a crack in plaster unless the magnitude of the vibration is excessively high. The most likely impact, where elevated levels of vibration do occur during the construction works, is associated with perceptibility.

For cosmetic damage to residential properties in good condition, i.e. without any specific structural weaknesses, Part 2 BS5228 repeats the guidance contained in BS7385: Part 2: 1993 *Evaluation and measurement for vibration in buildings - Part 2: Guide to damage levels from groundborne vibration*. It indicates that cosmetic damage may occur at peak particle velocities of 15 mm/s and above.

A13.2.2 TRL Report 53

The 1986 Transport and Road Research Laboratory (TRL) produced a report in 1986 titled *Ground vibration caused by civil engineering works* (TRL Report 53). The report set out the findings of TRL's research into predicting and assessing ground vibration from civil engineering works.

Of particular use for this assessment is Figure 3 of the report, which sets out typical vibration levels from construction activities. Figure 3 is included here as Figure A13.2.1.

Figure A13.2.1: Relative peak particle velocity (PPV) levels from various sources

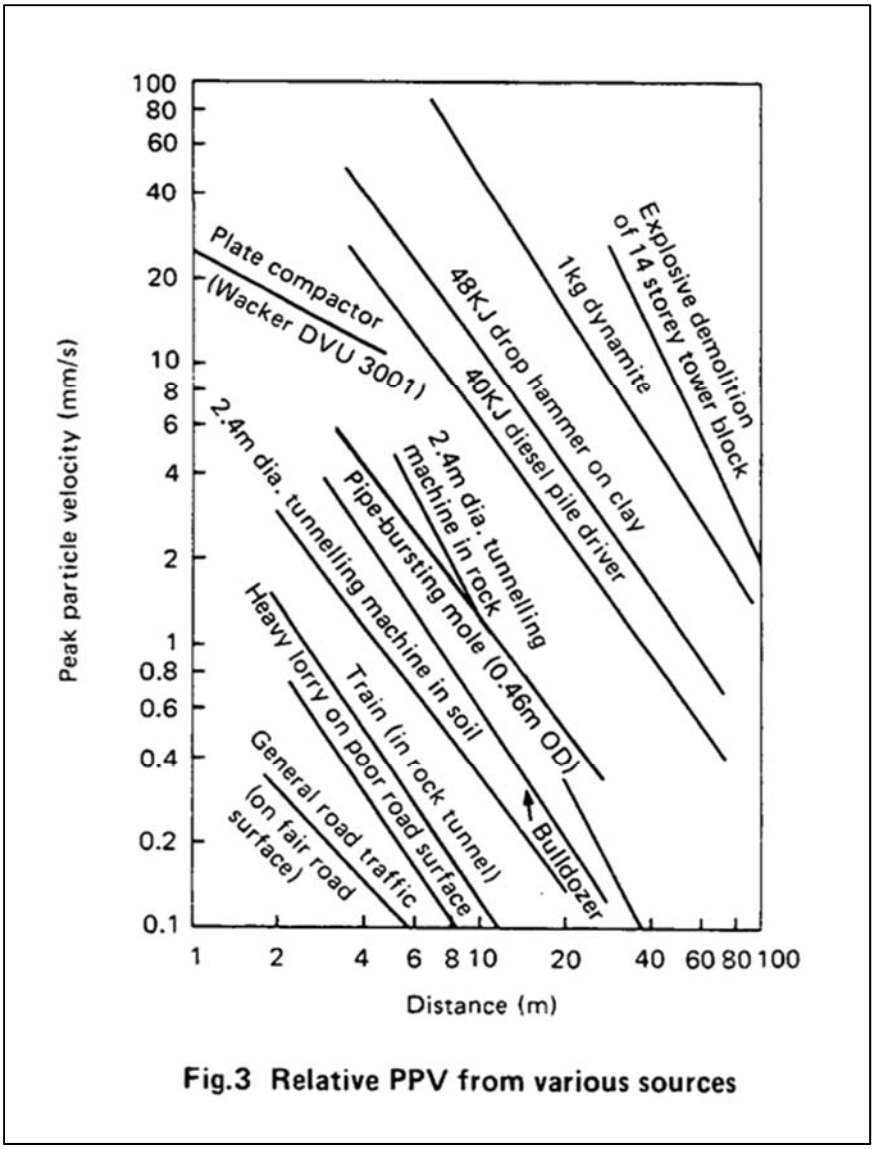

Fig.3 Relative PPV from various sources

The figure is of use in determining likely vibration levels from construction activities at the proposed development.

