HOARE LEA

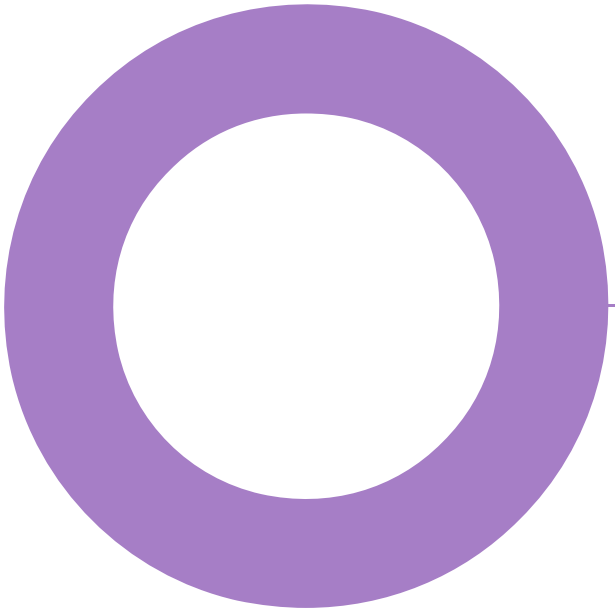
Z Hotels - 4 Wild Court Road. London.

Z Hotel Building Services Ltd.

ACOUSTICS

DISCHARGE OF PLANNING CONDITION 8

REVISION 00 – 19 MAY 2020



Audit sheet.

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Contents.

Executive summary.

The existing seven-storey building located at 4 Wild Court Road is to be converted into an eight-storey hotel complex. As part of the planning approvals process, acoustics related planning conditions have been imposed on the development.

This report has been produced in response to Planning condition 8 (Planning reference 2017/1611/P dated 23/11/2017), which relates to achieving suitable internal ambient sound levels and vibration levels within the development.

Environmental sound and vibration surveys.

Environmental sound and vibration surveys have been undertaken at the site to determine the existing baseline conditions.

The sound survey consisted of attended short-term and unattended measurements across the site. The site is exposed to moderate levels of sound at the façade overlooking Wild Court Road, dominated by road traffic activity along Kingsway. There is a small reduction in sound levels at night, which is typical of inner-city locations.

The vibration survey was conducted at basement and lower ground floor levels of the building. Detectable vibration was measured during the survey which has been attributed to underground trains.

Internal ambient sound levels.

The implication of the existing sound environment on the design of the façade and ventilation strategy have been assessed as follows:

- An acoustic model of the site has been produced using specialist acoustic software to predict the sound levels incident at the façades, taking into account the decrease in sound levels at the higher levels due to increased distance from the neighbouring roads.
- Using information from the acoustic model, calculations have been undertaken to determine the minimum sound reduction requirements for the different elements of the façade.
- The design proposals for both the solid and glazed elements of the façade have been reviewed in terms of their sound reduction performance. For the solid elements, the sound reduction performance of the constructions has been predicted using statistical analysis software.
- For the glazed elements, sound reduction performance values have been obtained from the manufacturer. The review undertaken indicates that the design proposals meet the required sound reduction performances and thereby should enable suitable internal ambient levels to be achieved.
- The ventilation strategy for the development is centred upon mechanical ventilation with heat recovery for the background ventilation, with fan coil units to be provided for cooling. This strategy avoids reliance on openable windows and therefore the strategy is considered suitable.

Vibration assessment.

A vibration assessment has been undertaken in line with guidance from British Standards. The assessment indicated that the vibration dose values are within the limits set by local authority, and therefore no additional mitigation will be required.

Summary.

On the basis of the assessment undertaken it is expected that suitable internal ambient sound levels and vibration levels will be achieved in line with the requirements of Planning Condition 8.

1. Introduction.

There are plans to redevelop the building located at 4 Wild Court Road in the London Borough of Camden. The proposals comprise redeveloping the existing seven-storey office building into an eight-storey hotel complex. There are also plans to connect the main building to a retail complex located at 75 Kingsway road, with the additional space to function as a café, reception and a few hotel rooms.

This report has been prepared as supporting evidence towards the discharge of Planning Condition 8 (application reference 2017/1611/P dated 23/11/2017) imposed on the scheme.

An environmental sound and vibration survey have been undertaken to establish the existing baseline conditions. The prevailing conditions have been compared against the local authority's requirements to identify any mitigation measures required as part of the scheme.

A glossary of the acoustic terms used in the report is provided in Appendix A.

2. Policy and guidance.

The following policy and guidance have been used for the survey and assessment:

- Camden Core Strategy adopted 2017;
- Camden development policy adopted 2010;
- British Standard 7445, 'Description and measurement of environmental noise',2003;
- British Standard 8233, 'Sound insulation and noise reduction in buildings – code of practice',2014;
- British Standard 4142, 'Methods for rating and assessing industrial and commercial sound',2014;
- World Health Organisation, 'Guidelines for Community Noise', 2012;
- British Standard 6472, 'Guide to evaluation of human exposure to vibration in buildings', 2008;
- ANC Guidelines, Measurement & Assessment of Ground borne Noise & Vibration, 2nd edition, 2012;

2.1 Planning Condition 8.

Planning Condition 8 states the following:

'Prior to commencement of the hotel use, details in respect of the following shall be submitted to and approved in writing by the local planning authority:

a) sound insulation for the building, to ensure that noise levels in the hotel bedrooms hereby approved shall meet the noise standard specified in BS8233:2014 for internal rooms and external amenity areas.

b) appropriate vibration mitigation measures where necessary for the building, to demonstrate that vibration will meet a level that has low probability of adverse comment and the assessment method shall be as specified in BS 6472:2008.'

2.2 British standard 8233, 'Sound insulation and noise reduction in buildings', 2014.

BS 8233 offers guidance on indoor ambient sound levels for various spaces. The internal sound criteria for hotel bedrooms are presented in Table 1.

Table 1: Ambient internal sound levels for hotel bedrooms

Period	Internal ambient sound level
Daytime (07:00 -23:00)	35 dB $L_{Aeq,16hrs}$
Night-time (23:00 – 07:00)	30 dB $L_{Aeq,8hrs}$

BS 8233 also states that regular individual noise events (passing trains or schedule aircraft) can cause sleep disturbance and hence a guideline value should be set in terms of L_{AFmax} depending on the character and number of events per night.

World Health Organisation guidelines suggests a limit of 45 dB L_{AFmax}. WHO also states that for a good night's sleep, individual events should not exceed this limit more than 10-15 times per night.

BS 8233 also provides recommendations for suitable external sound levels for amenity areas. It states that for traditional amenity areas such as patios or gardens a level of 50 dB $L_{Aeq,T}$ would be recommended. For noisier areas such as near strategic transport links, a higher guideline limit of 55 dB $L_{Aeq,T}$ would be acceptable.

Based on the planning condition, the above will be considered as the criteria for the design.

2.3 British Standard 6472, 'Guide to evaluation of human exposure to vibration in buildings', 2008.

BS 6472 provides guidance on the assessment of human response to vibration to buildings. This standard does not suggest limits of vibration; however, it does provide tentative guidance on the magnitude of vibration at which adverse comment may arise. These magnitudes are expressed in terms of vibration dose values (VDVs) and are presented in Table 2.

