BRAIDEN ACOUSTICS LTD

Innovation Forum // 51 Frederick Road // Salford // Manchester // M6 6FP

GYMNASIUM ACOUSTIC SURVEY

Prepared for : Linberg

Date : 23 Jan 2018

Site : Basement, 45-47 Newton St, Manchester

Report No. : 10579

1 INTRODUCTION

Braiden Acoustics has been commissioned by Linberg to undertake an acoustic survey at the site of Basement, 45-47 Newton St, Manchester in order to support planning application 118425/FO/2017 for the following proposal: 'Change of use from D1 to D2 (Gym) including external alterations comprising installation of 2 air conditioning units within ginnel'.

This is an updated report following on from the initial baseline survey dated 29th November 2017.

1.1 AIM

This report assesses potential noise impact on any potential nearby 'sensitive receivers' and recommends mitigation acoustic measures, where necessary, so that the Council's noise thresholds are met.

2 DESCRIPTION OF SITE

The site forms the basement of 45-47 Newton Street in the Northern Quarter district of Manchester. On the ground floor of the building is a proposed restaurant / bar with offices above that.

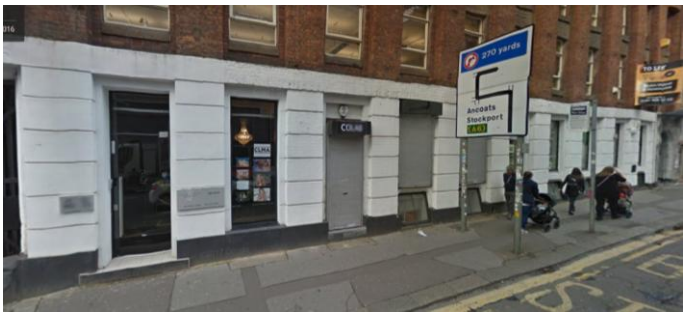


Figure 1
Street view of site

2.1 SITE LOCATION AND SURROUNDING AREA

The site is within Manchester City Centre and, as such, is predominantly a commercial area. The nearest residential is on the upper floors of Bradley House on Hilton Street, as outline in green in Figure 2, which is too far away and too shielded to be affected by noise from the proposed gym. The nearest accommodation, however, is a hotel on the opposite side of Newton Street. There are offices on the upper floor of the building with a proposed restaurant / bar on the ground floor.

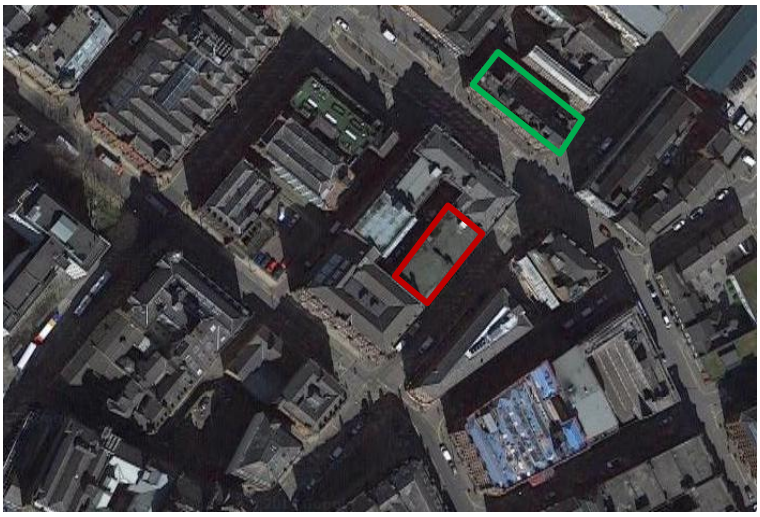


Figure 2
Site location and surrounding uses

The site is bounded by Newton Street to the south east, an alley way to the south west, a service yard to the rear and 49 Newton Street to the north east.

2.2 EXISTING USE

The basement has been used as a makeup studio – retail A1.

There are also some pavement window lights.

2.2.1 Ground Floor construction

The floor between the basement and the ground floor is constructed from the following build up:

- 70mm x 300 w mm T & G floor boarding plus 22mm T & G floor boarding plus finishes (to be decided).
- 25mm air gap
- 15mm Gyproc fire line board

2.3 PROPOSED USE

The gym will have two main studios (one a 'spin room') with segregated areas for female and male changing and a small office – see Figure 3. There will also be a seating area with viewing windows.

Studio 1 will have the potential for free weights that can impact on the ground.

Studio 2 will be the spinning room.



Figure 3
Gym layout

2.3.1 Proposed basement floor build up

The proposed floor finishes have been generally described as the studio areas having general rubber impact matting with increased depth pads in the main studio, especially for barbells. The sanitary areas will be tiled and the main corridor access and reception will also be tiled.

2.3.2 Mechanical services

There will be external condenser units, possibly located in the side alley, but details of these are not known at the time of writing.

2.3.3 Music system

A modest hi-fi type sound system will be used within the gym and recommendations are given later in this report.

2.3.4 Opening Hours

Monday to Sunday 07:00 to 22:00

3 ACOUSTIC CRITERIA AND METHODOLOGY

The main issues of noise are the following:

- internal impact noise transmission
- internal airborne noise transmission
- external plant noise
- airborne noise break out.

For external plant noise, Manchester City Council have criteria that are based upon BS 4142, whereby the noise level from external plant is compared to the background noise level, at the nearest sensitive receptor.

There are no formal assessment criteria for internal noise transmission from a gym. However, the Environmental Health Department of Manchester City Council have developed both airborne and impact noise criteria.

