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42 GLOUCESTER AVENUE
LONDON

PLANT NOISE IMPACT ASSESSMENT

JULY 2018

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1 Introduction

1.1 Mayer Brown Limited has been instructed by Evolutions Television Limited to assess noise emissions from the proposed additional building services plant at 42 Gloucester Avenue, London in order to determine compliance with the Camden Council operational noise limits.

1.2 This report is structured as follows:

- **Section 2** describes the location of the site
- **Section 3** describes the proposed plant installations.
- **Section 4** describes the existing noise environment at the site.
- **Section 5** outlines the operational noise limits that have been recommended based on the measurement data.
- **Section 6** details the calculated plant noise emissions at the most affected receptor.
- Conclusions are presented in **Section 7**.

1.3 A glossary of the acoustic terminology used in this report is attached at **Appendix A**.

1.4 Full noise emissions calculations are given in **Appendix B**.

1.5 An octave band curve for the proposed plant is given in **Appendix C**

2 Site Location

2.1 The building is bordered by Gloucester Avenue on the west, and mainline railway tracks into/out of Euston station to the north/east. A residential development is currently under construction directly to the west of the site.

2.2 The location of the site is shown in **Figure 2.1** below.

Figure 2.1: Site Location

2.3 The existing building A3(Restaurant or café) use on the ground floor, with B1a(Office) use on the upper floors. The building is located in an area of mixed use buildings comprising of office and residential uses.

3 Proposed Plant

3.1 The proposal is to install a single air conditioning unit (Daikin REYQ14T VRV).

3.2 The air conditioning unit is proposed to be installed on a flat roof area of the building, where building services plant already exits.

