

Condition 11 Assessment

**Residential Development
Whitworth Road, Rochdale**

Reference: 10171/JA

Client:



Document Control

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The report has been prepared in good faith, with all reasonable skill and care, based on information provided or available at the time of its preparation and within the scope of work agreement with the Client. We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above. The report is provided for the sole use of the named Client and is confidential to them and their professional advisors. No responsibility is accepted to other parties.

The report limits itself to addressing solely on the noise aspects as included in this report. We provide advice only in relation to noise and acoustics. It is recommended that appropriate expert advice is sought on all the ramifications (e.g. CDM, structural, condensation, fire, legal, etc.) associated with any proposals in this report or as advised and concerning the appointment. It should be noted that noise predictions are based on the current information as we understand it and on the performances noted in this report. Any modification to these parameters can alter the predicted level. All predictions are in any event subject to a degree of tolerance of normally plus or minus three decibels. If this tolerance is not acceptable, then it would be necessary to consider further measures.

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1. Introduction

Cornerstone Place appointed Acoustic Consultants Limited to provide a noise impact assessment for the proposed residential development spanning three separate blocks at Whitworth Road, Rochdale to address a planning condition.

This report provides the results of a noise survey conducted on the site and an assessment of external sources of noise on the sensitive elements of the development.

This noise impact assessment has been undertaken in accordance with the planning consent.

The author of this report is a Member of the Institute of Acoustics (MIOA) with over four years of experience within the field of noise and acoustics. The report and calculations have been checked and approved by a Full Member of the Institute of Acoustics (MIOA) with over 15 years of experience within the field of noise and acoustics.

2. The Site

The site is located over three separate areas in proximity to Whitworth Road, Grasmere Street, and Noon Sun Street. The areas to be developed are currently vacant plots of land, and are noted as Block A, Block B, and Block C.

The sites are flanked by the A671, Whitworth Road, to the east, and surrounding local road networks. There is a pub, Mark Twain, directly opposite proposed Block C location.

Blocks A and B are proposed as two-storey blocks of apartments, and Block C is a single-storey block of two apartments. The following figures provide the site location, the proposed site plan.

Figure 1: Site Location



Figure 2: Proposed Site Plan



3. Planning Condition

The site has planning approval with the following noise related condition:

11. No development shall take place until a Noise Impact Assessment is submitted to and approved in writing by the Local Planning Authority which provides the following internal noise levels within the habitable rooms:

- *35 dB(A) Leq (16 hour) in the bedrooms with windows shut and other means of ventilation provided between 7 am and 11pm;*
- *30dB(A) Leq 8 hour in the bedrooms with windows shut and other means of ventilation provided between 11pm and 7am;*
- *35 dB(A) Leq (16 hour) in the living room/s with windows shut and other means of ventilation provided between 7 am and 11pm;*
- *40dB(A) Leq (16 hour) in other habitable rooms with windows shut and other means of ventilation provided at all times.*

No part of the development shall be occupied until such time as a report providing details of the implemented acoustic mitigation measures, and demonstrating that internal noise levels within habitable rooms meet the levels set out above, has been submitted to and approved in writing by the Local Planning Authority. The duly installed mitigation measures shall be retained thereafter.

Reason: In the interests of ensuring a satisfactory standard of residential amenity for future occupiers in accordance with adopted Rochdale Core Strategy policies DM1 and G9 and the National Planning Policy Framework.
Reason for pre-commencement condition: An understanding of what mitigation measures will need to be put in place to protect the amenity of future occupiers.

4. Noise Survey

Attended noise surveys were undertaken on the 3rd of April during the day to obtain road traffic noise data, and separately on Saturday the 1st of April during the night to obtain noise data of the Mark Twain pub.

4.1. Monitoring Equipment

Sound Pressure Levels were measured using a Class 1 sound level meter with a half-inch condenser microphone, using the 'fast' setting. The equipment is checked regularly using a Quality System meeting the requirements of British Standard EN ISO/IEC 17025:2017 "General requirements for the competence of testing and calibration laboratories"; in accordance with British Standard EN 10012:2003 "Measurement management systems. Requirements for measurement processes and measuring equipment"; and traceable to the National Standards.

Vibration Dose Values were measured using a Rion XV-2P Tri-Axial Vibration Meter configured to enable Vibration Dose Value (VDV) measurements, PPV and Acceleration across the three axes. The equipment is checked using a Quality System to ensure it conforms with the requirements set out in British Standard 6472:1992, British Standard 7385-1:1990 and British Standard 7385-2:1993. All the recorded parameters were weighted as stated in the British Standard 6472 – 1:2008.

This equipment was checked and calibrated as noted below and the certificates are available for inspection.

Table 1: Equipment and Calibration Status

Equipment Description / Manufacturer / Type	Serial Number	Date of Calibration	Calibration Certification Number
SLM, NTI, XL2	A2A-18475-E0	19/10/2022	UK-22-106
Pre-Amp, NTI, MA220	9378	19/10/2022	UK-22-106
Microphone, NTI, MC230A	A19093	19/10/2022	UK-22-106
Calibrator, Larson Davis, CAL200	17656	07/02/2023	44552-17656- CAL200

The measurement system was checked before and after use with the noted calibrator and no significant drift was detected.

4.2. Weather Conditions

During the survey the weather was dry with a temperature of approximately 3 degrees Celsius. The wind was in a predominantly northerly direction with speeds not exceeding 5 metres per second.

