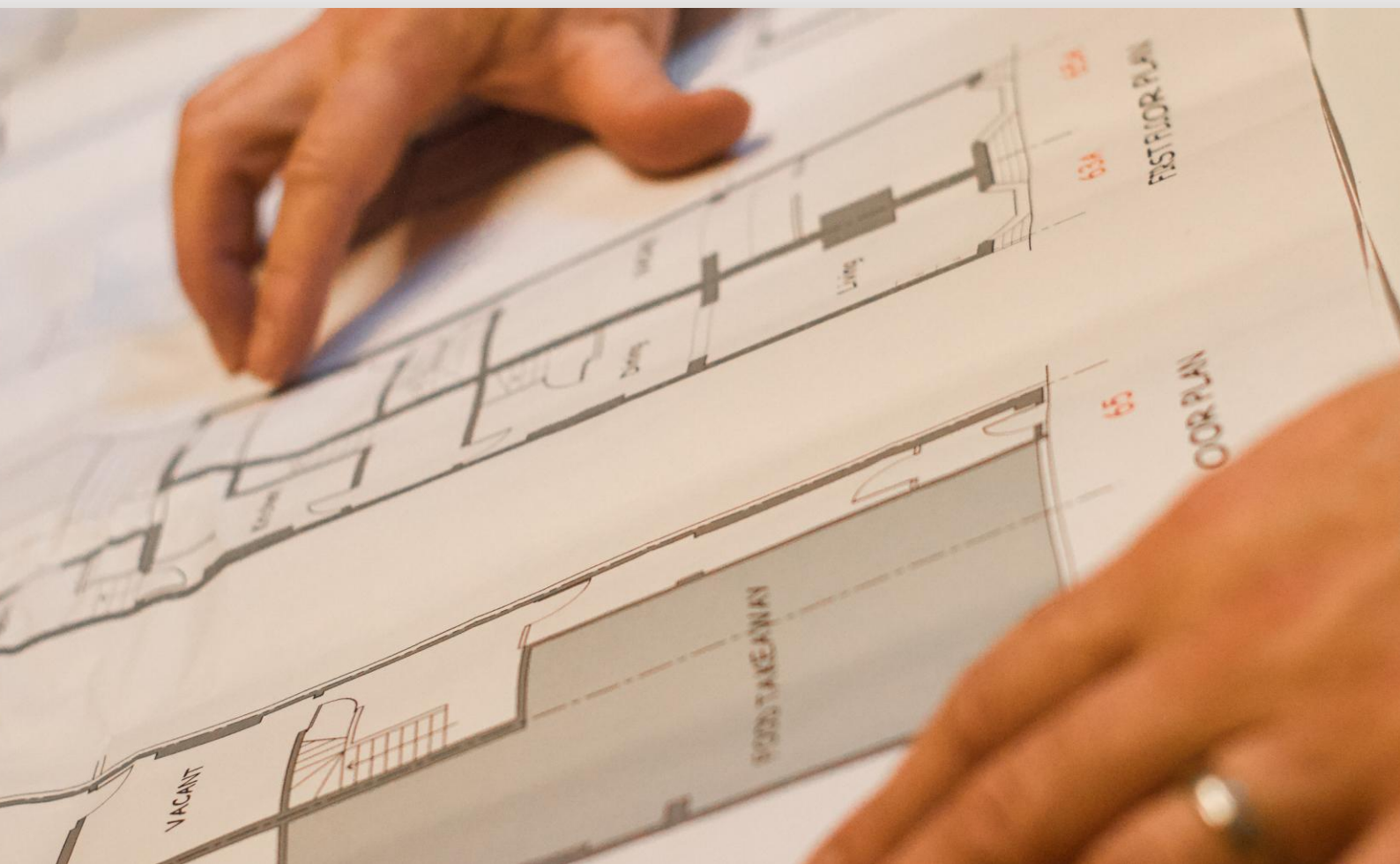


Mr M Redaoui

**Unit 12 City Court Trading Estate, Poland Street,
Manchester**

Acoustic Assessment



Mr M Redaoui

UNIT 12 CITY COURT TRADING ESTATE, POLAND STREET, MANCHESTER

Acoustic Assessment

Type of Document (Version) Public

Project no. PA1245

Date: September 2025

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Quality Control

Issue/revision	P01	P02	P03	P04
Remarks	Draft for comment			
Date	September 2025			
Prepared by	Joel Phillips			
Checked by	Jonathan Howell			
Authorised by	Jonathan Howell			
Project number	PA1245			
Report number	R01			
File reference	PA1245-P01-R01 Unit 12 City Court, Manchester_Acoustic Assessment			

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Appendix E

Report Limitations

1. Introduction

Peninsular Acoustics has been commissioned by Mr Mohamed Redaoui. (hereafter referred to as “the Client”), to undertake an acoustics assessment to support a planning application for the change of use of an existing commercial unit (hereafter referred to as “the Site”), into a gym.

This report presents the findings of a noise impact assessment on nearby residential receptors from the proposed change of use. The Site is understood to operate between 06:00 and 20:00 each day.

An acoustic glossary is provided in Appendix A to assist the reader.

1.1. Site Description

The property, hereafter referred to as ‘the Site’, is located at Unit 12 City Court Trading Estate, Poland Street, Manchester M4 6AL and is a two-storey commercial unit within a trading estate, comprising various business units with residential properties in the surrounding vicinity.

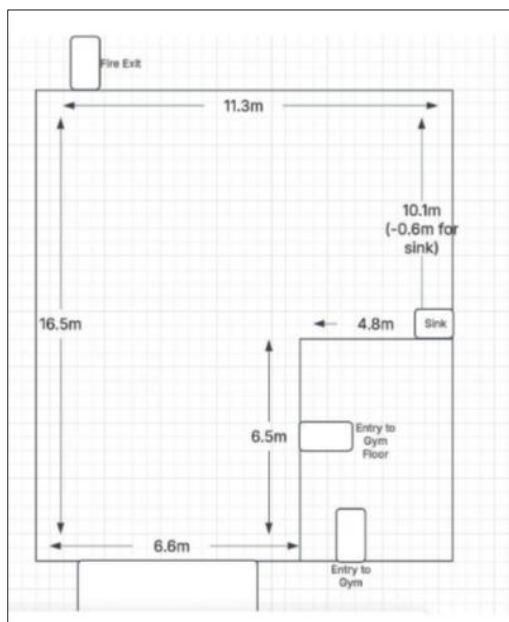
There are identical commercial units to the east, west and north of the Site within the City Court Trading Estate. The only identifiable unit is ‘Express Chef North’, all other units are of unknown uses.

The nearest Noise-Sensitive Receptor (NSR) is located directly behind the Site, where an apartment block is currently under construction. Additional residential receptors have also been identified nearby.