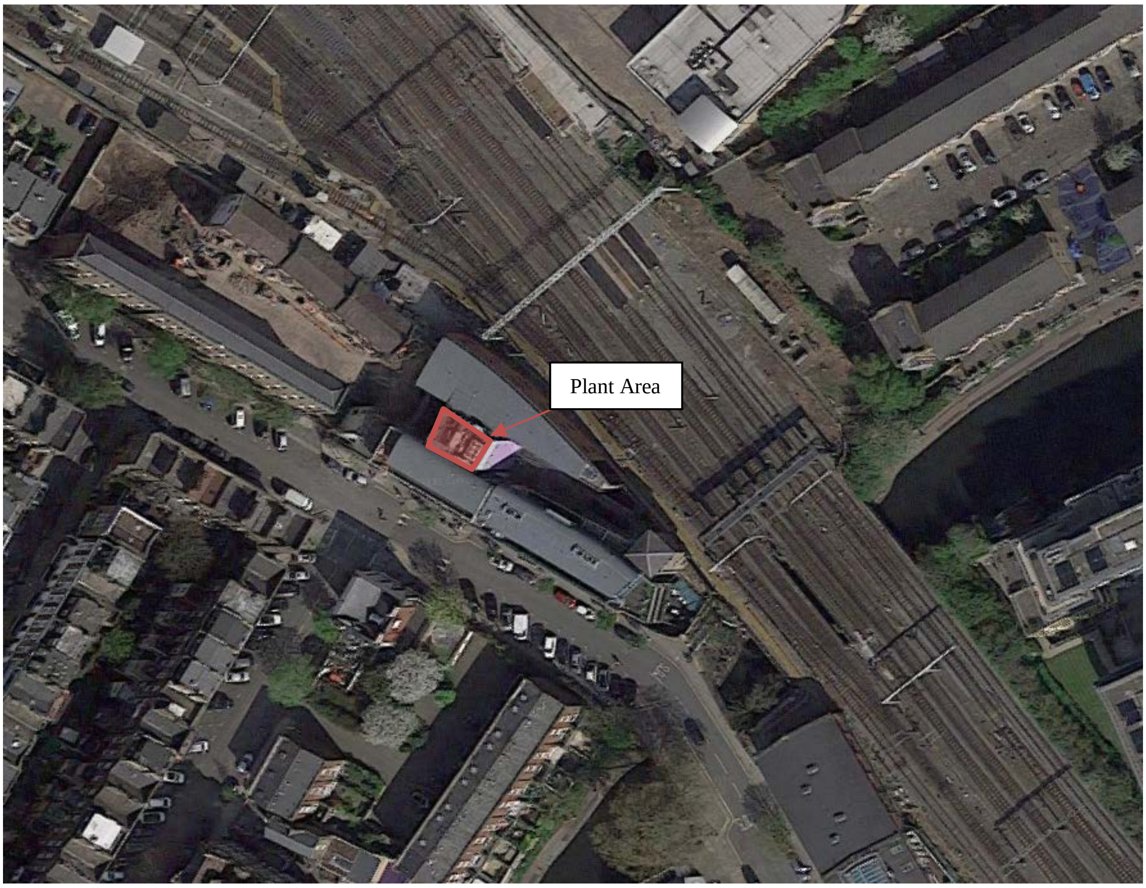

Figure 3.1: Plant Area

3.3 It is understood that the proposed new plant is to be operational from 08:00 to 20:00 on weekdays.

3.4 Manufacturers' noise data for the proposed plant has been confirmed and is summarised in **Table 3.1** below.

Equipment	Data	63	125	250	500	1000	2000	4000	8000	dBA
Daikin REYQ14T VRV	Sound Pressure Level (dB)	66	68	63	59	54	50	47	39	61

Table 3.1: Summary of Manufacturers' Plant Noise Data

4 Existing Noise Environment

Survey Methodology

4.1 A survey of the existing background noise levels was undertaken at the external location shown in **Figure 4.1** below:

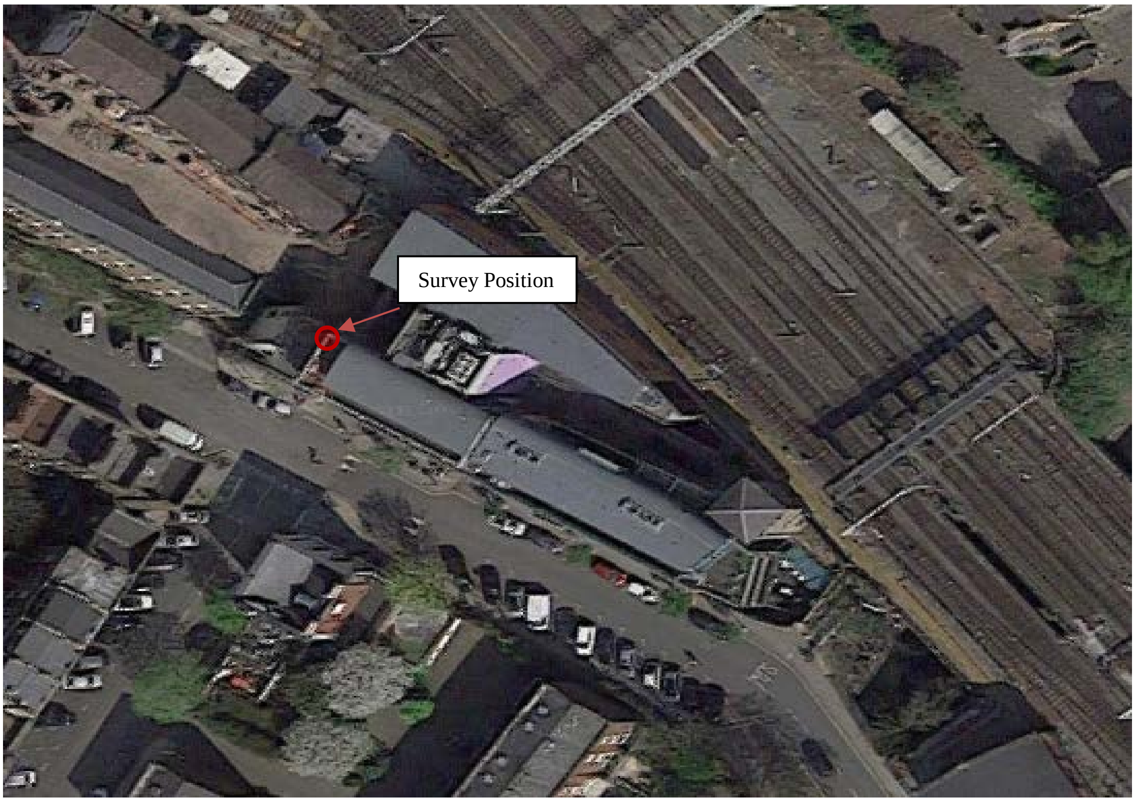

Figure 4.1: Measurement Locations

4.2 Measurements were taken in the north corner of the top floor balcony on the west side of the building. The microphone was at a height of 2m relative to the balcony floor.

4.3 Measurements were made during a 24 hour period between 15:00 on the 12th of June and 15:00 on the 13th of June.

4.4 These measurements will allow suitable noise criteria to be set for the new building services plant.

4.5 The following equipment was used during the course of the survey:

Description	Manufacturer	Model	Serial No.	Calibration Date
Sound Level Meter	Svantek	SVAN 71	55551	04/06/2018
Microphone		7052E	63681	
Preamplifier		SV18	57254	
Outdoor Mic. Kit		SA271U	n/a	n/a
Calibrator	Norsonic	1251	34058	01/03/2018

Table 4.1: Measurement Equipment

4.6 The calibration of the sound level meter was verified before and after use. No significant calibration drift was detected.

4.7 The weather during the survey was dry with light winds, which made the conditions suitable for the measurement of environmental noise.

4.8 Measurements were made generally in accordance with ISO 1996-2: 2017 – Acoustics - *Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels.*