A13.2.3 British Standard 4142

British Standard (BS) 4142: 2014: *Methods for rating and assessing industrial and commercial sound* describes a method for rating and assessing sound of an industrial or commercial nature, which includes:

- sound from industrial and manufacturing processes;
- sound from fixed installations which comprise mechanical and electrical plant and equipment;
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The industrial or commercial sound is assessed outside an existing or proposed dwelling or premises used for residential purposes. BS4142: 2014 does not consider internal spaces in terms of its numerical assessment.

The procedure contained in BS4142 is to quantify the *"specific sound level"*, which is the measured or predicted level of sound from the source in question over a one hour period for the daytime and a 15 minute period for the night-time. Daytime is defined in the standard as 07:00 to 23:00 hours, and night-time as 23:00 to 07:00 hours.

BS4142: 2014 sets out a number of methods of determining the specific sound level, including, for situations where the specific sound source does not yet exist, the ability to determine it through calculation alone, stating at Section 7.3.6:

> *"7.3.6 Determine the specific sound level by calculation alone if measurement is not practicable, for example if the source is not yet in operation. In such cases, report the method of calculation in detail and give the reason for using it."*

The specific sound level is converted to a rating level by adding penalties on a sliding scale to account for either potentially tonal, impulsive or intermittent elements. The standard sets out subjective and objective methods for determining the presence of tones or impulsive elements, but notes that the objective methods should be used where the subjective method is not sufficient.

The penalty for tonal elements is between 0dB and 6dB, and the standard notes:

> *"Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible."*

The penalty for impulsive elements is between 0dB and 9dB, and the standard notes:

> *"Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."*

Where the specific sound features acoustic characteristics that are distinctive against the residual acoustic climate, but are not tonal or impulsive in nature, a penalty of +3dB may be applied.

The standard also states that if a source has identifiable on/off conditions, a penalty may be applied for intermittency. The penalty for sources that have intermittent elements is stated as:

> *"If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."*

The background sound level should be established in terms of the L_{A90} noise index. The standard states that the background sound level should be measured over a period of sufficient length to obtain a representative value. This should not normally be less than 15 minute intervals. The standard states that:

> *"A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."*

The initial assessment outcome results from a comparison of the rating level with the background sound level. The standard states:

> *"a) Typically, the greater this difference, the greater the magnitude of the impact.*
> *b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*

c) *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*

d) *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

NOTE 2 Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

The standard states that contextual matters should be taken into account where they are relevant, and where they may modify the initial estimate of impacts. The following examples of relevant contextual matters are listed in Section 11 of the standard:

"1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse."

"3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:

i) *facade insulation treatment;*
ii) *ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*
iii) *acoustic screening."*

The contextual matters that BS4142: 2014 refers to include bot the absolute sound levels, and sound levels within the properties. These contextual matters can be factored into the overall assessment, and be used to modify the initial, numerical, assessment outcome.

BS4142 requires uncertainties in the assessment to be considered, and where the uncertainty is likely to affect the outcome of the assessment, steps should be taken to reduce the uncertainty.

A13.2.4 British Standard 8233

The scope of British Standard (BS) 8233: 2014 *Guidance on sound insulation and noise reduction for buildings* is the provision of 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 or refurbished buildings undergoing a change of use rather than to assess the effect of changes in the external noise climate.

BS8233: 2014 sets out internal criteria for residential properties, as shown in Table A13.2.3.

Table A13.2.3: BS8233 recommended internal noise levels, dB

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$

BS8233 contains the following relevant guidance in footnotes to the above information:

> *"Note 4:Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or LAmax,F, depending on the character and number of events per night. Sporadic noise events could require separate values.*
>
> *Note 5: If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.*
>
> *Note 7: Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved."*

Although Note 4 above refers to setting a guideline value for maximum noise levels, BS8233: 2014 does not provide any guidance on a suitable criterion.

Note 7 above effectively sets 'reasonable' criteria 5dB above the values in Table A13.2.3.

Section 7.7.3.2 of BS8233, titled *Design criteria for external noise* states:

> *"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 50dB LAeq,T, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments."*

BS8233: 2014 goes on to note that the upper guideline value may be exceeded in certain circumstances:

> *"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."*

Achieving the lowest practicable noise levels in gardens is deemed acceptable in BS8233: 2014 in circumstances where development is needed in areas where the upper 55dB limit can not be achieved.

Although BS8233: 2014 refers to the use of BS4142 for the assessment of industrial noise, it stands as the only British Standard or guideline on acceptable levels of noise in a residential environment.

All of the guideline values in BS8233: 2014 are valid for steady sources of sound with no distinctive acoustic characteristics. The standard notes in Section 7.7.1:

"Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate."

However, the standard does define what those lower limits should be.

