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Consultants in Acoustics, Noise & Vibration

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47 Peter Street, Manchester

Acoustic planning report

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F	12 July 19	Revised to reflect updates to scheme	Elma Ooro	James Atha
G	18 Oct 19	Revised to reflect new design (removal of staircase on Levels 2 and 3)	Elma Ooro	James Atha

Summary

Sandy Brown has been commissioned by Peter Street Exclusive Developments Limited to provide acoustic advice in relation to the proposed development of the upper floors of 47 Peter Street, Manchester, for use as a hotel with 32 guestrooms.

An environmental noise survey was performed between 24 November 2017 and 28 November 2017. The representative background sound levels measured during the survey were $L_{A90,5min}$ 60 dB during the daytime and $L_{A90,5min}$ 54 dB at night. Based on the requirements of Manchester City Council (MCC) and on the results of the noise survey, all plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed L_{Aeq} 55 dB during the daytime and L_{Aeq} 49 dB during the night.

The average ambient noise levels measured during the survey were $L_{Aeq,16h}$ 68 dB during the daytime and $L_{Aeq,8h}$ 68 dB at night. An initial assessment has been carried out to determine the required acoustic performance of the facade to the hotel guestrooms and provide guidance on glazing and the ventilation strategy.

Operational noise transfer from an existing restaurant on the ground floor level of 47 Peter Street to the hotel rooms above has been carried out along with outline advice on possible enhancements to the floor.

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1 Introduction

Sandy Brown has been commissioned by Peter Street Exclusive Developments Limited to provide acoustic advice in relation to the proposed hotel development at 47 Peter Street, Manchester to provide a total of 32 guestrooms.

An environmental noise survey has been carried out, the purpose of which was to establish the existing ambient and background sound levels in the vicinity of the site and nearby noise sensitive premises. The background sound levels measured during the survey are used as the basis for setting limits for noise emission from proposed building services plant. These limits are set in accordance with the requirements of MCC.

The facade sound insulation is assessed in order to determine the necessary performance required to achieve appropriate internal noise levels for hotel rooms in line with the requirements of MCC.

Operational noise transfer from an existing restaurant on the ground floor of the building to the hotel rooms above is considered.

This report presents the noise survey methods, the results of the survey, limits for noise emissions associated with the development and minimum sound insulation requirements for the building envelope.

2 Site description

2.1 The site and its surroundings

The site location in relation to its surroundings is shown in Figure 1 (highlighted in yellow). It is situated in a mixed-use area in the city centre, with retail sites, offices and hotels nearby. The site faces south onto Peter Street, a main road, and is bounded by Southmill Street to the west and Bootle Street to the north.

It is proposed to develop the upper levels of the existing Grade II listed 47 Peter Street building to a hotel featuring 32 guestrooms/suites.

There is an existing restaurant that occupies the ground floor and lower ground floor of the building which is proposed to remain.



1 Site map (courtesy of Google Earth Pro)

Many of the surrounding buildings comprises retail unit on the ground floor and offices above (various buildings highlighted in red). Opposite the site, on Peter Street, is the Theatre Royal (green), which is not currently in use but has been acquired by a hotel developer. Other neighbouring buildings include the Radisson Blu hotel (purple), the Friends' Meeting House (blue) and the Jackson's Row complex (orange), which under current plans will be developed into hotels, offices, residential and religious buildings. The buildings on the north side of Figure 1, which face onto Albert Square, are mostly pubs, restaurants and clubs.

3 Method

Details of the equipment used, the noise indices and the weather conditions during the survey are provided in Appendix A. Further information on the specific survey method is provided in this section.

3.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over four days to determine the existing background sound levels in the vicinity of nearby noise sensitive premises.

The unattended measurements were performed over 5 minute periods between 11:50 on 24 November 2017 and 10:30 on 28 November 2017. The equipment was installed by Gwyn Richards and Kane Mitchell, and collected by Gwyn Richards and Jessica Wright.

The measurement position used during the survey is indicated in Figure 1, denoted by the letter 'L1'. Photographs showing the measurement location are provided in Figure 2 (the microphone position is circled in the left-hand photograph). The microphone was positioned to be approximately 1 m from the building facade, at level 2. This location was chosen to be reasonably representative of the noise levels experienced by the nearest noise sensitive premises (currently the Radisson Blu hotel), and also of ambient noise levels experienced at the facade to the hotel guestrooms overlooking Peter Street.



