

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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Gym fit-out, Hilton House, Manchester

Acoustic testing report

London, Manchester, Edinburgh, Birmingham, Belfast

Sandy Brown Ltd

Registered in England & Wales

No. 13227735

post@sandybrown.com

www.sandybrown.com

Registered Office: 55 Charterhouse Street, London EC1M 6HA

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Version	Date	Comments	Author	Reviewer
A	5 May 21		Kane Mitchell	Matthew Robinson

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Summary

Sandy Brown has been commissioned by Cert Property Limited to provide acoustic advice in relation to the gym fit-out at Hilton House, Manchester. This includes measurements of the floor sound insulation performances between the basement unit and the ground floor areas, measurements of background noise levels within ground floor spaces as well as an assessment of operational noise transfer.

The measured floor sound insulation performances between the basement unit and ground floor spaces varied between $D_{nT,w}$ 53-59 dB.

The background noise levels measured within the ground floor spaces varied between NR 39 to NR 48.

Whilst the gym tenant was playing music over their bluetooth speaker system, noise levels within the basement unit were in the region were in the region of L_{Aeq} 72 dB. The proposed bluetooth speaker system operating at this level has been assessed to be suitable, provided that the louvres within the basement unit are boarded up as part of the fit-out works.

Based on the measured floor sound insulation performances and background noise levels, operational noise limits have been determined. If operational noise levels greater than those set out are required, enhancements will need to be provided to the basement unit. Potential enhancements which could be implemented have been discussed.

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1 Introduction

Sandy Brown has been commissioned by Cert Property Limited to provide acoustic advice in relation to the gym fit-out at Hilton House, Manchester. This includes measurements of the floor sound insulation performances between the basement unit and the ground floor areas, measurements of background noise levels within ground floor spaces as well as an assessment of operational noise transfer.

2 Proposed development

2.1 Proposals

A gym fit-out is proposed to the basement unit of Hilton House, Manchester.

Operational hours for the gym have not been provided however for the purpose of this assessment it is assumed the gym will be capable of operating during the daytime (07:00-23:00) and night-time (23:00-07:00).

The gym is to operate primarily as a personal training space, with background music provided by a bluetooth speaker system. A photograph of the basement unit is provided in Figure 1.

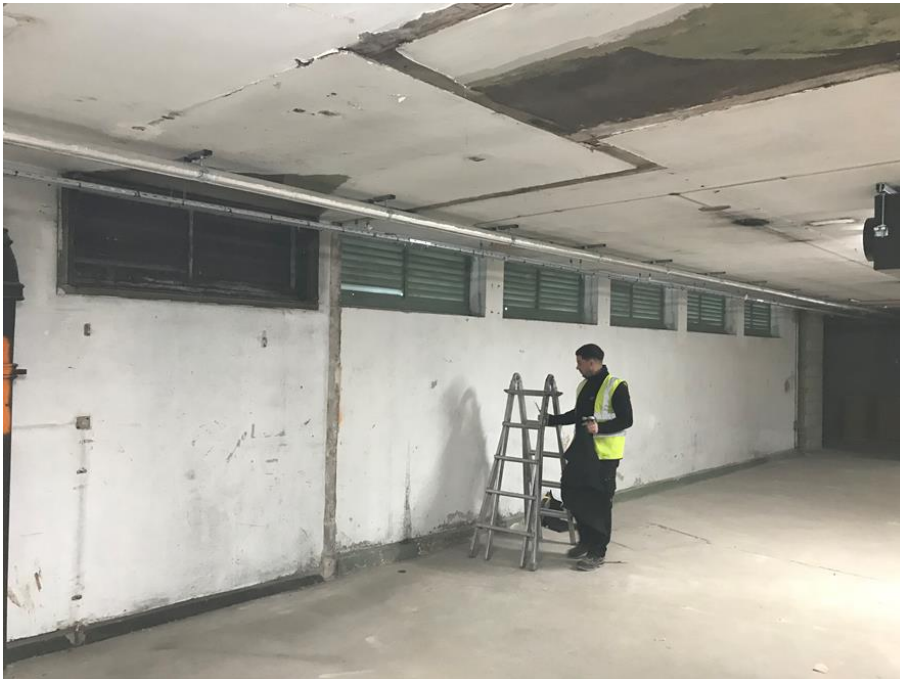


Figure 1 Photograph of the basement unit

A photograph of the basement gym tenants bluetooth speaker system is provided in Figure 2.



