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77 CASTLE ROAD, LONDON

NOISE & VIBRATION IMPACT ASSESSMENT

Report 14104.NVA.01.Rev.A

Prepared on 17 July 2018

For:

SJT Associates

15 Maiden Lane

London

WC2E 7NG

Site Address	Report Date	Revision History
77 Castle Road, London, NW1 8SU	20/04/2016	A – 17/07/2018

Contents

LIST OF ATTACHMENTS

1.0 INTRODUCTION

KP Acoustics has been commissioned by SJT Associates, 15 Maiden Lane, London, WC2E 7NG to assess the suitability of the site at 77 Castle Road, London, NW1 8SU for a residential development in accordance with the provisions of the National Planning Policy Framework and the Noise Policy Statement for England (NPSE).

This report presents the results of the environmental survey undertaken in order to measure prevailing background noise and vibration levels and outlines any necessary mitigation measures.

2.0 ENVIRONMENTAL NOISE SURVEY

2.1 Procedure

A noise and vibration survey was undertaken on the proposed site at the locations as shown in Figure 14104.SP1. The locations were chosen in order to collect data representative of the worst-case levels expected on the site due to all nearby noise and vibration sources.

Continuous automated monitoring was undertaken for the duration of the survey between 11:30 on 13th July and 11:00 on 16th July 2018. Weather conditions were generally dry with light winds and therefore suitable for the measurement of environmental noise. The measurement procedure complied with ISO 1996-2:2007 Acoustics "Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels".

In addition to the noise survey, an assessment of vibration was carried out. This survey addressed both train and background vibration and was conducted during the course of the noise survey as described above.

The vibration monitoring was undertaken at the location as shown on the site plan as shown in Figure 14104.SP1. Measurements were made of vertical (z-axis) and horizontal (x - y axes).

2.2 Noise Breakout Measurements

In order to assess the effectiveness of current elements of the external building fabric in attenuating noise break-out, a number of manual measurements were undertaken utilising pink noise.

A spatial average of the resulting noise levels was obtained by using a moving microphone technique over a minimum period of 15-20 seconds at one position within the ground floor bar area of the existing premises.

The same measurement procedure was repeated approximately 1m outside the windows of the East façade of the premises, in order to assess the noise break-out from the ground floor bar area to the external environment.

2.3 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used was as follows:

1 No. Svantek Type 958 Class 1 Sound Level Meter

1 No. Svantek Type 958 Class 1 Sound Level Meter

1 No. Svantek Type 958A Sound & Vibration Analyser

1 No. NTi XL2 Class 1 Sound Level Meter

1 No. RCF ART 310A

1 No. NTi Audio Minirator MR-PRO

B&K Type 4231 Class 1 Calibrator

1 No. Dytran accelerometer

3.0 RESULTS

3.1 Noise Survey

The $L_{Aeq:\ 5min}$, $L_{Amax:\ 5min}$, $L_{A10:\ 5min}$ and $L_{A90:\ 5min}$ acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as a time history in Figures 14104.TH1-2. Average daytime and night time noise levels are shown in Table 4.1.

3.2 Vibration Survey

The results of the background and rail traffic vibration measurements are shown in Figures 14104.VS1-3 as acceleration levels over the 1Hz to 80Hz frequency range.

3.3 Breakout Measurements

Summarised results of the airborne tests are shown in Table 3.1. Source noise levels were in the region of approximately 95-100 dB(A) within the ground floor bar area. This amplitude enables us to investigate the maximum possible airborne sound insulation performance of the separating elements.

Test Element	Source	Receiver	D_w
External Façade	Ground Floor Bar Area	Exterior Environment–East Façade	33dB

Table 3.1: Breakout Test Results

4.0 DISCUSSION

The main part of the site is bounded by mainline railway tracks to the West, Castle Road to the North, and Hadley Street to the East.

At the time of the survey, the background noise climate was dominated by rail traffic noise from the mainline railway tracks to the West.

Measured noise levels are representative of worst case noise exposure levels expected to be experienced by the facades of the proposed development, and are shown in Table 4.1.

	Automated Monitoring Position 1 dB(A) (TH1)	Automated Monitoring Position 2 dB(A) (TH2)
Daytime $L_{Aeq,16hour}$	59	65
Night-time $L_{Aeq,8hour}$	51	60

Table 4.1 Site average noise levels (L_{Aeq}) for daytime and night time

5.0 NOISE ASSESSMENT

Internal noise requirements are based on BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'. This standard recommends internal noise levels for good or reasonable resting conditions during daytime (07:00-23:00 hours) and night-time (23:00-07:00). These levels are shown in Table 5.1.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Rooms	35 dB(A)	-
Dining	Dining Room/area	40 dB(A)	-
Sleeping (daytime resting)	Bedrooms	35 dB(A)	30 dB(A)

Table 5.1 BS8233 recommended internal background noise levels

The external building fabric would need to be carefully designed to achieve these recommended internal levels. It is currently understood that the non-glazed external building fabric elements of the proposed development would be comprised of blockwork. This would contribute towards a significant reduction of ambient noise levels in combination with a good quality double-glazed window configuration, as shown in Section 6.

5.1 Vibration Assessment

BS6472-1:2008 ‘Guide to evaluation of human exposure to vibration in buildings’ defines the vibration magnitudes at which complaints are likely to occur. These are defined by a series of standardised curves against which measured vibration values are compared.

Curve 1 may be considered as the threshold of human perception of vibration, so any levels below Curve 1 would not be tactile. In dwellings, the minimum vibration thresholds equating to a “low probability of complaints” is Curve 1.4 during night-time and Curve 2 for daytime.

Figures 14104.VS1-3 compare vibration acceleration magnitudes for rail traffic pass-bys to the BS6472 curve family. The z-axis vibration level, which is the most important when annoyance is considered, is significantly below the threshold of perception and would, consequently, not constitute a significant concern for this development.