Figure 2 Measurement position for noise survey

3.2 Attended measurements

Attended sample measurements were performed by Gwyn Richards at two other locations overlooked by the building. These are indicated in Figure 1 as positions 'L2' and 'L3'. The attended measurements were carried out on 29 November 2017, over 5 minute periods, with the purpose of determining the existing noise levels from road traffic, pedestrians and other significant noise sources in the area.

In each case the microphone was mounted on a tripod approximately 1.5 m above the ground level and at least 1 m from any other reflective surface.

3.3 Internal measurements

Attended sample measurements were performed by Gwyn Richards and Jessica Wright at a number of locations inside the building. The attended measurements were carried out on 28 November 2017, over 5-minute periods, with the purpose of determining the existing levels of noise ingress to the building.

On Level 3, measurements were taken inside the building at the position indicated by L1 (ie, facing the windows above and below the unattended microphone position shown in Figure 2). In each case the microphone was approximately 3 m from the facade and mounted on a tripod approximately 1.5 m above the floor.

3.4 Sound insulation testing

Sound insulation measurements were also undertaken by Gwyn Richards and Jessica Wright on 28 November 2017 from the existing ground level restaurant to level 1 of the development, directly above it. This was carried out to assess the sound insulation performance of the existing construction.

4 Measurement results

4.1 Observations

4.1.1 Noise survey

The dominant noise sources observed at the site during the attended measurements consisted of road traffic, which was constant on Peter Street and intermittent on the quieter Southmill Street and Bootle Street; noise from nearby building plant; and pedestrians talking to each other, or on the telephone, while passing by.

Less significant noise sources included sirens and clock bell chimes.

4.1.2 Internal measurements

During the internal measurements on Level 3, the dominant noise source was from road traffic on Peter Street. Less significant sources included construction noise, car alarms, clock bells chiming, and flying birds (within the building).

The main weakness in the facade was noise ingress via the existing windows.

4.1.3 Sound insulation testing

The existing floor features 22 mm thick floorboards on timber joists with a 180 mm cavity to the plasterboard restaurant ceiling below.

Noise transfer from the restaurant area was noted to be greatest near the façade where gaps in the floor were observed.

Noise breakout from the restaurant ductwork running through the space also limited the results.

4.2 Unattended measurement results

The results of the unattended noise measurements are summarised in the following tables. A graph showing the results of the unattended measurements is provided in Appendix B.

The day and night-time ambient free-field noise levels measured during the unattended survey are presented in Table 1.

Table 1 Ambient noise levels measured during the survey

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Friday 24 November 2017	-	68
Saturday 25 November 2017	69	70
Sunday 26 November 2017	67	67
Monday 27 November 2017	67	66
Average	68	68

The minimum background sound levels measured during the unattended survey are given in Table 2.

Table 2 Minimum background sound levels measured during the survey

Date	Daytime (07:00 – 23:00) $L_{A90,5min}$ (dB)	Night (23:00 – 07:00) $L_{A90,5min}$ (dB)
Friday 24 November 2017	61*	55
Saturday 25 November 2017	54	55
Sunday 26 November 2017	54	53
Monday 27 November 2017	57	53
Tuesday 28 November 2017	57*	-

* Measurement not made over full period due to monitoring start and end time

The lowest background sound levels measured during the survey were $L_{A90,5min}$ 54 dB during the daytime and $L_{A90,5min}$ 53 dB at night.

4.2.1 Statistical analysis

In line with BS 4142:2014, for the purpose of analysis and establishing representative background sound levels, day and night-time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Daytime and night time statistical analysis of representative values for the site are given in Figure 3 and Figure 4.