Figure 2 Photograph of the bluetooth speaker system proposed to the basement gym unit

2.2 Adjacent spaces

The ground floor comprises of the building reception and two commercial units, one of which is unoccupied and the other is a cafe.

2.3 Existing constructions

The basement unit was not fitted-out at the time of testing. The floor and soffit of the basement unit were concrete. The walls were a predominantly concrete, with some newly constructed blockwork walls. The columns of the basement unit were also concrete.

There were doors between the basement unit and adjacent circulation spaces and staircases.

3 Basis of report

3.1 Design information

This report is based on the following:

- Basement and ground floor general arrangement layouts provided via email on 23 March 2021
- BS 8233: 2014 *Sound insulation and noise reduction for buildings – code of practice*
- CIBSE Guide A: *Environmental design* (2015)
- The Control of Noise at Work Regulations 2005
- The Disability Discrimination Act 2004.

3.2 Performance criteria

It is recommended that operational noise transfer from the proposed basement gym to the ground floor commercial units and reception does not exceed 10 dB below the measured background noise level.

4 Acoustic testing

Acoustic testing was carried out between the proposed basement gym and the adjacent ground floor commercial units and reception on 28 April 2021 by Kane Mitchell and Jose Gonzalez.

Details of the testing methodology and equipment are provided within Appendix B.

4.1 Testing locations

The testing locations are shown in Figure 3 and Figure 4. The testing included the following:

- Measurements of the floor sound insulation performances between the basement unit and ground floor spaces
- Background noise level measurements within the ground floor spaces
- Measurements of operational noise transfer between the basement unit and ground floor spaces, utilising the proposed bluetooth speaker system.

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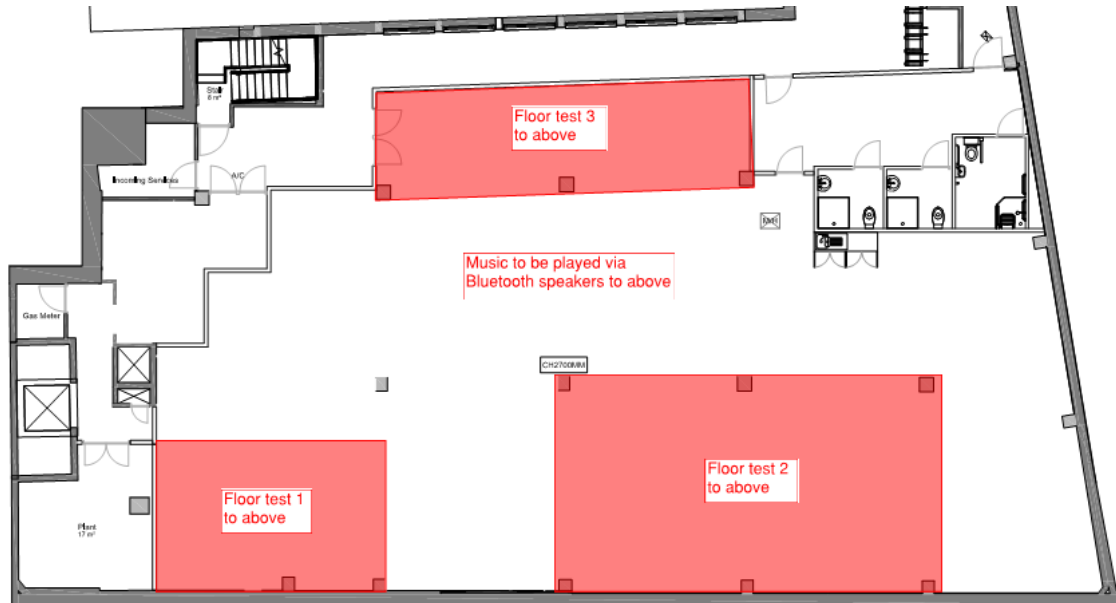


Figure 3 Basement acoustic testing locations



Figure 4 Ground floor acoustic testing locations

4.2 Airborne sound insulation tests

4.2.1 Results

The results of the sound insulation measurements are provided in Table 1.