The nearest NSRs are identified as follows:

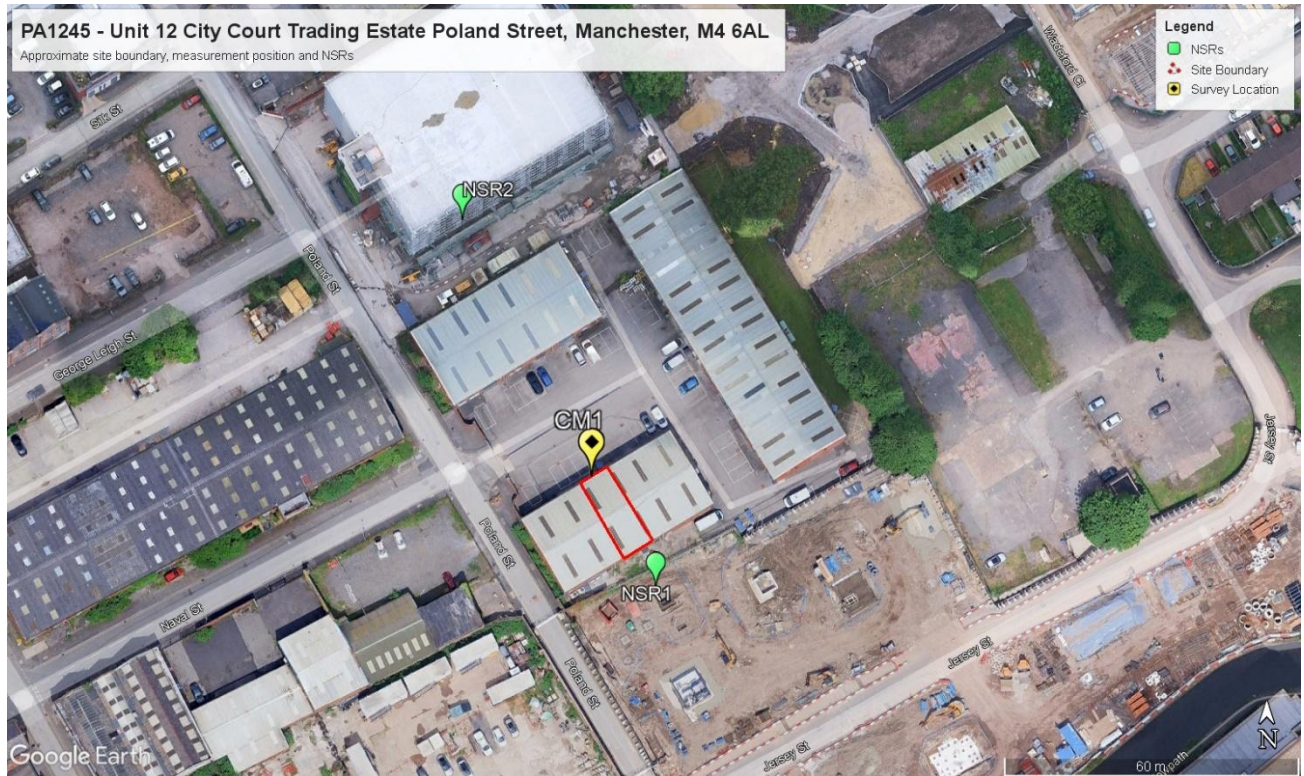
- **NSR1:** Residential apartment block (currently under construction), circa 8m from the south façade of Site; and
- **NSR2:** Assumed residential apartment block along Poland Street (Ancoats Mobility Hub), circa 50m from north façade of Site.

Figure 1.1: Proposed layout



The approximate redline boundary of the Site, along with the locations of NSRs and measurement positions adopted for the survey are shown in Figure 1.2.

Figure 1.2: Site plan



1.2. Scope of Works

The following scope of works has been undertaken:

- An unattended environmental sound survey has been undertaken to determine background sound levels representative of nearby residential receptors;
- External noise breakout from the site has been assessed, based on existing and enhanced envelope constructions;
- Assessment of noise breakout in relation to background sound levels;
- Internal noise level limits have been established based on the sound insulation performance of the proposed building construction; and
- Development of a noise management plan.

2. Planning Policy, Guidance and Criteria

2.1. Relevant Policy and Guidance Documents

Relevant national planning policy and guidance documents comprise:

- National Planning Policy Framework (2023);
- Noise Policy Statement for England (2010);
- Manchester City Council 'Planning and Noise – Technical Guidance' (2022)

A summary of each of the above documents is provided in Appendix B.

2.2. Assessment Criteria

In the absence of any specific and relevant criteria, the following criterion has been adopted to control noise impact at any external NSRs:

- Amplified noise (L_{Aeq}) should be controlled to 5 dB below the typical background noise ($L_{A90,15min}$) at the nearest noise sensitive location.

3. Sound Surveys

3.1. Methodology and Equipment

An unattended environmental sound survey has been undertaken between 09:45 on Thursday 14th August and 22:00 Sunday 17th August 2025 to establish representative background sound levels.

One sound level meter (SLM) was installed at first-floor level, extended 1m from partially opened window in the positions described as follows:

- **Continuous Measurement 1 (CM1):** North facing façade, overlooking City Court Trading Estate, shown in Figure 1.2.

Measurements were taken using class 1 integrating/averaging SLMs housed, where appropriate, in environmental protection apparatus. The SLMs were field calibrated before and after the survey, using a Class 1 calibrator, with no significant drift in calibration noted.

The SLMs were setup to record A-weighted ambient, maximum and background sound levels as a minimum along with associated octave band spectra.

3.2. Survey Conditions and Observations

3.2.1. Meteorological Conditions

Weather conditions during installation and collection of equipment were dry with low wind speeds.

Weather data was monitored over the course of the survey using local weather apps which generally indicates suitable measurement conditions i.e., wind speeds of <5m/s and mostly dry.

Therefore, it can be concluded that there were no adverse meteorological conditions, and all measurement data is acceptable to inform the assessment.

3.2.2. Site Observations

Site notes indicate that during setup of the equipment, construction noise from the site immediately to the south was the dominant source of noise, along with distant road traffic and vehicle movements associated with other businesses within the City Court Trading Estate.