A13.2.5 World Health Organisation Guidelines

The World Health Organisation (WHO) *Guidelines for Community Noise* (1999) set out guidance on suitable internal and external maximum noise levels in and around residential properties.

The guidance on internal noise levels is the same as set out in BS8233: 2014 in terms of L_{Aeq} values, but the WHO guidelines also provide guidance on night-time maximum noise levels, stating:

"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."

The internal target noise level of 45dB L_{AFmax} translates to an external target noise level of 60dB L_{AFmax} when a correction of 10 to 15dB is taken into account, which is the correction that the WHO guidance states is the effect of an open window.

As with BS8233: 2014, the values set out in the WHO Guidelines apply to steady sources of noise without character.

A13.2.6 Design Manual for Roads and Bridges

Potential impacts associated with off-site operational traffic have been considered against the guidance set out in the Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 *Noise and Vibration*.

DMRB provides guidance on how to assess noise and vibration from road schemes in the UK. DMRB gives guidance and interpretation on the magnitude of noise impact from road traffic sources and it includes example impact scales for classifying the magnitude of short term and long term impacts, as shown in Tables A13.2.4 and A13.2.5.

Table A13.2.4: DMRB short term impact scale

Change in Noise Level dB(A)	Magnitude of Impact
0	No change
0.1 - 0.9	Negligible
1.0 – 2.9	Low
3.0 – 4.9	Moderate
5+	High

Table A13.2.5: DMRB long term impact scale

Change in Noise Level dB(A)	Magnitude of Impact
0	No change
0.1 - 2.9	Negligible
3.0 – 4.9	Low
5.0 – 9.9	Moderate
10+	High

The criteria above reflect key benchmarks that relate to human perception of sound. A change of 1dB is classed in DMRB as the smallest change that is considered perceptible in the short term, a 3dB change is considered to be the smallest change in noise that is perceptible in the long term, and a 10dB change is approximately a halving or doubling of loudness.

The short term criteria specified in Table A13.2.4 have been used to assess the potential impacts from both construction and operational traffic associated with the Proposed Development.

The DMRB sets out procedures for estimating the potential impact of road traffic vibration, which may manifest as a combination of airborne vibration, which is commonly caused by vehicle engines or exhausts dominant in the audible frequency range of 50-100 Hz, and groundborne vibration, which is often produced by the interaction between rolling wheels and the road surface dominant in the frequency range 8-20 Hz.

By maintaining roads in good condition, free for potholes or discontinuities, groundborne vibration can be reduced by maintaining roads in good condition.

In terms of airborne vibration, DMRB states in Section A6.21:

> *"The relationship between the percentage of people bothered by largely airborne vibration and this noise exposure index is similar to that for noise nuisance except that the percentage of people bothered by vibration is lower at all exposure levels."*
>
> *"On average traffic induced vibration is expected to affect a very small percentage of people at exposure levels below 58 L_{A10} dB and therefore, zero per cent should be assumed in these cases."*

For the ease of assessment, rather than assume that the impact of traffic vibration is lower than that caused by traffic noise, it is assumed that the impact is the same.

A13.2.7 Guidelines for Environmental Noise Impact Assessment

There are no clear British Standard methods for assessing the potential impact of noise from changes in railway noise, in the same way that there is for road traffic noise.

The Institute of Environmental Management and Assessment (IEMA) produced *Guidelines for Environmental Noise Impact Assessment* in October 2014, and the guidance contained in this document has been taken into account here.

To determine the potential impact of changes in the sound environment, it is first necessary to determine an appropriate impact scale that refers to known indicators of human response to sound.

The IEMA Guidelines state:

> *"Measuring in decibels means that a 3dB increase is equivalent to a doubling of the sound energy, and a 10dB increase is a tenfold increase in energy. For broad band sounds which are very similar in all but magnitude, a change or difference in noise level of 1dB is just perceptible under laboratory conditions, 3dB is perceptible under most normal conditions, and a 10dB increase generally appears to be twice as loud. These broad principles may not apply where the change in noise level is due to the introduction of a noise with different frequency and/or temporal characteristics compared to sounds making up the existing noise climate. In which case, changes of less than 1dB may be perceptible under some circumstances."*

A tenfold increase in energy is commonly perceived to be twice as loud. Since the impact scale is to be used to determine the potential impact of changes in railway noise, i.e. where

the source does not change, it is considered appropriate to set the lowest threshold of audibility at 3dB.

The impact scale adopted for the assessment of changes in rail traffic noise is shown in Table A13.2.6. The categories have been related to the guidance in the NPPF, NPSE and the PPG for noise.