Table 2: Vibration Dose Assessment as per BS 6472

Location	Period	Low probability of adverse comment, $ms^{-1.75}$	Adverse comment possible $ms^{-1.75}$	Adverse comment probable $ms^{-1.75}$
Residential	Day (07:00-23:00)	0.2 - 0.4	0.4 - 0.8	0.8- 1 .6
	Night (23:00-07:00)	0.1 - 0.2	0.2 - 0.4	0.4 - 0.8
Office/Retail	Day (07:00-23:00)	0.4 - 0.8	0.8- 1 .6	1.6 - 3.2

Based on the planning condition, the hotel development should be designed to achieve VDVs that would result in a low probability of adverse comment.

3. The site and surroundings.

The site is situated in the London Borough of Camden in a primarily commercial area, close to Holborn Underground station (see Figure 1). The building is situated near two roads, Kingsway to the east and Wild Court Road to the south.

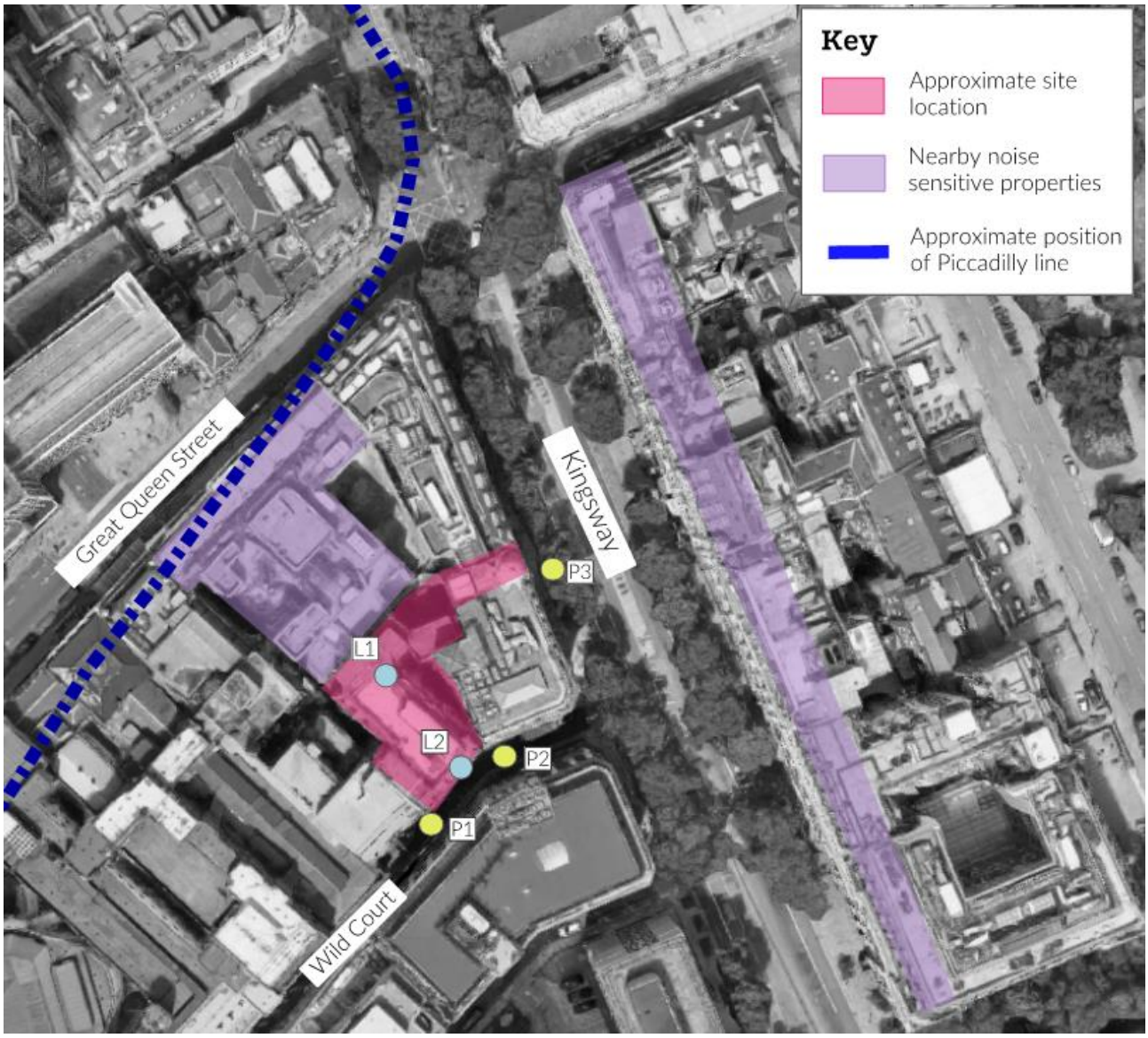


Figure 1: Site and local environment. Image Source: Google.

The local sound environment is dominated by road traffic activity from Kingsway which is a busy road. Wild Court Road is a small access road occasionally utilised by cars and vans for parking or turning onto the main road.

There are residential properties located on the upper floors of neighbouring buildings. The nearest noise-sensitive receptor to the development is the Kingsway House Hotel located on Great Queen Street.

4. Environmental sound survey.

4.1 2017 survey.

An environmental sound survey was undertaken by Hoare Lea between the 5th of January 2017 and the 17th of January 2017. The survey comprised long term unattended measurements at fixed positions, supplemented with several short term attended measurements. The measurement positions are indicated on Figure 2.

The long term survey was undertaken at two locations. Location 1 was located at the roof of the building. Measurements taken at this location are considered to be representative of the free-field environmental sound levels experienced at the noise-sensitive receptors in the area.

Location 2 was located on the south-west façade of the existing building at first-floor level and was used to measure representative environmental sound levels incident on the façade overlooking Wild Court Road.

The short-term survey was undertaken at multiple positions around the site at a distance of 1.5 metres above the ground and are presented in Figure 2 as P1 – P3.

Figure 2: Measurement locations. Image source: Google

A summary of the survey details and results have been provided in Sections 4.1.1 and 4.1.2. Full details of the survey and graphical representation of the data gathered has been included in Appendix B.

4.1.1 Long-term survey results.

The long-term survey was undertaken between the 5th of January and 17th of January 2017.

For Location 1, a Rion NL 32 type sound level meter was installed at roof level of the seven-storey building at a position representative of the nearest noise-sensitive receptor. This survey was undertaken between 5th January 2017 and 10th January 2017 and logged contiguous 15-minute samples under free-field conditions.

For Location 2, the Rion NL 31 type sound level meter was installed from a window on the first floor at a distance of 1 metre overlooking Wild Court Road. The location was chosen to be representative of sound levels incident on the south-east façade of the proposed development. The survey at this location was undertaken between 11th of January 2017 and 17th of January 2017 and logged contiguous five-minute samples.

As the sound level meter was located one metre away from a façade, a 3 dB façade correction has been applied to the results to provide equivalent free field sound levels.

A summary of the results of Location 1 and Location 2 is provided in Table 3 and Table 4.