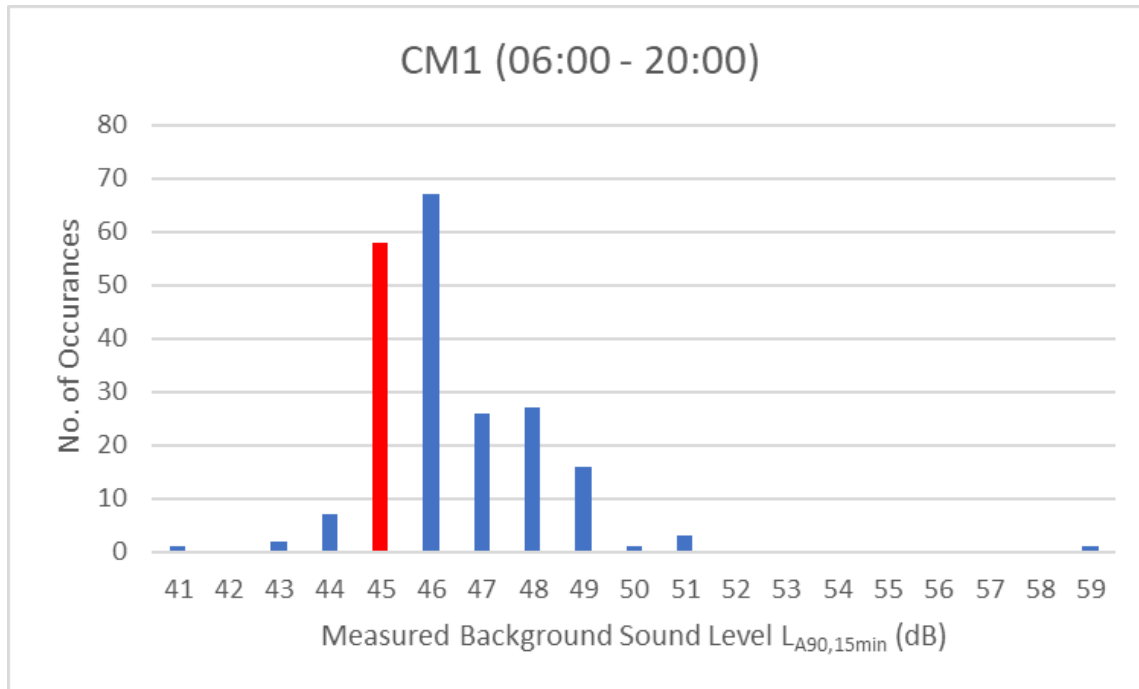
3.3. Measurement Data Analysis

All measurement data collected during the monitoring period, including days with and without construction noise was included in the analysis. A statistical analysis of background sound levels was undertaken to determine representative baseline conditions at the nearest noise-sensitive receptors. The selected background sound level, shown in red in Figure 3.1, is considered robust and was confirmed from data outside the construction periods and across the proposed opening hours on various days. The typical level identified is 45 dB $L_{A90,15min}$.

As the measurement is considered a 'façade level', a deduction of -3 dB has subsequently been applied to convert to a free-field sound level therefore the assessment level is considered as 42 dB $L_{A90,15min}$.

Full time-histories of measured noise survey results are presented in Appendix C.

Figure 3.1: Statistical analysis of background sound levels (façade levels) during proposed operating period



4. External Noise Breakout Assessment

4.1. Target Noise Level

Based on the identified background sound level of 42 dB $L_{A90,15min}$ and the adopted criterion, a gym activity noise level of 37 dB $L_{Aeq,5min}$ or lower is targeted at the receptors.

4.2. Methodology and Assumptions

As the gym is not yet operational, this assessment evaluates the acoustic performance of the building envelope to determine the required level of mitigation required based on a realistic internal source noise level from library data, that can be generated without exceeding acceptable noise levels at nearby receptors.

The construction details of the building have been reviewed, and assumptions regarding the sound insulation performance of key elements (walls, roof, roller-shutter door, fire door) have been made based on typical materials.

The external construction of the premises primarily comprises masonry brick walls, metal corrugated roof and metal shutter door. For the purposes of this assessment, noise breakout through the shutter door and roof has been considered the dominant transmission paths for the north facade, as the masonry brick walls are expected to provide significantly greater sound attenuation, resulting in negligible contribution to the calculation process. It is assumed that the metal corrugated roof, has the same mass per unit area as the corrugated roof transparent panels, and that the perimeter of the roller-shutter doors are well sealed.

The sound reduction indices (SRI) are presented below. Performance data for the roller shutter door, roof and walls have been predicted using Insul.

Table 4.1: Sound insulation performance of building envelope

Element	Sound Reduction Indices (dB) at Octave band Centre Frequency (Hz)							R_w (dB)
	63	125	250	500	1k	2k	4k	
Roller Shutter Door - 0.6mm Steel (North Facade)	8	10	14	19	24	29	34	23
Corrugated Roof - 1.6mm Aluminium (South Facade)	8	10	14	19	24	29	32	23
225mm Masonry Brick	41	39	44	52	59	63	58	55
50mm Steel Door with good seals (BB93 data)	16	21	27	32	34	36	36	34

4.3. Noise Breakout Assessment

Breakout calculations to each identified NSR are shown below based on the existing building construction and an internal noise level of 75 dBA. The spectrum is taken from Peninsular Acoustics library data of a similar situation with a gym class with amplified music and weights being used within an industrial unit.

Figure 4.1: Noise breakout calculation to NSR1 – Existing Construction

GYM NOISE EMISSION CALCULATIONS											
Calculation to NSR1											
Sound pressure level inside, Lp,in	dB	63	125	250	500	1000	2000	4000	8000	dB(A)	NR
		50	62	73	72	71	67	63		75	
Via South Façade Wall											
		63	125	250	500	1000	2000	4000	8000	dB(A)	NR
Diffusivity term for the inside sound field, Cd	-6 dB	-6	-6	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'	dB	41	39	44	52	59	63	58			
Width of segment	11.3 m										
Height of segment	5.5 m										
Area of the segment	59.6 m ²										
Sound power level of the substitute point source, Lw		21	35	40	32	24	16	17			
Directivity correction in the direction of the receptor, Dc	0	0	0	0	0	0	0	0			
Distance to receptor	8 m										
Acoustic screening	dB										
Total attenuation from building element to receptor		24	24	24	24	24	24	24			
Sound pressure level at receptor, Lp		-3	11	17	8	1	-7	-7		11	
Via South Façade Door											
		63	125	250	500	1000	2000	4000	8000	dB(A)	NR
Diffusivity term for the inside sound field, Cd	-6 dB	-6	-6	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'	dB	16	21	27	32	34	36	36			
Width of segment	1.2 m										
Height of segment	2.1 m										
Area of the segment	2.52 m ²										
Sound power level of the substitute point source, Lw		32	39	44	38	35	29	25			
Directivity correction in the direction of the receptor, Dc	0	0	0	0	0	0	0	0			
Distance to receptor	8 m										
Acoustic screening	dB										
Total attenuation from building element to receptor		23	23	23	23	23	23	23			
Sound pressure level at receptor, Lp		9	16	21	15	12	6	2		18	
Total from Wall & Door @ receptor Lp											
		63	125	250	500	1000	2000	4000	8000	dB(A)	NR
		9	17	22	16	13	7	3		19	