Table 1 Sound insulation test results

Test ref.	Adjacency	Measured sound insulation performance, $D_{nT,w}$ (dB)
Floor test 1	Basement to reception	59
Floor test 2	Basement to cafe	55
Floor test 3	Basement to unoccupied commercial unit	53

The sound insulation performances measured would be expected to provide a reasonable level of acoustic separation between the basement unit and ground floor spaces.

4.2.2 Observations

From observations on site there are number of holes within the exposed slab of the basement unit as per Figure 4. It is recommended that these are infilled and made good as part of the basement unit fit-out works.



Figure 5 Photograph showing existing holes within ground floor slab

For floor test 3, one weakness noted was flanking sound transmission via the external windows. This resulted from noise breakout via the basement unit louvres. The louvres are shown in the left of Figure 1.

It is recommended that these louvres be boarded up as part of the fit-out works. This boarding should comprise of 2 x 15 mm standard plasterboard and any building services should be ducted to the rear of the louvres with atmosphere side attenuation provided.

4.3 Background noise level measurements

The measured background noise levels measured within the ground floor spaces are as follows:

- NR 40 within the reception, resulting from building services and environmental noise ingress
- NR 48 within the cafe, resulting from environmental noise ingress and noise from the cafe fridges
- NR 39 within the unoccupied unit, resulting from environmental noise ingress.

The background noise levels measured are considered representative of these spaces and no extraneous noise sources were noted.

4.4 Operational noise measurements

The measured noise levels of the tenants bluetooth speaker system in the gym were in the region of L_{Aeq} 72 dB. Subjectively, no music was audible within any of the ground floor spaces whilst the tenant had their sound system operating. As such, the proposed bluetooth speaker system operating at this level has been assessed to be suitable.

5 Operational noise transfer

5.1 Noise egress to nearby noise sensitive premises

It is understood that a change of use planning application is not required and as such noise egress to nearby noise sensitive premises is excluded from the scope of work.

5.2 Noise transfer to noise sensitive spaces within the development

The noise transfer limits to the ground floor commercial units and reception are set out in Section 3.2.

5.3 Assessment of operational noise limits

5.3.1 Operational noise limits

An operational management strategy should be developed by the gym operator for the management of amplified sound/music.

The maximum operational noise levels from amplified sound within the gym have been assessed, based on the following:

- Meeting the noise transfer criteria to the ground floor commercial units and reception set out in Section 3.2.
- The airborne sound insulation performance of the existing ground floor set out in Section 4.2.
- The measured background noise levels in the ground floor commercial units and reception set out in Section 4.3. If the background noise levels were to be reduced in any of these spaces, there is potential for operational noise transfer from the gym to cause disturbance.

The maximum operational noise levels ($L_{eq,5mins}$) from amplified sound within the gym are set out in Table 2. Maximum sound pressure levels ($L_{Fmax,5mins}$) should be limited to values 5 dB above those set out below. These limits are driven by noise transfer between the basement gym and the unoccupied unit. These limits also assume the louvres have been boarded as per Section 4.2. The limits are provided for guidance only as in practice, there will be some variation in background noise levels within noise sensitive spaces.

Table 2 Basement gym operational noise limits

	Maximum operational noise level, $L_{eq,5mins}$ (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Basement gym operational noise limits	76	76	77	75	78	78	76	76

5.3.2 *Guidance if fixed loudspeakers are used*

Due to the basement gym tenant using a bluetooth speaker system, it would not be practical to implement a sound level limiter.

If a fixed loudspeaker system were to be used, it is recommended that:

- Loudspeakers are mounted to the walls of the basement gym rather than to from the soffit in order to control structure borne noise transfer. Ideally, resilient loudspeaker mounts should be provided in order to help further control noise transfer to the ground floor spaces.
- An electronic sound level limiter be provided in order to ensure the noise levels within the gym do not exceed those set out in Table 2.

5.3.3 *Potential further enhancements for higher operational noise levels*

If operational noise levels greater than those set out in Table 2 were required, enhancements would need to be provided. These enhancements could include, but are not limited to, a combination of the following:

- Providing a sound insulating ceiling to the basement gym unit.
- Providing acoustically rated doorsets between the gym unit and circulation spaces / lift lobby.
- Providing plasterboard linings to any columns/common elements between the basement unit and ground floor spaces.
- Providing plasterboard linings to flanking partitions that extend from basement level to ground floor.