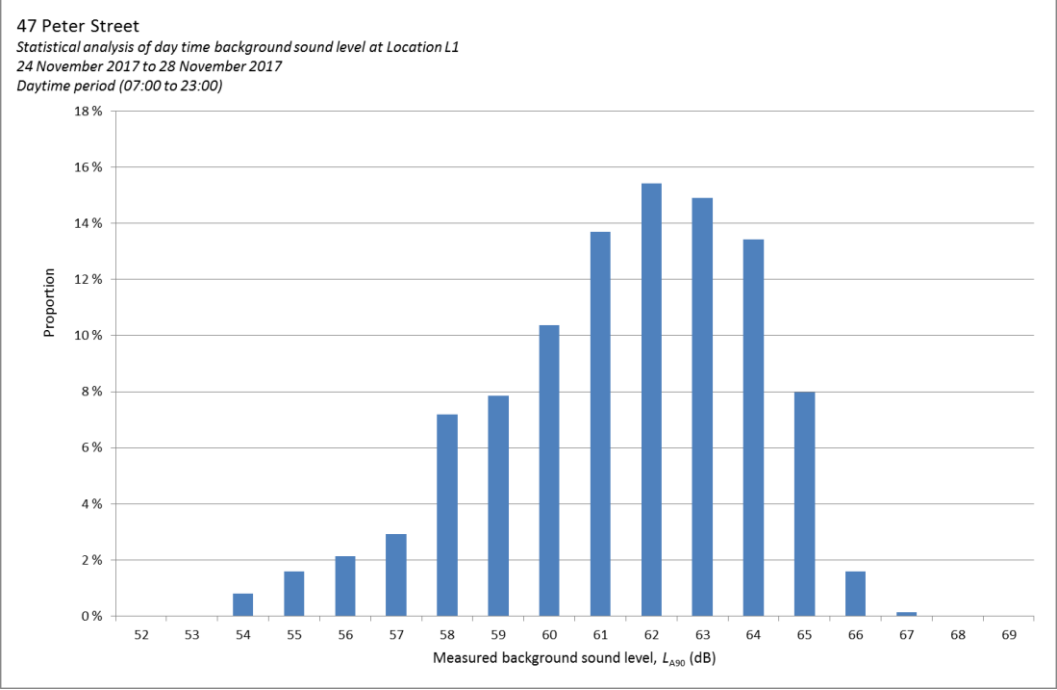


Figure 3 Day time statistical analysis of background sound levels at Location L1

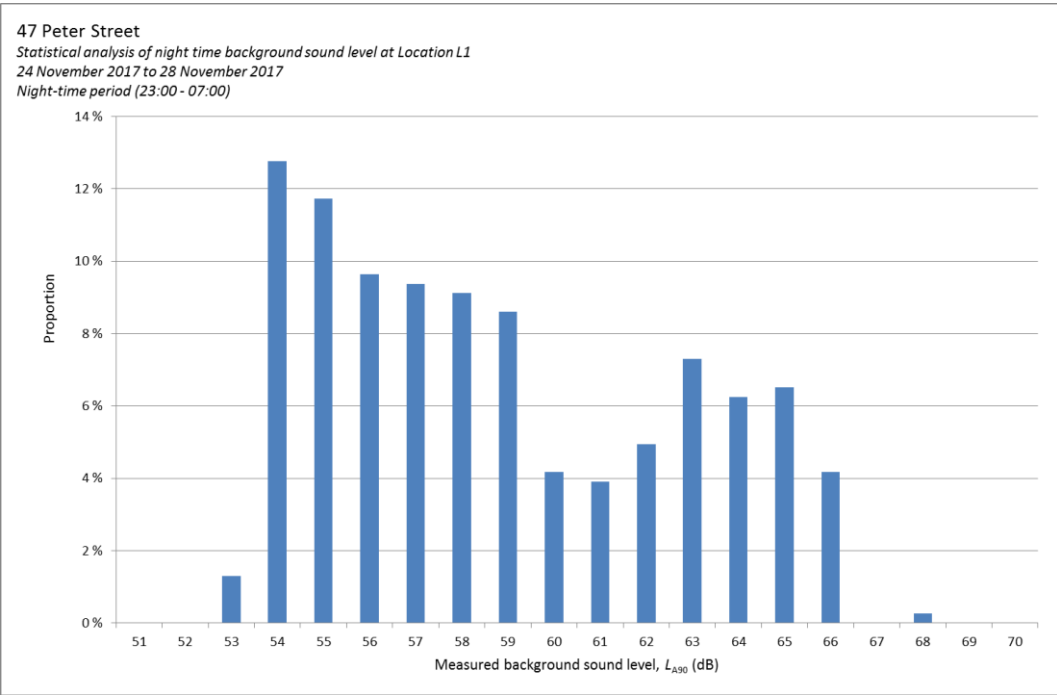


Figure 4 Night time statistical analysis of background sound levels at Location L1

From this analysis, the representative background sound levels measured during the survey were $L_{A90,5min}$ 60 dB during the daytime and $L_{A90,5min}$ 54 dB at night.