GYM NOISE EMISSION CALCULATIONS											
Calculation to NSR1											
Sound pressure level inside, Lp,in	dB	63	125	250	500	1000	2000	4000	8000	dB(A)	NR
		50	62	73	72	71	67	63		75	
Via South Façade Wall & Door Combined											
		63	125	250	500	1000	2000	4000	8000	dB(A)	NR
Sound pressure level at receptor, Lp		9	17	22	16	13	7	3		19	
Via Roof											
		63	125	250	500	1000	2000	4000	8000	dB(A)	NR
Diffusivity term for the inside sound field, Cd	-6 dB	-6	-6	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'	dB	8	10	14	19	24	29	32			
Width of segment	11.3 m										
Height of segment	16.5 m										
Area of the segment	186 m ²										
Sound power level of the substitute point source, Lw		23	23	23	23	23	23	23			
Directivity correction in the direction of the receptor, Dc	0	59	69	75	70	64	55	48			
Distance to receptor	8 m	0	0	0	0	0	0	0			
Acoustic screening	dB										
Total attenuation from building element to receptor		25	25	25	25	25	25	25			
Sound pressure level at receptor, Lp		34	44	51	45	39	30	23		46	
Total receptor Lp											
		63	125	250	500	1000	2000	4000	8000	dB(A)	NR
		34	44	51	45	39	31	23		46	

Figure 4.2: Noise breakout calculation to NSR2 – Existing Construction

GYM NOISE EMISSION CALCULATIONS														
Calculation to NSR2														
Sound pressure level inside, Lp,in				dB	63	125	250	500	1000	2000	4000	8000	dB(A)	NR
					50	62	73	72	71	67	63	50	75	
Via North Façade														
					63	125	250	500	1000	2000	4000	8000	dB(A)	NR
Diffusivity term for the inside sound field, Cd				-6	dB	-6	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'					dB	8	10	14	19	24	29	34		
Width of segment				5.5 m										
Height of segment				4 m										
Area of the segment				22 m2										
Sound power level of the substitute point source, Lw						49	59	66	60	55	46	37		
Directivity correction in the direction of the receptor, Dc				0		0	0	0	0	0	0	0		
Distance to receptor				50 m										
Acoustic screening					dB									
Total attenuation from building element to receptor						39	39	39	39	39	39	39		
Sound pressure level at receptor, Lp						10	20	27	21	16	7	-2	23	
Via Roof														
					63	125	250	500	1000	2000	4000	8000	dB(A)	NR
Diffusivity term for the inside sound field, Cd				-6	dB	-6	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'					dB	8	10	14	19	24	29	32		
Width of segment				11.3 m										
Height of segment				16.5 m										
Area of the segment				186 m2										
Sound power level of the substitute point source, Lw						23	23	23	23	23	23	23		
Directivity correction in the direction of the receptor, Dc				0		59	69	75	70	64	55	48		
Distance to receptor				50 m		0	0	0	0	0	0	0		
Acoustic screening					dB									
Total attenuation from building element to receptor						39	39	39	39	39	39	39		
Sound pressure level at receptor, Lp						20	30	36	31	25	16	9	32	
					63	125	250	500	1000	2000	4000	8000	dB(A)	NR
Total receptor Lp					20	30	37	31	26	17	9		33	

Based on the existing construction of the building, the predicted levels at receptors do not comply with the criteria of being 5 dBA below the background sound at any of the identified NSRs.

Table 4.2: Evaluation of noise impact – Existing Construction

Row		NSR1	NSR2
A	Predicted Level at Receptor (LAeq)	46 dB	33 dB
B	Background Sound Level (LA90)	42 dB	42 dB
C = A – B	Level of Excess	+4 dB	-9 dB

4.4. Recommended Mitigation

4.4.1. Enhanced Constructions

To address the exceedance of noise criteria at all assessed receptors, enhancements to the building façade are recommended to effectively contain internal noise and limit breakout to nearby NSRs. Specifically, the installation of an enhanced roof structure is required.

The recommended constructions are as follows:

Roof

- Existing corrugated roof;
 - Minimum 400mm cavity;
 - Suspended Metal Frame ceiling on acoustic hangers with 100mm mineral wool insulation within the void of min. density 40-45kgm³; and
 - 1no. layers 15mm SoundBloc plasterboard
- *specification to be checked with structural and fire engineers.*

A revised assessment incorporating these improvements indicates that, with the proposed mitigation in place, predicted noise levels from the gym are expected to remain significantly more than 5 dB below the existing background sound levels at all receptors, thereby meeting the proposed noise criteria.

However, it is critical for these calculations / recommendations to work in practice that all windows remain closed, and a double entrance door system (lobby) is installed to protect from noise breakout with people entering and leaving the premises. An integral part of this design will be an appropriate mechanical ventilation system which allows the windows/doors to remain closed while providing adequate background ventilation to the premises. Any mechanical system would have to be acoustically treated to ensure no noise breakout via inlets and outlets to the system.

An evaluation of noise impact is provided below in Table 4.3 with the full ISO 12354-4 enhanced construction calculations included in Appendix D.

Table 4.3: Evaluation of noise impact – With recommended mitigation in place

Row		NSR1	NSR2
A	Predicted Level at Receptor (L _{Aeq})	20 dB	23 dB
B	Background Sound Level (L _{A90})	42 dB	42 dB
C = A – B	Level of Excess	-22 dB	-19 dB

4.4.2. Noise Limiter

To mitigate airborne noise breakout from the proposed gym, a noise limiter is recommended as the primary control measure.

A limiter should be installed on all amplified sound systems, with a calibrated maximum output level of 75 dBA. This limit has been determined based on the performance of the proposed building envelope and the need to maintain acceptable noise levels at nearby receptors.

The sound system should include a mixing desk, amplifier, speakers, and a compressor-type limiter, calibrated by an acoustic consultant prior to use. Speakers should be mounted using resilient fixings and positioned away from structural elements such as columns or party walls to reduce vibration transmission.

This method allows instructors to maintain intelligible speech while controlling music levels. If the 75dBA limit is found to be insufficient for operational needs, further enhancements to the building's sound insulation may be required.

For example products, see [Formula Sound AVC-2 Automatic Volume Control](#).

5. Noise Management

5.1. Noise Management Plan

To ensure the proposed gym operates without causing disturbance to nearby residential receptors, particularly during sensitive hours, the following noise management measures are recommended.

5.1.1. Noise Control Measures

- **External Doors to Remain Closed**

All external doors, must remain closed during operational hours except for entry and exit and a double entrance door system (lobby) should be installed. This is critical to maintain the acoustic integrity of the building envelope and minimise breakout noise.

- **Noise Limiter Installation**

All amplified sound systems (e.g., music, personal trainer microphones) should be fitted with calibrated noise limiters. These systems must be commissioned by a qualified acoustic consultant to ensure internal noise levels remain within the limits determined by the breakout assessment.

- **Gym Impact Matting**

All free-weight areas must be fitted with gym impact matting to reduce structure-borne noise from dropped weights.

- **Anti-Vibration Stoppers**

All weight machines should be fitted with anti-vibration stoppers.

- **Ventilation Considerations**

Where doors must remain closed, alternative ventilation or summer cooling solutions should be considered to maintain comfort without compromising noise control.

5.1.2. Signage and Communication

- **Arrival and Departure Awareness**

Signage should be installed at entry points and within the car park to remind gym users to minimise noise when arriving or leaving, especially during early morning or late evening hours.

- **Vehicle Noise Control**

Notices should advise users to avoid slamming car doors and revving engines, particularly before 7:00am.