4.3. Monitoring Procedure

Measurements of road traffic along Whitworth Road were carried out between 11:35 hours and 14:50 hours in accordance with the shortened method of The Calculation of Road Traffic Noise (1988) (CRTN) published by the Department of Transport Welsh Office.

The main noise source affecting this location was road traffic along Whitworth Road. This is marked as Monitoring Location 1 on the figure below. The sound level meter was mounted on a tripod at 1.5 metres above ground in a free-field position, 3 metres from the edge of Whitworth Road.

Attended noise monitoring of the pub was undertaken at Monitoring Location 2 below. The survey was undertaken from 22:06 until 00:00. The microphone was mounted on a tripod at 1.5 metres above ground in a free-field position, 5 metres from the edge of Noon Sun Street.

The monitoring locations for both are shown on the figure below:

Figure 3: Monitoring Locations



4.4. Measured Levels

4.4.1. Monitoring Location 1: Shortened CRTN

The following 1-hour noise levels were measured at monitoring location 1 over three consecutive hours are as follows. These are free-field levels. Traffic has been noted to be constant at the site.

Table 2: Measured 1-hour Noise Levels over a 3-hour continuous period (free-field levels)

Date and Time	L _{Aeq} (1hr) (dB)	L _{A10} (1hr) (dB)	Typical L _{max} (dB)
Hour 1	70	72	83
Hour 2	68	71	77
Hour 3	69	72	83

4.4.2. Monitoring Location 2: Noon Sun Street

The measured equivalent, L_{Aeq}, noise levels from the monitoring exercise at Monitoring Location 2 are provided below. During the exercise, noise from the pub was not the dominant source of noise effecting the proposed development. The main source of noise was due to road traffic.

Table 3: Measured Noise Levels at Monitoring Location 2

Parameter	Measured Level (dB) per Frequency Band (Hz)								dB(A)
	63	125	250	500	1000	2000	4000	8000	
L _{Aeq} (2 hours)	63	59	53	51	52	51	47	40	57

No fixed plant noise was audible from the nearby pub.

5. Noise Modelling

5.1. Calculated Road Traffic Noise Levels

5.1.1. Daytime Calculation Method

Using the measured noise level across a 3 hour period during the daytime, the typical noise levels over a 24 hour period can be calculated using formulae described in *Calculation of Road Traffic Noise* (CRTN) by the Department of Transport and *Planning Policy Guidance: Planning and Noise* (PPG24).

These documents states that the A-weighted equivalent noise levels for daytime ($L_{Aeq,16 \text{ hour}}$) and night-time ($L_{Aeq,8 \text{ hour}}$) can be calculated as a function of the $L_{A10,3 \text{ hour}}$.

Following the CRTN methodology, the arithmetic mean of the consecutive hourly recorded values of L_{A10} was determined and converted to the $L_{A10,18 \text{ hour}}$ (which represents the background noise level exceeded for 10% of the time between 06:00 and 00:00 hours) using the following formula:

$$L_{A10 (18 \text{ hour})} = L_{A10 (3 \text{ hour})} - 1 \text{ dB}(A)$$

As defined in PPG24, the $L_{Aeq,16 \text{ hour}}$ is calculated as a function of the $L_{A10 18 \text{ hour}}$ using the following calculation:

$$L_{Aeq (16 \text{ hour})} \cong L_{A10 (18 \text{ hour})} - 2 \text{ dB}$$

5.1.2. Night-time Calculation Method

As detailed above, the $L_{A10 18 \text{ hour}}$ is calculated by subtracting 1 dB from the arithmetic mean of the consecutive hourly $L_{A10 3 \text{ hour}}$ values measured on-site.

Using the $L_{A10 18 \text{ hour}}$ night-time noise levels were predicted using Method 3 within the TRL report: 'Converting the UK traffic noise index $L_{A10, 18h}$ to EU noise indices for noise mapping (Abbot & Nelson, 2002).' The method is as follows:

$$L_{night} = 0.90 \times L_{A10,18h} - 3.77 \text{ dB}$$

5.1.3. Design Noise Levels

Following the methodology above the following A-weighted, equivalent noise levels for daytime and night-time periods at monitoring location A have been determined from noise from road traffic. The night-time max has been determined from the typical measured L_{AFmax} during the measurement period. This is considered a worst case.

The calculated free-field octave noise levels at the monitoring location are as follows:

Table 4: Calculated Spectral Noise Levels at Monitoring Location 2 (free-field)

Octave Band	63	125	250	500	1000	2000	4000	8000	dB(A)
Day, $L_{eq}(16 \text{ hour})$	72	71	65	63	64	63	57	50	69
Night $L_{eq}(8 \text{ hour})$	63	62	57	55	56	54	49	43	60
Night-time L_{Fmax}	83	82	77	75	76	74	69	63	80

Based on our measured data and site observations we would consider that the road traffic noise effecting each block is the most onerous to control when compared to noise emanating from the nearby pub.

We therefore consider the above design noise levels to be representative of the noise climate at the site.

5.2. Noise Modelling Parameters

To determine noise levels across the site, noise modelling has been undertaken using computer modelling package Cadna:A by DataKustik and the road traffic data noted above.

The software predicts road traffic noise propagation using the method of 'The Calculation of Road Traffic Noise 1988', and a verification model has been created to ensure the measured and predicted levels are comparable.