Appendix A

Glossary of terms

General terms

Airborne sound	Sound propagating through the air.
Airborne sound insulation	The ability of building elements or structures to reduce airborne sound transmission.
Flanking element	Any building element that contributes to the sound transmission between rooms in a building that is not the separating element in question. It is typically an element which continues past the separating element
Flanking sound transmission	Sound transmitted between rooms via flanking elements instead of directly through separating elements, or along any path other than the direct path.
Frequency	The number of cycles per second. The unit of frequency is the Hertz (Hz). Frequency gives a sound its distinctive tone.
Frequency band	A continuous range of frequencies between stated upper and lower limits (see also 'Octave band' and 'One-third octave band').
Separating element	An element (such as a wall, floor, door, window) which separates buildings or parts of buildings.
Sound pressure level	A logarithmic measure of the effective sound pressure of a sound relative to a reference value, measured in decibels, dB. Sound pressure levels are dependent on the conditions under which they are measured.
Structure-borne sound	Sound which is transferred by vibration via the structure of a building.

Acoustic parameters

'A' weighting	Frequency weighting based on the frequency response of the human ear which has been found to correlate well with the subjective response to sound.
Decibel (dB)	A logarithmic unit used for many acoustic values to indicate the level with respect to a reference level
$D_{nT,w}$	A single number weighted quantity which characterizes the airborne sound insulation between rooms, corrected for reverberation time. A higher numerical quantity represents a better performance.
Hz	Hertz (Hz) is the unit of frequency (see also 'Frequency')
$L_{Aeq,T}$	Equivalent A-weighted sound pressure level of a steady noise that has the same acoustic energy as a fluctuating noise over the measurement period (T). When not weighted it is denoted $L_{eq,T}$.
$L_{Amax,T}$	The highest A-weighted sound pressure level measured in the period (T) with either fast (L_{AFmax}) or slow (L_{ASmax}) time weightings. When not weighted it is denoted L_{Fmax} or L_{Smax} .
NR	Noise rating. Single figure term used to reflect the spectral content of noise. This is generally applied within rooms in relation to building services noise.
Octave band	A frequency band in which the upper limit of the band is twice the frequency of the lower limit.

Appendix B

Methodology and equipment information

Methodology

Airborne sound insulation tests (walls and floors)

Broadband continuous steady pink noise is generated in each chosen source room using a single loudspeaker in two fixed positions and the sound pressure level measured in the source and receiving rooms.

Sound pressure levels in the source and receiving rooms are measured using the moving microphone technique for each loudspeaker position. Background noise levels in the receiving rooms (without the loudspeaker operating) are also measured.

The measured noise levels are taken in one-third octave bands from 100 Hz to 3150 Hz inclusively. Each measurement is time-averaged over a 30 s period.

The level differences between source and receiving rooms are calculated and used in combination with the measured average reverberation times to determine the Standardised Level Differences (D_{nT}) in one-third octave bands from 100 Hz to 3150 Hz.

The Standardised Level Differences are then weighted in accordance with BS EN ISO 717-1: 1997 to obtain the $D_{nT,w}$ values for comparison with the requirements of the specification.

Noise level measurements

Measurements are carried out by an engineer who will have set up the equipment to record the required noise level parameters for specific intervals, over a specified time period.

Measurements are carried out using a battery operated sound level meter mounted on a tripod (approximately 1.2-1.5 m above the surface).

The sound level meter will be set to record third octave band and A-weighted noise levels over a suitable predetermined period.

Equipment

The measurements were taken using a BK2250 sound level meter.

Calibration details for the equipment used are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	2250/3011964	Brüel & Kjær	4 Sep 21	UCRT19/1970, UTRC19/1976
Microphone	4189/3100176	Brüel & Kjær	4 Sep 21	UCRT19/1970, UTRC19/1976
Pre-amp	ZC0032/26376	Brüel & Kjær	4 Sep 21	UCRT19/1970, UTRC19/1976
Calibrator	4231/3019123	Brüel & Kjær	3 Sep 21	UCRT19/1969

^[1] Calibration of the meters used for the measurements is traceable to national standards. Calibration certificates for the sound level meters used in this survey are available upon request.

Calibration checks were carried out on the meter and their measurement chains at the beginning and end of the testing. No significant calibration deviation occurred.