4.2.2 MCC - typical background method

MCC sets out a method for determining representative background sound levels. The method is detailed in Appendix A of the *Planning & Noise Technical Guidance* document dated December 2015. These calculations are provided in Appendix D to this report.

From this analysis, the typical background sound levels measured during the survey are $L_{A90,15min}$ 56 dB during the daytime and $L_{A90,15min}$ 55 dB at night.

4.2.3 Representative background levels

Taking the lowest of the representative levels during the day and night time from the two methods described above, the representative background sound levels are taken to be $L_{A90,15min}$ 56 dB during the daytime and $L_{A90,15min}$ 54 dB at night. The corresponding octave band levels are provided in Table 3.

Table 3 Representative measured octave band levels at location L1

	Representative background sound levels (dB)						
	Octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
Daytime (07:00 - 23:00)	67	60	54	54	52	47	40
Night-time (23:00 - 07:00)	66	58	53	53	49	43	35

4.3 Attended measurement results

The sound pressure levels recorded during the attended measurements are summarised in Table 4. The dominant noise sources noted during the measurements are also described in Table 4.

Table 4 Sound pressure levels from attended measurements

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
L2	16:50	63	80	57	Traffic (mainly on Peter Street), pedestrians talking.
L2	16:56	63	75	58	Traffic (mainly on Peter Street), pedestrians talking, clock bells chiming.
L2	17:01	64	78	58	Traffic (mainly on Peter Street), pedestrians talking, distant emergency services sirens.
L2	17:06	62	73	58	Traffic (mainly on Peter Street), pedestrians talking.
L2	17:11	64	78	59	Plant noise from nearby building, traffic (mainly on Peter Street), pedestrians talking.
L2	17:16	65	86	59	Plant noise from nearby building, traffic (mainly on Peter Street), pedestrians talking.
L3	17:23	60	77	56	Plant noise from nearby building, traffic (from Peter Street and, intermittently, on Southmill Street and Bootle Street).
L3	17:28	63	77	57	Plant noise from nearby building, traffic (from Peter Street and, intermittently, on Southmill Street and

					Bootle Street), mechanical garage door closing, workers chatting, rolling luggage wheels, large group of noisy children passing.
L3	17:33	62	81	57	Plant noise from nearby building, traffic (from Peter Street and, intermittently, on Southmill Street and Bootle Street), large group of noisy children continues past.
L3	17:38	62	78	57	Plant noise from nearby building, traffic (from Peter Street and, intermittently, on Southmill Street and Bootle Street), pedestrians talking.
L3	17:43	63	80	57	Plant noise from nearby building, traffic (from Peter Street and, intermittently, on Southmill Street and Bootle Street), pedestrians talking.
L3	17:48	62	89	56	Plant noise from nearby building, traffic (from Peter Street and, intermittently, on Southmill Street and Bootle Street), pedestrians talking.

4.4 Internal noise measurement results

The internal noise levels measured at level 3 are presented below along with the result of the simultaneous external measurements at position L1.

Table 5 Internal noise measurement results and level differences

Start time	Sound pressure level $L_{Aeq,5min}$ (dB)		
	Internal measurement	External measurement	Difference ¹
10:45	43	66	23
10:50	43	67	24
10:55	43	65	22

¹Approximately equivalent to $R_w + C_{tr}$ (dB).

4.5 Sound insulation testing results

The measured performance of the existing floor between the ground floor restaurant and level 1 was $D_{nT,w} + C_{tr}$ 33 dB.

A graph showing the sound insulation performances measured is provided in Appendix C.

5 Assessment criteria

5.1 NPPF and NPSE

The National Planning Policy Framework (NPPF) sets out the government planning requirements, and supersedes previous guidance notes such as PPG24. No specific noise criteria are set out in the NPPF, or in the Noise Policy Statement for England (NPSE) to which it refers.

The NPPF states:

'Planning policies and 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.'*

The NPSE states that its aims are as follows:

'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.'*

As such, although neither of these documents sets out specific acoustic criteria for new residential development, the requirement to control both the effect of existing noise on the new development and the effect of noise from the development on the surroundings needs to be considered.

5.2 Plant noise egress

5.2.1 Standard guidance

Guidance for noise emission from proposed new items of building services plant is given in BS 4142: 2014 *'Methods for rating and assessing industrial and commercial sound'*.

