CAHILL DESIGN CONSULTANTS
FIRE ENGINEERING | ACOUSTIC DESIGN

HAYES PARK NORTH
HILLINGDON

RIBA STAGE 2 – NOISE IMPACT ASSESSMENT

CLIENT: SHALL DO HAYES DEVELOPMENTS LIMITED

REVISION 1.0 – APR-24

NOTICE

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1. EXECUTIVE SUMMARY

1.1 A site visit and noise survey were undertaken in 2021 around the North Building which is proposed to be converted into residential accommodation.

1.2 The change of use from B1a (office) to C3 (residential) is subject to the condition (Condition MA.2.) that before beginning the development, under Class MA, the developer must apply to the local planning authority for a determination as to whether the prior approval of the authority will be required as to (amongst other things) - Impacts of noise from commercial premises on the intended occupiers of the development.

1.3 Nearby businesses comprise two office buildings. At the time of the site visit, both of these buildings were unoccupied.

1.4 Based on the subsequent noise impact assessment, it is more likely than not that the proposed conversion of the North Building to residential will not impose unreasonable restrictions to the operation of these two office buildings (when these are occupied in the future).

2. INTRODUCTION

2.1 It is currently proposed to change the use of the office accommodation building called North Building located at the Hayes business park in Hillingdon, into residential use.

2.2 The proposals allow for a change of use of the building from Class B1(a) (offices) to Class C3 (dwelling houses). The proposal is under prior notification under Class MA in Part 3 of Schedule 2 of The Town and Country Planning (General Permitted Development etc) (England) (Amendment) Order 2021. Class MA of the General Permitted Development Order (GPDO) is a planning tool that allows the change of use of a property that currently falls within the Class E (commercial, business and service) planning use to create Class C3 dwelling houses / residential units.

2.3 The change of use from B1a (office) to C3 (residential) is subject to the condition (Condition MA.2.) that before beginning the development, under Class MA, the developer must apply to the local planning authority for a determination as to whether the prior approval of the authority will be required as to (amongst other things) - Impacts of noise from commercial premises on the intended occupiers of the development.

2.4 This report presents the results of a site visit alongside the results of a fully manned environmental noise survey and noise impact assessment.

2.5 To assist with the understanding of this report a brief glossary of acoustic terms can be found in Appendix B.

3. SITE LOCATION

3.1 The North Building is located in a business park comprising three buildings at Hayes Park in Hillingdon. It is a three-storey building, with a "sealed" [1]façade and a large car park situated to the west of the building. It is surrounded by fields and parkland with two office buildings located to the South.

3.2 The location of the North Building is shown in Error! Reference source not found. below.

Figure 1: North Building Location Map

4. PLANNING POLICIES

4.1 A great deal of change has occurred in recent years in the assessment of noise impacts and their relationship with planning decisions. In 2010 the publication of the Noise Policy Statement for England (NPSE) introduced clear aims in relation to the management of noise via government policy. It introduced new assessment terms like LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level) and provided the government vision for the control of noise impacts.

4.2 In 2012 the National Planning Policy Framework (NPPF) was published that replaced previous guidance (the PPG24) and reiterated the aims in the NPSE. It set a requirement for local authorities to update their local plans in order to show alignment with the aims of the NPPF and importantly if such an alignment is not evident, planning decisions should view the NPPF as a material consideration and therefore place more weight to an NPPF compliant assessment. In 2018 and 2023, the NPPF was updated and in relation to noise the changes have been subtle. The NPSE or the NPPF do not contain technical guidance for the assessment of noise through the planning system. No British Standards or any documents are quoted therein as suitable for the assessment of noise. In March 2014, the Planning Practice Guidance was published that constituted technical guidance for the application of the NPPF. However, it too did not contain any objective levels to base an assessment of noise impacts.

4.3 In order to undertake an assessment relating to environmental noise, the assessor now has to propose suitable (in his or her professional opinion) values for the LOAEL and SOAEL based on guidance documents, research, standards etc. and these values may be unique to each project and may be different for different sources and even different time periods.

4.4 In a nutshell, if the impact is below the LOAEL, planning permission ought to be granted without any conditions. If the impact is above the SOAEL, planning permission may be refused if suitable mitigation measures are not available or when other sustainability targets are not met. When the impact is predicted to lie between the LOAEL and SOAEL, planning permission ought to be granted with a suitable planning condition to ensure that the impact is reduced as far as reasonably practicable when the development reaches the detailed design stage and the proposals develop further.