The noise predictions have been undertaken using supplied plans of the proposed site and the following general modelling parameters:

- The site layout is based on Google Maps imagery and the provided plans.
- The topography of the site is considered flat.
- The noise sources considered in the modelling are road traffic. The noise source was calibrated to the measured levels at receivers positioned at the monitoring locations shown above.
- Existing building heights are based on Google Street View observations for the surrounding buildings and measured on the elevations for the proposed dwellings.
- Proposed building heights are based on drawings provided by Triangle Architects.
- The ground is considered hard and reflective.
- A third order reflections have been calculated.
- The noise maps below show noise levels across the site from the noted noise sources at a height of 4.5 metres above the ground (first floor height) for Block A and B. Building evaluations within Block C are at 1.5 metres above ground (ground floor level).
- Building evaluation levels are reported as the worst-case level per façade.

5.3. Noise Modelling Results

The following figures provide the day, night, and night-time maximum noise modelling predictions across the site.

Figure 4: Daytime dB $L_{Aeq}(16hr)$ noise affecting the development.

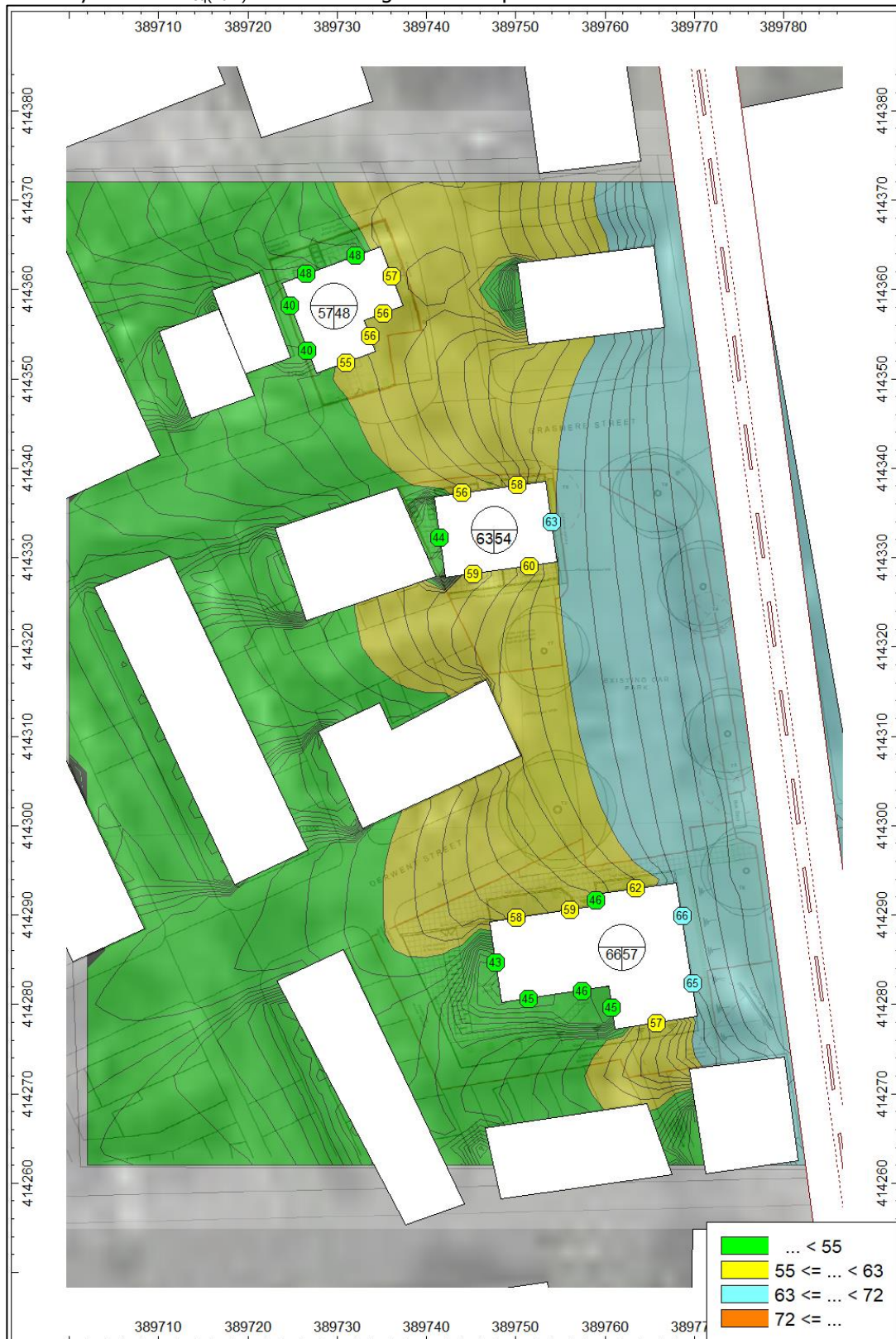


Figure 5: Night-time dB LAeq(8hr) noise affecting the development.