With regards to structural or cosmetic damage to the building, this is considered significant in the frequency range above 4Hz. The small increase at the low frequency end which is seen in the attached Figures would not be considered to present any danger to the shell of the building.

5.2 Breakout Assessment

In this instance, ‘An appropriate automatic noise control device must be fitted to all amplified sound equipment. The device must be:

(a) Set so that the volume of any amplified sound emanating from the premises does not cause a public nuisance…

We propose to set the noise criterion for the noise emissions of the venue in this instance, so that the ’A’ weighted sound pressure level from the outdoor bar area, when operating at its noisiest, shall not at any time exceed a value of 10dB below the existing ambient noise level, at a point 1 metre outside the window of the closest receiver, as shown in Table 5.2.

	Daytime (07:00 to 23:00)	Night-time (07:00 to 23:00)
Noise criterion at nearest residential receiver (10dB below average L_{Aeq})	49 dB(A)	41 dB(A)

Table 5.2 Proposed noise emissions criteria

It is understood that noise generated within the existing venue would be typical of a social venue with amplified music. Following a visual inspection of the site, the closest noise-sensitive receiver is the 1st floor window of the proposed development at an approximate distance of 4m.

Using a typical source level of 93-95 dB(A), L_{eq} as the maximum level expected within the ground floor bar area, and the measured D_w rating of the building façades, Table 5.3 shows the predicted sound pressure level at the nearest noise sensitive receiver due to the existing venue activity, compared against the measured minimal background noise. Detailed calculations are shown in Appendix B.

Receiver - Nearest Noise Sensitive Facade	
Criterion ($L_{Aeq, 5min}$) Daytime	41 dB(A)
Noise Level at Receiver	40 dB(A)

Table 5.3 Predicted noise level and criterion at nearest noise sensitive location

Sound Limiter

The system designer should be able to advise on the type and standard of sound limiter suitable for the proposed installation.

The limiter should enable the separate control of the different zones and incorporate all elements of the AV system, including any additional filters or amplifiers. Programmable limiters are preferred as these permit more sophisticated control of frequency content and volume and are fully tamper-proof.

The use of a limiter is considered to be a management function. It will need to be set in conjunction with the management in co-ordination with the above spaces and the sound system engineer. The principal means of ensuring satisfactory limits are established will be listening tests in the closest noise sensitive receiver space.

On-going attention will need to be given by the management to transmitted noise levels to ensure that the final operational conditions do not undermine the settings of the limiter. Different types of music and activities can result in varied subjective effects. It is strongly recommended that the management remain aware as the operation becomes established and reset the limiter if necessary.

In this case, we would recommend a limiter set to the maximum music playback level, as shown in table 5.4 in order to minimise the risk of complaints.

Maximum Music Playback Level (L_{eq})	Octave band centre frequency, dB								
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)
	75	78	79	80	82	79	72	65	85

Table 5.4: Maximum spectral envelope for music playback

6.0 EXTERNAL BUILDING FABRIC SPECIFICATION

Sound reduction performance calculations have been undertaken in order to specify the minimum performance required from glazed and non-glazed elements in order to achieve the internal noise levels shown in Table 5.1. Taking into account average and maximum noise levels monitored during the environmental noise survey.

Typical sized bedrooms with a high ratio of glazing to masonry have been used for all calculations in order to specify glazing and render this assessment exercise as robust as practically possible.

As a more robust assessment, L_{Amax} spectrum values of night-time peaks have also been considered and incorporated into the glazing calculation in order to cater for the interior limit of 45 dB L_{Amax} for individual events, as specified in BS8233:1999.

6.1 Non-Glazed Elements

All non-glazed elements of the building façade have been assumed to provide a sound reduction performance of at least the figures shown in Table 6.1 when tested in accordance with BS EN ISO, 140-3:1995.

Element	Octave band centre frequency SRI, dB					
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Non glazed element SRI	41	43	48	50	55	55

Table 6.1 Assumed sound reduction performance for non-glazed elements

6.2 Glazed Elements

Minimum octave band sound reduction index (SRI) values required for all glazed elements to be installed are shown in Table 6.2.The performance is specified for the whole window unit, including the frame and other design features such as the inclusion of trickle vents. Sole glass performance data would not demonstrate compliance with this specification.

Glazing performance calculations have been based both on average measured night-time noise levels as well as verified against the L_{Amax} spectrum of individual events in order to comply with a maximum internal noise level of 45dB(A) in bedrooms as recommended by BS8233. The combined most robust results of these calculations are shown in Table 6.2.

Glazing Type	Octave band centre frequency SRI, dB					
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
North, West and South facing facades (Type 1) Shown by on SP2.	39	40	42	46	38	36
East facing facades (Type 2) Shown by on SP2.	21	24	30	35	29	18

Table 6.2 Required glazing performance

The above sound reduction figures could be achieved with the following window systems:

Type 1: Overall attenuation of 42-44dB, R_w with acoustic trickle vents providing a rated performance of 41-42dB, $D_{n,e,w}$, should natural ventilation be required

Type 2: Overall attenuation of 29-32dB, R_w with acoustic trickle vents providing a rated performance of 28-29dB, $D_{n,e,w}$, should natural ventilation be required

All major building elements should be tested in accordance with BS EN ISO 140-3:1995.

Independent testing at a UKAS accredited laboratory will be required in order to confirm the performance of the chosen system for an “actual” configuration.

No further mitigation measures would be required to achieve good internal noise levels.

7.0 DIRECT NOISE TRANSFER FROM EXISTING GROUND FLOOR OPERATIONS

In order to satisfy the requirements of Approved Document E of the 2010 Building Regulations, the minimum sound insulation performance criteria, as shown in Table 7.1 should be met by all floor constructions.