4.5 It ought to be highlighted that noise impact assessments undertaken to support the planning application can only offer an outline of a design for any mitigation measures and these will always be discretional at this stage of the development.

4.6 Appendix A presents the relevant planning policies on a national level, as well as the guidance documents that will be used in order to propose suitable LOAEL and SOAEL values for the assessment of the relevant impacts. These values will be presented within the body of this report but the background to these is available in Appendix 1.

4.7 Of particular relevance to this planning application, Paragraph 193 in the NPPF introduces the "Agent of Change" principal as follows:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they

were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

Hillingdon Council

4.8 Policy S010 from Hillingdon's Local Plan states that it is a strategic objective to *"Improve and protect air and water quality, reduce adverse impacts from noise including the safeguarding of quiet areas and reduce the impacts of contaminated land".*

4.9 Under Policy EM8, it is stated that "*The Council will seek to ensure that noise sensitive development and noise generating development are only permitted if noise impacts can be adequately controlled and mitigated".*

4.10 In Paragraph 8.121 it is stated that "*Noise can have a significant effect on the environment and on the quality of life enjoyed by individuals and communities. In Hillingdon, environmental noise arises from a variety of different sources, in particular aircraft (Heathrow Airport & RAF Northolt), major roads (M4, A4 and A40) and railways (London Underground, the Paddington, Marylebone and Heathrow Express lines)."*

5. MEASUREMENT OF NOISE

Details of Environmental Sound Survey

5.1 A Class 1 sound level meter was used to undertake sound pressure level measurements around the site on 6 May 2021.

Measurement Positions

5.2 The measurements of sound pressure levels were undertaken at six locations. The approximate locations of the microphone are indicated in Error! Reference source not found. below. At all locations, the sound level meter was located on a tripod and was positioned around 1.5 metres from ground level and at least 3 metres from any vertical hard surface.

Figure 2: On Site Sound Pressure Level Measurement Positions

Equipment

5.3 Details of the equipment used during the survey are provided in Table 1 below. The sound level meter was subjected to sensitivity checks (or a 'field calibration') before and after the survey; no significant changes (+/-0.2 dB) in the level were noted.

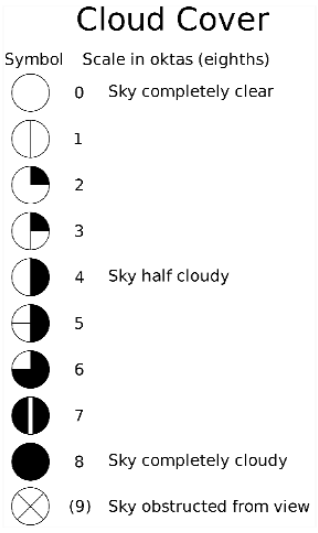
Table 1: On Site Instrumentation

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Cirrus / G068718	30 June 2020	142899
Condenser microphone	MK224 / 205242A		142900
Calibrator	CR515		142898

Weather Conditions

5.4 Weather conditions were determined during the noise survey. It is considered that the meteorological conditions were appropriate for environmental noise measurements. Table 2 below presents the weather conditions recorded on site.

Table 2: Weather Conditions

Date/Time	Description	
06/05/2021 15:30-17:30 hours	Temperature (°C)	11
	Precipitation:	0
	Cloud cover (oktas - see guide)	0
	Presence of fog/snow/ice	Nil
	Presence of damp roads/wet ground	Nil
	Wind Speed (m/s)	<4.4
	Wind Direction	Northwest
	Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No

Results

5.5 At the beginning and end of the survey, the dominant source of noise around the site was distant road traffic from the north (from the direction of the A40). Sounds from birdsong and leaves blowing due to the wind were also present. Local plant noise emissions were also evident in a few locations (measurement positions 1 and 5).