3.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

The National Planning Policy Framework is the current document for planning guidance. Paragraph 123 of the NPPF says that planning decisions should aim to:

- 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 arising from noise from 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; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

3.2 BS 4142

BS 4142:1999 "Method for rating industrial noise affecting mixed residential and industrial areas" [1] assesses industrial noise with regards to nearby residential dwellings. The guidance is commonly used to compare the equivalent noise from an industrial source only (*specific noise level*), L_{Aeq}, to the background noise level, L_{A90}, at the nearest sensitive receptor (NSR).

This Standard has been recently updated, BS 4142:2014 "Methods for rating and assessing industrial and commercial sound" [2]. Whereas the old standard added 5dB 'penalty' to the Specific Noise Level (SNL) if the noise source has a 'character' that can draw attention that may be described as tonal, intermittent or impulsive, the new standard gives clearer guidance on noise 'character'. Furthermore, the previous Standard gave only one 5 dB penalty whereas the new Standard may not. When added to the specific noise level it forms the *rating level*. The new Standard gives the guidance for the following types of noise character:

> *Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.*
>
> *Correct the specific sound level if a tone, impulse or other characteristic occurs, or is expected to be present, for new or modified sound sources.*
>
> *NOTE 1 The prominence of tonal or impulsive sound from a source can be masked by residual sound. In many cases the amount of masking varies as the residual sound changes in level and possibly character. The source's tonal and/or impulsive characteristics could also vary with time.*
>
> *Consider the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention.*
>
> *Tonality*
>
> *For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.*
>
> *Impulsivity*
>
> *A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a*

penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible.

Other sound characteristics

Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

NOTE 2 Where tonal and impulsive characteristics are present in the specific sound within the same reference period then these two corrections can both be taken into account. If one feature is dominant then it might be appropriate to apply a single correction. Where both features are likely to affect perception and response, the corrections ought normally to be added in a linear fashion.

Intermittency

When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Once a penalty for noise character is added to the Specific Noise Level then this is termed the *Rating Level*.

The background level is then compared to the rating level. It is usual that the rating level due to the source should be below the background noise level at the nearest sensitive receptor; indeed BS 4142 states:

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

3.3 BS 8233: 2014

3.3.1 Residential

The British Standard BS 8233:2014 "Guidance on sound insulation and noise reduction for buildings" gives guidance on recommended indoor ambient noise levels for residential dwellings.

Room	Criterion	$L_{Aeq,T}$	
		night	day
Bedroom	Sleeping	30	35
Dining Room/Area	Dining	--	40
Living Room	Resting	--	35

Table 1
Recommending indoor ambient noise level thresholds from anonymous noise (taken from Table 4, BS 8233:2014)

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

Internal noise levels in habitable rooms are calculated using either the simple or rigorous method as described in Annex G in BS 8233:2014.

3.3.1.1 Noise levels in external living areas

For external living areas such as gardens and balconies, BS 8233:2014 § 7.7.3.2 recommends an upper limit of 55dB $L_{Aeq,day}$ although there is a caveat:

> *However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.*

3.3.1.2 Maximum noise levels

In the 2014 edition of the Standard, the criterion of 45dB L_{AFMax} inside bedrooms has been removed although there is Note 4:

> *NOTE 4 regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or LAmax,P depending on the character and number of events per night. Sporadic noise events could require separate values.*

The use of the phrases 'may be set' and 'could require' imply that this is a discretionary criterion.

3.3.2 Other building uses

The British Standard BS 8233 [3] deals with noise in and around buildings. Section 7 deals with noise is certain building types and Table 2 gives typical noise levels of a variety of building types that are assumed to be unoccupied.

Table 2 **Indoor ambient noise levels in spaces when they are unoccupied and privacy is also important**

Objective	Typical situations	Design range $L_{Aeq,T}$ dB
Typical noise levels for acoustic privacy in shared spaces	Restaurant	40 – 55
	Open plan office	45 – 50
	Night club, public house	40 – 45
	Ballroom, banqueting hall	35 – 40
	Living room	35 – 40

NOTE See Noise control in building services [28] and BS EN ISO 3382.

Table 2
Typical ambient unoccupied noise levels for different building types

Some uses, such as restaurants and open plan offices, benefit from a residual amount of broadband noise as this aids masking and thus helps privacy amongst users.

3.4 COUNCIL CRITERIA

3.4.1 External plant noise

External plant noise should be 5dB or more below the background noise level in each octave band; basically following a BS 4142 type methodology.

3.4.2 Gym impact and airborne noise

In an email communication with Manchester Council[1] the following criteria were established for a gym:

> *For airborne noise the building should achieve a reduction of 65dB[2].*

[1] Email communication between John Braiden (Braiden Acoustics) and Gerard Lennox (MCC) dated 15th December 2015

[2] The precise sound insulation parameter has not been defined.

For structure borne (impact noise) we would want the 60kg barbell drop test not to register above background noise when measured from the flat above.

NB** The gym noise criteria above are for residential in the same building which is not the case here.

4 Monitoring Details

There have been two distinct sets of noise measurements:

- airborne noise from basement to first floor
- external background noise.

There are also some historical noise data that measured noise from typical gym activities and a spinning class – shown in Section 5.1.

4.1 AIRBORNE

The airborne sound insulation test was taken between the ground floor and basement floor of 47 Newton Street. The airborne sound insulation test followed the standard procedure given in Building Regulations Part E.