BS 4142 provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive premises.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

5.2.2 Local Authority criteria

MCC provides guidance in relation to plant noise emissions in *Planning and Noise Technical Guidance* document dated December 2015 states the following in relation to plant noise egress:

'The development should be designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.'

Corrections for tonal or attention catching characteristics would need to be applied to the rating level in accordance with BS4142.

5.3 Internal noise level – noise ingress

5.3.1 Standard guidance

Guidance on acceptable internal noise levels in residential dwellings is given in BS 8233:2014 *Sound insulation and noise reduction for buildings*, and is also provided by the World Health Organisation. The guidance given by BS 8233 and WHO is shown in Table 6. Hotel guestrooms are typically considered as bedrooms during the night and living rooms during the day.

Table 6 Internal noise criteria for sleeping/resting

Internal space	Indoor ambient noise level L_{Aeq} (dB)		
	BS 8233 (07:00 to 23:00)	BS 8233 (23:00 to 07:00)	WHO
Living rooms	35	-	30/35 ¹
Dining room	40	-	-
Bedrooms	35	30 ²	30 ²

¹ WHO does not differentiate between different types of living spaces, but recommends L_{Aeq} 30 dB in relation to sleep disturbance and L_{Aeq} 35 dB in relation to speech intelligibility. WHO provides a 16 hour time base when referring to speech intelligibility and an 8 hour time base when referring to sleep disturbance.

² BS 8233 notes that individual noise events can cause sleep disturbance, and that a guideline value may be set depending on the character and number of events per night, although no specific limit is provided. Section 3.4 of the WHO guidelines for community noise suggests that good sleep will not generally be affected if internal levels of L_{Amax} 45 dB are not exceeded more than 10-15 times per night.

5.3.2 Local Authority requirements

Manchester City Council stipulates the criteria provided in Table 7 with regards to internal noise in residential developments. Hotel guestrooms are typically considered as bedrooms during the night and living rooms during the day.

Table 7 MCC internal noise criteria for residential developments

Internal space	Internal noise limit, L_{Aeq} (dB)	
	Day time (07:00 to 23:00)	Night time (23:00 to 07:00)
Living rooms	35	-
Bedrooms	-	30

It is also stipulated that individual noise events in bedrooms should not exceed L_{Amax} 45 dB more than 15 times per night (ie, between 23:00 and 07:00).

In addition, where entertainment noise is a factor in the noise climate, MCC states the following for residential developments:

‘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) 47 dB and 41 dB (L_{eq}), respectively’.

Although MCC do not specifically stipulate the entertainment noise criteria for hotels, this is a useful reference for assessing noise transfer from the restaurant below.

5.3.3 Hotel operator requirements

As a hotel development is proposed, the operator may have specific requirements relating to noise ingress. These will need to be considered as the design progresses.

6 Plant noise limits

6.1 Limits

6.1.1 Basic limits

Based on the criteria described in section 5.2.2, and the measurement results, the cumulative noise level resulting from the operation of all new plant at 1 m from the worst affected windows of the nearest noise sensitive premises should not exceed the limits set out in Table 8.

Table 8 Plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises ($L_{Aeq,5min}$ dB)
Daytime (07:00-23:00)	51
Night-time (23:00-07:00)	49

Where an item of plant makes noise with tonal characteristics, appropriate corrections will need to be applied in line with BS4142.

6.2 Assessment

At this stage, no information is available in relation to the proposed installation of building services plant, and this will need to be assessed in detail as the design progresses. However, all plant items will be designed to achieve the plant noise limits set out above, including any corrections for attention catching features.

7 Facade sound insulation – noise ingress to guestrooms

This section discusses internal noise level criteria and assesses the required facade sound insulation performance. In principle, the required facade specification depends on two factors – the external noise levels at the site, and the internal noise criteria.

The following assessment is based on achieving the internal noise levels recommended in BS 8233 and by MCC, which are set out in Section 5.3.

7.1 External noise levels

From the survey results, the predicted external noise levels have been grouped into four zones which are marked-up in Figure 5 and set out in Table 9. These zones apply on all levels of the proposed development.