Table 3: Summary of results from long-term monitoring at the roof (Location 1)

Period, T	Average ambient sound levels, $L_{Aeq, T}$	Typical background levels, $L_{A90,15mins}$
Day (07:00-23:00)	55 dB	51 dB
Night (23:00-07:00)	53 dB	50 dB

Table 4: Summary of the results from long-term monitoring at the façade overlooking Wild Court Road (Location 2)*

Period, T	Average ambient sound levels, $L_{Aeq, T}$	Typical maximum event levels, L_{Afmax}
Day (07:00-23:00)	66 dB	84 dB
Night (23:00-07:00)	65 dB	82 dB

* A façade correction has been applied to these results due to provide free-field results.

The results indicate that the ambient sound levels in the area are moderately high. There appears to be little variation between daytime and night-time levels except between the hours of 01:00 and 05:00 where a reduction of 2 dB was observed.

There are regular higher-level sound 'events' occurring throughout the day and night are were typically caused by buses and heavy goods vehicles passing on Kingsway. Peak sound events occur frequently between 79 dB L_{Amax} and 84 dB $L_{Amax.}$ Events do not regularly exceed 84 dB L_{AFmax} during the day and 81 dB L_{AFmax} at night, Based on observations on site it was observed to be the results of emergency vehicle sirens. In line with guidance from BS 8233, these maximum events have been addressed within the design of the building envelope.

4.2 Verification measurements.

A series of attended verification measurements were undertaken in February 2020 to understand if there had been any changes in the sound environment since the original survey.

A comparison of the results from the attended measurements undertaken in 2017 and the ones undertaken in 2020 is presented in Table 5.

Table 5: Summary of attended sound measurements.

Measurement position	2017 measurements		2020 measurements	
	Average ambient sound levels, L_{Aeq}	Maximum measured sound level, L_{Afmax}	Average ambient sound levels, L_{Aeq}	Maximum measured sound level, L_{Afmax}
Overlooking Wild Court Road	66	78	66	79
Overlooking Kingsway	72	85	70	83

The measurements undertaken in 2017 and 2020 show that there is minimal change in the sound levels over time. The measurements on Kingsway indicated slightly lower levels than those measured in 2017. However, it should be noted that the measurements in 2017 ranged from 71 dB L_{Aeq} – 73 dB L_{Aeq}. However, the sound levels measured at the development on Wild Court Road were very similar to those measured in 2017.

The worst-case measured L_{Aeq} levels and the typical L_{AFmax} levels will be used for the calculations to determine the façade sound insulation requirements for the building.

5. Façade sound insulation requirements.

In order to enable suitable internal sound levels to be achieved in line with BS 8233 requirements, consideration has been given to the sound insulation performance of the façade as well as the ventilation strategy.

5.1 Prediction of sound levels at the façade.

The results of the environmental sound survey have been used to validate a specialist computer model of the existing site using an acoustic modelling tool (Cadna-A software). The model undertakes calculation in accordance with Calculation of Road Traffic Noise (CRTN). The model was utilised to predict the variation in sound levels at different parts of the proposed scheme.

Images of the model results for the average daytime $L_{Aeq,T}$ are shown in Figure 3 (note that buildings on the opposite side of Wild Court were included within the model, but have been switched off to aid visibility). Similar calculations have also been undertaken to determine the night-time average and maximum.

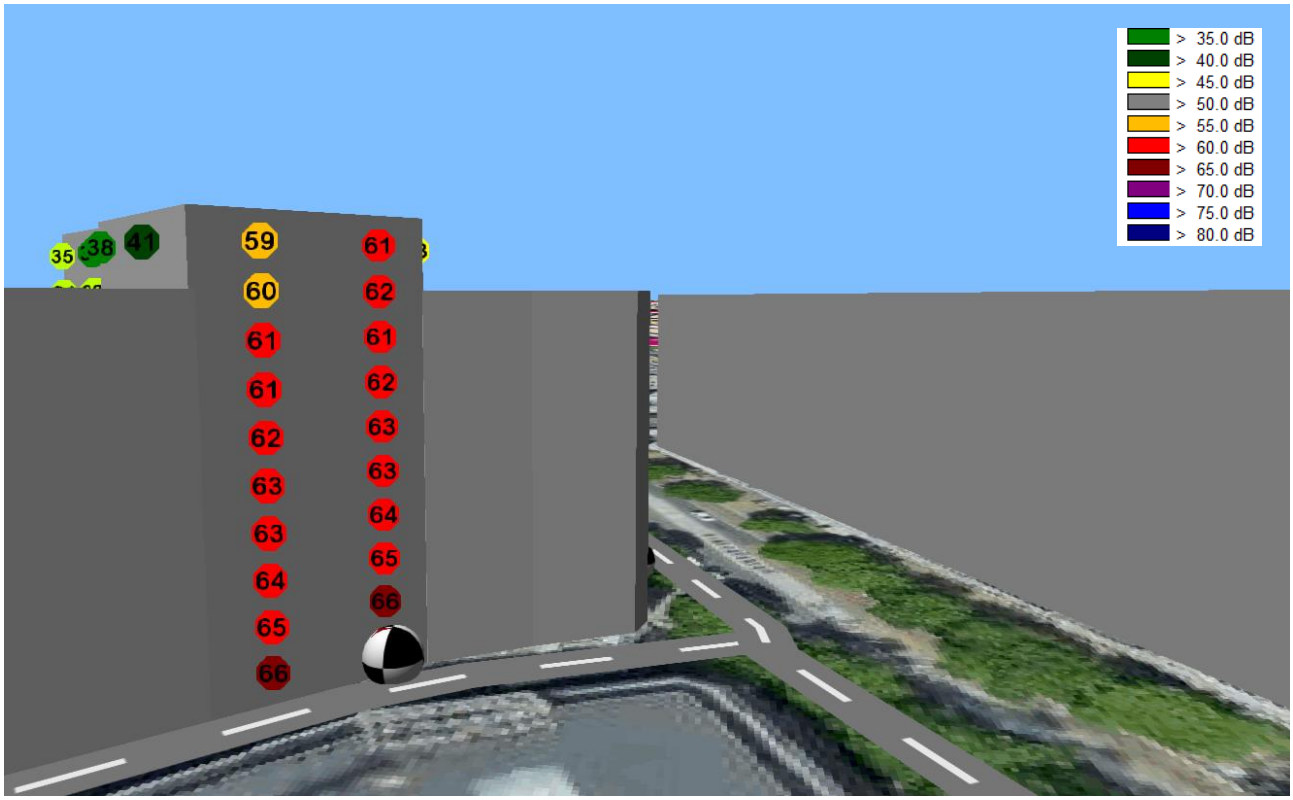


Figure 3: Incident sound levels (L_{Aeq} daytime) on the development – south-east view.

The modelling indicated that there is a decrease in the incident sound levels at the upper levels of the façade. A drop in sound level is observed at the higher levels of the building moving away from the nearby roads. A difference of 5 dB is observed at the highest level i.e. levels 6 and 7 as visible in the figure above.