The result of the airborne sound insulation test between ground and basement floors was:

$$46 \text{ dB } D_{nT,w} + C_{tr}$$

Details can be seen in the Appendix.

4.2 EXTERNAL BACKGROUND NOISE

4.2.1 Overview

Personnel: John Braiden, BSc & MSc Acoustics, MIOA.

Equipment: NTi XL2 integrated real time analyser & B&K 4231 calibrator.

4.2.2 External noise monitoring details - front

External ambient noise measurements were made at the front of the site on Newton Street.

Weather: 14-18^{o}C temperature; ~5ms^{-1} wind; ~60-80% cloud;

Location: microphone approx 1.5 m at the entrance to the side alley.

Date / Time: Thu 01/06/2017– see Figure 4 for time period.

The sound level meter was calibrated before after the measurements with no significant drift reported.

Monitoring was unmanned with audio recorded.

4.2.3 Monitoring results

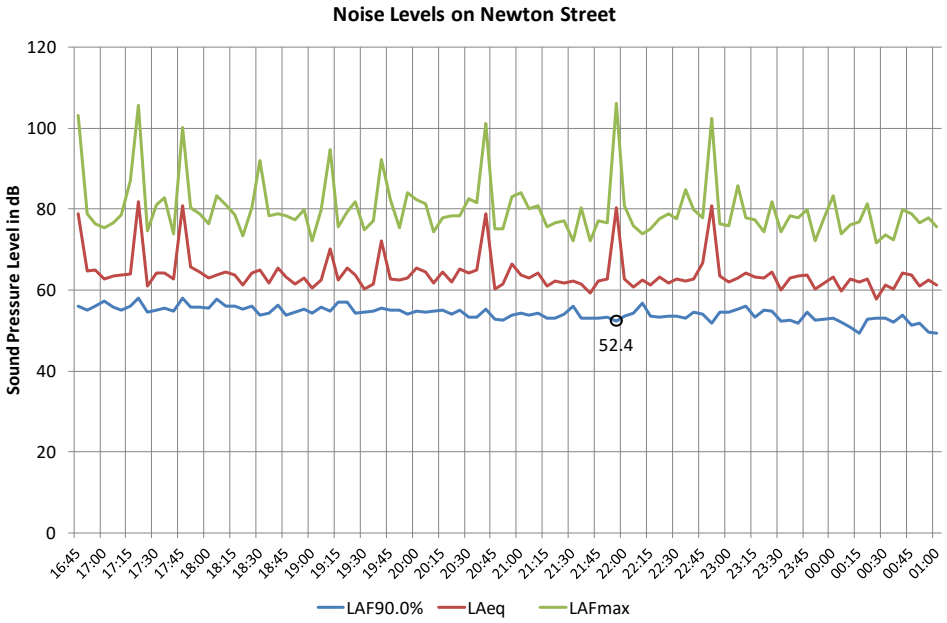


Figure 4
Time history

The lowest background noise level, during proposed opening hours, was 52.4 dB(A).

Ambient noise was predominantly road traffic noise and general 'hub bub' of a city centre. Figure 4 shows that the underlying noise (background noise L_{A90}) did not significantly decrease once into the night time period, i.e beyond 23:00 and so was relatively constant.

4.3 EXTERNAL NOISE MONITORING DETAILS - REAR

External ambient noise measurements were made in the internal courtyard to the rear.

Weather: 21°C temperature; ~5ms^{-1} wind; ~20% cloud;

Location: microphone approx 1.5 m from ground and 3.5m from nearest wall.

Date / Time: Fri 26/05/2017– see Table 3 for time period.

The sound level meter was calibrated before after the measurements with no significant drift reported.

Monitoring was manned with audio recorded.

4.3.1 Monitoring results

Short term noise levels to the rear were more to account for noise from external plant venting to the rear courtyard and thus potentially affecting office workers. Noise measurements were made during a mid afternoon when noise levels would be at their lowest during office hours (i.e. not during a rush hour or lunchtime).

Time		Duration	Time Period	L_{A90} dB	L_{Aeq} dB	L_{Amax} dB
Start	Finish					
15:17:50	15:37:27	00:19:37	day	51.5	56.4	74

Table 3
Monitoring results at rear

The background noise level, during proposed opening hours and office hours, was 51.5 dB(A).

5 ACOUSTIC ASSESSMENT

There are various issues to assess regarding noise:

- Internal noise transmission
    - airborne
    - impact
- noise break out
- external building services noise

5.1 INTERNAL NOISE LEVELS

In the section, some noise levels are shown of a similar gym that also has main gym area with free and fixed weights as well as a spin room.

5.1.1 Main gym

Noise levels have been measured in a similar gym and are shown below in Figure 5.