4.9 The below tables and figures show the measurement results:

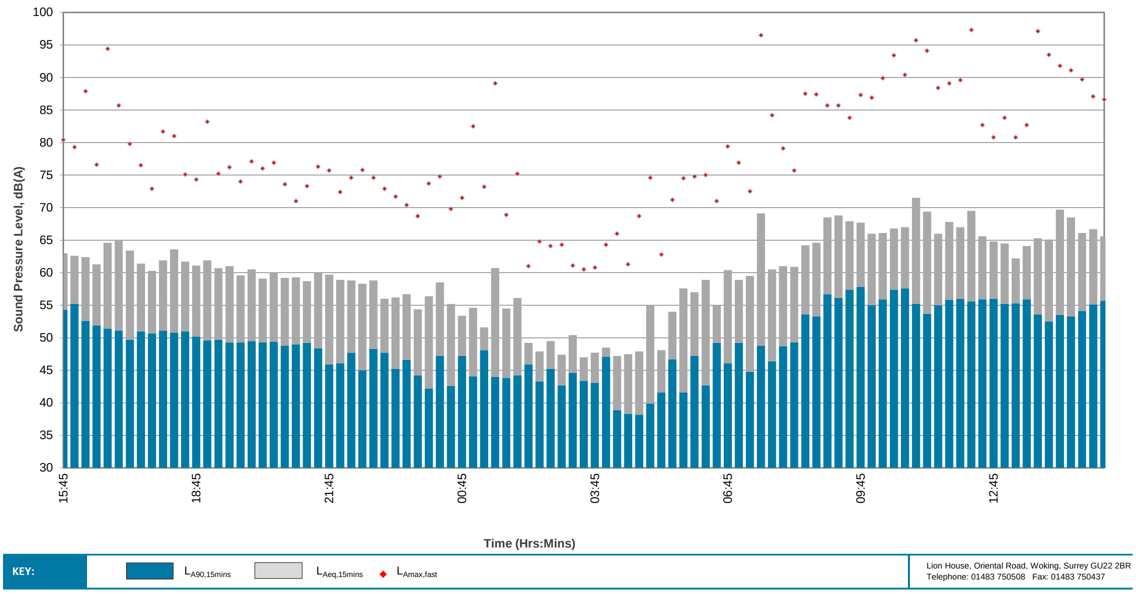

Figure 4.2: Measurement Results Graph

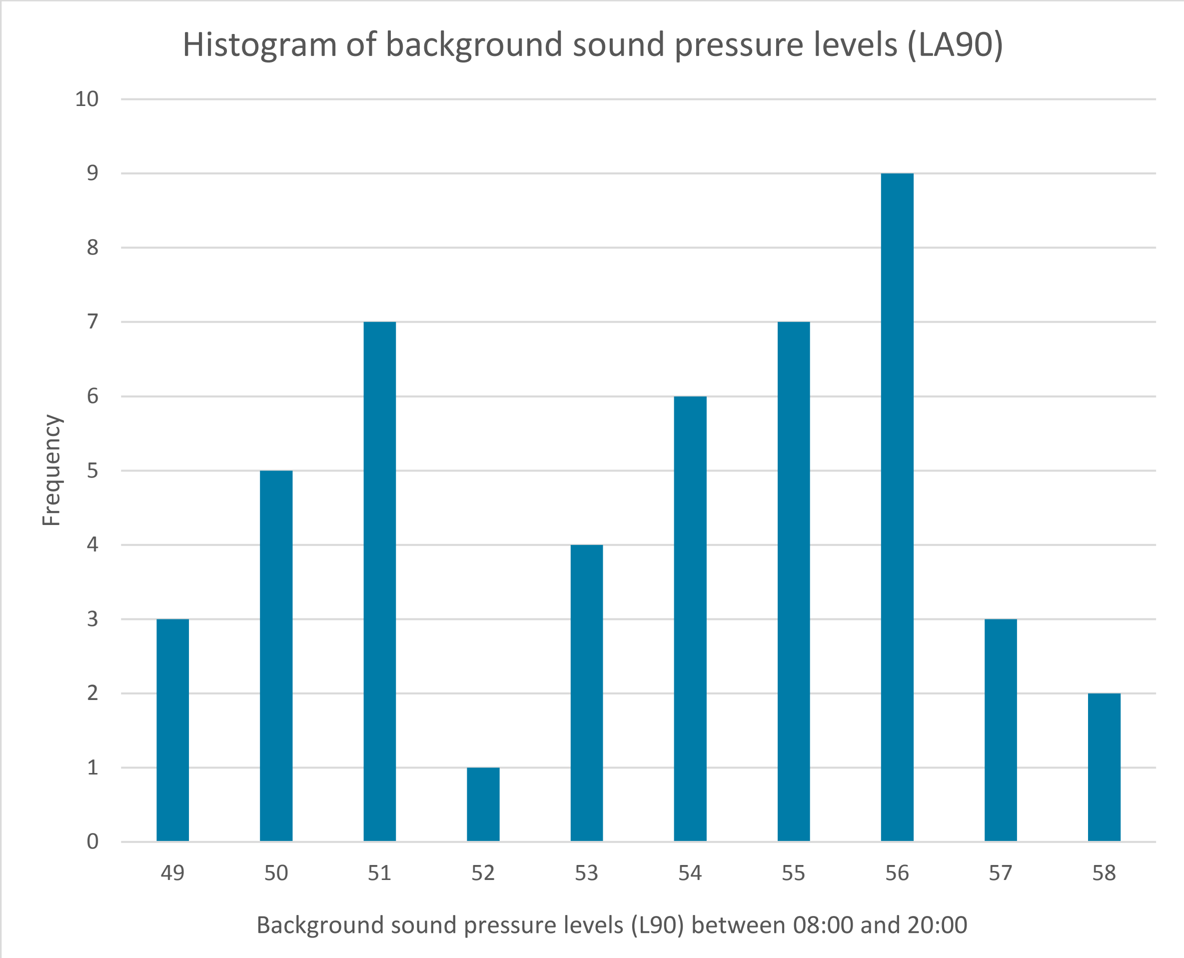

Figure 4.3: Measurement Frequency Chart

4.10 Based on the above, the worst case background level of 49dB has been assumed for the period of 08:00 to 20:00.

4.11 The background noise climate at each of measurement positions was dominated by road traffic noise from the surrounding streets. Trains are audible in the area but are unlikely to contribute to the overall L_{A90}.