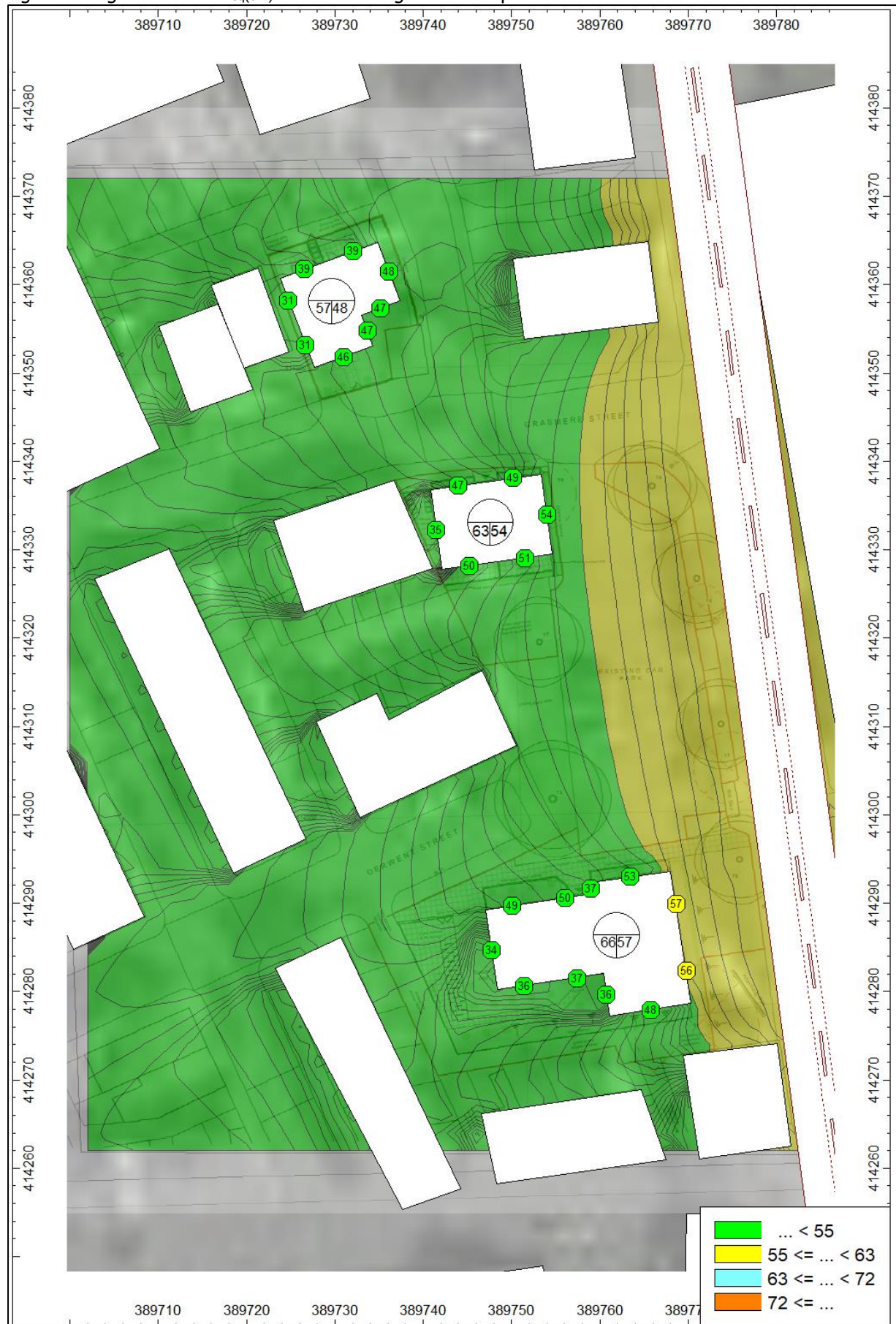
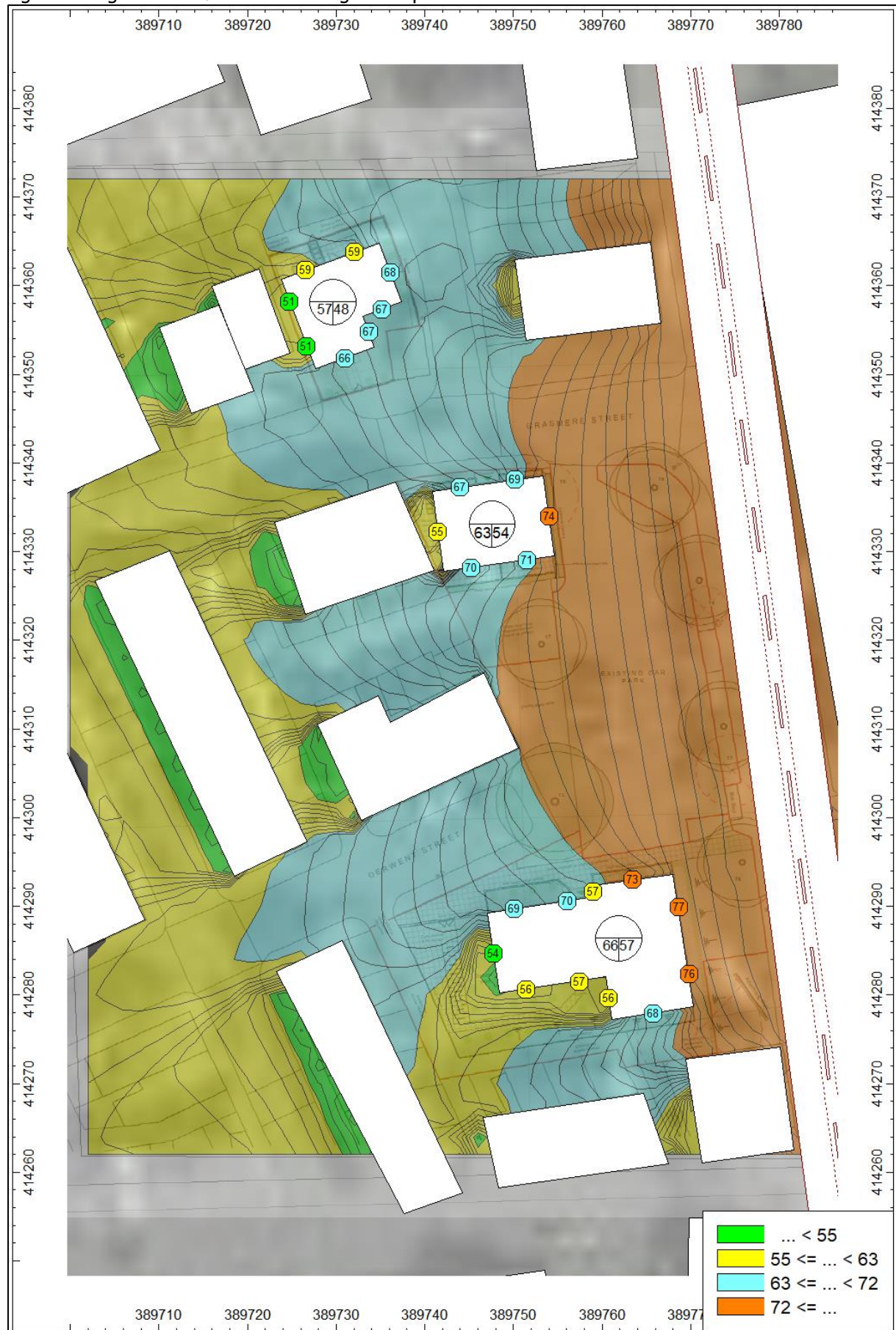