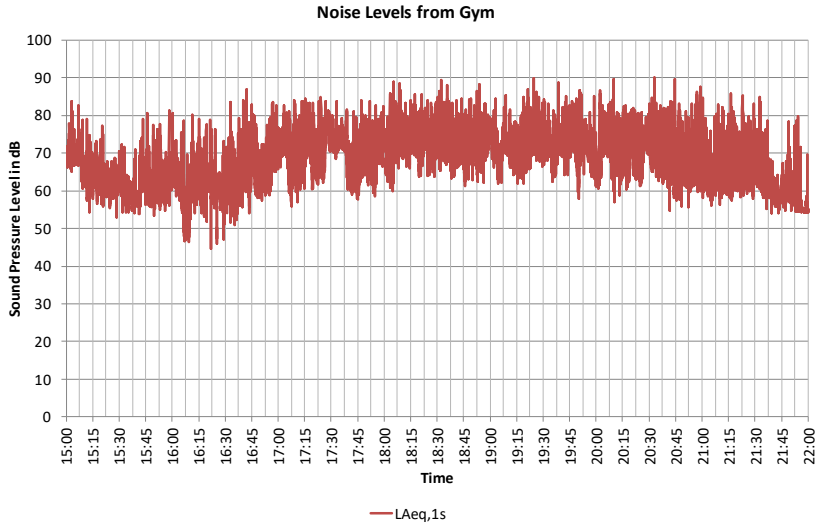


Figure 5
Typical Noise Levels in a gym

Noise levels are generally between 70- and 80 dB(A) although 90 dB(A) can be reached. These noise levels are due to patron noise (talking / laughing etc.), impact noise due to weights / machines and, to a lesser degree, the sound system which was operating between 65 and 70 dB(A). Noise levels of the

sound system did not increase over 70 dB(A) as it would have made verbal communication difficult; hence this is an operational level that modern gyms naturally work to.

5.1.2 Spinning room

Noise levels from a similar spinning class are shown in Figure 6. The levels do vary a lot although when the class is in full operation the average noise levels were between 85 and 90 dB(A). As a worst case the highest noise level is

98 dB L_{Aeq}

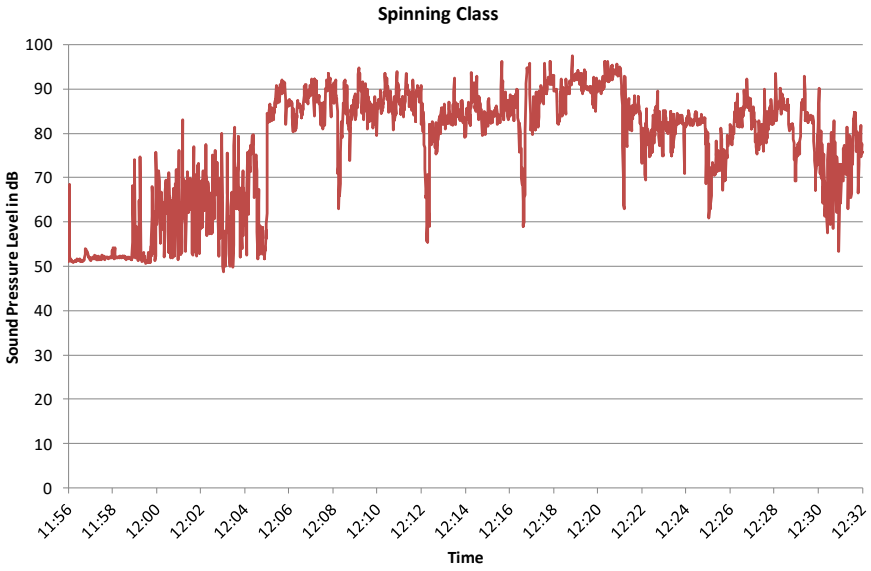


Figure 6
Noise levels from similar spinning class

The noise level is comprised of music and vocal noise from the instructor. These are usually high intensity sessions so the vocal effort of the instructor is significant.

5.2 INTERNAL NOISE TRANSMISSION

5.2.1 Internal impact noise transmission

Following on from a similar gym in Manchester, the following floor build ups are recommended and have been proved to work.

1. All areas 10mm dense rubber
2. Areas of potential direct impact (10mm dense rubber) + Sylomer 42 + Sylomer 28 + floor finish

Areas of potential direct impact are where heavy items could potentially impact on the floor, when dropped for example.

More advice can be found at Total Vibration Solutions http://www.totalvibrationsolutions.com

5.2.2 Airborne sound transmission to the ground floor unit

The current floor build up has a sound insulation performance of 46 dB $D_{nT,w} + C_{tr}$. However, the following upgrade has been recommended:

- current ceiling to be removed to reveal underside of large timber t&g boards;

- all gaps / holes etc. appropriately filled;
- 1 x 15mm Fireline board directly attached to the underside of the large t&g boards;
- timber joist constructed perpendicular to the beams but not touching the underside of the t&g boards to create a 150mm cavity;
- 100mm of acoustic mineral wool insulation in the cavity;
- resilient bars connected perpendicular to the joists but not touching the beams;
- 2 x 15mm acoustic boards correctly attached to the resilient bars (no shorting) and not touching the beams. 2-3mm gaps around the perimeter and filled with acoustic sealant;
- all joints should be staggered and filled with acoustic sealant;
- no penetrations through the acoustic ceiling.

The improved ceiling should give an increase in sound insulation of approximately 20 dB; thereby, achieving the 65 dB recommended by the Council.

The spinning room noise level is higher than the main gym noise levels, therefore the assessment of airborne noise transmission via the floor shall be based on a gym noise level of 98 dB(A).

Therefore the noise level at ground floor will be approximately 32 dB(A) and thus not breaching the levels give in Table 2.

5.2.2.1 Window junction

The current floor becomes reduces to the 70mm timber boards in order to meet the head of the 'floor light' windows – see Figure 7. It is proposed that an internal glazed unit should be installed at an angle to encourage light penetration whilst offering sufficient sound insulation.