5.6 Table 3 below presents the incident free field noise levels at the measurement positions.

Table 3: Results of environmental noise survey

Position	Time (hh:mm)	Free field sound pressure level (dB)		Dominant source
		L_{Aeq}	L_{A90}	
1	16:01-16:02	71	70	"Trane" heat rejection plant
2	16:07-16:22	50.4	38.6	Distant road traffic, local UPS vans
3	16:23-16:38	46.2	39.6	Distant road traffic
4	16:40-16:55	41.6	38.8	Distant road traffic
5	17:00-17:03	56.5	55.1	Plant noise emissions from plant room
6	17:10-17:25	42.4	38.1	Distant road traffic

6. DISCUSSION OF RESULTS AND ASSESSMENT

6.1 During the site visit, only the North Building (the one subject to the planning application) was operational and occupied at the business park. The other two buildings on the site (the South and Central Buildings) were unoccupied. However, as per the noise readings at Position 5, there is audible plant noise present at the south of the South building.

6.2 An external review of the external building fabric of the three buildings showed that these comprise "sealed" facades, predominantly glazed with no openings for natural ventilation. The glazed elements of the facades appear to not be openable.

6.3 A heat rejection plant compound is located to the west of the Central building. The compound comprises brick walls with an open roof top to allow ventilation into the plant units. The use of these items of plant is unknown. It is assumed that these are used to serve either the Central and South buildings or even all three buildings at the business park. However, it should be noted that at the rear of the North Building we noted a heat rejection plant compound (ground level, a few metres to the north of the North Building) with intermittently operational plant (see noise reading at Position 1 undertaken when the heat rejection plant was operational).

6.4 The results of the environmental noise survey showed that background sound levels are generally in the high 30s dB (L_{A90}). Ambient noise levels were in the low to mid 40s dB (L_{Aeq}). Based on the readings on site, a review of the road network around the site, and our experience, it is more likely than not that typical environmental noise levels around the North building are lower than 50 dB $L_{Aeq\ (16\ hours)}$ over the daytime. It should be noted that BS8233 (see Appendix 1) includes a suggested design limit for noise affecting external amenity areas at 50 dB $L_{Aeq,T}$.

6.5 As man-made noise (road traffic) is audible throughout the site, it is not considered that the site is categorised as a tranquil site, albeit environmental noise levels around the site are considerably lower than typical noise levels found in similar sites across most of London.

6.6 We could not identify any nearby businesses to the North Building that are associated with noisy activities such as light or heavy industry or leisure venues with music playback. We identified a farm located at around 185 metres from the North Building to the south west. During our site visit we did not subjectively note any discernible noise associated with the operation of this farm. It should be noted that a residential building is located around 85 metres to the south of the heat rejection plant compound. During our site visit, this residential property was empty and deserted. It is unknown whether this residential house was occupied whilst the three office buildings were fully operational. This building is located around 25 metres to the east of the neighbouring farm. It is likely that the residential house would have been occupied at some time in the past whilst the neighbouring farm was also occupied. Further residential dwellings (which are occupied) are located to the south of the farm (along Mellow Lane East) at around 60 metres from the farm. It is assumed therefore, that the noise impact associated with the operation of the farm is in line with nearby residential use and this ought to include the future conversion of the North Building to residential use.

6.7 Therefore, based on the existing situation around the site, noise should not be viewed as a constraint to the development proposals.

6.8 However, the local planning authority may wish to review or consider a future scenario where the two nearby buildings (which are businesses) are fully occupied.

6.9 The plant noise emissions emanating from the south of the South Building were not audible at the North Building. A substantial basement plantroom exists at the west elevation of the Central Building. However, the location of this plantroom is screened by the profile of the building.

6.10 The noise emissions from the heat rejection plant located around 100 metres to the southwest of the North Building are likely to constitute the greatest noise impact associated with the operation of a neighbouring business. A review of satellite imagery shows that the compound comprises around 4No 6 fan units and two smaller 2 fan units. The noise emissions from these items of plant is unknown.

6.11 Based on our experience (and measurements made at Position 1 of similar plant), typical noise emissions at 1 metre from such plant is in the mid-70s dB. Assuming all the items in the compound serve the Central and South buildings only, and taking into consideration distance attenuation, attenuation due to barrier losses (the masonry compound that surrounds the plant), the combined plant noise impact would be an L_{Aeq} in the low to mid 40s dB. Assuming the plant is only used to provide cooling, such an impact will only occur during the daytime hours on warm days.