	Design Criteria	
Element	Airborne	Impact
Floor	$D_{nT,w} + C_{tr} \geq 43$ dB for conversions	N/A

Table 6.2 ADE design criteria for party element separating residential and commercial unit

It is understood that the current floor system separating the commercial premises and the residential premises above is constructed from the following elements:

Original floorboards

200mm (Approx.) timber joists

Assumed lathe and plaster ceiling in the restaurant below

To provide a level of sound insulation that satisfies the requirements of Approved Document E of the 2010 Building Regulations and minimises disturbance to future residents of the proposed development, we would recommend installing a party floor system that provides a performance 10dB better than the minimum Building Regulation requirement.

We would therefore recommend the following upgrade proposals:

Remove the existing floor boards

Install 2x50mm CMS QuietSlab mineral wool insulation (60kg/m^3 density), separated with polymeric mass barrier (mass 10kg/m^3) within the void of the existing joists

Install 2x12mm layers of Versapanel cementitious board on timber noggins, or steel angles

Replace the existing floorboards with 1x18mm layer of Versapanel fixed to the top of the existing timber joists

Create an independent flooring system using 140mm timber joists and fix to the new Versapanel layer

Fill the void with 75mm of RWA3 mineral wool (or any similar material with a similar density of 60kg/m^3)

Install 1x18mm layer of Versapanel to the top of the new timber joists

Install end walking surface

The above floor system would be expected to present an airborne sound reduction index $D_{nT,w} + C_{tr}$ of approximately 53-55dB. A detailed design of the proposed flooring system can be seen in attachment DWG.1.

8.0 INTERNAL BUILDING FABRIC

8.1 Design Aspirations

To provide sound insulation levels within the new dwellings that would comfortably satisfy the requirements stipulated within ADE 2003, we would recommend adopting the following constructions for the separate party elements:

Party Wall System

2x15mm layers of SoundBloc plasterboard

Gypframe 146 AS 50 Acoustud with RWA45 mineral wool (or any similar material with a minimum density of 45kg/m3 within the void)

2x15mm layers of SoundBloc plasterboard

The system detailed above would be expected to present an airborne sound reduction index $D_{nT,w} + C_{tr}$ of approximately 44-46 dB therefore satisfying Build Regulations requirements.

Party Floor System

Final floor finish (timber floor, tiles, carpet, vinyl), adhesively installed on

Regupol 3912 (6mm) for timber floors, or Regupol 4515 (4.5mm) for tiles, carpet, or vinyl, adhesively installed on

JCW Acoustic Deck 37

Existing Timber Joists (200mm Assumed) with 100mm Rockwool RWA45 mineral wool (or any similar mineral wool with a minimum density of 45kg/m^3)

2x15mm layers of SoundBloc suspended from RB1 resilient bars.

The system detailed above would be expected to present an airborne sound reduction index $D_{nT,w} + C_{tr}$ of approximately 47-49 dB and an impact sound reduction index L'_{nTw} of approximately 59-61 dB therefore satisfying Build Regulation requirements.

General

Yelofon ES5/100 Flanking strips should be installed around the perimeter of the floor in order to isolate floor from wall and skirtings. All air gaps should be sealed with non-setting acoustic mastic.

Interfaces between walls and all other adjacent elements should be built to ensure that the sound insulation performance of the wall is not affected. All gaps should be tightly packed with mineral wool and all joints should be sealed with a flexible sealant, such as silicone caulk.

Ideally, a gap between the head of the wall and the underside of the soffit should not be greater than 10mm. A polyethylene backing rod could be inserted in the gap with tightly packed mineral wool while silicone caulk is used to seal the joint. When constructing cavity walls, care should be taken not to drop debris into the cavity, which may bridge the leaves of construction.

In the case of all walls, isolation strips would need to be used, which would isolate the wall leaves from the sub-floor, therefore minimising any flanking paths. Please note that a material such as Monarfloor or Regupol Isolation Strip can be used to isolate any new walls built on the sub-floor.

Care should be taken to block any transmission paths from any I-beam flanges to adjacent structures. For this reason, Corofil C144 or a similar material could be used to seal any paths through the gaps between the beams and the plank. Encasing the I-beams with dense plasterboard would also be recommended in order to control flanking paths.

Where any ducts, pipes, conduits or other services penetrate the wall, provide an air-tight seal between the service and partition using a flexible sealant. All gaps should be tightly packed with mineral wool and sealed with plasterboard pattress and mastic seal.

All cavities at the junction of every floor with the external wall should be blocked by means of a cavity stop, unless the cavity is fully filled with mineral wool insulation or expanded polystyrene beads.

9.0 PLANT NOISE & BUILDING SERVICES

It is understood that there are no current proposals to install any external plant, machinery or equipment that would require assessment. If at a later project stage the installation of external plant units is specified, a Planning Compliance Review can be produced to assess the installation according to BS4142:2014.

There are no current proposals for a scheme of mechanical ventilation, so no building services assessment has been undertaken at this project stage.

10.0 CONCLUSION

An environmental noise and vibration survey has been undertaken at 77 Castle Road, London allowing the assessment of daytime and night-time levels likely to be experienced by the proposed development.

The survey revealed that the current ambient noise profile of the area is characteristic of an urban soundscape. The presence of the nearby railway line has no effect the proposed development site.

Measured noise levels allowed a glazing specification to be proposed which would provide internal noise levels for all residential environments of the development commensurate to the design range of BS8233. No further mitigation measures should be required in order to protect the proposed habitable spaces from external noise intrusion.

Measurement of vibration from train activity indicates that vibration levels are below the threshold of human perception in accordance with all current Standards and that it would not affect the amenity of future residents.

Further specifications with regards to the internal building fabric have been made to provide sound insulation levels that would comfortably exceed the requirements of Approved Document E 2003, of the 2010 Building Regulations.