Figure 6: Night dB LAFmax noise affecting development.

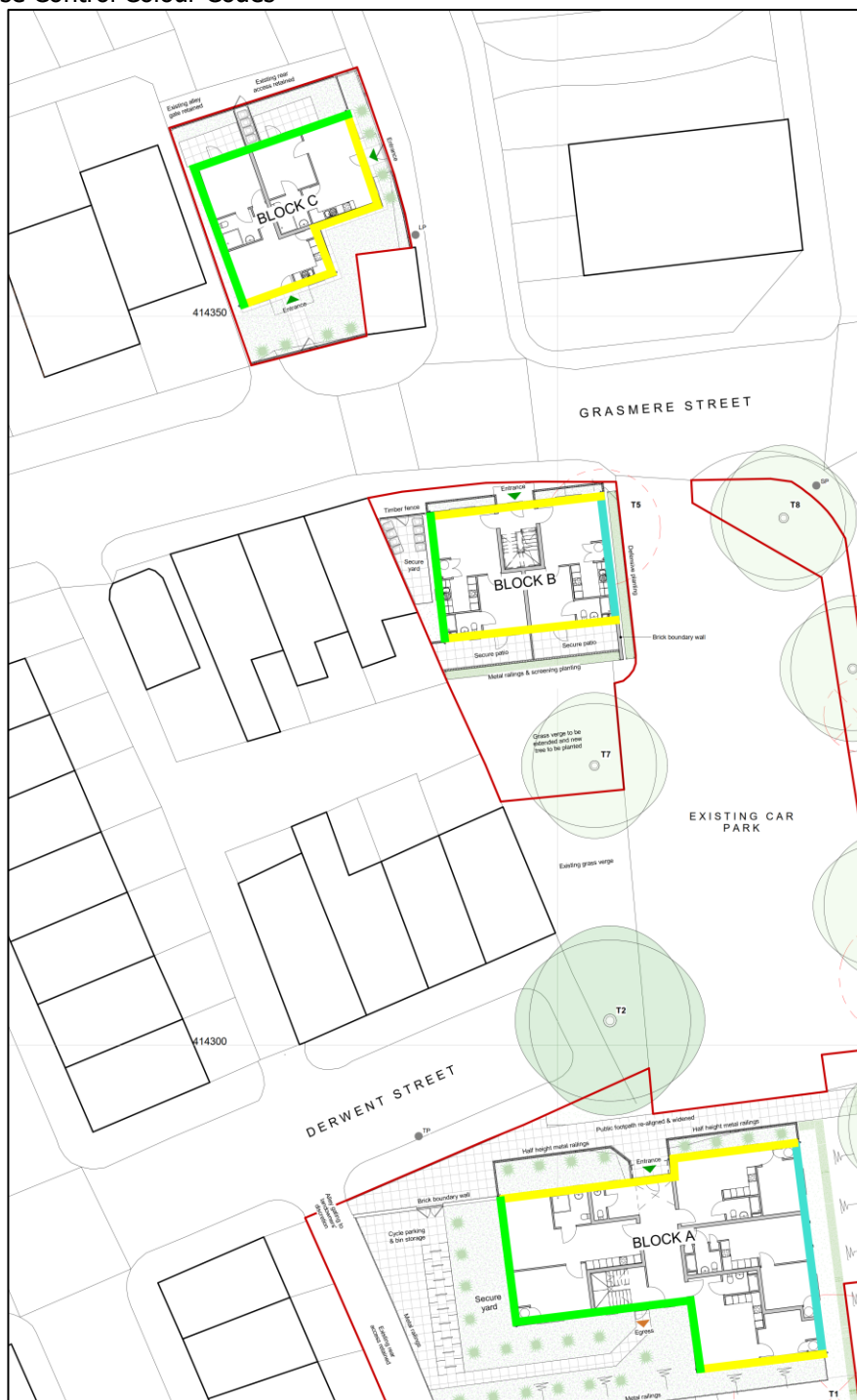


6. Noise Control Measures

It will be necessary to design the building envelope to control external noise based on the predicted road traffic noise levels impacting upon the proposed building.