5.1.3. Operational Monitoring

- **Routine Noise Checks**

Regular monitoring of noise levels should be undertaken during sensitive periods to ensure compliance with the internal noise limit and identify any emerging issues.

- **Complaint Response Protocol**

Any noise complaints should be logged and investigated promptly. Where necessary, additional mitigation measures (e.g., enhanced insulation) should be considered.

6. Conclusions

Peninsular Acoustics was commissioned by Mr M Redaoui to undertake a noise assessment for a proposed gym to evaluate its potential impact on nearby residential receptors.

The assessment demonstrates that the existing construction is not sufficient to adequately contain typical internal noise levels without risk of disturbance.

Recommendations have been made within the report to provide enhancements, which include an upgraded roof structure and noise limiter for example, along with a noise management plan.

The report demonstrates that when following the recommendations the proposed criteria of 5dBA or more below background at the receivers will comfortably be achieved.

Limitations applicable to this report are contained within Appendix E.



Appendix A

Technical Terminology

Noise	Typically defined as unwanted, unpleasant or disturbing sound
Frequency (Hz)	The number of oscillations in acoustic pressure per second. It represents the 'tone' of the sound. Often determined in octave bands
Maximum sound pressure level (L_{Fmax})	The maximum or highest sound pressure level measured with a 'fast' time weighting
Equivalent continuous sound pressure level ($L_{eq,T}$)	The average of the total sound energy over a specified time period (T). L_{eq} represents the equivalent sound level that a fluctuating source would have compared to a steady source with the same total sound energy over a specific time period. Commonly used as a descriptor of human perception of sound over time.
'A' weighting	Frequency-dependent weighting based on the response of the human auditory system which has been found to correlate well with the subjective response to sound. Denoted by the use of the letter 'A'. For example, dBA denotes an 'A' weighted sound level in decibels, or L_{Amax} denotes an 'A' weighted maximum sound pressure level.
Internal Ambient Noise Level (IANL)	The noise level within a room or enclosed space. Usually determined as an equivalent continuous sound pressure level over a specific time period ($L_{Aeq,T}$, dB)
Noise Rating (NR) curve	A single figure term used to reflect the spectral frequency content of noise. Although originally proposed to assess environmental noise, NR curves are now typically used to describe noise from mechanical ventilation systems in buildings.
Mechanical cooling	Cooling by means of a refrigerant cycle. This would include 'air conditioning' systems and the use of fan coil units (FCUs).
MEV	Mechanical extract ventilation.
Façade level	The sound pressure level measured close to a building façade that includes contribution from both the incident sound and the sound reflected from the façade. Normally taken to be 3dB higher than the equivalent free-field level, when located at 1 metre from a façade.
Free-field level	A measured sound pressure level that is independent of any contributions due to reflections from nearby surfaces and is therefore representative of the direct path only.
R / R_w	The laboratory tested airborne sound insulation of a building element
Sound insulation	The capacity of a structure to prevent sound from reaching a receiving location. Sound energy is not necessarily absorbed; impedance mismatch, or reflection back toward the source, is often the principal mechanism

Appendix B

Relevant National Policy and Guidance

NATIONAL PLANNING POLICY FRAMEWORK

The 'National Planning Policy Framework' (NPPF) was published by central government in 2012 and replaces previous Planning Policy Guidance Notes. It does not replace the Noise Policy Statement (England) 2010 to which it refers. The Planning Practice Guidance (PPG) online resource for the NPPF was launched in March 2014 to assist practitioners with the content of the NPPF.

The NPPF includes a *"presumption in favour of sustainable development that is the basis for every plan, and every decision"*. This is a very clear direction which may conflict with the application of existing local policies in development control decisions and will influence the eventual replacement of those policies.

To clarify this point, the PPG says "Where the development plan is absent, silent or the relevant policies are out of date [the NPPF] requires the application to be determined in accordance with the presumption in favour of sustainable development unless otherwise specified".

Also, "The NPPF represents up-to-date Government policy and must be taken into account where it is relevant to a planning application or appeal. If decision takers choose not to follow the NPPF, clear and convincing reasons for doing so are needed".

LPAs are therefore obliged to follow the NPPF unless they have up-to-date local policies that would justify a departure and, even then, the NPPF has 'material consideration' status. Where local policies conflict with one another, considerations shall be *'guided by the NPPF'*. Where local noise policies are dated, absent or in conflict it appears that national noise policy must take precedence.

The NPPF contains four aims as follows:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life as a result of new development, including through the use of conditions
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established
- Identify and protect areas of tranquillity

The reference numbers 27 and 28 point respectively to the Explanatory Note to the Noise Policy Statement for England (NPSE) (see below) and the provisions of the Environmental Protection Act 1990 and other relevant law.

NOISE POLICY STATEMENT FOR ENGLAND

The 'Noise Policy Statement for England' (NPSE) was published in March 2010. The NPSE is the overarching statement of noise policy for England and applies to all forms of noise other than occupational noise, setting out the long-term vision of Government noise policy which is to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

That vision is supported by the following aims which are reflected in three of the four aims for planning policies and decisions in paragraph 123 of the NPPF:

"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 NPSE introduces the concepts of NOAEL, LOAEL and SOAEL in relation to the potential health implications of a noise/vibration effect, defined as follows:

- "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."

It is acknowledged, however, that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise, in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that *"further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise."*

MANCHESTER CITY COUNCIL GUIDANCE

3.7.1.2 Entertainment Venues

Noise from entertainment venues, e.g. noise from recorded music, live bands, or karaoke, can be particularly annoying for local residents and businesses if not adequately contained within the venue.

When considering the potential impact of a proposal for an entertainment venue, consultants should consider the overall noise level (L_{Aeq}) and the 63 Hz and 125 Hz octave band noise levels (L_{eq}). Music noise in the 63 Hz and 125 Hz octave bands, often described as 'bass noise', is particularly difficult to contain and the impulsive and non-steady character of low frequency music noise is particularly disturbing for local residents exposed to it.

Applicants and consultants should note that, although a particular business model may require a 'chilled out' or 'acoustic' venue, planning approval for an entertainment venue will remain in place as long as the development exists. Subsequent owners or tenants may wish to provide louder entertainment in the future. For this reason, applicants and consultants should predict the noise impact of a proposed entertainment venue using noise levels representative of those found in 'typical' venues of the kind being applied for. Consultants should provide their rationale for using particular noise levels and reference the source of the noise levels used during their predictions.

A lively city centre bar can operate around 95dB L_{Aeq} and nightclubs can be even higher at 105dB L_{Aeq} . The range of levels at 63Hz and 125Hz octave bands is wider than the A-weighted levels and can be up to 115dB L_{eq} and 110dB L_{eq} respectively (Davies *et al* 2005).

There is a lack of consensus on an assessment method for noise levels within habitable rooms with regard to entertainment noise. The design aim, however, should be to design to

'inaudible'*. The building structure is therefore key and will usually involve a high performing solution in loud music venues.

Existing noise standards/criteria are not appropriate for evaluating low frequency noise; in almost all other situations the established noise descriptors are based on the A-weighted sound level (dBA), which effectively filters out low frequency sounds (Moorhouse *et al* 2011).