Noise Sensitive Receptors

4.12 On site observations revelated that the nearest noise sensitive receptor will be flats currently under construction at 44 Gloucester Avenue. This development is understood to be completed by the end of 2018.

5 Design Criteria

Camden Council

5.1 Camden Councils local plan was adopted on 3rd of July 2017.

5.2 The local plan states that in relation to commercial plant that:

'*A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).*

Existing Noise sensitive receptor	Assessment location	Design period	LOAEL(Green)	LOAEL to SOAEL(Amber)	SOAL(Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL$_{Amax}$	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L$_{Amax}$	'Rating level' greater than 5dB above background and/or events exceeding 88dBL$_{Amax}$

**10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or* *other criteria curves) for the assessment of tonal or low frequency noise may be required.*

***levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.*

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room' (based upon measured or predicted Leq,5mins noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area.'

Proposed Target Noise Levels

5.3 It is assumed that plant will not exhibit any "acoustic features" requiring correction. Whilst condenser units may operate intermittently (responding to the building cooling demand), a total of 6 units are currently installed and any change in operation of individual units cycling in and out should not be perceptible against the underlying level noise of other operational units.

5.4 Plant noise emissions criteria that should not be exceeded at the nearest noise sensitive receptors should, therefore, be set to the proposed levels detailed in **Table 5.1**.

Receptor Position	Proposed Noise Emissions Design Criteria, $L_{Aeq,T}$
44 Gloucester Avenue	39

Table 5.1 Proposed Noise Emissions Design Criteria

5.5 The above values have been set to be in accordance with Camden Council guidelines for fixed plant.

6 Plant Noise Assessment

Airborne Noise

6.1 Calculations have been undertaken to assess the environmental noise emissions from the proposed plant. Due allowance has been made for the distance between the plant and the neighbouring dwellings, plant directivity and any acoustic screening afforded by the roof edge, barriers and intervening structures.

6.2 The sound level calculated at the nearest dwellings during standard operation, is **$L_{Aeq,T}$ 36 dB**. This is assuming a distance of 19m from plant to nearest receptor. As noted earlier, this is considered to be a "worst case" assessment, on the assumption that the plant is operating at full capacity.

6.3 Detailed calculations verifying the determination of this sound level are attached at **Appendix B**.

6.4 The predicted worst-case noise emissions are equal or below the design criterion identified in **Table 5.1.**

6.5 It is therefore concluded that the proposed plant complies with Camden Council fixed plant noise emission limits without any need for additional mitigation.

7 Conclusions

7.1 Noise emissions from the proposed plant has been assessed in accordance with the Camden Council local plan guidance.

7.2 It is concluded that noise from the proposed plant installation will comply with the recommended atmospheric noise emissions targets determined by Camden Council without the need for additional mitigation

GLOSSARY OF ACOUSTIC TERMINOLOGY

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General

A vibrating surface or turbulent fluid flow will cause pressure fluctuations in the surrounding air. These pressure fluctuations are perceived by the human ear as "sound".

Measurement Units

The human ear can detect sound pressures as low as about 20 μPa, and can tolerate (for short periods) sound pressures as high as 200 Pa, an amplitude range of 10 million times. To take account of this huge amplitude range, sound pressure levels (often written in "acoustic shorthand" as SPL or Lp) are quantified using a logarithmic scale, the decibel (dB) scale. This is based on a reference pressure of 20μPa, thus a sound pressure of 20μPa would equate to 0dB and a pressure of 200Pa would equate to 140dB.