We provide the following noise control measures based on our data obtained and predictions above. We have consolidated the noise control requirements per façade represented with the following colour coded areas.

Figure 7: Noise Control Colour Codes



6.1. Calculation Method

Calculations for the internal ambient noise levels due to external noise have been undertaken using the calculation method provided in Annex G Section G.2 of British Standard 8233:2014.

The calculations have been undertaken using the building façade construction specified below and the octave band free-field design equivalent noise levels and maximum noise levels taken from the measured noise spectra noted above. The calculations are based on the proposed site Plan (Drawing Number: WHI-TRI-ZZ-ZZ-DR-A-3010) and the assumption of 1 vent per space.

We advise that building elements, having the sound insulation performances noted below, be incorporated into the design of the façades including the windows, doors, floor, and the building roof.

6.2. Building Façade Constructions

Alternative constructions to those noted below could be used, however they would need to be assessed to ensure they control external noise to within the recommended internal ambient noise level criteria.

6.2.1. External Wall Construction

We have been informed that the client utilises a timber cassette construction throughout their development. The typical build-up is provided below, as noted from drawing P-315-4-SS, and Contractor Proposal P-315-4 5000, Revision A. We have included the surface mass or material density of certain elements of the construction. These have been sourced from manufacturer technical data. The architect should ensure that these can be met and/or achieved in the final construction of the external walls.

- External render finish coat
- 80mm Steico ProtectDry wood fibre board (minimum surface mass 12 kg/m²)
- 12mm OSB or similar (minimum surface mass 6 kg/m²)
- 144mm timber studs and 600mm centres
- Fully fill with 150mm SteicoFlex 036 insulation (minimum density 55 kg/m³)
 - The manufacturer's test data indicates this has a density of 60m³
- 12mm Durelis Vapourblock or Medivent Pro layer
- 38mm service void filled with 40mm SteicoFlex 036 insulation
 - The manufacturer's test data indicates this has a density of 60m³
- 12mm Fermacell lining board
- Second 12mm Fermacell lining (in some areas, where 60mins fire rating required)

We understand that the construction is to be consistent across the scheme.

We have modelled the above construction using Marshall Day Acoustics, Insul software. The prediction from the software noting the above constructions is expected to achieve the following sound reduction indices:

Table 5: Required minimum sound insulation performance of external walls

Construction Type	Sound Reduction Index per Octave Band / dB							R _w
	63	125	250	500	1k	2k	4k	
Agile Timber Cassette	27	41	47	52	55	60	64	56

Please note that the modelling software, Insul, has tolerances that are not quantifiable. We have no test data of the above construction to accurately confirm the above sound reduction index is fully achievable once constructed on site. We would advise that testing of the construction is completed in an existing building utilising the construction.

Any alternative constructions must achieve the above noted performance.

6.2.2. Roof

All dwellings could have a roof constructed using traditional techniques, such as a timber construction with concrete/slate tiles (minimum mass per unit area of 30 kg/m²) with a loft space and a plasterboard ceiling above the habitable rooms.

The above construction is expected to achieve the following sound reduction indices:

Table 6: Required minimum sound insulation performance of roof

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	R _w
R (dB)	25	39	47	53	58	56	60	55	56

Any alternative constructions must achieve the above noted performance.

6.2.3. Glazing

The windows on all elevations can be openable, at occupier discretion for purge ventilation for example. The windows should be constructed from sturdy good quality frames with airtight compression seals.

The minimum sound reduction indices required of the windows are provided in the table below. The supplier should provide test data confirming the glazing specification meets the below performance.

Table 7: Required SRI of Glazing

Zone	Room Type	R (dB) at Octave Band Frequency (Hz)								R _w	Typical Glazing
		63	125	250	500	1k	2k	4k	8k		
	Daytime Rooms	16	21	20	31	39	37	47	46	33	6/12/6.4
	Night-time Rooms	20	25	22	33	40	43	44	44	36	10/12/4
	All Habitable Rooms	20	24	20	25	35	38	35	36	31	4/12/4
	Daytime Rooms	20	24	20	25	35	38	35	36	31	4/12/4

6.3. Ventilation Provisions

6.3.1. Background Ventilation

There will be a need for suitable attenuated ventilation provisions to the habitable rooms across the development.

The vents are required to achieve the following element normalised level difference (D_{n,e}) in the open position. The supplier of any chosen ventilation product should provide test data confirming that the ventilation system meets the following performance data. There should be no unattended vents or openings in the façade.