When dealing with noise control, especially at the lower frequencies, it is usual to look at the octave band data as a Z-weighting (linear) and not the A-weighting, due in main to the amount you have to 'take off', resulting in meaningless data (-26.2dB at 63Hz), and also with respect to the sound insulation performance of various constructions materials.

Rather than just A-weighted levels being assessed, e.g. internal noise levels as per BS 8233: 2014, a low frequency band analysis should be carried out (McCullough *et al* 2004).

*Noise is considered to be inaudible when it is at a sufficiently low level such that it is not recognisable as emanating from the source in question and it does not alter the perception of the ambient noise environment that would prevail in the absence of the source in question.

The DEFRA report 'Noise from Pubs and Clubs – Phase 1' on page 17 reproduces the Institute of Acoustics (IOA) working group guidance to achieve music noise levels which are 'virtually inaudible' inside a residential property.

In the 'Procedure for the assessment of low frequency noise complaints (NANR45) – Revision 1', Moorhouse *et al* (2011) use limits for low frequency noise levels in 1/3 octave bands between 10Hz and 160Hz.

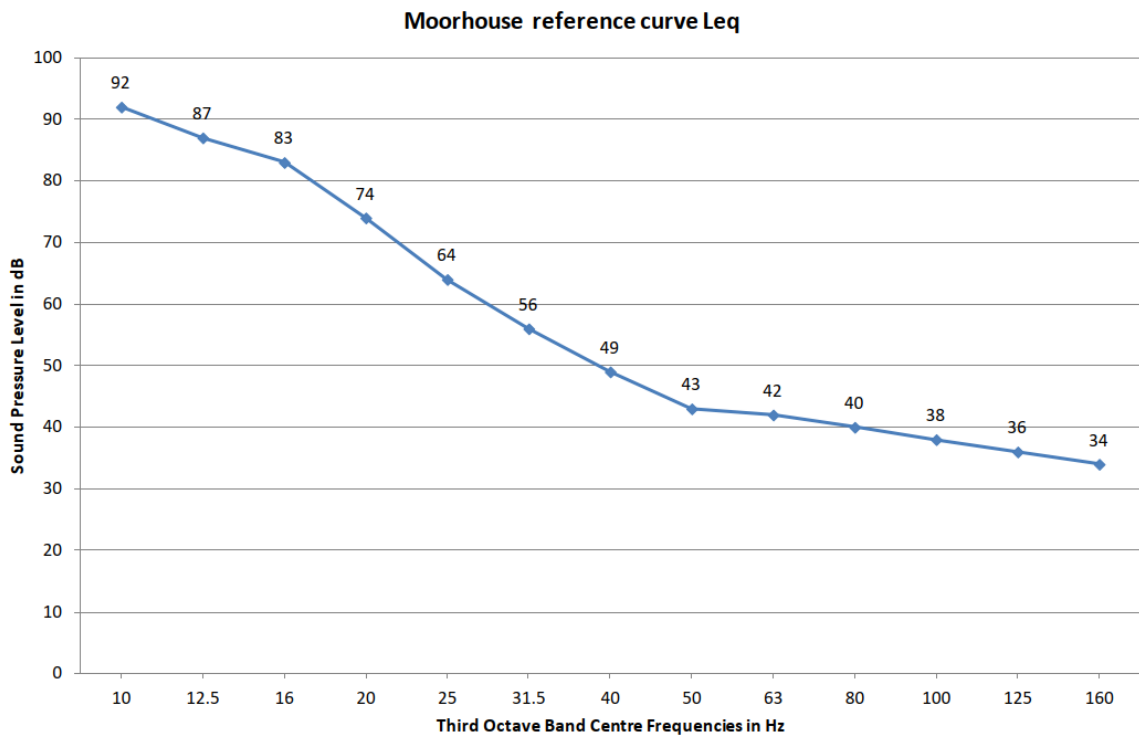


Figure 1

For the assessment of low frequency music noise, it is more practical to consider the 63 Hz and 125 Hz octave bands. The Noise Council's Code of Practice (1995) on 'Environmental Noise Control at Concerts' suggests limits on both these octave bands.

The DEFRA report 'Noise from Pubs and Clubs – Phase 1' suggests limits on 1/3 octave bands. However the problem with this particular suggestion, and one of the reasons it is not widely used, is due to the difficulty in obtaining 1/3 octave band sound insulation performance data for various construction materials.

With regards to assessing music noise, the 63 Hz and 125 Hz octave band levels as shown in Figure 1 have been plotted against the NR 15 curve as shown in Figure 2, and a good correlation at low frequencies is evident (the octave bands were calculated from the 'Moorhouse curve' by logarithmically adding the adjacent 1/3 octave bands).

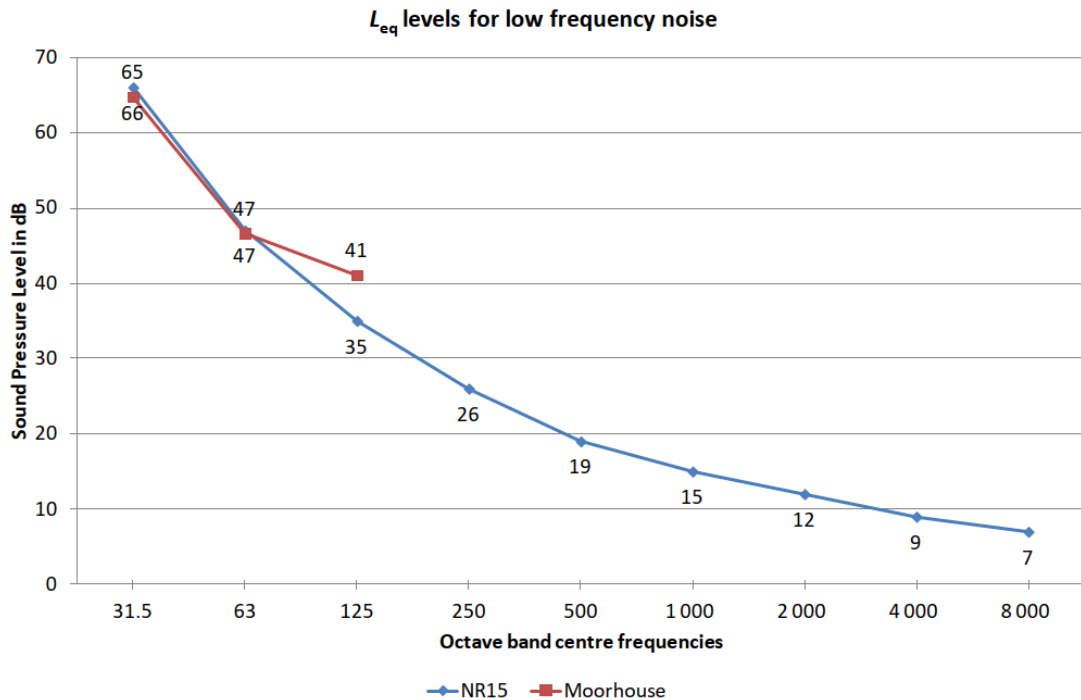


Figure 2

However, the NR curve may be too stringent at mid and higher frequencies and may be lower than background noise levels in habitable spaces. Furthermore, the NR curve is most commonly used to set limits for mechanical services noise in buildings, i.e. steady, continuous noise sources. Music noise has different characteristics and as such can be described as unsteady and non-continuous in comparison.