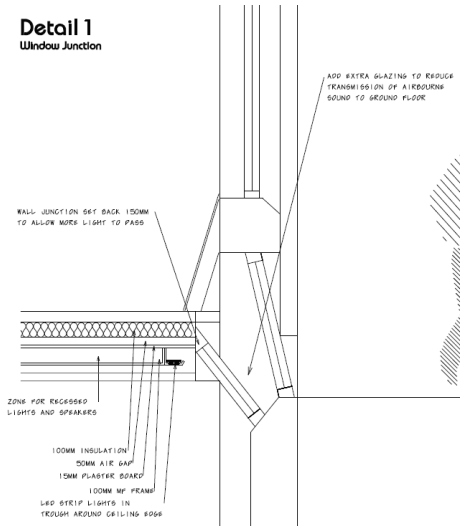


Figure 7
Typical 'pavement light' window detail

The following details are recommended:

1. The 'skirting' within the ground floor window should be improved with 2x15mm soundbloc on the window side and fully sealed with acoustic sealant.

2. The minimum airspace between the internal and external glazed units should be at least 200mm at the most narrow point.
3. The internal and external units should have separate frames that should be in contact with each other.
4. The internal glazed unit should be at least 10mm thick.
5. The reveals should be lined with an acoustic tile, mineral wool or similar absorptive material, to inhibit resonances with the cavity – see Figure 8 for guidance.

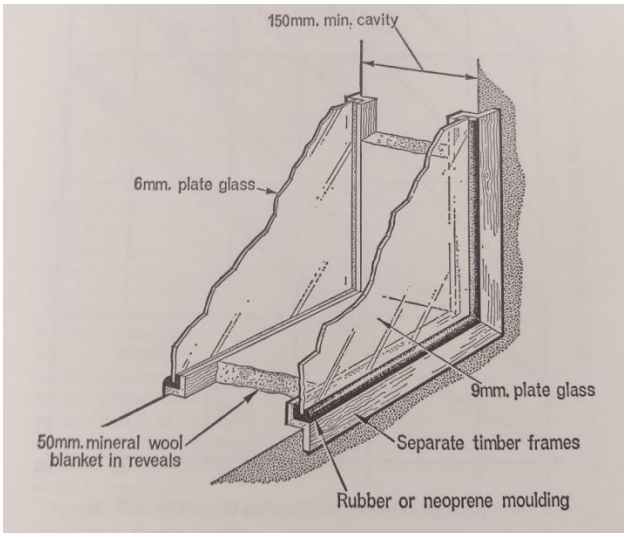


Figure 8
Typical secondary glazed units with absorption in the reveal (THIS IS NOT THE EXACT DETAIL)

5.2.3 Low frequency noise

There are to be no subwoofers or large (PA) loudspeakers to be installed. Loudspeakers should not have drives units larger than 150mm diameter.

Braiden Acoustics should be consulted to ensure compliance

5.3 NOISE BREAK OUT

The site is within the basement of the building; however there are small pavement level windows for potential sound egress.

The performance of the secondary glazed arrangement mentioned in Section 5.2.2.1 is [4] shown in Figure 9.

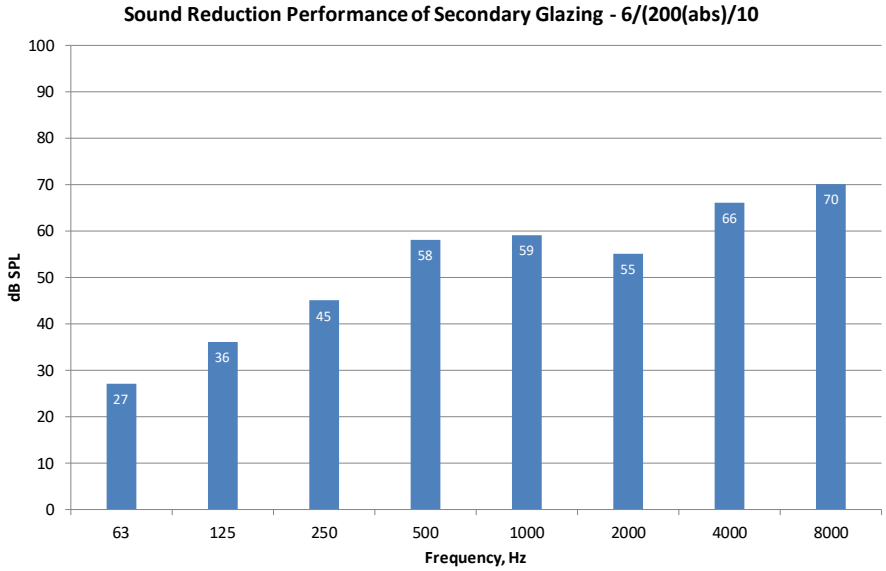


Figure 9
Sound Reduction Performance of Secondary Glazed Unit

Noise break out can occur via the spinning room to the front and then up to the nearest office on the first floor and also to the hotel across the road. Noise break out can also occur to the rear and up to the first floor offices again and also to the office on the opposite side of the courtyard.

A noise break out calculation was done for each break out scenario to see what the allowable maximum internal noise level would be. This can then be compared to the measured noise levels of typical gym and spinning activities in Section 5.1.

The lowest permissible noise levels in the gym and spinning room are shown in the Figure below.