Table 8: Required sound reduction of ventilation

Zone	Room Type	Required Ventilator Sound Insulation Performance, D _{n,e} per Octave Band (Hz)								D _{n,e,w} (dB)	Typical Construction
		63	125	250	500	1k	2k	4k	8k		
	All Habitable Rooms	44.5	47	46	50	55	65	68	60	54	Wall Vent <i>Greenwood MA3051</i>
	Daytime Rooms	31.7	32	36	36	35	34	35	38	35	<i>Titon Trimvent 90</i>
	Night-time Rooms	31.5	32	37	37	36	36	35	40	37	<i>Titon Trimvent 4000</i>
	All Habitable Rooms	Open Window									

6.3.2. Overheating Conditions: Night-time Hours

Approved Document O (ADO) is currently a Building Regulations requirement in England. As such, the implications of this document should be considered at planning stage.

Please note, the following applies only where overheating of the bedrooms is deemed likely to occur at night. A full overheating assessment would be required to assess this fully in terms of noise. The following is an outline scenario of having the bedroom windows open for the full duration of the night.

ADO states:

"3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

3.3 Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).*
- b. 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am).*

ADO states the following regarding means of removing excess heat:

"Excess heat should be removed from the residential building by any of the following means:

- a) Opening windows (the effectiveness of this method is improved by cross-ventilation).*
- b) Ventilation louvres in external walls.*
- c) A mechanical ventilation system.*
- d) A mechanical cooling system."*

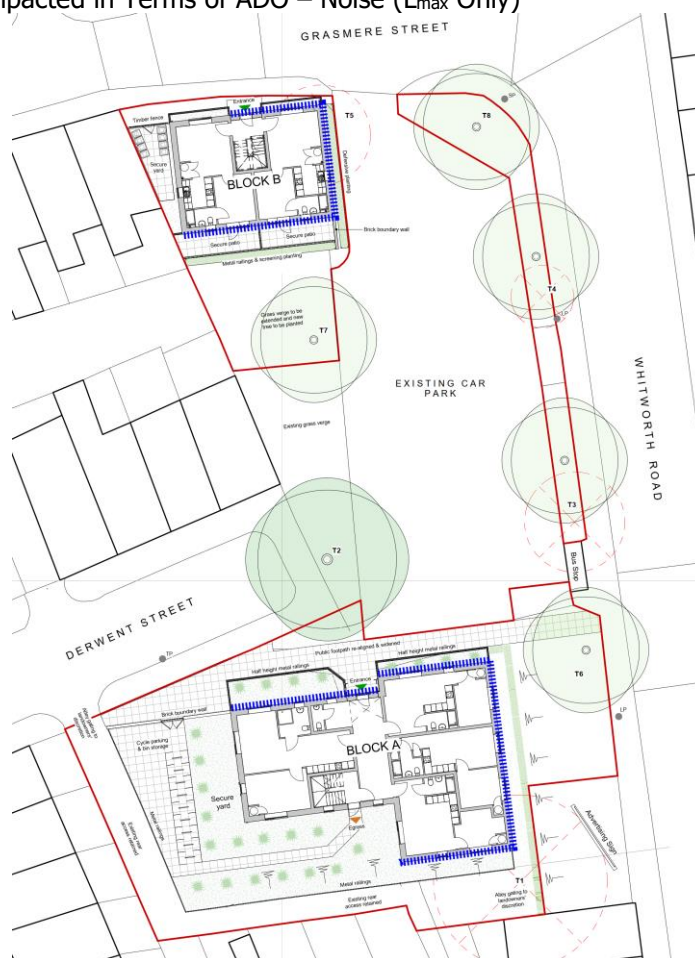
ADO states that bedroom windows are likely to be closed during sleeping hours where internal noise levels exceed 40 dB $L_{Aeq,8hour}$ and 55 dB L_{AFmax} .

On the basis that a partially open window achieves up to 13 dB attenuation, bedrooms on the most exposed façades to Whitworth Road in Blocks A and B will exceed this internal level with windows open, due to night-time maximum noise levels only, (i.e., not 8-hour equivalent noise levels). These façades are noted in blue in the following figure.

Therefore, an alternative form of ventilation may be required. However, a full overheating assessment would be required to assess this further.

All habitable rooms within Block C are expected to fall below the ADO internal noise level thresholds for open window requirements.

Figure 8: Facades Impacted in Terms of ADO – Noise (L_{max} Only)



Please note well, the above ADO assessment is outline. The 8-hour equivalent levels during the night do not affect the ADO outline assessment; it is only the night-time maximum noise levels; therefore Condition 11 requirements are still achieved.

A full overheating assessment would be required to understand if the noted façades are expected to be affected by night-time overheating.

6.4. Effect of Mitigation Measures

With the mitigation measures installed to habitable rooms of the bedrooms in the areas noted above, the predicted internal noise levels are below the BS8233 criteria. The predictions for the worst-case night-time room facing on to Whitworth Road are provided below.