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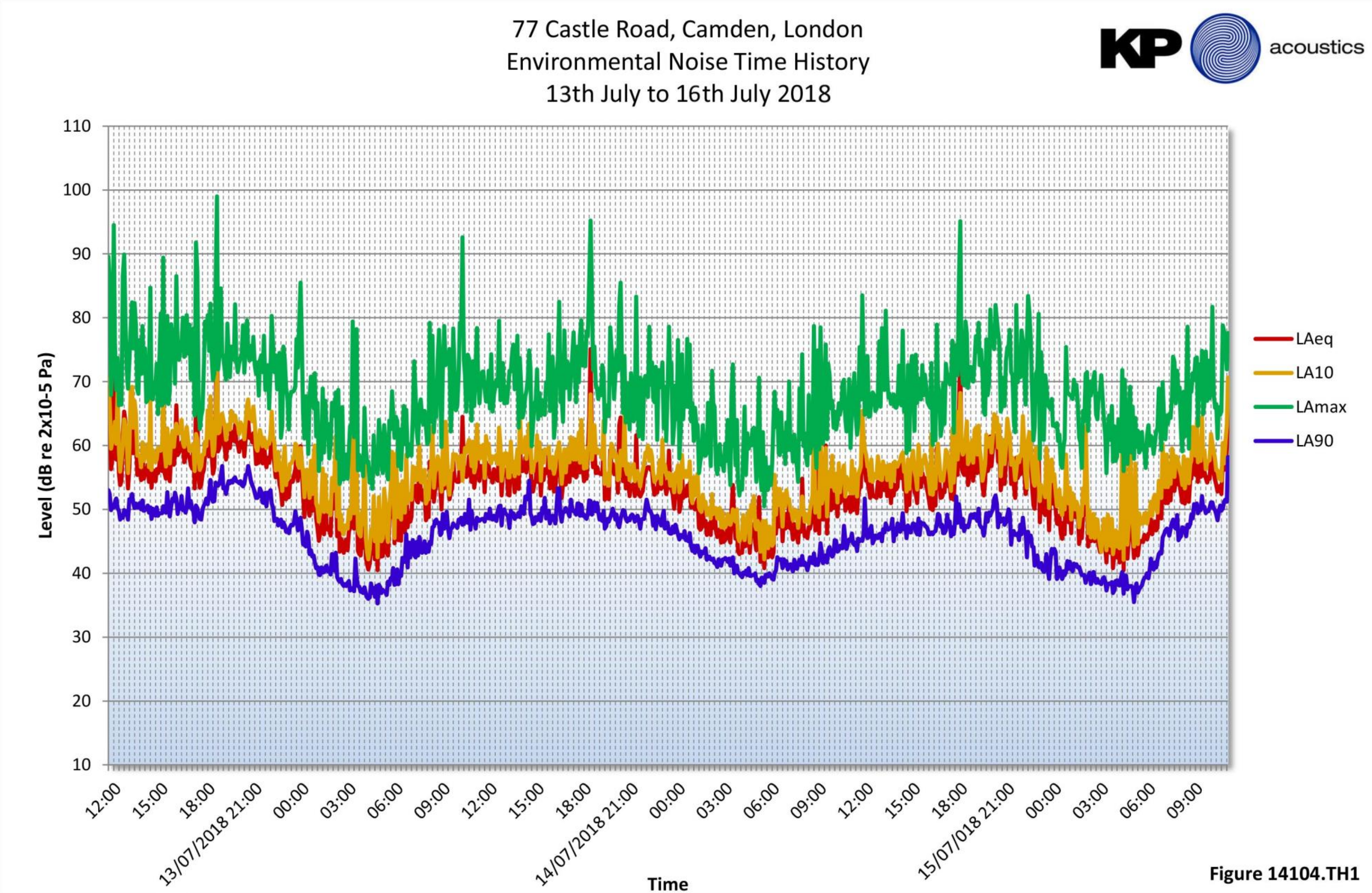