6.12 This predicted likely plant noise impact will be higher than the representative background sound level outside the west and south elevations of the North Building. A review of the guidance in BS4142:2014 (see Appendix 1) in conjunction with the advice in the NPPF does initially indicate that this predicted impact may not be desirable. However, a review of the likely internal noise impact in the proposed residential apartments (at the North Building) shows that such an impact ought to be considered acceptable in planning terms.

6.13 The proposed details for the conversion are unknown. The converted apartments will still have to comply with the relevant building regulations. Therefore, it is unlikely that the glazing will be changed to one with a lesser sound reduction performance.

6.14 In relation to ventilation, it is also unlikely that natural ventilation will be the chosen design intent. However, at a worst-case scenario where somehow the proposed apartments are ventilated using a trickle ventilator (as per Approved Document F) solution, the composite sound reduction of the façade will be around 20 dB. Therefore, in this worst-case scenario the internal noise impact from the plant in the compound will be significantly lower than the desirable levels in BS8233:2014.

6.15 Furthermore, in all likelihood, the ventilation strategy will utilise mechanical ventilation (either via MVHR units or a centralised system), and therefore the composite sound reduction of the external building fabric will be higher than 20 dB, and the associated plant noise impact will be even lower. Comfort cooling is most likely going to be provided via mechanical means (if required) mainly due to the sealed nature of the glazed elements of the existing external building fabric.

6.16 It should be noted that the landlord for the three office buildings located in Hayes Park is the same. Therefore, the landlord also has access to the heat rejection plant compound and if needs be, noise control measures can also be utilised at the plant within the compound (for instance the installation of absorptive panels on the walls of the compound and/or the incorporation of outlet attenuators on top of the units).

6.17 Based on the above assessment it is more likely than not that the proposed conversion of the North Building to residential will not impose unreasonable restrictions to existing neighbouring businesses.

APPENDIX A

PLANNING POLICY

Noise Policy Statement for England 2010 (NPSE)

The NPSE defines government policy aims for noise management as follows:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The Explanatory Note of NPSE introduces the concept of observable effect levels.

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level This is the level above which significant adverse effects on health and quality of life occur.

National Planning Policy Framework 2023 (NPPF)

Following on from the NPSE, NPPF describes how noise should be considered in relation to planning applications. Section 191 of the NPPF states as follows:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should*:*

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life**;*

b) identify and protect tranquil areas which have remained relatively undisturbed by

noise and are prized for their recreational and amenity value for this reason; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

* for the definition of adverse impacts reference is made here to the Explanatory Note to the NPSE 2010 i.e. the observable effect levels.

Paragraph 193 introduces the "Agent of Change" principle as follows:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

Planning Practice Guide (PPG)

The following table from PPG identifies the increasing noise effect levels and action guidance outlined in the NPSE and NPPF:

Perception	Examples of Outcomes	Increasing Effect Level	Action
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect (NOAEL)	No specific measures required
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect (LOAEL)	Mitigate and reduce to the minimum

Noticeable and Disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect (SOAEL)	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non- auditory	Unacceptable Adverse Effect (UOAEL)	Prevent

The PPG also states that noise impact may be partially offset if the residents of dwellings have access to:

- a relatively quiet façade as part of their dwelling;
- a relatively quiet amenity space for their sole use (eg a garden or balcony);
- a relatively quiet amenity space for shared use;
- a relatively quiet public park or green space nearby (eg within 5 minutes).

In section 1 of the guidance, PPG also notes that although Noise can override other planning considerations neither the Noise Policy Statement for England nor the National Planning Policy Framework (which reflects the Noise Policy Statement) expects noise to be considered in isolation, separately from the economic, social and other environmental dimensions of proposed development.

Local Authority Planning Policy

The section of the Local Development Framework 2010 dealing with noise in this context (Policy SQ6) refers to the obsolete PPG25. The local planning department have been contacted and have advised that reference to WHO and BS8233:2014 would be expected in any noise impact assessment.

The local planning department have also indicated that an assessment should include analysis of the likely noise impact when windows are open for cooling purposes.