Even though the Moorhouse curve does not specifically relate to entertainment noise (as per the caveat in the revised edition) these levels provide a good practical basis to assess low frequency music noise. They also provide a workable prediction for planning applications and a measurement method and assessment for in-situ low frequency issues in existing habitable spaces.

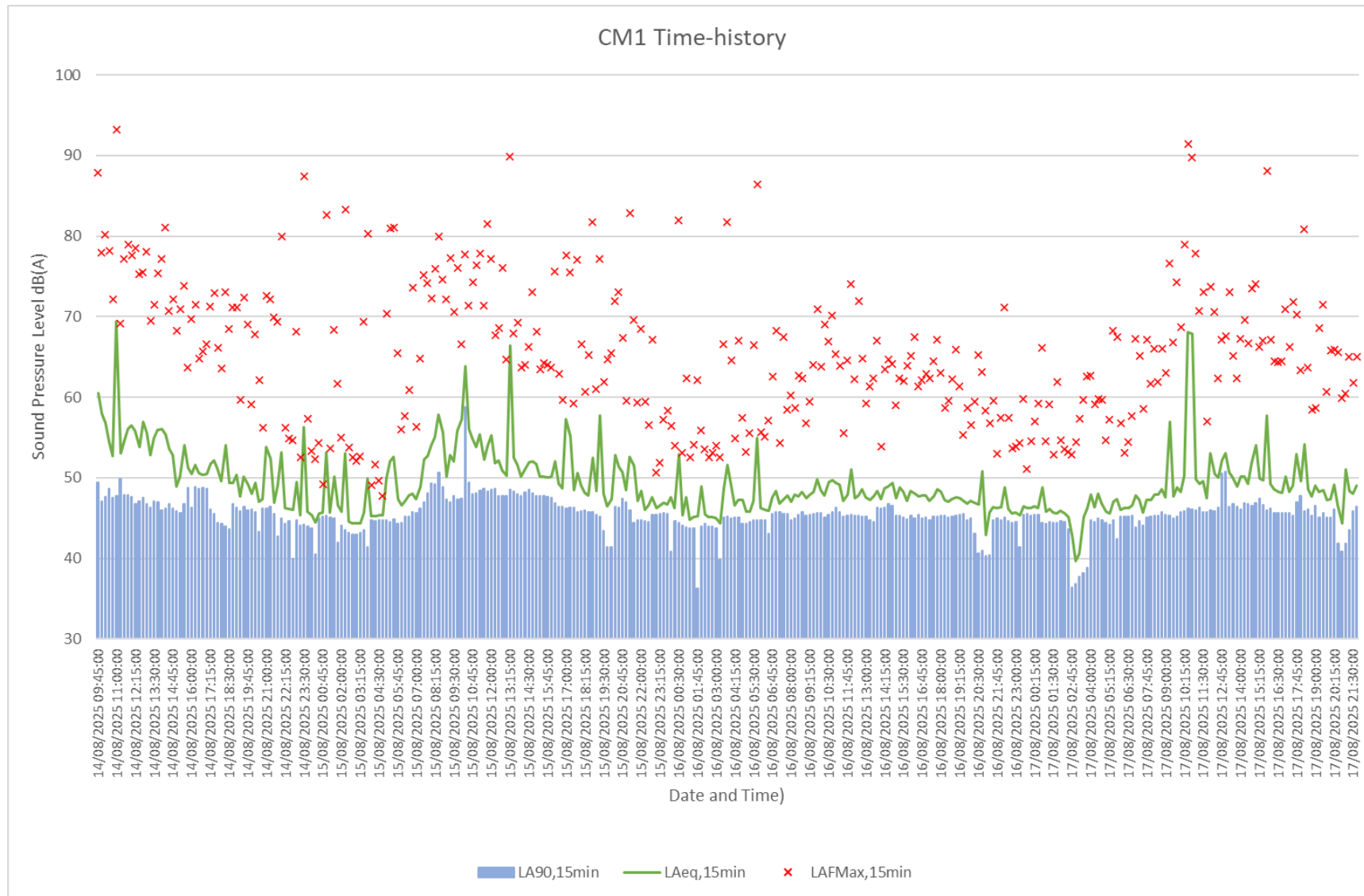
Therefore, a criterion that would achieve a condition of 'inaudible' / 'virtually inaudible' which is applicable for new residential developments that are structurally connected to entertainment venues (or vice versa) would be:

'Music noise levels in the 63Hz and 125Hz octave centre frequency bands (L_{eq}) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB ($L_{eq,5min}$), respectively'.

This criterion may also be applicable for new residential developments that are structurally separate from an existing entertainment venue.

Appendix C

Time-histories of noise survey results





Appendix D

ISO 12354-4 Enhanced Construction Calculations

Figure 6.1: Noise breakout calculation to NSR1 – Enhanced Constructions

GYM NOISE EMISSION CALCULATIONS										
Calculation to NSR1										
Sound pressure level inside, Lp,in		63	125	250	500	1000	2000	4000	8000	
	dB	50	62	73	72	71	67	63		dB(A) NR
Via South Façade										
Diffusivity term for the inside sound field, Cd	-6	dB	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'		dB	41	39	44	52	59	63	58	
Width of segment	11.3 m									
Height of segment	5.5 m									
Area of the segment	59.6 m ²									
Sound power level of the substitute point source, Lw			18	18	18	18	18	18		
Directivity correction in the direction of the receptor, Dc	0		21	35	40	32	24	16	17	
Distance to receptor	8 m		0	0	0	0	0	0	0	
Acoustic screening		dB								
Total attenuation from building element to receptor			24	24	24	24	24	24		
Sound pressure level at receptor, Lp			-3	11	17	8	1	-7	-7	11
Via Door										
Diffusivity term for the inside sound field, Cd	-6	dB	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'		dB	16	21	27	32	34	36	36	
Width of segment	1.2 m									
Height of segment	2.1 m									
Area of the segment	2.52 m ²		4	4	4	4	4	4		
Sound power level of the substitute point source, Lw			32	39	44	38	35	29	25	
Directivity correction in the direction of the receptor, Dc	0		0	0	0	0	0	0	0	
Distance to receptor	8 m									
Acoustic screening		dB								
Total attenuation from building element to receptor			23	23	23	23	23	23		
Sound pressure level at receptor, Lp			9	16	21	15	12	6	2	18
Total South façade - Wall & Door Lp										
		63	125	250	500	1000	2000	4000	8000	dB(A) NR
		9	17	22	16	13	7	3		19