Figure 14104.TH1

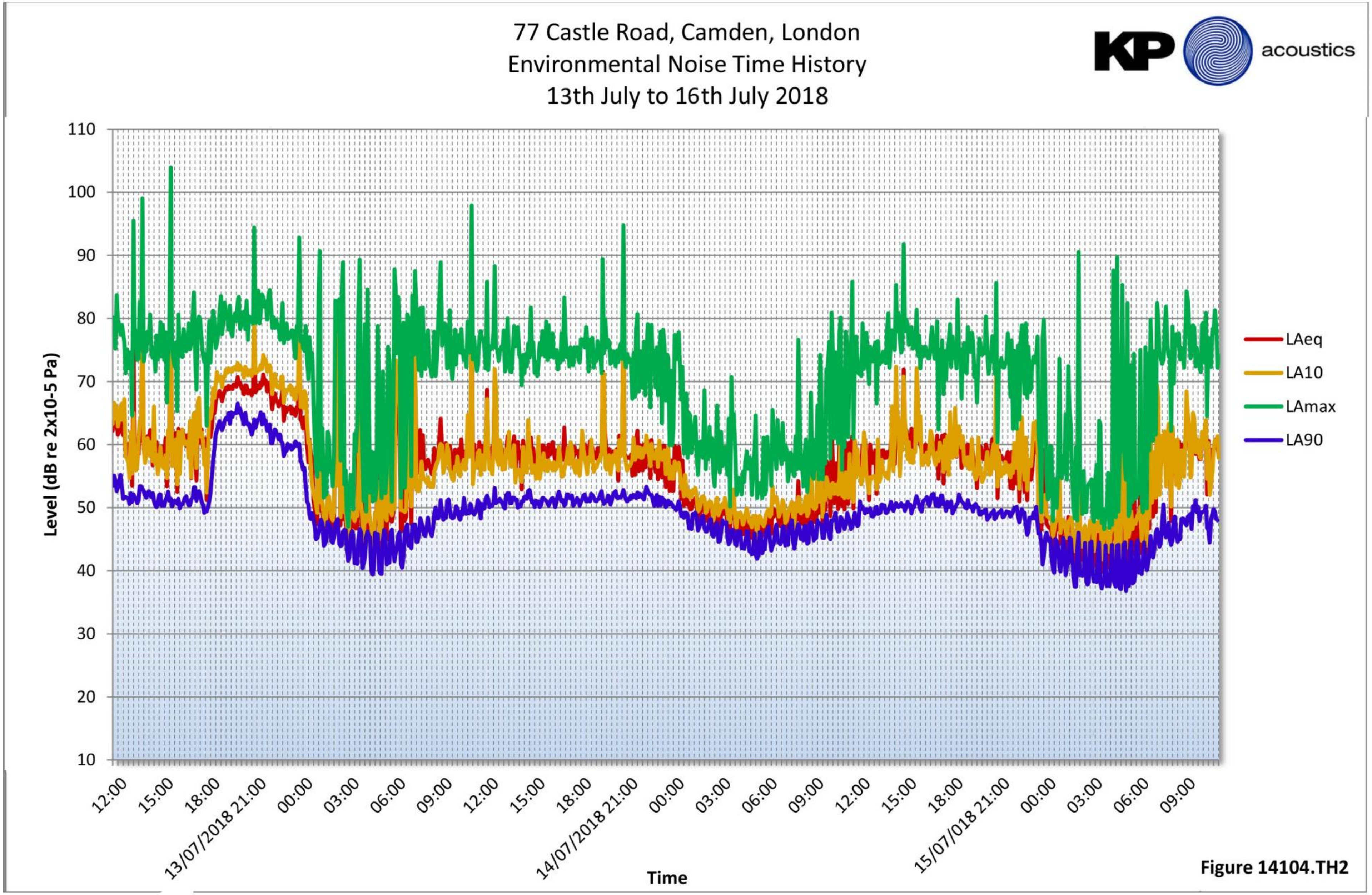


Figure 14104.TH2

77 Castle Road, London

MAXIMUM HORIZONTAL VIBRATION LEVELS

X-AXIS

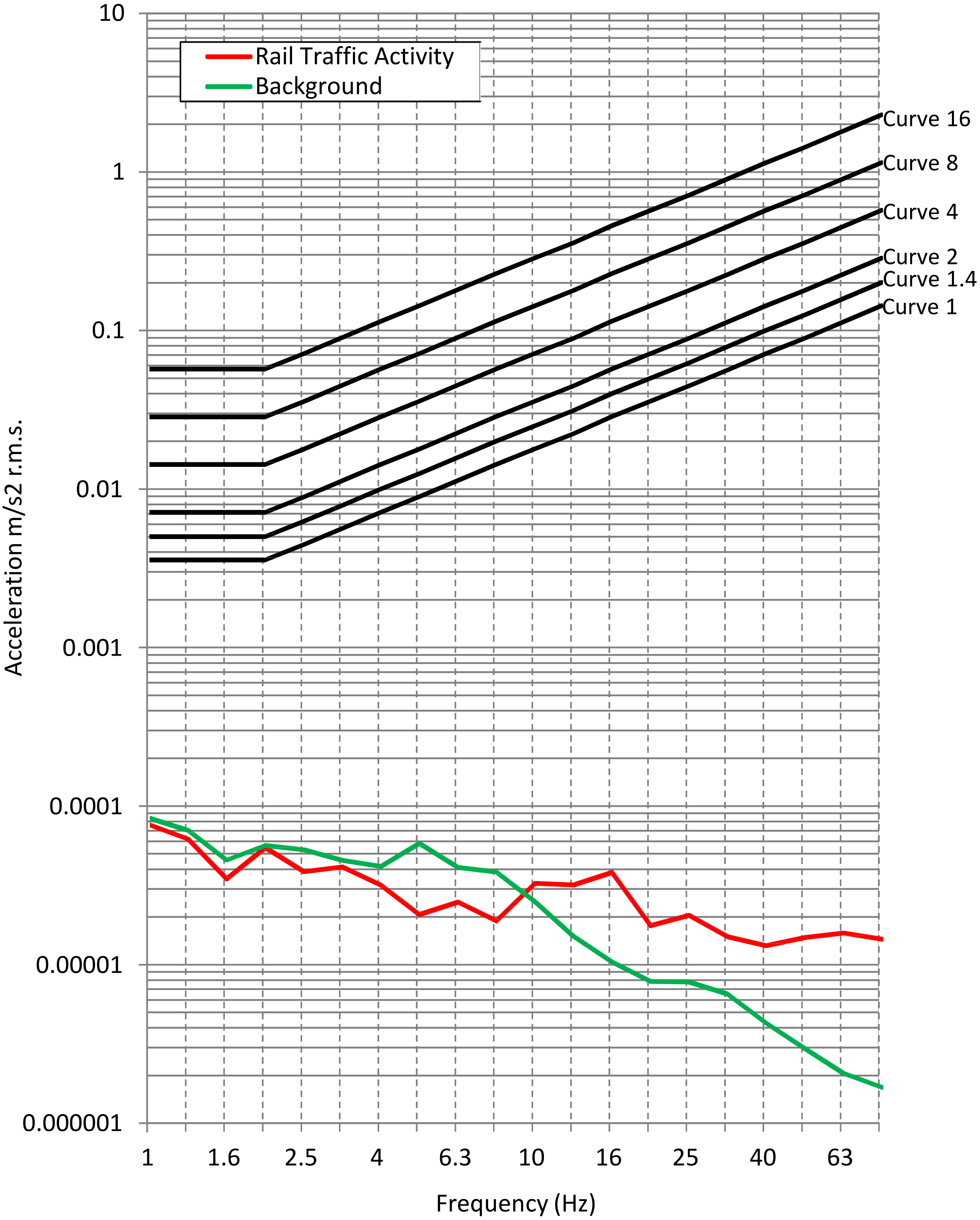


Figure 14104.VS1

77 Castle Road, London

MAXIMUM HORIZONTAL VIBRATION LEVELS

Y-AXIS

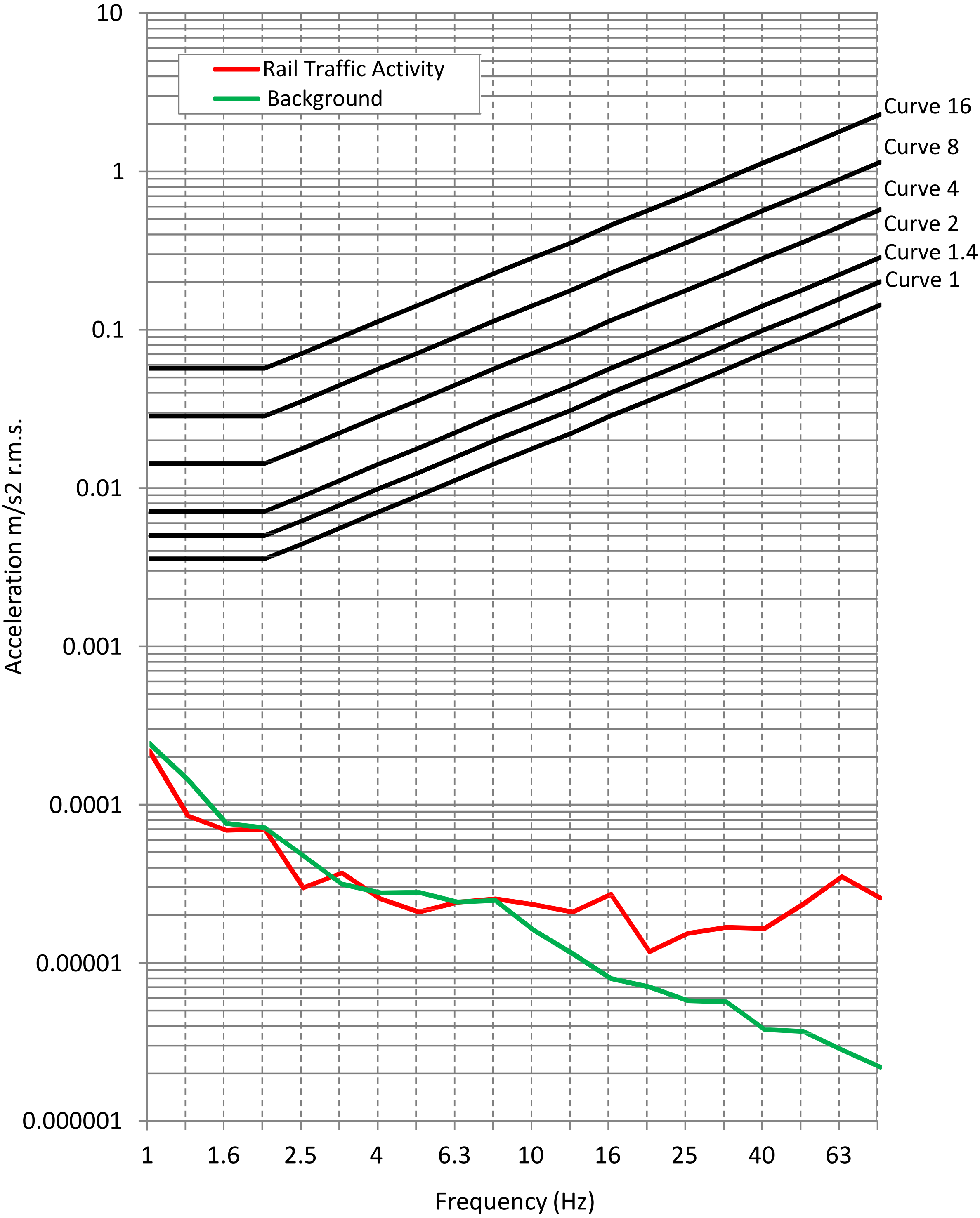


Figure 14104.VS2

77 Castle Road, London

MAXIMUM VERTICAL VIBRATION LEVELS