Further Guidance and British Standards

World Health Organisation 1999 and 2018 (WHO)

WHO Environmental Noise Guidelines for the European Region (2018) partially supersede the previously published Community Noise Guidelines (1999) and compliment the intervening Night Noise Guidelines (2009)

The following noise limit recommendations for health protection are in the form of average noise levels, found external at the worst affected facade:

WHO 2018 Noise Limit Recommendations		
Noise source	L_{den} dB[1]	L_{night} dB[2]
Road Traffic Noise	53	45
Railway Noise	54	44
Aircraft Noise	45	40

[1] *compound day, evening and night time yearly average*

[2] *night time yearly average*

The WHO noise guidelines further state:

"In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level (L_{Amax}) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit awakenings and other physiological reactions that are mostly determined by L_{Amax}. Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators."

The following guidelines are considered to carry over from the previous WHO 1999 publication Guidelines for Community Noise:

WHO 1999 Guidelines for Community Noise				
Environment	Critical Health Effect	$L_{Aeq,T}$ dB	L_{Afmax} dB	Time base
Outdoor living area (noise from sources other than road traffic, railways, aircraft or wind turbines)	Serious annoyance, daytime and evening	55	-	16 hours 07:00-23:00
	Moderate annoyance, daytime and evening	50	-	16 hours 07:00-23:00
Dwellings indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	16 hours 07:00-23:00
	Sleep disturbance, night time	30	45	8 hours 23:00-07:00

BS8233:2014

The guidance set out in BS8233:2014 is closely aligned with WHO and specifically provides guideline limits for noise within internal living spaces and external amenity areas.

Table 4 from BS8233:2014 gives the following internal guideline values:

BS8233:2014 internal guideline levels			
Activity	Location	07:00-23:00	23:00-07:00
Resting	Living Room	35 dB $L_{Aeq\ 16hr}$	
Dining	Dining room/area	40 dB $L_{Aeq\ 16hr}$	
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq\ 16hr}$	30 dB $L_{Aeq\ 8hr}$

In certain circumstances a 5 dB relaxation of the limits shown in the table above is considered reasonable in BS8233:2014 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."

In BS8233 design limits for noise affecting external amenity areas is given as 50 dB $L_{Aeq,T}$ with an upper guideline of 55 dB $L_{Aeq,T}$. It is further noted that in areas where achieving these levels is deemed to be not realistically feasible (e.g. city centres or urban areas adjoining a strategic transportation network) developments should be designed to achieve the lowest practicable levels in these amenity areas.

In Section 7.7.3.2 of BS8233:2014, Design Criteria for External Use, it is noted that in developments such as flats and apartment blocks "Specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses"

The Noise Insulation Regulations 1975

The Noise Insulation Regulations 1975 define the conditions under which habitable rooms are eligible for noise insulation to control internal noise levels. The conditions relate to the level of traffic noise at the façade, the increase in noise levels as a result of the highway and the contribution of the new or altered scheme to the noise level received at the façade. Noise insulation qualification criteria must abide by a few tests that include the following two:

- The facade noise threshold of 68dB $L_{A10,18h}$ is met or exceeded;
- That there must be a noise increase of at least 1dB compared to the prevailing noise level immediately before the construction of a highway or an additional carriageway were begun.

Ventilation Requirements for Habitable Rooms

Background Ventilation

Three types of ventilation are required under Part F. Whole building ventilation provides nominally continuous air exchange that may be reduced or ceased when the building is not occupied. It can be provided via background ventilators operating alone, or together with:

passive stack ventilators;

continuous mechanical extract; or

continuous mechanical supply and extract with heat recovery.

Extract ventilation is applicable to rooms where most water vapour and/or pollutants are released (e.g. kitchens and bathrooms). It can be provided by intermittent fans,

passive stack or continuous mechanical extract with or without mechanical supply and heat recovery.

The four systems described in Part F do not present solutions that utilise the use of opening windows for background ventilation. Opening windows do not provide a controllable means of ventilation and also pose security risks. Therefore, it is not possible to offer to the market a residential dwelling that utilises opening[2] windows for background ventilation.

Purge Ventilation

Purge ventilation is required throughout the building to aid the removal of high concentrations of pollutants and water vapour. It is commonly provided simply by opening windows and doors. Even though purge ventilation is recommended via opening windows, the temporary and intermittent occurrence of this does not normally result in an unacceptable increase of internal noise levels. Part F goes on to say[3] that "Purge ventilation provisions may also be used to improve thermal comfort, although this is not controlled under the Building Regulations."