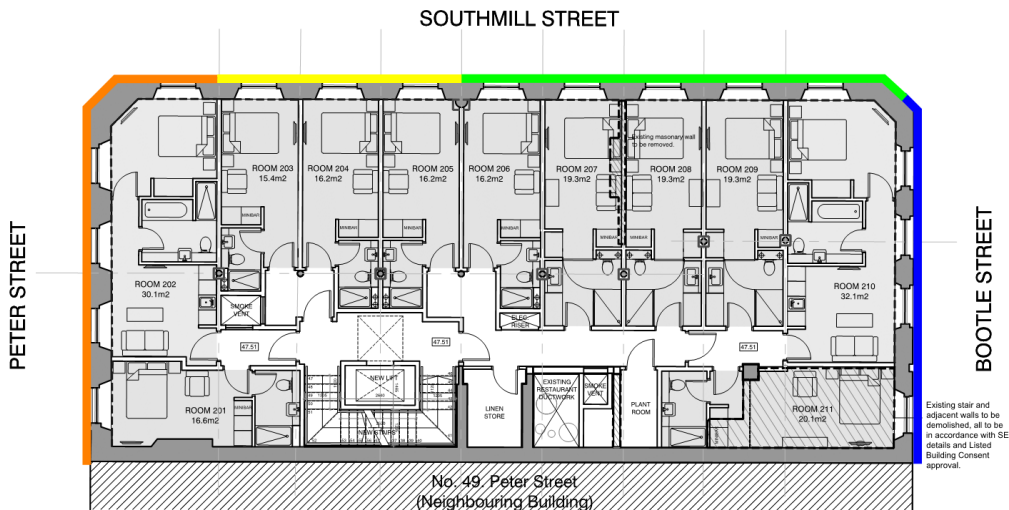


Figure 5 Facade noise level zones

Table 9 Predicted facade noise levels by zone

		Daytime $L_{Aeq,16hr}$ (dB)	Night time $L_{Aeq,8hr}$ (dB)	Night time L_{AFmax} (dB) not normally exceeded
Zone A		69	70	87
Zone B		67	68	85
Zone C		66	67	84
Zone D		64	65	82

7.2 Facade sound insulation

To achieve the internal noise criteria given in section 5.3 for the guestrooms, minimum facade sound insulation requirements have been determined, based on the external noise levels at each facade zone stated above.

The minimum sound insulation performances for guestrooms in the different facade zones are given in Table 10.

Table 10 Facade sound insulation performance requirements

Facade	Overall sound insulation performance $R'_w + C_{tr}$ (dB)
Zone A 	40 (42 for dual aspect rooms)
Zone B 	38
Zone C 	35
Zone D 	33

7.3 Guidance on facade construction, glazing, and ventilation strategy

7.3.1 Existing facade

Based on the simultaneous internal and external measurement results, the existing facade provides sound insulation performance of approximately $R'_w + C_{tr}$ 23 dB, which does not meet the requirements.

The performance is limited by the existing windows, as discussed in Section 4.1.2. The existing external walls were noted to consist of solid masonry at least 400 mm thick.

The current proposal is to retain the facade and install secondary glazing and/or provide new glazing.

On the basis that the existing glazing is made good (or replaced with new double glazing) and well-sealed, installing 6 mm secondary glazing throughout, with at least 100 mm cavity between primary and secondary glazing, is expected to be capable of achieving the facade sound insulation requirements set out above.

If new double glazing is relied on to provide the required sound insulation performance, it will need to be capable of enabling the overall facade sound insulation performances in Table 10 to be met.

Guestrooms in facade zones A and B are likely to require a mechanical ventilation strategy without any reliance upon openings in the facade for ventilation. Guestrooms in facade zones C and D could be ventilated via high performance acoustically attenuated passive ventilation.

7.3.2 New windows

Table 11 sets out some examples of glazing build ups and ventilation strategies that could be employed to achieve the required sound insulation performance for any new windows to mezzanine bed areas in the existing roof space.

Table 11 Example glazing configurations and ventilation strategies

Sound insulation R_w+C_{tr} (dB)	Example glazing configuration	Ventilation Strategy
33-35	6.4 mm/12 mm/10 mm	High performance acoustically attenuated passive ventilation
38	12.8 mm/12 mm/10 mm	Mechanical ventilation (eg, whole house ventilation)
40	12.8 mm/20 mm/10 mm	Mechanical ventilation (eg, whole house ventilation)
42	This represents a very high sound insulation performance. The highest performance typically achievable using double glazing is around R_w+C_{tr} 42 dB (16.8 mm/20 mm/16.8 mm). For higher performances, a substantial facade construction, limited glazing area, and mechanical ventilation is likely to be required.	