Frequency (Pitch) Characteristics

The sound received at any particular location is not solely influenced by the sound pressure level, the frequency characteristics (pitch) of the noise is also an important factor. Noise audible to a human (with "normal" hearing), typically covers the frequency range 20 Hertz to 20,000 Hertz. Hertz (Hz) are defined as the number of times the sound pressure fluctuates in one second. "Low" pitched sounds fluctuate less times per second than "high" pitched sounds. Whilst humans are capable of detecting a wide range of frequencies, the ear is not equally sensitive to all frequencies – the ear is most sensitive at frequencies towards the middle of the audible range and less sensitive to the lower and higher frequencies.

To take account of this frequency response, sound pressure fluctuations are normally quantified by applying a frequency-weighting network or filter which simulates the frequency response of the ear. In essence, this means that more significance is given to the frequencies at which the ear is most sensitive and less significance to those at which the ear is less sensitive. Noise measurements relating to human reaction are generally made using an "A-weighting" network. These measurements are reported as A-weighted decibels or dB(A). The A-weighted sound pressure level is written in "acoustic shorthand" as L_A.

Variation of Sound with Time

It will be appreciated that the sound pressure level of most noise sources will fluctuate with time. In order to take account of the way in which the human ear perceives noise, it is normal for the sound pressure level to be quantified using a time weighting network, to mimic the speed of response of the human ear. The standardised setting for most types of noise is a "Fast" time weighting.

The manner in which sound fluctuates with time can also influence the subjective manner in which noise is perceived. Noise can be continuous (showing no significant variation with time as in the case of a fan), intermittent (i.e. the noise is transient in it's nature, such as a train pass-by) or impulsive (i.e. there is a sudden build up of noise - this can range from "clanking" types sounds as might be experienced next to railway goods yard or a high energy discharge such as an explosion)

Measurement of Sound

Sound pressure levels are measured using equipment comprising a pressure-sensitive microphone, associated amplifier, frequency weighting network, time weighted network and output indicator. In its simplest form this is a small hand-held instrument called a sound level meter. More sophisticated instrumentation (a sound level analyser) is also available which allows the real-time output of the frequency characteristics of the sound to be quantified.

Comparison of Sound Levels

To put the significance of noise measurement into context, the following Table presents the A-weighted sound pressure level of some typical sources:

Sound Pressure Level, dB(A)	Typical Noise Source . Activity
160	Saturn Rocket Taking Off
140	Military Jet Taking Off at 30m
100	Nightclub
90	Heavy goods vehicle driving past at 7m
80	Busy urban road
70	Domestic vacuum cleaner at 3m
60	Busy office environment
55	Normal speech at 1m
40	Whispered conversation at 2m
30	Bedroom at night (BS 8233: 1999)
20	Remote country location
0	Threshold of hearing – a very eery silence

Addition of Sound Levels

It is important to note that the use of a logarithmic scale to describe noise does not allow normal arithmetic addition. This means that two noise sources each generating a level of, say, 60dB(A) will not generate a combined sound level of 120dB(A). The values must be added logarithmically, which would actually yield a combined sound level of 63dB(A) in this example.

Subjective Perception of Sound Levels Changes

With regard to the human perception of sound level changes, the human ear:

- Cannot generally perceive a sound level difference of less than 3dB(A)
- Will perceive a sound level difference of 4-5dB(A) as "noticeable"
- Will perceive a sound level difference of 10dB(A) as a doubling (or halving) of loudness.

Acoustic Terminology

As stated previously, most sources of noise will fluctuate with time. In order to characterize such noise, it is therefore normal to represent the noise climate using a variety of noise parameters and statistical indices. The most commonly adopted noise parameters are described below:

$L_{Aeq,T}$ This is the equivalent continuous A-weighted sound level measured over a specified time period "T". This is the notional continuous sound level which, over the time T, contains the same amount of energy as the actual fluctuating sound being measured. This parameter is widely accepted as being the most appropriate noise descriptor for most environmental noise and the effects of noise on humans.