Summary in Relation to Ventilation

In summary, background ventilation for new residential dwellings should be provided via one of the four systems in Approved Document F. The composite external building fabric should be designed to ensure that appropriate internal noise levels due to external incident noise are met during background ventilation. This can be secured via a planning condition if deemed necessary.

Purge ventilation for residential dwellings should be provided via open windows. The slight increase of internal noise levels should be considered acceptable.

BS4142:2014

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

[2] Meaning without any restrictions on opening size
[3] Paragraph 4.15 in Approved Document F

- Sound from industrial and manufacturing processes;
- Sound from fixed installations that 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 a dwelling or premises used for residential purposes, upon which sound is incident.

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.

The specific sound level is converted to a rating level by adding penalties on a sliding scale to account for either potentially tonal or impulsive elements. The standard sets out objective methods for determining the presence of tones or impulsive elements, but notes that it is acceptable to subjectively determine these effects.

The penalty for tonal elements is between 0 dB and 6 dB, and the standard notes: "Subjectively, this can be converted to a penalty of 2 dB for a tone that 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 0 dB and 9 dB, and the standard notes: "Subjectively, this can be converted to a penalty of 3 dB for impulsivity that is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."

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

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- 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.

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 goes on to note that: "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."

In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:

"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."

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.

APPENDIX B

GLOSSARY OF TERMS

GLOSSARY OF TERMS

AIRBORNE SOUND

Sound in the air is generated by a material vibrating which in turn causes air molecules to vibrate and create a sound wave. For example, sound produced by a loudspeaker in a room can be classified as 'airborne' sound.

AIRBORNE SOUND INSULATION

Airborne sound insulation is the ability of a material or room to contain sound within it or exclude sound from it. This is commonly measured in terms of sound reduction index (in dB) being the ratio of sound transmitted by the material to that incident upon it.

AMBIENT AND BACKGROUND NOISE LEVEL, $L_{A90,T}$

The A-weighted sound pressure level of non-specific noise in decibels exceeded for 90% of the given time, T.

A - WEIGHTING dB(A)

The sound pressure level determined when using the frequency-weighting network A. The A-weighting network modifies the electrical response of a sound level meter so that the sensitivity of the meter varies with frequency in approximately the same way that the sensitivity of the human hearing system varies with frequency.

The human ear has a non-linear frequency response; it is less sensitive at low and high frequencies and most sensitive in the range 1 to 4 kHz. The A-weighting is applied to measured or calculated sound pressure levels so that these levels correspond more closely to the response of the human ear. A-weighted sound levels are often denoted as dB(A).

DECIBEL

The ratio of sound pressures which we can hear is a ratio of 10^6:1 (one million to one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is 10times the logarithmic ratio, the laws of logarithmic addition and subtraction apply.

EQUIVALENT CONTINUOUS A-WEIGHTED SOUND PRESSURE LEVEL (L_{Aeq})

Value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval T starting at t1 and ending at t2 and measured in decibels, has the same mean square sound pressure as the sound under consideration whose level varies with time.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, eg 2 kHz = 2000 Hz. Human hearing generally ranges approximately from 20 Hz to 20 kHz.

IMPACT SOUND

Sound produced by a vibrating material or panel due to direct impact. The vibrating material or panel causes the air molecules to vibrate which leads to an airborne sound wave being created. For example, footsteps on a floor can be classified as 'impact' sound.

IMPACT SOUND INSULATION

Impact sound insulation is the ability of a material to dampen sound. This is commonly determined by measuring the sound pressure level (in dB) on the receiver side of the material being excited by a sound source on the source side.

OCTAVE BANDS AND OCTAVE BAND SOUND PRESSURE LEVEL

The octave-band pressure level of a sound is the band pressure level for a frequency band corresponding to a specified octave. (The location of the octave-band pressure level on a frequency scale is usually denoted by the geometric mean of the upper and lower frequencies of the octave.) The ISO standard octave centre frequencies are 31.5, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16k Hz (etc.). For design purposes, the octave bands between 63 Hz to 8 kHz are generally used.

PERCENTILE LEVEL (STATISTICAL SOUND LEVEL INDICES, L_{AN}, L_{A90})

LAN is the dB(A) level exceeded N% of the time measured on a sound level meter with Fast(F) time weighting, eg L_{A90} the dB(A) level exceeded for 90% of the time, is commonly used to estimate background noise level. L_{A10}, the dB(A) level exceeded for 10% of the time, is commonly used in the assessment of road traffic noise.