The performance required by each element will depend on the construction of the solid elements, the glazing specification, the relative areas of the solid and glazed elements, and the ventilation strategy (including the acoustic performance of the trickle ventilators and the number of ventilators required to serve individual rooms, if applicable).

As the design progresses, a more detailed facade sound insulation assessment will need to be undertaken.

8 Operational noise transfer from restaurant

Operational noise associated with the restaurant will need to be controlled to meet with suitable limits within the guestrooms.

Initial testing of the existing floor between the guestrooms and restaurant below resulted in a measured performance of $D_{nT,w}+C_{tr}$ 33 dB. The sound insulation test results are presented in detail in Appendix C.

Assuming typical sound level associated with background music in the restaurant, this construction would not be capable of controlling noise transfer to the guestrooms. The sound

insulation performance of the floor also falls below the minimum requirements of The Building Regulations (ADE 2003).

A minimum sound insulation performance of $D_{nT,w} + C_{tr}$ 50 dB with a low frequency performance of D_{125Hz} 46 dB is recommended for this adjacency. The floor will require enhancements to achieve this.

A possible enhancement option for achieving this is provided below based on retaining the existing ceiling in the restaurant. Alternative constructions may need to be investigated as the design progresses if this cannot be accommodated (eg due to weight restrictions):

- 50 mm thick floated normal-weight concrete slab ($\geq 2200 \text{ kg/m}^2$) on a slim line dovetail decking (such as Lewis Auf Sylomer)
- 25 mm resilient bearings
- 200 mm joists containing 100 mm mineral fibre
- 2 x 15 mm SoundBloc (or equivalent) installed between the existing joists above the existing ceiling in the restaurant with a minimum cavity of 150 mm to the underside of the dovetail decking above.
- 100 mm cavity to existing ceiling below containing 50 mm thick mineral fibre insulation.

If it is not possible to provide enhancements to the ceiling from the restaurant below, an intrusive survey will be required to confirm the exact build-up and enhancement options from above will need to be investigated further.

It is also advisable that sample noise measurements be carried out in the restaurant to check the operational noise levels.

9 Conclusion

The representative background sound levels were $L_{A90,5min}$ 56 dB during the day, and $L_{A90,5min}$ 54 dB during the night. Based on the requirements of the Local Authority, the relevant plant noise limits at the worst affected existing noise sensitive premises would be L_{Aeq} 51 dB during the day, and L_{Aeq} 49 dB during the night. These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent than those set out above.

In order to meet internal noise criteria in the proposed hotel rooms, enhancements to the facade and to floor of level 1 will be required. Options for retaining the existing facade with secondary glazing, and enhancements to the Level 1 floor, have been provided.

Appendix A

Survey details

Equipment

A Rion NL-52 sound level meter was used to undertake the unattended measurements. The attended measurements were carried out using a Brüel & Kjær 2250 sound level meter. The calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	NL-52/00932326	Rion	15 Mar 19 ¹	TCRT17/1087
Microphone	UC-59/05549	Rion	15 Mar 19 ¹	TCRT17/1087
Pre-amp	NH-25/32354	Rion	15 Mar 19 ¹	TCRT17/1087
Calibrator	NC-74/34125432	Rion	15 Mar 19 ¹	TCRT17/1085
Sound level meter	2250/3011964	Brüel & Kjær	4 Sep 19	UCRT17/1750, UTRC17/1781
Microphone	4189/3100176	Brüel & Kjær	4 Sep 19	UCRT17/1750, UTRC17/1781
Pre-amp	ZC0032/26376	Brüel & Kjær	4 Sep 19	UCRT17/1750, UTRC17/1781
Calibrator	4231/3019123	Brüel & Kjær	4 Sep 19	UCRT17/1748

¹Survey work carried out prior to calibration expiry.

Calibration of the sound level meters used for the tests is traceable to national standards. The calibration certificates for the sound level meters used in this survey are available upon request.

The sound level meters and microphones were calibrated at the beginning and end of the measurements using their respective sound level calibrators. No significant deviation in calibration occurred.

Noise indices

The equipment was set to record a continuous series of broadband sound pressure levels. Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

The L_{A90} is considered most representative of the background sound level for the purposes of complying with any local authority requirements.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures*.