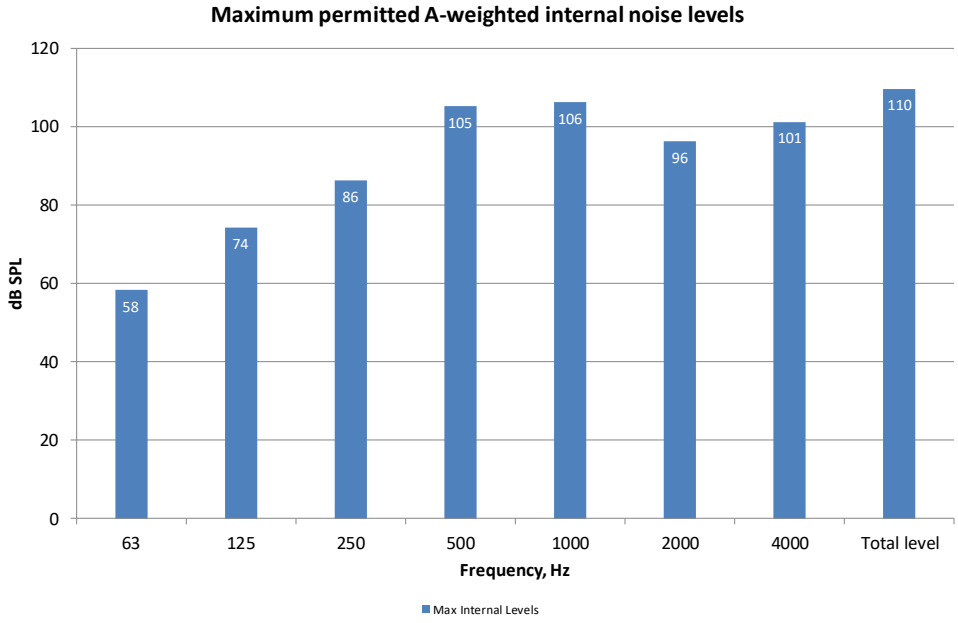


Figure 10
Maximum permitted noise levels in either Studio 1 or 2

The overall permitted noise level in either studio is shown to be 110dB(A). This is far in excess of typical gym and spinning noise levels shown in Section 5.1 and thus the mitigation specified meets the Council's noise criteria.

5.4 EXTERNAL PLANT NOISE

There is to be heat recovery ventilation system that will use the existing ventilation grill window as seen in Figure 11 and Figure 12. This window is the corridor of the gym, therefore sound insulation of noise egress from the Studios is not compromised.

The condensers will be located alongside the existing condensers in the ginnel.

Exact details of the ventilation system will only be known once a M&E contractor has been assigned pending planning approval and a condition relating to the external plant. All external plant should achieve 5dB below backgroound at the nearest sensitive receiver.