Figure 9: Worst-case Room IANL Predictions

Free Field Level at Façade									
Octave Band	63	125	250	500	1000	2000	4000	8000	dBA
Day, $L_{eq24h(road)}$	69	68	62	60	61	60	54	47	66
Night $L_{eq(10hr)}$	60	59	54	52	53	51	46	40	57
Night-time $L_{max(10hr)}$	80	79	74	72	73	71	66	60	77
Building Façade Construction									
External Element	D_{ref}	63	125	250	500	1000	2000	4000	
Wall Vent - Greenwood MA3051 - 54 Dnew		44.5	47	46	50	55	65	68	60
	Number of	1							
		0.00002	0.00001	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000
2x100mm block plastered/render both sides 100mm void, 1880 Kg/m ³ + 400 kg/m ³ - 52 Rw		31	38	46	45	55	66	77	70
	Area	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Double Glazed: 10/12/4 - 36 Rw		20	25	22	33	40	43	44	44
	Area	1.5							
		0.00093	0.00029	0.00058	0.00005	0.00001	0.00000	0.00000	0.00000
Pitched Roof - 56 Rw		25	39	47	53	58	56	60	55
	Area	9							
		0.001756821	6.99403E-05	1.10848E-05	2.78437E-06	8.80496E-07	1.39549E-06	5.55556E-07	1.75682E-06
Agile Wall Construction - See Report for Details	R	27	41	47	52	55	60	64	55
	Area	6							
		0.000702037	2.79486E-05	7.02037E-06	2.22004E-06	1.11265E-06	3.51852E-07	1.40075E-07	1.11265E-06
Calculations to BS EN 12354									
	63	125	250	500	1000	2000	4000	8000	
Sum	0.003409669	0.00048512	0.00061783	5.75833E-05	1.32499E-05	6.56599E-06	4.47964E-06	7.17294E-06	
10log sum	-24.6766794	-33.93068977	-32.09130731	-42.39702142	-48.77787385	-51.82699553	-53.48756816	-51.44303067	
10log S/A	3.20774054	3.207740539	4.397685474	5.553384727	6.389720747	4.317258271	3.17698895	3.17698895	
correction factor +3	3	3	3	3	3	3	3	3	
Octave Band	63	125	250	500	1000	2000	4000	8000	dBA
Day, $L_{eq24h(road)}$	50.5	40.3	37.3	26.2	21.6	15.5	6.7	1.7	32.1
Night $L_{eq(10hr)}$	41.5	31.3	29.3	18.2	13.6	6.5	-1.3	-5.3	23.8
Night-time $L_{max(10hr)}$	61.5	51.3	49.3	38.2	33.6	26.5	18.7	14.7	43.8

Condition 11 requirements can be comfortably met as shown above.

7. Summary & Conclusions

Cornerstone Place appointed Acoustic Consultants Limited to provide a noise impact assessment for the proposed residential development spanning three separate blocks at Whitworth Road, Rochdale.

This report provides the results of a noise survey conducted on the site and an assessment of external sources of noise on the sensitive elements of the development.

This noise impact assessment has been undertaken in accordance with the planning consent.

A fully attended site noise survey has been carried out. The measured noise levels and site observations indicate that the dominant night-time noise source is road traffic. Noise from the nearby pub is audible but to a lesser extent than road traffic.

With the noted noise control measures implemented into the design of the buildings, BS8233 criteria can be achieved within the internal habitable rooms of the development.

In terms of overheating at night (ADO), the most exposed façades to Whitworth Road at Block A and B may require further mitigation if a certain level of overheating is deemed probable through a full overheating assessment. This is due to night-time maximum noise levels only.

The presented assessment shows that Condition 11 requirements can easily be achieved at the proposed site.

8. Appendix 1 – Glossary of Acoustic Terminology

A-weighted sound pressure p_A – value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network

A-weighted sound pressure level, L_{pA} – quantity of A-weighted sound pressure given by the following formula in decibels (dBA)

$$L_{pA} = 10 \log_{10} (p_A/p_0)^2$$

where:

p_A is the A-weighted sound pressure in pascals (Pa);
 p_0 is the reference sound pressure (20 μ Pa)

Background sound level, $L_{A90,T}$ – A-weighted sound pressure level that is exceeded by the residual sound assessment location for 90% of a given time interval, T, measured using weighting F and quoted to the nearest whole number of decibels

Break-in - noise transmission into a structure from outside.

Decibel (dB) – The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$ – value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{Aeq,T} = 10 \log_{10} \left\{ (1/T) \int_{t_1}^{t_2} [p_A(t)^2/p_0^2] dt \right\} \quad (1)$$

where:

p_0 is the reference sound pressure (20 μ Pa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure (Pa) at time t

NOTE The equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number of decibels.

Facade level – sound pressure level 1 m in front of the façade. Facade level measurements of L_{pA} are typically 1 dB to 3 dB higher than corresponding free-field measurements because of the reflection from the facade.

Free-field level – sound pressure level away from reflecting surfaces. Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the source).

Octave and Third Octave Bands – The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

Sound pressure level – Sound pressure level is stated on many of the charts. It is the amplitude of the acoustic pressure fluctuations in a sound wave, fundamentally measured in Pascals (Pa), typically from 20 micro-Pascals to 100 Pascals, but commonly simplified onto the decibel scale.

Sound reduction index, R – laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.

Specific sound level, $L_s = L_{Aeq,Tr}$ – equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .

Structure-borne noise – audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements

Rating level, $L_{Ar,Tr}$ – Specific sound level plus any adjustment for the characteristic features of the sound.

Reverberation Time, T – The reverberation time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level, once the noise source has stopped. It is measured in seconds. Often a 60 dB decay cannot be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60 dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20 dB decay multiplied by three) and T30 (time taken for a 30 dB decay multiplied by two).

Vibration Dose Value, VDV – measure of the total vibration experienced over a specified period of time.

Estimated Vibration Dose Value, $eVDV$ – estimation of the total vibration experienced over a specified period of time. This is usually based on the number of events and shortened measurement data.

Weighted sound reduction index, R_w – Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The weighted sound reduction index is used to characterize the insulation of a material or product that has been measured in a laboratory (see BS EN ISO 717-1).



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