$L_{Amax,fast}$ This is maximum A-weighted sound pressure measured with a fast frequency response recorded during the stated measurement period. It is typically used to characterise the highest sound level caused during a noise event.

$L_{A90,T}$ This is the A-weighted sound pressure level exceeded for 90% of the specified time period "T". It is normally used to describe the underlying background noise level of an environment since it inherently excludes the effects of transient noise sources.

Noise Rating (NR) Level

When describing noise from building services installations, it is common to express noise levels in terms of a Noise Rating (NR) Level. The NR level is determined by plotting the measured frequency spectrum of a noise against a series of reference curves, which roughly approximate to equal loudness values. This method permits higher sound levels at low frequencies corresponding to the sensitivity of the human ear. The NR level is defined as the value of the highest curve "touched" by the plotted frequency spectrum. For typical sources of building services noise, the overall A-weighted sound level is numerically around 5-6dB higher than the NR level of the noise.

Airborne Sound Insulation Measurement Parameters

The ability of a building element to reduce airborne noise can be described by a number of different parameters relevant to both laboratory and on-site performance evaluation. In general, the higher these values, the better the resistance of the construction to the transmission of airborne sound. The most commonly used parameters include:

R_w The **"Weighted Sound Reduction Index"** (R_w) is a single value measure of the intrinsic sound reduction capabilities of a construction, as measured in an acoustic laboratory. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013.

R'_w The **"Weighted Apparent Sound Reduction Index"** (R'_w) is a single value measure of the apparent sound reduction capabilities of a construction, when installed on-site (which will normally be some way lower than the laboratory value due to less favourable installation conditions, the quality of workmanship, etc.). Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013. In practice, the R'_w of a construction can only be reliably determined if "direct" sound transfer through the partition can confidently be taken as the dominant noise transfer path (i.e. there is no "flanking" sound transmission.

D_w The **"Weighted Sound Level Difference"** (D_w) is a single value measure of the on-site sound reduction between two rooms. This value inherently includes "direct" sound transmission through any separating construction and "flanking" transmission through other building elements. Measurement values are determined in accordance with BS EN ISO 140-4: 1998 (for Building Regulations compliance purposes) or BS EN ISO 16283-1: 2014 and weighted in accordance with BS EN ISO 717-1: 2013.

$D_{n,fw}$ The "**Weighted Normalised Flanking Level Difference**" ($D_{nf,w}$) is a single figure measure of the sound reduction between two rooms solely due to sound transmission through a specified flanking path. This parameter is frequently used to provide an indication of the sound reduction capabilities of suspended ceiling and raised access floor constructions where there is common void between adjacent rooms or as a measure of sound that may be transmitted between rooms through external curtain walling. Measurements are undertaken in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-1: 2013.

Impact Sound Insulation Measurement Parameters

Some building elements also have the potential to generate "impact" noise, for example due to human "footfall" on floor structures, or the impact of rainfall on lightweight roofing components. A variety of parameters are again available to define the amount of noise likely to be generated. In general, the lower these values, the less sound the construction will generate as a result of impacts. Typical measurements parameters include:

$L_{nT,w}$ The "**Standardised Impact Sound Pressure Level**" is a "single number" rating describing the intrinsic impact sound insulation capabilities of a construction (such as a floor system) as measured in an acoustics laboratory. Values are determined in a vertical sound transmission suite by locating a "tapping machine" in the upper room of the suite and measuring the amount of sound radiated by the floor in the room below. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-2: 2013.

$L_{nf,w}$ The "**Normalised Flanking Impact Sound Pressure Level**" is a "single number" rating describing the amount of flanking sound that would be transmitted to an adjoining space (separated by a partition) due to impacts on the test sample. It is, for example, used to indicate the amount of noise that may be generated due to footfall noise on a raised access floor system. Values are determined in a horizontal sound transmission suite by locating a "tapping machine" one side of a separating partition built off the test sample and measuring the amount of noise radiated by the floor in the adjoining space on the other side of the partition. Measurement values are determined in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-2: 2013.