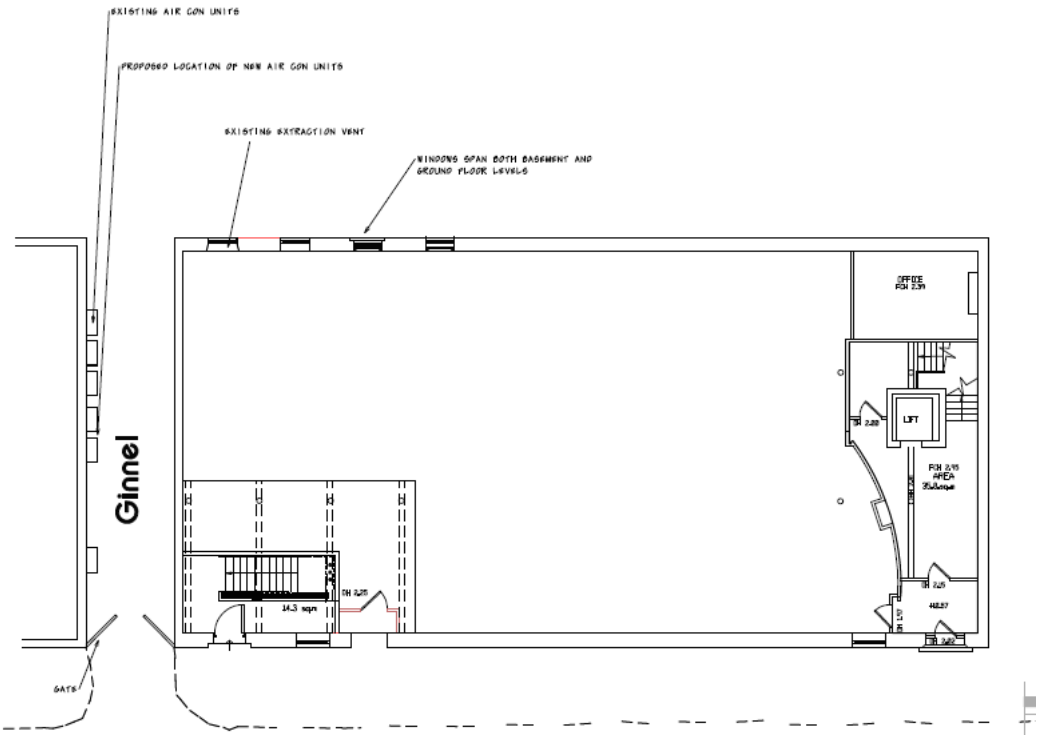


Figure 11
Locations of air extract vent and condenser units - plan

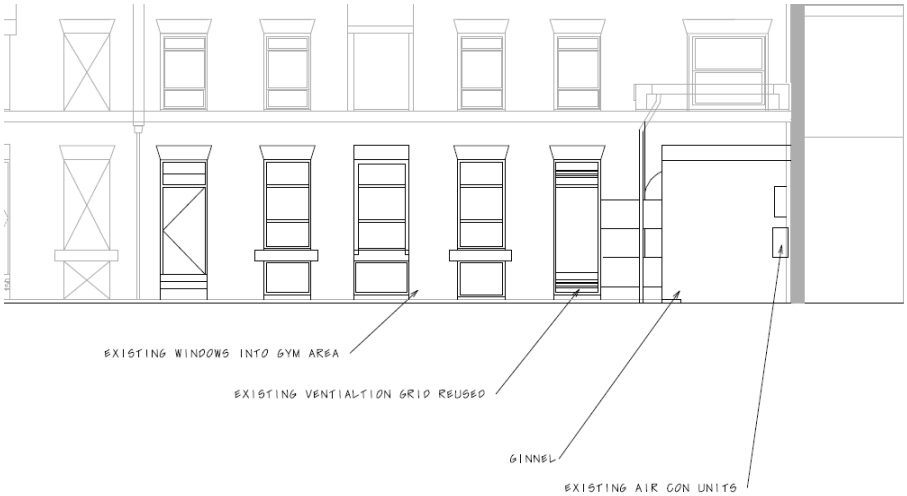


Figure 12
Locations of air extract vent and condenser units – rear elevation

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6 Conclusion

An acoustic survey has taken place at the Basement, 45-47 Newton St, Manchester to support a planning application for the change of use to a gym.

Mitigation has been recommended to ensure impact and airborne noise break out is within Council limits. Noise from external plant will be assessed pending planning approval and an M&E consultant commissioned.

7 References

[1] BS 4142: 1997
Method for Rating industrial noise affecting mixed residential and industrial areas
British Standards Institute, 1997.

[2] BS 4142: 2014
Methods for rating and assessing industrial and commercial sound
British Standards Institute, 2014.

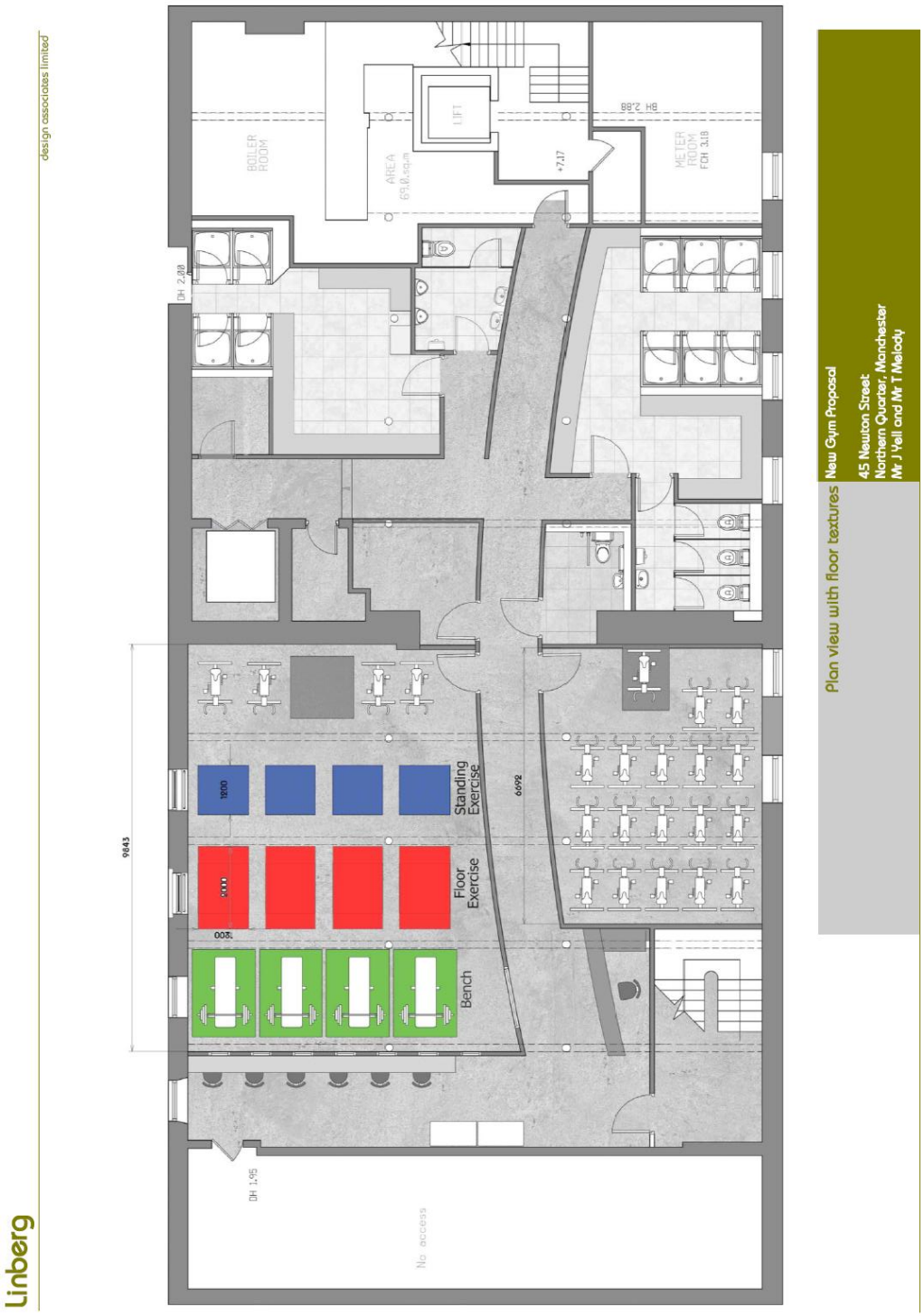
[3] BS 8233:2014
Guidance on sound insulation and noise reduction for buildings
British Standards Institute, 2014.

[4] Marshall Day Acoustics
Insul
Marshall day Acoustics, New Zealand, 2009.