Table A13.2.6: Impact scale for comparison of future noise against existing noise

Change in Noise Level dB(A)	Subjective Response	Magnitude of Impact
0	Not noticeable	No change
0.1 to 0.9	Unlikely to be noticeable	Negligible
1.0 to 2.9	Noticeable but unlikely to be intrusive	Low
3.0 to 9.9	Noticeable and potentially intrusive, particularly at higher end of scale	Moderate
10.0+	Noticeable and disruptive	High

The impact scale set out in Table A13.2.6 has been used to assess the potential impact of off-site railway noise.

A13.2.8 ISO9613

The noise levels generated by the operation of the proposed development site have been calculated using the proprietary noise modelling software CADNA, which implements the common European methods of noise prediction. In this instance, the noise predictions have been undertaken in general accordance with the noise prediction framework set out in ISO9613-2 *Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation*.

The noise calculations are based on individual noise sources acting as either point sources, where the noise level reduces by 6dB for every doubling of distance, as line sources, where the noise level reduces by 3dB for every doubling of distance or plane sources, where the noise level reduces by between 0 and 6dB for every doubling of distance, depending on the dimensions of the plane source and the proximity of the receptor.

The model takes into account the distance between the sources and the receptors and the amount of attenuation due to atmospheric absorption. The model assumes downwind propagation, i.e. a wind direction that assists the propagation of noise from the source to all receptors.

The inherent uncertainty in ISO9613 is stated in the standard as being accurate to ±1dB for distances of up to 100 metres, or ±3dB for distances of between 100 metres and 1km, with an average height of propagation of up to 30 metres.

A13.7.9 Calculation of Road Traffic Noise

Calculations of road traffic noise have been undertaken using the *Calculation of Road Traffic Noise* (CRTN), published in 1988 by the former Department of Transport and The Welsh Office.

CRTN sets out standard procedures for calculating noise levels from road traffic. The calculation method uses 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, to predict the $L_{A10,18hrs}$ or $L_{A10,1hr}$ noise level for any receptor point at a given distance from the road.

CRTN applies a correction for roads with a flow of less than 4,000 vehicles per 18 hours; the CRTN calculation method does not cover roads with a flow of less than 1,000 vehicles per 18 hours.

A13.7.10 Calculation of Railway Noise

Calculations of railway noise have been undertaken using the Calculation of Railway Noise (CRN), published in 1995 by the Department of Transport.

CRN sets out standard procedures for calculating noise levels from railways. The calculation method uses a number of input variables, including vehicle type, speed, site geometry and the presence of noise barriers or acoustically absorbent ground to predict a Sound Exposure Level (SEL) at the receiver point. The SEL is converted to daytime and night-time values by applying appropriate corrections and accounting for the number of trains within each time period.

In this instance, the calculation algorithms have been used to calculate train noise levels, based on timetabled and anticipated movements.

Reference has also been made to the 2007 DEFRA document *Additional railway noise source terms for "Calculation of Railway Noise" 1995,* which provides source terms for trains built after the publication of CRN in 1995. Of particular note in this assessment are the source terms for Pendolinos, Voyagers, Class 350 and 150 multiple units, and Class 66 freight locomotives.

A13.7.11 British Standard 6472

British Standard 6472: 2008 *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting* contains a method for assessing the human response to vibration in terms of the vibration dose value. The advice contained in Section 3.5 of BS6472 states:

> *"The effect of building vibration on the people within is assessed by finding the appropriate vibration dose. Present knowledge shows that this type of vibration is best evaluated with the vibration dose value (VDV).*
>
> *The VDV defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response"*

The vibration dose value is a single figure descriptor that represents the cumulative dose of transient vibrations, taking into account the frequency spectrum and duration of each event. The measured values are weighted to account for the way in which people perceive building vibration, which is dependent on various factors, including the vibration frequency and direction.

For occupants within buildings, the frequency-weighting curve is defined in British Standard 6841: 1987 *Measurement and Evaluation of Human Exposure to Whole-Body Mechanical Vibration and Repeated Shock*.

The vibration dose value is determined over a 16 hour daytime period or 8 hour night-time period, and the guidance in BS6472 is as shown in Table A13.2.7.

Table A13.2.7: Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings, $ms^{-1.75}$

Place and Time	Low probability of adverse comment[1]	Adverse comment possible	Adverse comment probable[2]
Residential buildings 16h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Notes:

[1]: Below these ranges adverse comment is not expected

[2]: Above these ranges adverse comment is very likely

The above guidance relates to vibration measured at the point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper storey floor, rather than the point of entry into the building, for example a foundation element.

Where the vibration is measured at another location, BS6472 states that a transfer function should be applied; however, BS6472 does not itself contain any guidance on suitable transfer functions although it does reference other publications that contain transfer functions.