5.2 Design of the façade.

The façade has been designed to provide suitable level of sound insulation in order to comply with internal ambient sound criteria. The attenuation of the external noise ingress provided by a building's façade will depend on the sound reduction provided by each element of the façade, i.e. the external walls, glazing, roof, etc.

5.2.1 Ventilation strategy.

Background ventilation is to be provided by the use of mechanical ventilation with heat recovery (MVHR) throughout the development. This avoids the need for acoustically rated trickle ventilators within the façade.

Fan coil units (FCU) are to be installed for comfort cooling. This is considered to be a suitable approach to achieve suitable internal sound conditions within hotel rooms as it removes the reliance on openable windows.

5.2.2 Facade proposals for solid elements.

There are two main façade proposals for the solid elements of the developments – the existing brick façade that has been retained with internal plasterboard linings and a new metal façade system for the seventh floor and courtyard extensions.

The façade proposals have been illustrated in Figure 4 and Figure 5.

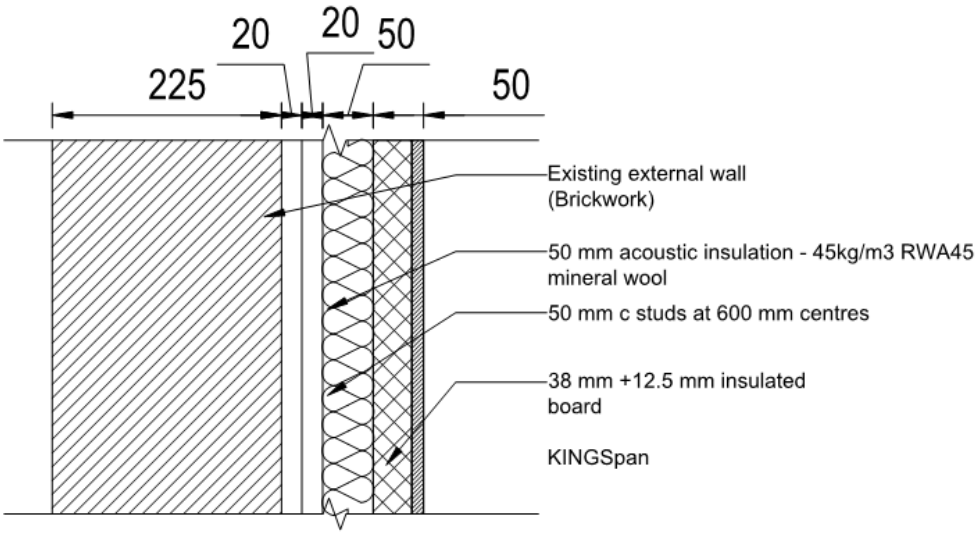


Figure 4: Improvement to the existing brick facade.

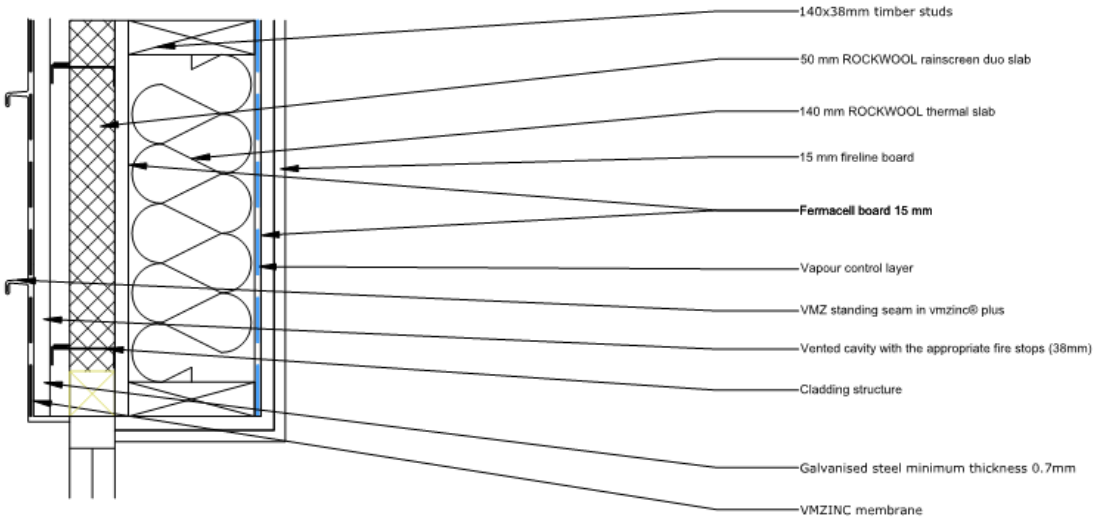


Figure 5: New VMZinc facade system

The sound reduction performance of the above constructions has been estimated using in-house statistical energy analysis modelling software.

The existing brick façade with an internal lining is expected to provide a minimum sound reduction performance of 52 dB R_w. The new zinc façade being a more light-weight structure is expected to have a lower sound reduction performance of 43 dB R_w.

5.2.3 Performance requirements for window system.

Calculations have been undertaken based measured external sound environment to determine the minimum sound reduction requirements for the window systems. The calculations assume the worst-case environmental sound levels and take into account the reduction provided by the solid elements of the façade.

The sound reduction performance requirements have been presented in Table 6.

Table 6: Sound reduction performance requirements for window systems.

Location	Calculated sound reduction performance of solid façade elements	Minimum sound reduction performance required for window systems
Facades overlooking Wild Court Road (lower levels)	52 dB R_w	38 dB R_w
Facades overlooking Wild Court Road (levels 6 and level 7)	43 dB R_w	39 dB R_w
Facades overlooking inner courtyard areas	43 dB R_w	39 dB R_w

5.2.4 Window proposals.

It is understood that for majority of the spaces, the existing windows are to be retained and refurbished with new seals. In addition to this secondary glazing is to be installed with a 200 mm cavity between the existing window.

Based on available manufacturer's data, the glazing units in combination with the existing 4mm single glazed unit should be able to achieve a performance of 53 dB R_w which is an improvement over the minimum requirements specified in Table 6.

For the new build areas, i.e. the seventh floor and courtyard extension double glazed with acoustic laminates have been specified. Based on the manufacturer's data, the glazing is expected to provide a minimum sound reduction performance of 40 dB R_w which is an improvement over the minimum requirements specified in Table 6.

Manufacturer's information for both the window systems is provided in Appendix C.

On the basis of this assessment, it is therefore expected that internal ambient levels in line with BS 8233 should be achieved

6. Vibration survey.

Due to the proximity of the site to the nearby Piccadilly underground lines (as can be visualised in Figure 1), there is a risk of perceivable vibration to the future occupants.

A vibration survey was undertaken on 5th January 2017 at two positions on-site, one at basement level and the other at lower ground level. The survey was undertaken with the intent of quantifying the vibration levels generated from underground train movements.

The first position was located at the lower ground level, in an area likely to be closest to the underground railway lines. The position of the measurement is indicated on Figure 6 and was chosen to measure worst-case vibration levels while avoiding movement of building occupants and other external influences as far as was practicable.

The second position was located within the smaller basement plant room. This area is dominated by noise from existing plant equipment. The position is indicated in Figure 7.