Appendix

A1 Proposed layout

A1.1 Basement



John Braiden BSc MSc MIOA
Acoustic Consultant

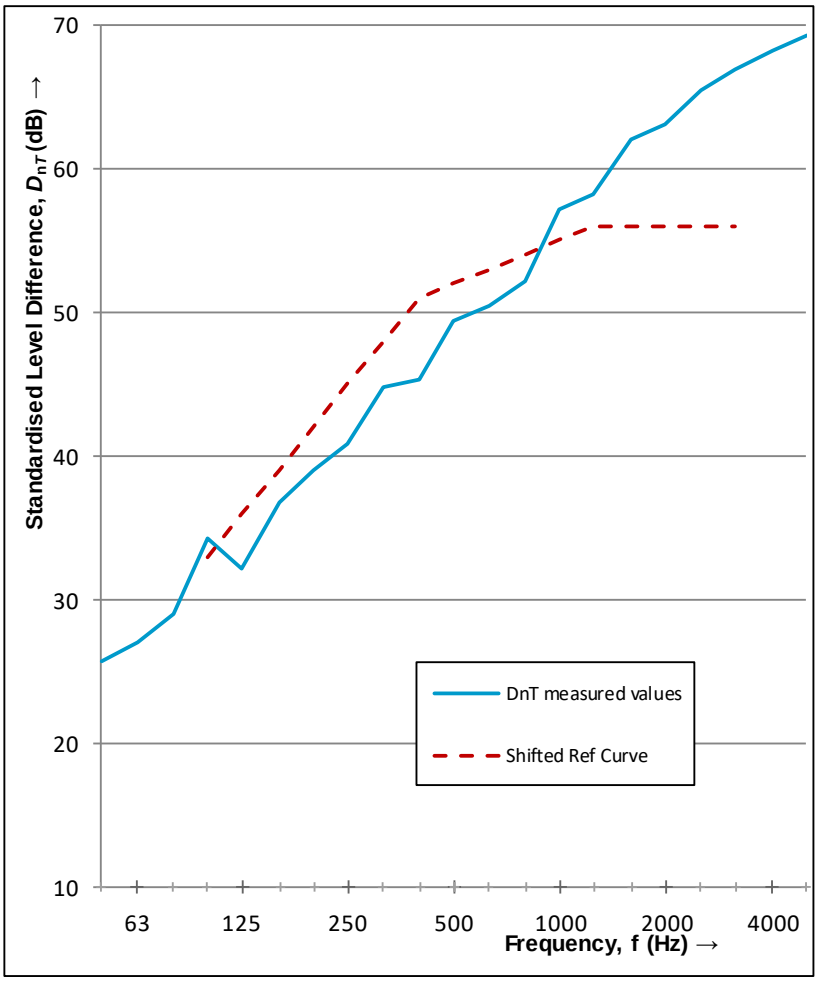
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A2 SOUND INSULATION TEST

Standardized Level difference according to ISO 140-4
Field measurements of airborne sound insulation between rooms

Client:	Linberg	**Date of Test:**	28-Nov-17
Source Room	45-47 New ton St	**Receiver Room**	45-47 New ton St
Description:	Ground Floor	Description:	Basement Floor
Volume:	m^3	Volume:	m^3
Construction:	22mm t&g Floorboard on 70mm t&g floorboards w ith Fireboard on 25mm battens		

1/3rd OBCF (Hz)	D_{nT} (dB)
50	21.8
63	21.5
80	26.7
100	32.5
125	29.6
160	33.5
200	34.9
250	36.9
315	40.4
400	41.3
500	45.1
630	46.2
800	48.2
1000	53.2
1250	54.3
1600	58.8
2000	60.5
2500	62.8
3150	64.3
4000	66.0
5000	67.4



Rating according to ISO 717-1

$D_{nTw}(C; C_{tr}) >= 52 (0; -6)$ dB

$$D_{nTw} + C_{tr} >= 46 \text{ dB}$$

Evaluation based on field measurement results obtained by an engineering method

No. of test report: 10579_SI_1 **Name of test institute:** Braiden Acoustics Limited

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A3 NOISE BREAK OUT CALC

Noise Break Out Calculation					Octave band centre frequency								
Term			Description	Details	63	125	250	500	1000	2000	4000	Total level	Rw
L_{A90}			BNL @ NSR	A weighted	28.0	35.0	38.0	44.0	44.0	38.0	32.0	48.3	
	-10	dB	MCCs criterion		-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0		
SPL_{ext}			Target noise level at receiver		18.0	25.0	28.0	34.0	34.0	28.0	22.0	38.3	
r	2	m	Distance correction in metres	20log10(r)	6	6	6	6	6	6	6		10
			Air absorption	20°C; 70% humidity	0.00	0.00	0.00	0.01	0.01	0.02	0.05		
δ	0	m	Barrier attenuation	none or n/a	0	0	0	0	0	0	0		
DI	4	Q	Directivity DI = 10log(Q)	2 surfaces	-6	-6	-6	-6	-6	-6	-6		
S	2.4	m2	Area of building element	Total area of glazing	-4	-4	-4	-4	-4	-4	-4		
R_{wi}			SRI glazing	6/200(abs)/9	27.0	36.0	45.0	58.0	59.0	55.0	66.0		
			Numerical correction		17	17	17	17	17	17	17		
$L_{A,int}$			Internal reverberant noise level		**58.2**	**74.2**	**86.2**	**105.2**	**106.2**	**96.2**	**101.2**	**109.7**	**dB**

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