Weather conditions

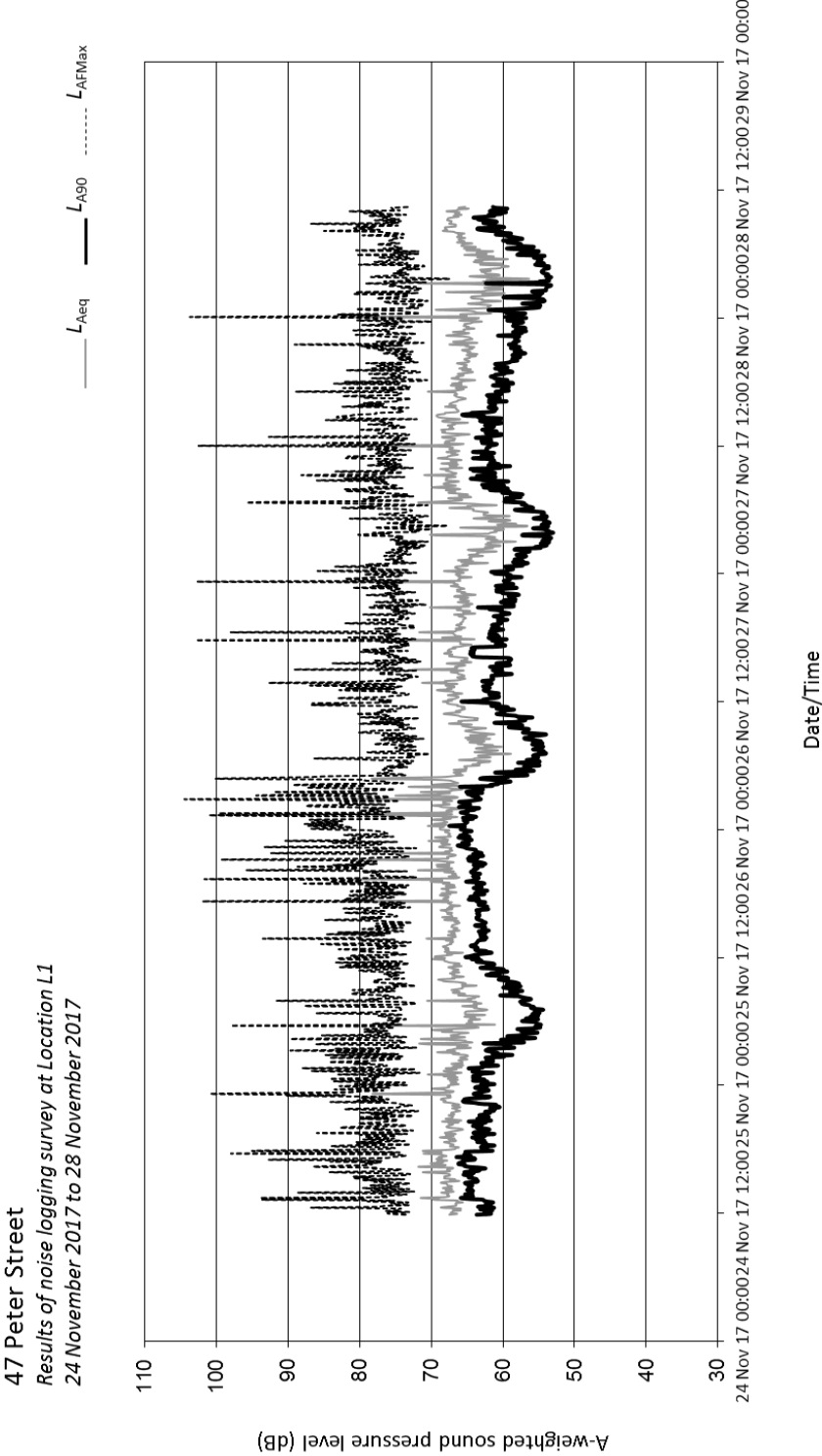
During the attended measurements carried out on 28 November 2017, the weather was generally clear and dry and no rain occurred. Wind speeds varied between approximately 0 and 2 m/s.

During the unattended noise measurements between 24 November 2017 and 28 November 2017, weather reports for the area indicated that temperatures varied between 0°C at night and 9°C during the day, and the wind speed was less than 8 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at Location L1



Appendix C

Sound insulation graph

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Appendix D

MCC - typical background level calculations

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