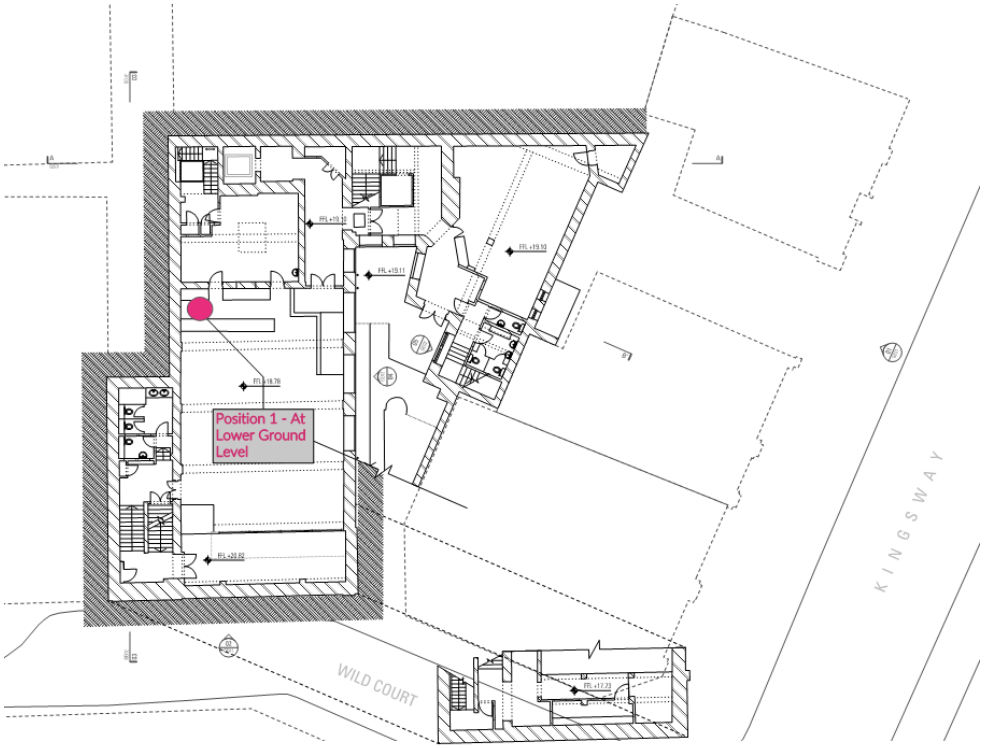


Figure 6: Vibration position 1 located at the lower ground floor of the building (existing building layout)

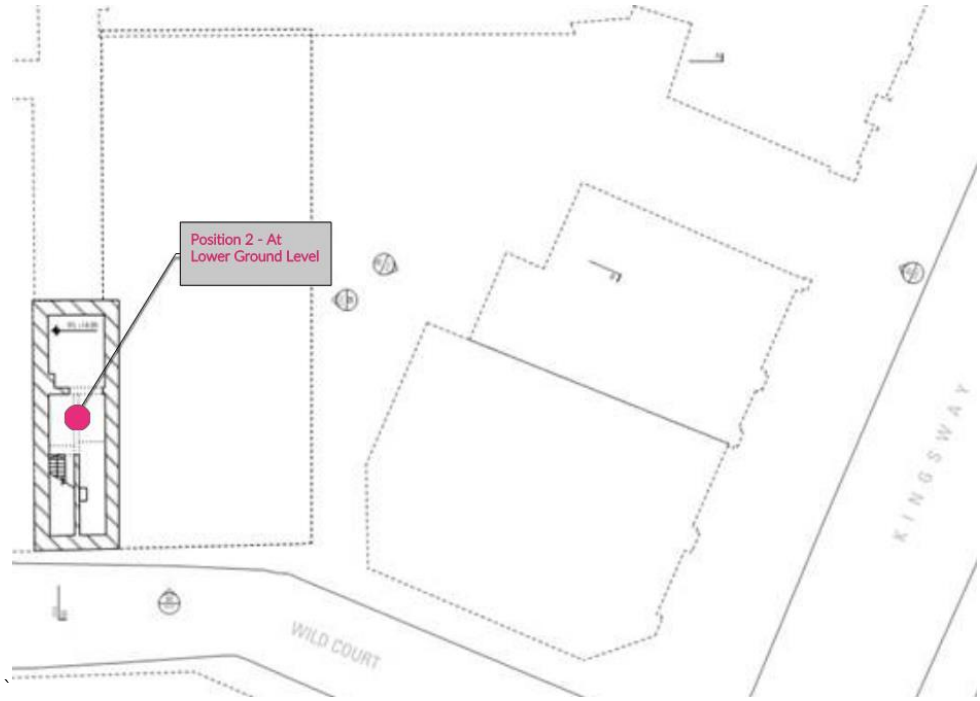


Figure 7: Vibration position 1 located at the basement level of the building (existing building layout)

During the survey, the meter was able to detect distinct 'vibration events', occurring at the two positions. The vibration from the events were not perceptible to touch.

A more detailed description of the survey, including measurement periods, is provided in Appendix D. The data has not been included in its entirety but is available on request.

7. Vibration assessment.

The vibration from underground trains has been assessed using guidance from BS 6472. The assessment considers the vibration experienced during the 16-hour daytime and 8 hour night-time periods. The assessment has been undertaken for both measurements positions and considers vibration dose levels for weekdays and weekends. It should be noted that the vibration levels would decrease at the higher levels and therefore the assessments undertaken present a worst-case scenario.

The number of trains passing the site has been estimated based on the number of underground trains passing through Holborn London Underground station on the Piccadilly line. On weekdays, it is estimated that typically there are 640 trains operated during the daytime period and 160 trains operated during the night-time period. For weekends it is estimated that there are 640 trains operated during the daytime and 250 trains operating during the night-time.

The assessment has been performed for the two scenarios and has been detailed in Sections 8.1 and Sections 8.2.

7.1 Vibration assessment at the lower ground floor.

A summary of the vibration assessment undertaken at the lower ground floor for weekday periods is presented in Table 7 and for weekends is presented in Table 8.

Table 7: Vibration assessment during weekday periods.

Assessment	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Predicted VDV	0.09 $ms^{-1.75}$	0.06 $ms^{-1.75}$
BS 6472 assessment category	Less than band 0.2 $ms^{-1.75}$	Less than band 0.1 $ms^{-1.75}$
BS 6472 assessment	Low probability of adverse comment	Low probability of adverse comment
Local Authority assessment	Meets criteria	Meets criteria

Table 8: Vibration assessment during weekend periods.

Assessment	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Predicted VDV	0.09 $ms^{-1.75}$	0.07 $ms^{-1.75}$
BS 6472 assessment category	Less than band 0.2 $ms^{-1.75}$	Less than band 0.1 $ms^{-1.75}$
BS 6472 assessment	Low probability of adverse comment	Low probability of adverse comment
Local Authority assessment	Meets criteria	Meets criteria

The prediction suggests that there is low probability of adverse comment, and therefore, the vibration levels are within local authority limits.

7.2 Vibration assessment at the basement level.

A summary of the vibration assessment undertaken at the lower ground floor for weekday periods is presented in Table 9 and for weekends is presented in Table 10.

Table 9: Vibration assessment during weekday periods.

Assessment	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Predicted VDV	0.02 $ms^{-1.75}$	0.01 $ms^{-1.75}$
BS 6472 assessment category	Less than band 0.2 $ms^{-1.75}$	Less than band 0.1 $ms^{-1.75}$
BS 6472 assessment	Low probability of adverse comment	Low probability of adverse comment
Local Authority assessment	Meets criteria	Meets criteria

Table 10: Vibration assessment for during weekends periods.

Assessment	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Predicted VDV	0.02 $ms^{-1.75}$	0.01 $ms^{-1.75}$
BS 6472 assessment category	Less than band 0.2 $ms^{-1.75}$	Less than band 0.1 $ms^{-1.75}$
BS 6472 assessment	Low probability of adverse comment	Low probability of adverse comment
Local Authority assessment	Meets criteria	Meets criteria

The prediction suggests that there is low probability of adverse comment, and therefore, the vibration levels are within local authority limits.

Appendix A – Glossary of acoustic terms.

Decibel (dB)

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

Octave and Third Octave Bands

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

A-Weighting

The 'A' weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies. An 'A' weighted value would be written as dB (A).

Equivalent Continuous Sound Level $L_{eq,}$

The $L_{eq,}$ is a parameter defined as the equivalent continuous sound pressure level. Over a defined time period 'T', it is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal. The $L_{eq,T}$ can be seen to be an "average" sound pressure level over a given time period (although it is not an arithmetic average). Typically the $L_{eq,T}$ will be an 'A' weighted noise level in dB(A). It is commonly used to describe all types of environmental noise sources.

Background Noise Level L_{90}

The $L_{90,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe the prevailing background noise level or underlying noise level.

$L_{max,T}$

The Lmax,T is a parameter defined as the maximum sound pressure level that occurred during the time period 'T'. It is commonly used to describe the highest noise level that occurred during an event such as a vehicle pass-by.

VIBRATION

Oscillation of a body about an equilibrium position, disturbed by an external force or internal force.

The vibratory motion of a surface can be characterised by:

(a) displacement (m),

(b) velocity (m/s), or

(c) acceleration (m/s^2).

The magnitude of the vibration can be quantified in several ways:

Peak to Peak

The total excursion of the oscillation about the zero datum.

Peak

This value gives the maximum excursion of the oscillation above or below the zero datum.

r.m.s.

This value gives the root mean square of the time history over a specific time interval (time constant).

dB

Vibration levels can be expressed in dB. A reference level of 10^{-6} m/s^2 r.m.s. is usually used for acceleration.

Vibration Dose Value, V.D.V. ($m/s^{1.75}$)

The V.D.V. assesses both the magnitude of vibration and its duration. It can be estimated from the frequency weighted r.m.s. value of the acceleration and its duration and is then referred to as the estimated Vibration Dose Value (e.V.D.V.).

Re-radiated Noise

The level of noise, in dB, radiated by a surface excited by vibration, e.g. a floor or wall.

Appendix B – Environmental sound survey.

Long-term survey.

A long term survey was undertaken at two locations between the 5th of January and the 17th of January 2017. The sound monitor was initially placed at Location 1 on the roof to determine background sound levels in the area. The sound monitor was then moved to Location 2 overlooking Wild court road, to establish sound levels incident on the external façade.

The survey on the roof (Location 1) was undertaken between the 5th of January and the 10th of January 2017 and logged in 15-minute samples using a Rion NL-32 sound level meter. The results measured on-site are presented in Figure 8. The sound levels from each day have been summarised and are presented in Table 11.

Table 11: Summary of long-term measurements results at Location 1.

Day and Date	Period	Average ambient sound levels, L_{Aeq} dB	Typical maximum event levels, L_{Amax} dB	Typical background levels, L_{A90} dB
05/01/2017 Thursday	Day (13:00 - 23:00)	56	73	52
	Night (23:00 - 07:00)	53	67	51
06/01/2017 Friday	Day (07:00 -23:00)	56	73	53
	Night (23:00 - 07:00)	54	69	51
07/01/2017 Saturday	Day (07:00 -23:00)	54	71	51
	Night (23:00 - 07:00)	52	66	50
08/01/2017 Sunday	Day (07:00 -23:00)	53	70	51
	Night (23:00 - 07:00)	53	64	50
09/01/2017 Monday	Day (07:00 -23:00)	56	75	52
	Night (23:00 - 07:00)	52	68	50
10/01/2017 Tuesday	Day (07:00 -11:00)	56	77	53

It was observed that the measurements in the area is dominated by noise from existing plant equipment. There appears to have been some erroneous data occurring on the 8th of January between the hours of 23:00 and 02:00. This has been omitted from the analysis.

The survey at the façade (Location 2) was undertaken from the 11th of January until the 17th of January 2017 and logged in five-minute samples using a Rion NL 31 sound level meter. The results are presented in Figure B2. The sound levels from each day have been summarised and are presented in Table 12.

The results indicate that the ambient sound levels in the area are moderately high. There appears to be little variation between from daytime and night-time levels except between the hours of 01:00 and 05:00 where a reduction of 2 dB was observed.

There also appear to be a large number of louder events occurring during the night. Higher maximum noise events that appear to be outliers to the general data has also be excluded from the analysis as these are expected to be uncommon and are usually due events like sirens.

Table 12: Long-term measurement results for Location 2

Day and Date	Period	Average ambient sound levels, L_{Aeq} dB	Typical maximum event levels, L_{Amax} dB	Typical background levels, L_{A90} dB
11/01/2017 Wednesday	Day (13:00 - 23:00)	67	86	61
	Night (23:00 - 07:00)	67	86	61
12/01/2017 Thursday	Day (07:00 -23:00)	68	87	64
	Night (23:00 - 07:00)	66	82	60
13/01/2017 Friday	Day (07:00 -23:00)	69	87	63
	Night (23:00 - 07:00)	67	85	61
14/01/2017 Saturday	Day (07:00 -23:00)	69	83	62
	Night (23:00 - 07:00)	67	87	62
15/01/2017 Sunday	Day (07:00 -23:00)	67	84	61
	Night (23:00 - 07:00)	68	84	60
16/01/201 Monday	Day (07:00 -11:00)	69	88	63
	Night (23:00 - 07:00)	67	87	60
17/01/2017 Tuesday	Day (07:00 -11:00)	68	88	63

The weather conditions for the majority of the survey period were dry with minimal cloud cover. There were a few days within the week commencing the 11th of January where wind and rain was observed, and this data has been omitted. The exact periods of exclusion are presented in Figure 9.

The equipment used for the long term surveys has been summarised in Table 13. All equipment was calibrated before and after the survey. No significant drift was observed.

Table 13: Equipment used for long-term survey.