Room Acoustic Measurements

T The "**Reverberation Time**" (T) of a room is defined as the time taken for the sound energy produced by a source Time (RT) to decay by 60 dB after the source has been switched off. The reverberation time of a space can be calculated by considering the volume of the room and the areas and sound absorption qualities of room surface finishes. Small, "soft" rooms tend to give low reverberation times, whilst large, "hard" rooms tend to give long reverberation times.

α_p The "**Practical Acoustic Absorption Coefficient**" (α_p) is a measure of how much sound energy is absorbed by a building element at a particular frequency, as measured in accordance with BS EN ISO 354: 2003.

α_w The "**Weighted Absorption Coefficient**" (α_w) is a single figure measure of the overall sound absorption capabilities of a building element determined in accordance with BS EN ISO 11654: 1997.

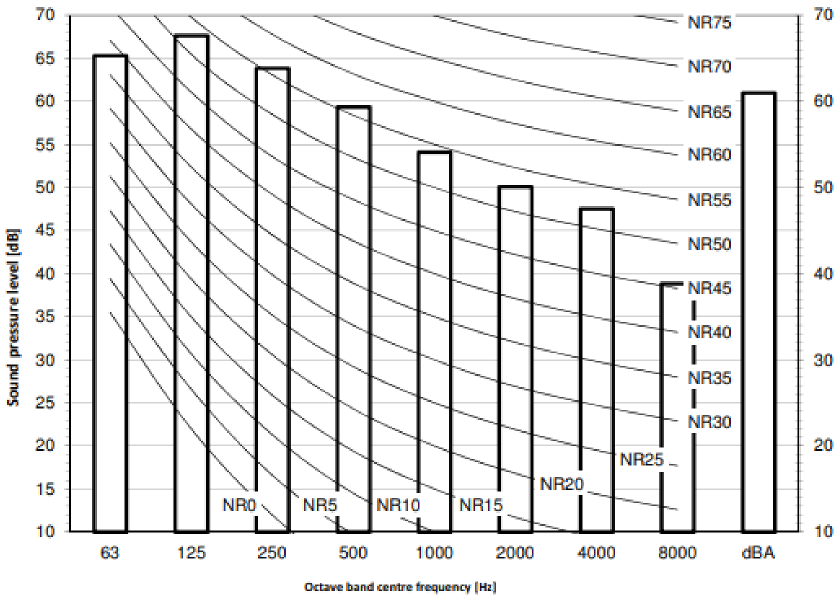
APPENDIX B:

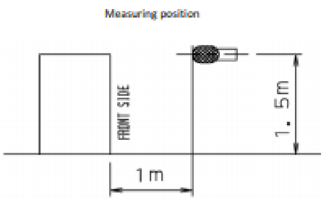
Calculations

Daikin REYQ14T	Octave Band Sound Level							
	63Hz	125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz
Discharge Sound Pressure Level, Lp	66	68	63	59	54	50	47	39
Directivity Correction, D_c	0	0	0	0	0	0	0	0
Geometric Divergence, A_{div} (Distance = 19m)	25	25	25	25	25	25	25	25
Atmospheric Absorption, A_{atm}	0	0	0	0	0	0	0	0
Ground Attenuation, A_{gr}	0	0	0	0	0	0	0	0
Barrier Attenuation, A_{bar}	0	0	0	0	0	0	0	5
Miscellaneous Attenuation, A_{misc}	0	0	0	0	0	0	0	0
Reflections	0	0	0	0	0	0	0	0
Sound Level at Receiver	**36 dB(A)**							

APPENDIX C:
Plant Data Sheet

REYQ14T





Notes :
1. Data is valid at free field condition.
2. Data is valid at nominal operation condition.
3. dBA = A-weighted sound pressure level (A scale according to IEC).
4. Reference acoustic pressure 0 dB = 20 µPa

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