Z-AXIS

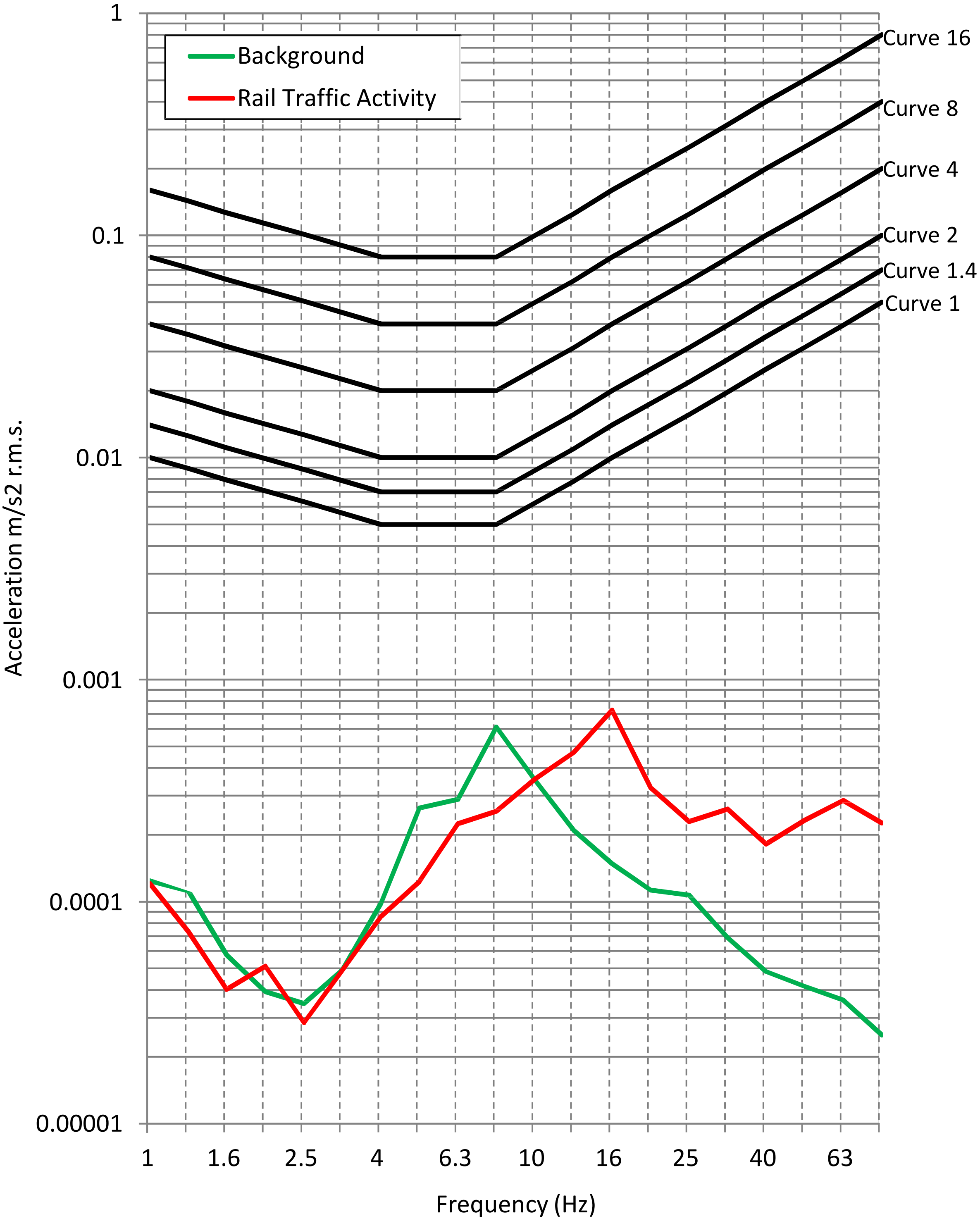
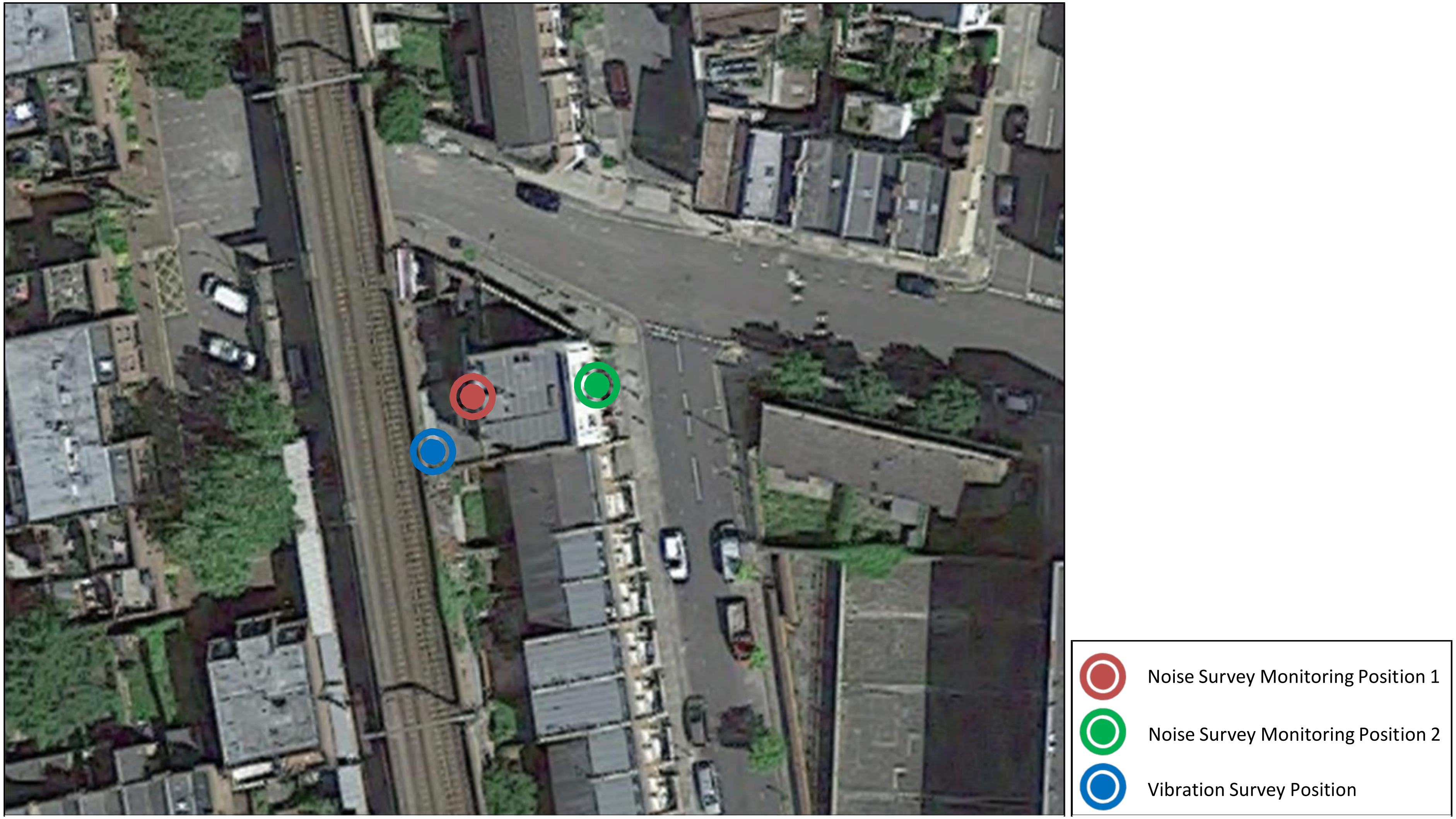


Figure 14104.VS3



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Indicative site plan showing noise monitoring position (Image Source: Google Images)

Date: 17 July 2018

FIGURE 14104.SP1.Rev.A

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Glazing Type 1 | Glazing Type 2

Title:

Indicative site plan showing different glazing types

(Image Source: Google Images)

Date: 17 July 2018

FIGURE 14104.SP2.Rev.A

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APPENDIX A

GENERAL ACOUSTIC TERMINOLOGY

Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of 10^{13} units, that only a logarithmic scale is the sensible solution for displaying such a range.

Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq}. The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

L_{90}

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, Description and Measurement of Environmental Noise.

APPENDIX A

APPLIED ACOUSTIC TERMINOLOGY

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud

Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.

APPENDIX B

77 Castle Road, London

NOISE BREAKOUT EMISSIONS CALCULATIONS - REAR FAÇADE

Acoustic Calculation used for Indoor to Outdoor Transmission:

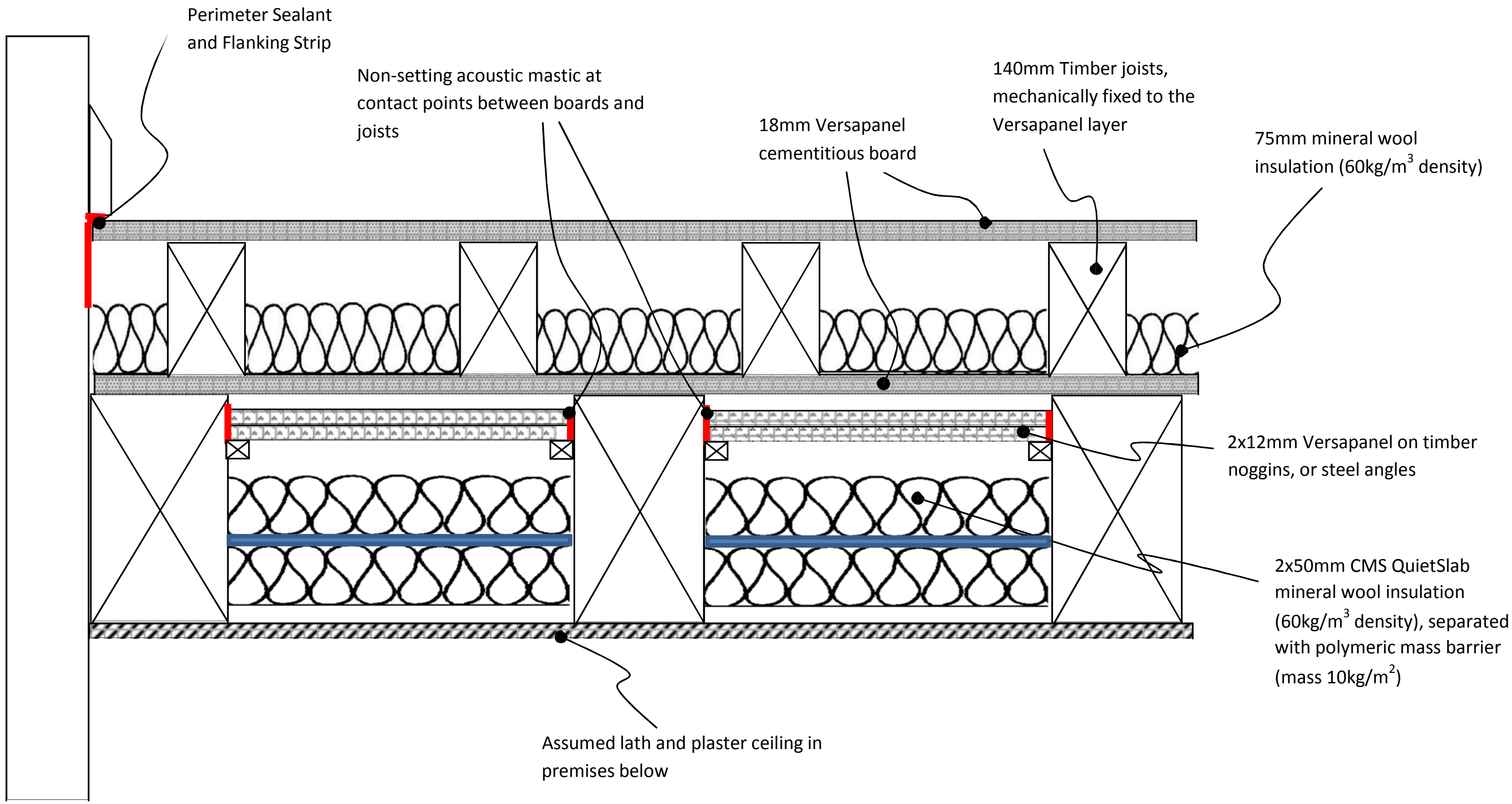
$$SPL_{outdoor} \quad SPL_{indoor} \quad SRI_{composite} \quad 10\log_{10} S \quad 10\log\left(\frac{Q}{4\ r^2}\right) \quad 6dB$$

Source: Predicted Internal Levels	Frequency, Hz								
Receiver: Nearest Residential Window	63	125	250	500	1k	2k	4k	8k	dB(A)
Measured Sound Pressure Levels Predicted Internal Levels	75	78	79	80	82	79	72	65	85
Composite sound reduction index of façade Correction									-33
for total area of building facade (S = 24m^2) Correction for									14
directivity (Q) and distance (r) (Q=2, r=4m)									-20
Non reverberant correction									-6
Predicted sound pressure level 1m from nearest residential receiver									40

Design Criterion	41

Receiver: Inside Nearest Residential Window

	Frequency, Hz								
Source: Amplified Music	63	125	250	500	1k	2k	4k	8k	dB(A)
Sound pressure level outside window									40
Minimum attenuation from partially open window, dB									-10
Sound pressure level inside nearest residential window									30



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Proposed Floor Upgrade Measures (NTS)

Date: 17 July 2018

FIGURE 14104.DWG.1

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