Survey details	Instrumentation description	Manufacturer	Model	Serial Number
Location 1	Sound Level Meter	Rion	NL - 32	1161938
	Microphone	Rion	UC-53A	311039
	Pre-amp	Rion	NH-21	21973
	Acoustic Calibrator	Rion	NC - 74	34557134
Location 2	Sound Level Meter	Rion	NL - 31	841830
	Microphone	Rion	UC-53A	317811
	Pre-amp	Rion	NH-21	12962
	Acoustic Calibrator	Rion	NC - 74	34172704

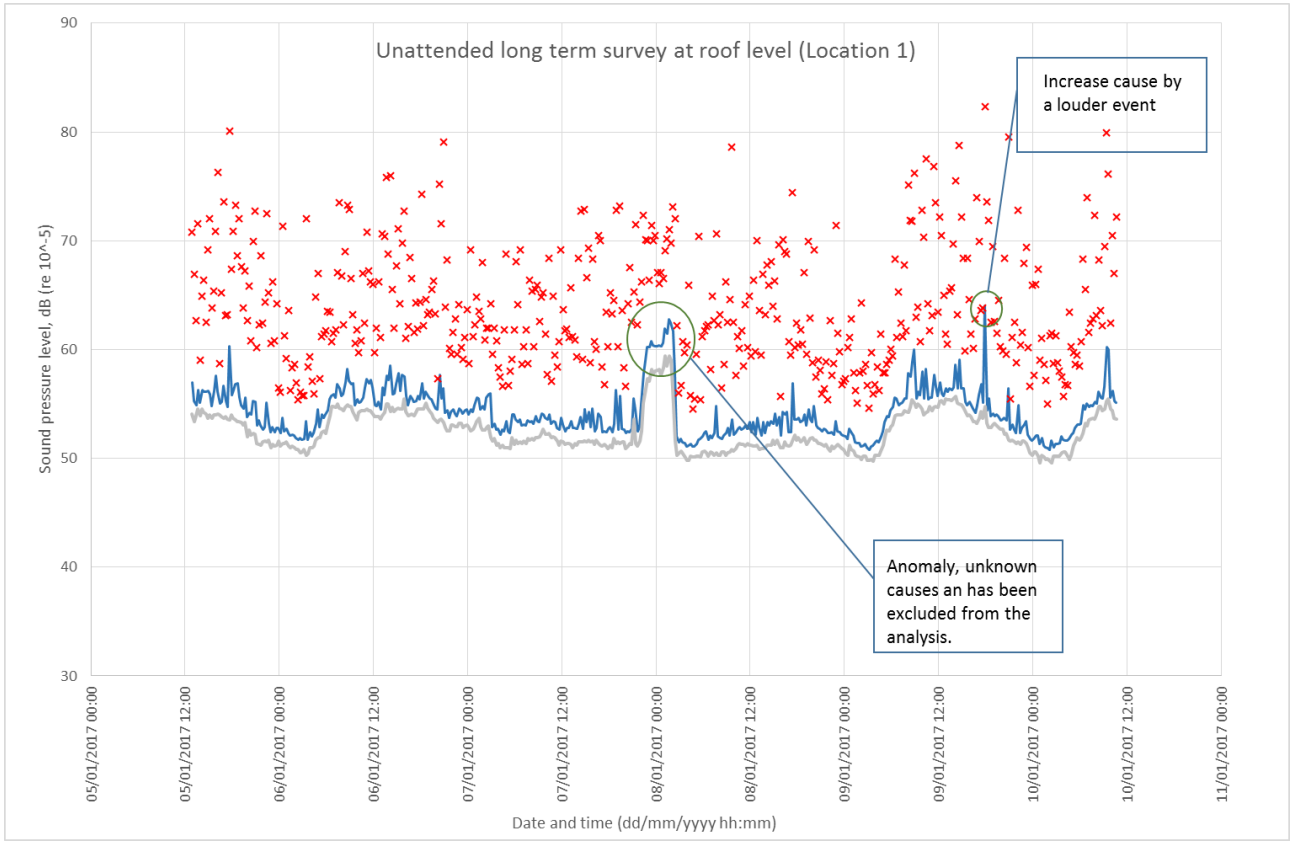


Figure 8: Long-term survey results at Location 1 -roof level

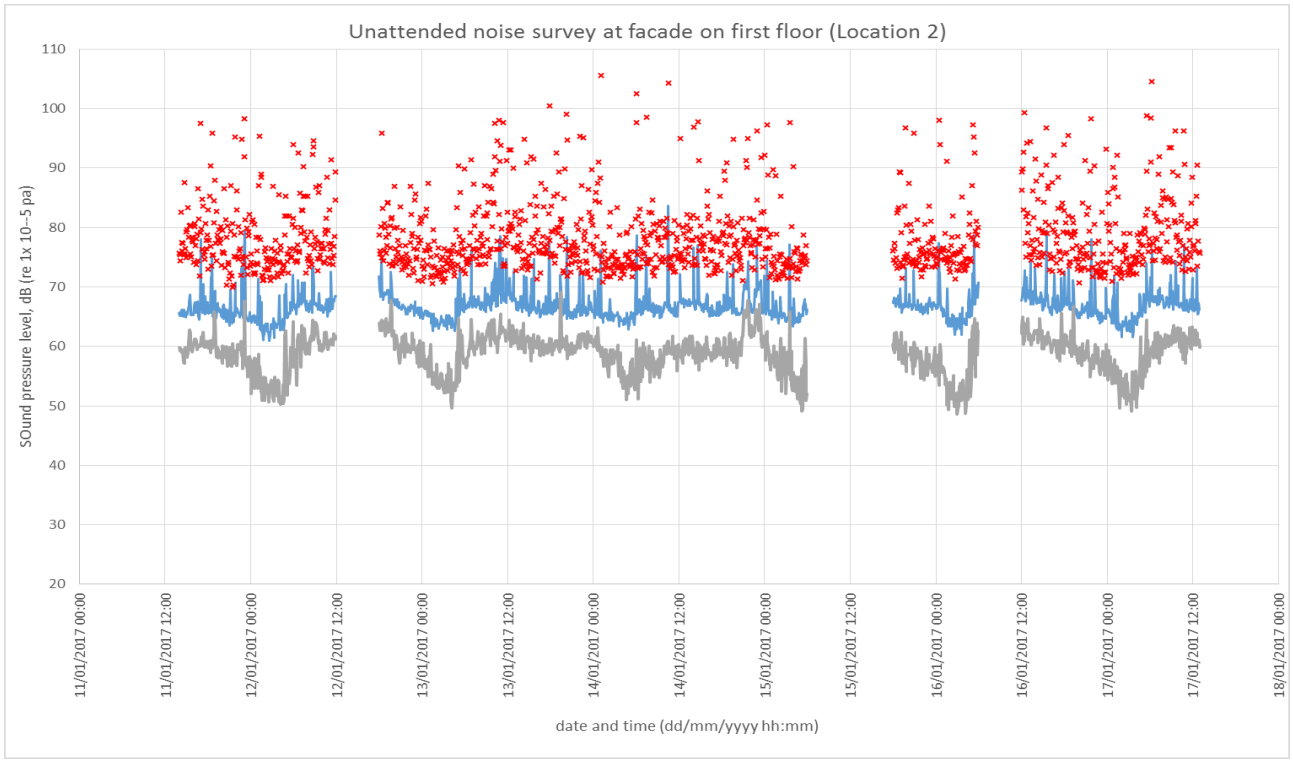


Figure 9: Long-term survey results at Location 2- first-floor facade

Attended measurements in 2017.
The attended short term measurements were performed on Thursday 5th of January and on Tuesday 10th of January and taken in five-minute samples. A summary of the measurements undertaken have been summarised in Table 5. The measurements collected both broad band as well as spectral sound data during the interval. The full measurements have not been included but are available on request.

Table 14: Equipment used for attended survey in 2017.

Survey details	Instrumentation Description	Manufacturer	Model	Serial Number
Attended measurements	Sound Level Meter	Brüel & Kjær	2250	3004050
	Microphone	Brüel & Kjær	4189	2887265
	Pre-amp	Brüel & Kjær	2C0032	19776
	Acoustic Calibrator	Brüel & Kjær	4231	2445715

Attended measurements in 2020.
A summary of the measurements undertaken have been summarised in Table 5. The measurements collected both broad band as well as spectral sound data during the interval. The full measurements have not been included but are available on request.

Table 15: Equipment used for attended survey in 2017.

Survey details	Instrumentation Description	Manufacturer	Model	Serial Number
Attended measurements	Sound Level Meter	Rion	NL - 32	1161938
	Microphone	Rion	UC-53A	311039
	Pre-amp	Rion	NH-21	21973
	Acoustic Calibrator	Rion	NC - 74	34557134

Appendix C – Manufacturer's data for glazing systems.

Sections of the manufacturers data sheets have been included below for reference. The full sheets can be provided if requested.

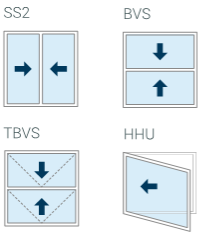
Secondary glazed units.

The existing windows are 4mm single glazed units and the future proposals are BVS model with 6.4 acoustic laminate secondary glazing with cavity. The manufacturer's data states that the units will provide sound reduction performance of 53 dB R_w as seen below.

Acoustic Performance Results

	Primary Window 4mm Float Glass				Primary Window 6mm Float Glass				Primary Window 4mm Float Glass				Primary Window 6mm Float Glass			
	200mm Glass to Glass				200mm Glass to Glass				150mm Glass to Glass				150mm Glass to Glass			
Secondary Glazing	**SS2**	**HHU**	**BVS**	**HTBVS**	**SS2**	**HHU**	**BVS**	**HTBVS**	**SS2**	**HHU**	**BVS**	**HTBVS**	**SS2**	**HHU**	**BVS**	**HTBVS**
4mm Toughened	49	50	49	47	51*	51	51	48	48*	48*	47*	46*	51*	50*	50*	47*
6mm Toughened	50*	51*	51*	47*	51*	52*	52*	48*	49*	49*	48*	46*	51*	50*	50*	47*
6.4mm Acoustic Laminate	51	52	53	48	52*	53*	54*	50	50*	50*	49*	47*	52	51*	52*	48*
8.8mm Acoustic Laminate	NA	52*	NA	48*	NA	53*	NA	49	NA	50*	NA	47*	NA	51*	NA	48*
10.8mm Acoustic Laminate	NA	53*	NA	NA	NA	54	NA	NA	NA	51*	NA	NA	NA	52*	NA	NA
4/12/6.4mm Sealed Unit	NA	53*	NA	NA	NA	53	NA	NA	NA	51*	NA	NA	NA	52*	NA	NA

Key :



Granada Secondary Glazed windows have been tested at Chiltern Dynamics in accordance with BS EN ISO 10140-2: 'Laboratory measurement of airborne sound insulation of building elements'. The table shows results for secondary windows set at a 200mm and 150mm cavity with 4mm or 6mm float glass in the primary window. Chiltern's Dynamics lab is UKAS Accredited No.1762

* Sound reduction figures predicted by Chiltern Dynamics using the basis of actual laboratory test results. Sound Reduction (Rw) measured in dB.

Figure 10: Secondary glazing proposals.

New-build glazing.

For the new build areas, i.e. the seventh floor and courtyard extension double glazed with acoustic laminates (6/16/6.8) have been specified. Based on the manufacturer's data, the glazing is expected to provide a minimum sound reduction performance of 40 dB R_w

Sound insulation data for Pilkington **Optiphon™**

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						R_w (C; C_{tr})	R_w	R_w+C	R_w+C_{tr}
	125	250	500	1000	2000	4000				
Single glazing										
6.8 mm Pilkington **Optiphon™**	22	26	31	37	40	40	36 (-1; -4)	36	35	32
8.8 mm Pilkington **Optiphon™**	27	29	34	38	40	43	37 (0; -2)	37	37	35
10.8 mm Pilkington **Optiphon™**	26	30	35	39	40	46	38 (-1; -3)	38	37	35
12.8 mm Pilkington **Optiphon™**	29	32	36	41	42	51	40 (-1; -3)	40	39	37
16.8 mm Pilkington **Optiphon™**	31	33	38	41	43	54	41 (-1; -3)	41	40	38
Insulating glass units										
6 mm / 16 mm argon / 6.8 mm Pilkington **Optiphon™**	21	28	37	48	48	54	40 (-2; -6)	40	38	34
6 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	25	27	38	48	47	55	41 (-2; -6)	41	39	35
8 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	21	30	39	47	50	55	42 (-3; -8)	42	39	34
10 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	28	31	42	45	50	58	44 (-2; -6)	44	42	38
10 mm / 20 mm argon / 8.8 mm Pilkington **Optiphon™**	28	36	43	47	49	58	46 (-2; -6)	46	44	40
8.8 mm Pilkington **Optiphon™** / 16 mm argon / 12.8 mm Pilkington **Optiphon™**	28	36	45	53	56	64	48 (-2; -7)	48	46	41
10.8 mm Pilkington **Optiphon™** / 24 mm argon / 16.8 mm Pilkington **Optiphon™**	35	41	48	53	55	65	52 (-2; -6)	52	50	46
12.8 mm Pilkington **Optiphon™** / 20 mm argon / 16.8 mm Pilkington **Optiphon™**	35	45	49	50	54	65	51 (-1; -4)	51	50	47

Measurements undertaken in accordance with BS EN ISO 10140 and Rw (C; C_{tr}) determined in accordance with BS EN ISO 717-1.
For insulating glass units, there is little difference in the sound insulation for cavity widths in the range 6 to 16 mm.
To calculate performance data for Pilkington products, please use our Spectrum online calculator at https://spectrum.pilkington.com/
For glass combinations to achieve an R_w value higher than 52 dB, please contact us for more details.

Appendix D- Vibration survey.

vibration survey was undertaken at two positions on the 5th of January 2017 using a fixed vibration monitor. The first measurement was undertaken on the lower ground floor from 12:10 and 12:30 on the day. The second measurement was undertaken at the basement level (plant room area) between 12:40 and 13:00. The measurements positions have been detailed in Figures 4 and 5 in Section 7. The results of the survey have not been included but are available on request.

The equipment used for the survey has been detailed in Table 16.

Table 16: Equipment details for vibration survey

Survey details	Instrumentation description	Manufacturer	Model	Serial Number
Vibration	Vibration meter	SVAN	949	11224
	Accelerometer	Dytran	3191A1	1906
	Vibration calibrator	APT	AT01	7001

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