GYM NOISE EMISSION CALCULATIONS										
Calculation to NSR1										
Sound pressure level inside, Lp,in		63	125	250	500	1000	2000	4000	8000	
	dB	50	62	73	72	71	67	63		dB(A) NR
Via South Façade										
Sound pressure level at receptor, Lp		9	17	22	16	13	7	3		19
Via Roof										
Diffusivity term for the inside sound field, Cd	-6	dB	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'		dB	12	31	42	53	61	63	72	
Width of segment	11.3 m									
Height of segment	16.5 m									
Area of the segment	186 m ²									
Sound power level of the substitute point source, Lw			23	23	23	23	23	23		
Directivity correction in the direction of the receptor, Dc	0		55	48	47	36	27	21	8	
Distance to receptor	8 m		0	0	0	0	0	0	0	
Acoustic screening		dB								
Total attenuation from building element to receptor			25	25	25	25	25	25		
Sound pressure level at receptor, Lp			30	23	23	11	2	-4	-17	16
Total receptor Lp										
		63	125	250	500	1000	2000	4000	8000	dB(A) NR
		30	24	25	17	13	7	3		20

Figure 6.2: Noise breakout calculation to NSR2 – Enhanced Constructions

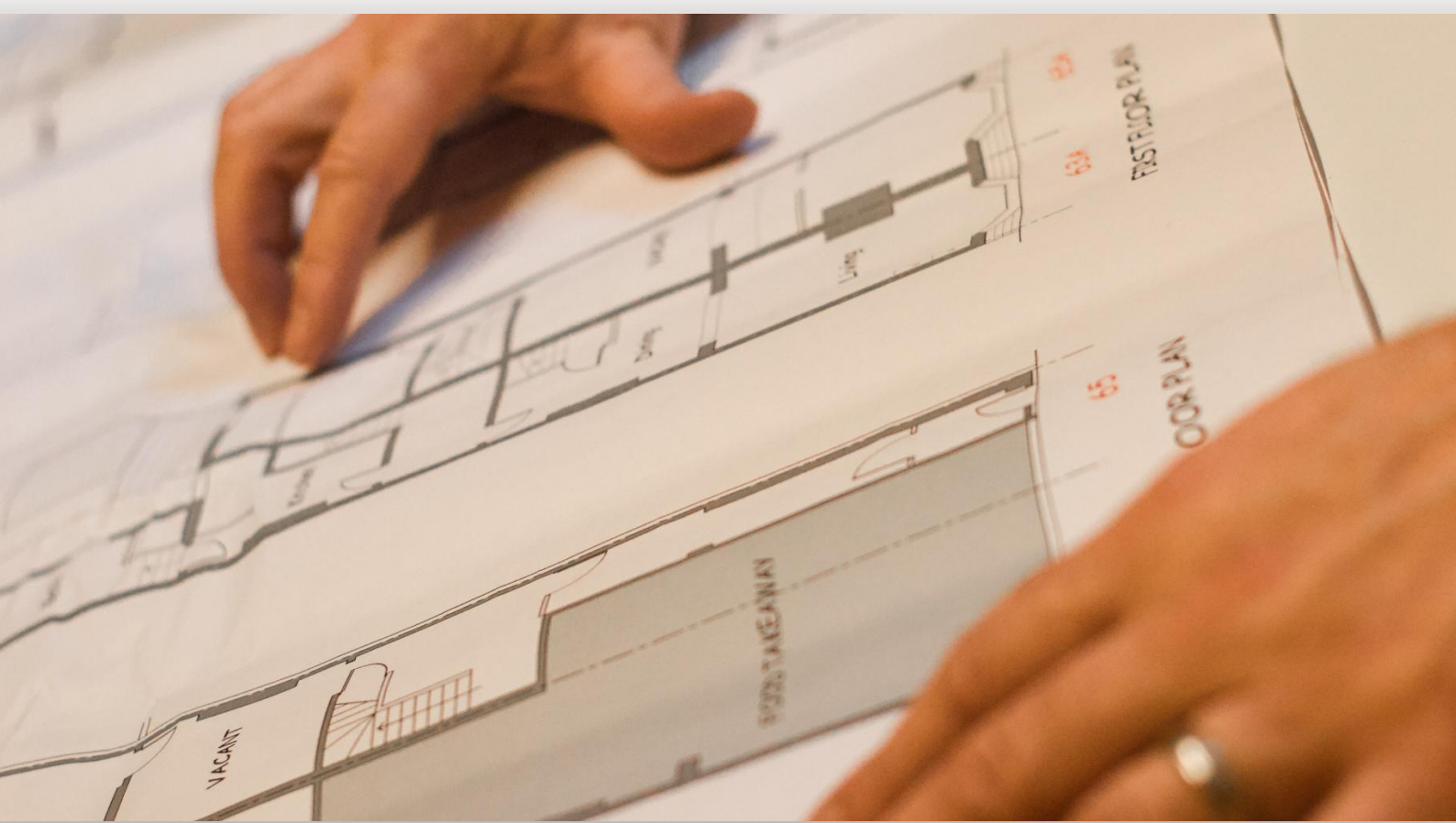
GYM NOISE EMISSION CALCULATIONS										
Calculation to NSR2										
Sound pressure level inside, Lp,in		63	125	250	500	1000	2000	4000	8000	
	dB	50	62	73	72	71	67	63	50	75
Via North Façade										
		63	125	250	500	1000	2000	4000	8000	
Diffusivity term for the inside sound field, Cd	-6 dB	-6	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'	dB	8	10	14	19	24	29	34		
Width of segment	5.5 m									
Height of segment	4 m									
Area of the segment	22 m ²	13	13	13	13	13	13	13		
Sound power level of the substitute point source, Lw		49	59	66	60	55	46	37		
Directivity correction in the direction of the receptor, Dc	0	0	0	0	0	0	0	0		
Distance to receptor	50 m									
Acoustic screening	dB									
Total attenuation from building element to receptor		39	39	39	39	39	39	39		
Sound pressure level at receptor, Lp		10	20	27	21	16	7	-2		23
Via Roof										
		63	125	250	500	1000	2000	4000	8000	
Diffusivity term for the inside sound field, Cd	-6 dB	-6	-6	-6	-6	-6	-6	-6		
Sound reduction of the segment, R'	dB	12	31	42	53	61	63	72		
Width of segment	11.3 m									
Height of segment	16.5 m									
Area of the segment	186 m ²	23	23	23	23	23	23	23		
Sound power level of the substitute point source, Lw		55	48	47	36	27	21	8		
Directivity correction in the direction of the receptor, Dc	0	0	0	0	0	0	0	0		
Distance to receptor	50 m									
Acoustic screening	dB									
Total attenuation from building element to receptor		39	39	39	39	39	39	39		
Sound pressure level at receptor, Lp		16	9	8	-3	-12	-18	-31		4
Total receptor Lp										
		63	125	250	500	1000	2000	4000	8000	
		17	21	27	22	16	7	-2		23

Appendix E

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