REVERBERATION AND REVERBERATION TIME (RT60)

The time, in seconds, taken for a sound within a space to decay by 60 dB after the sound source has stopped. An important indicator of the subjective acoustic within an auditorium. The symbol T_{mf} to represent the mid-frequency arithmetic average of the reverberation time in the 500 Hz, 1 kHz and 2 kHz octave bands. Reverberation time can be measured using the procedures set out in BS EN ISO 3382. The symbols T20 and T30 are the reverberation times extrapolated from a 20 or 30 dB dynamic range, starting at the -5 dB point, in order not to introduce errors due to irregularities in the early reflections

SIGNAL-TO-NOISE RATIO (S/N)

This is the difference between the source noise level and the background (or ambient) noise level. The higher the difference, the better the speech intelligibility of the PA/VA system. For PA/VA system announcements, it is preferable to have an S/N ration of at least 15 dB(A) and preferably 25 dB(A) for the hearing impaired.

SOUND ABSORPTION AND SOUND ABSORPTION COEFFICIENT

When sound waves strike a material, some of the sound energy is absorbed and the remaining energy is reflected. The ability of a material to absorb sound is expressed in terms of sound absorption coefficient. The sound absorption coefficient (α) is the percentage of sound absorbed by the material. If a material has α = 0.8 at 500 Hz it means that 80% of the sound is absorbed at this frequency.

Sound absorption can be measured using the procedures set out in BS EN 20354. Single figure descriptors include the practical sound absorption coefficient (α_p) and weighted sound absorption coefficient (α_w) as defined in BS EN ISO 11654. Other commonly used terms (in the USA) are ncC (Noise Reduction Coefficient) which is the arithmetic average of α at 250 Hz, 500 Hz, 1 kHz and 2 kHz rounded to the nearest 5%.

SOUND POWER LEVEL (L_w)

The sound power level of a sound source, in decibels, is 10 times the logarithm to the base 10 of the ratio of sound power radiated by the source to a reference power. The reference power is 1 picowatt (1 x 10-12 watt).

The sound power level is the fundamental measure of the total sound energy radiated by a source per unit time.

SOUND LEVEL DIFFERENCE (D)

The sound insulation required between two spaces may be determined by the sound level difference (D) needed between them. Single figure descriptors include the weighted sound level difference (D_w) and the normalised weighted sound level difference (D_{nTw}) as defined in BS EN ISO 717-1.

SOUND PRESSURE LEVEL (SPL)

The level of the pressure of the sound above the internationally accepted reference value of 20 µPa ($2x10^{-5}$ N/m^2), which corresponds to the pressure of the quietest sound an average person can hear at the frequency of 1000 Hz. It is a quantity that can be measured; thus, the quantity of a sound can be derived from it.

A value equal to 10 times the logarithm to the base 10 of the ratio of the root-mean-square pressure of a sound to a reference pressure, which is normally taken to be $2x10^{-5}$ N/m^2.

SOUND REDUCTION INDEX (R)

The sound reduction index, R, (or transmission loss) of a building element is a measure of the loss of sound through the material, i.e. its attenuation properties. It is a property of the component, unlike the sound level difference which is affected by the common area between the rooms and the acoustic of the receiving room. The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1. The R_w is calculated from measurements in an acoustic laboratory. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings.

SPEECH TRANSMISSION INDEX (STI)

A physical quantity representing the transmission quality of speech with respect to intelligibility, i.e. the ability to understand the spoken word.

VIBRATION LEVEL

Vibration is generally measured in terms of the velocity (in mm/s or m/s) or the acceleration (in mm/s^2 or m/s^2) but can also be measured in terms of amplitude (in mm or m). These values are often converted into dB values on a logarithmic scale.

VIBRATION DOSE VALUE (VDV)

A measure of the amount of vibration as experienced by a person. It is a dosage based on both the total exposure time and the vibration acceleration level experienced. Only vibrations in the range of 1 Hz to 80 Hz are considered and these are weighted in accordance with BS 6472.

WEIGHTED SOUND REDUCTION INDEX (R_w)

The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1: 1997. The R_w is calculated from measurements in an acoustic laboratory to BS EN ISO 140-3 and rated to BS EN ISO 717-1. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings.