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BS4142 Noise Impact Assessment

Project Reference Number: PA260

Assessment Standard: BS 4142:2014

Client: Sinoore Kamal

Site: Land adj. 29 Cambert Lane, Manchester, M18 8HA.

Written By	**Checked By**
L. Hatton, BSc (Hons), AMIOA	I. Baxter, BSc (Hons)
Acoustic Consultant	Acoustic Consultant
info@acousticsurveys.co.uk	info@acousticsurveys.co.uk



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Project Information

Peak Acoustics have been commissioned to undertake the assessment detailed within this report. Below is a summary of pre-commencement requirements and comments as communicated to Peak Acoustics by involved parties, this information forms the basis of the assessment and report.

Client Contact	Mr Sinoore Kamal
Client Requirement	A previous assessment conducted has been rejected due to the requirement of doors being closed to maintain sound insulation. The client has also revised their chosen equipment to with view of reducing noise emissions
Site details as communicated by client.	The revised location shows the openable access doors facing away from the NSR location.
Selected Methodology	In order to assess the noise impact of the equipment on the nearest sensitive receptor, Peak Acoustics will undertake measurement and assessment using BS4142:2014.
Methodology Justification	BS4142:2014 is the prescribed standard for assessing sources of industrial noise on residential receptors for the UK. Internal noise levels are to be measured within an existing site representative of the applicant site. The internal noise source is to be corrected for breakout through the proposed building façade. External noise source to be considered are car doors closing and car engines starting.
Local Authority Contact	N/A
Local Authority Consultation	N/A
Local Authority Guidance/Unitary Development Plans/Unique or bespoke standards	A noise survey is required and an assessment is required detailing the impact of the development upon the nearest noise sensitive occupiers.

Assessment Summary

A noise assessment has been undertaken at the proposed site location on Cambert Lane, Manchester. This is to assess the likelihood of complaints arising due to a change of use from a builder's yard to a vehicle maintenance facility.

The nearest noise sensitive receptors (NSRs) have been identified as 29 Cambert Lane and 92 Furnival Road at distances of approximately 10m and 50m from the centre of the site under assessment.

Background levels have been recorded on site during the daytime and night-time, and measured at their lowest as **43.5dB $L_{A90,\ 1hr}$** during the proposed operating hours.

Mitigation measures discussed with the client include a 3m boundary wall or acoustic fence to the eastern and northern boundaries. With the boundary treatments included, the sound rating level will as a worst case exceed the background noise level by 1dB. With contextual considerations, this is considered as *Low Impact* in accordance with BS4142:2014.

1. Noise Source

1.1 Internal noise sources at the proposed development have been identified as a battery-operated wheel gun, general maintenance work, music from a radio and idling car engines. External noise sources have been identified as car doors closing, car engines starting and the idling of car engines.

1.2 The proposed hours of operation are hours, 09:00 – 17:00 Mon – Fri.

1.3 The sources operate intermittently throughout the working day.

2. Subjective Impressions

2.1 Residual noise was identified primarily as vehicle traffic along Cambert Lane and surrounding roads. Secondary noise sources included aircraft and the closing of car doors within the supermarket car park to the south of the site.

3. Existing Context

3.1 The site of the proposed facility is currently used as a builder's storage yard and is comprised mainly of hard concrete ground and sparse shrubbery. Residential dwellings are situated approximately 10m and 50m from the proposed site, separated by a concrete wall.

4. Measurement Locations

4.1 Measurements were taken at the eastern side of the proposed site location, 2.5 metres from the perimeter wall.

4.2 The measurement location is shown below and was chosen to be representative of the current background noise levels at the NSR location.

Figure 1: Site, Measurement and NSR Locations



Measurement Location

Site Location

NSR_1 (Southern Façade)

NSR_1 (Northern Façade)

NSR_2

5. Measurement Equipment

5.1 Measurements were undertaken using a Svantek 971 Class 1 Sound Level Meter, SN: 40305. Full equipment details can be found in **Appendix B**.

5.2 The calibrator reference level was 114.0dB.

5.3 Calibration levels were measured at 113.50 dB before measurement and 113.49 after (0.01 dB drift). Full calibration details can be found in **Appendix D**.

6. Weather Conditions

6.1 Wind speed 4.4 ms^{-1}, Westerly, no precipitation. Full meteorological conditions are detailed in **Appendix C**.

7. Measurement Procedure

7.1 Background noise measurements were undertaken from 13:28 on 5th July 2016 to 13:13 on 6th July 2016. Full measurement times and durations can be found in **Appendix A**.

7.2 Background noise measurements were obtained in 5min time intervals.

7.3 The reference time interval of 1 hour is considered as only daytime (09:00 – 17:00) operation is proposed.

7.4 Internal noise measurements were undertaken within a representative vehicle maintenance facility from 09:34 – 10:51 on 27th April 2017.

8. Noise Source Levels

Internal Noise Level – Maximum Operational Capacity

8.1 Internal noise levels were measured during maximum operational capacity within a representative site as **78.0dB $L_{Aeq,1hr}$**. Details of the measured noise level and activities taken are shown in **Appendix E** and noise source data is shown in **Appendix F**.

8.2 Internal noise levels are to be corrected for noise breakout through the building façade, roof and open access door. Sound insulation properties have been modelled within Insul™ (Marshall Day Acoustics) and are shown in **Appendix G**. Where facades are made up of multiple materials, a composite sound reduction index has been calculated.

8.3 Noise levels were measured whilst two mechanics performed maintenance on two taxis. Noise sources included usage of hand tools (screwdrivers, spanners, drills etc.), two car lifts, two idle car engines, radio, conversation/laughing etc, one wheel-gun and a compressor. Measurements were taken at various locations on site at the positions where the mechanics were working with distances between the microphone and noise sources of 1-5m.

8.4 The wheel-gun and compressor used are an older model than that is to be used on the applicant site and are therefore deemed a worst-case scenario with regards to noise emissions. The noise measurement of 78.7dB $L_{Aeq,1hr}$ is therefore a worst-case scenario for maximum operational capacity of the applicant site.

8.5 The measured 1hr noise level is used for the assessment of noise impact

Internal Noise Level Battery Operated Wheel Gun

8.6 A measurement of a battery-operated wheel-gun, as proposed to be used on the applicant site, was measured in isolation of other noise sources as **81.9dB $L_{Aeq,20s}$** @1m. This is deemed to be the loudest source that is to be used on the applicant site and will be used to assess the impact of impulsive and intermittent noise emissions.

Parking Cars – Car Engine Starting

8.7 The sound power level of a car engine starting have been taken from a library provided within SoundPLAN as 97.9dB L_{WA}

8.8 The sound power level has been on-time corrected to consider the sound occurring for 4s per parking bay; corresponding to two cars using the bay within an hour with each car engine taking 2s to start.

Parking Cars – Car Door Closing

8.9 Noise levels of a car closing have been taken from a library provided within SoundPLAN as 97.0dB L_{WA}

8.10 The sound power level has been on-time corrected to consider the sound occurring for 4s per parking bay; corresponding to two cars using the bay within an hour with each car having 1 door close upon arrival and one door close upon departure (2 door closes per car per bay), with each door slam emitting sound for 1s.

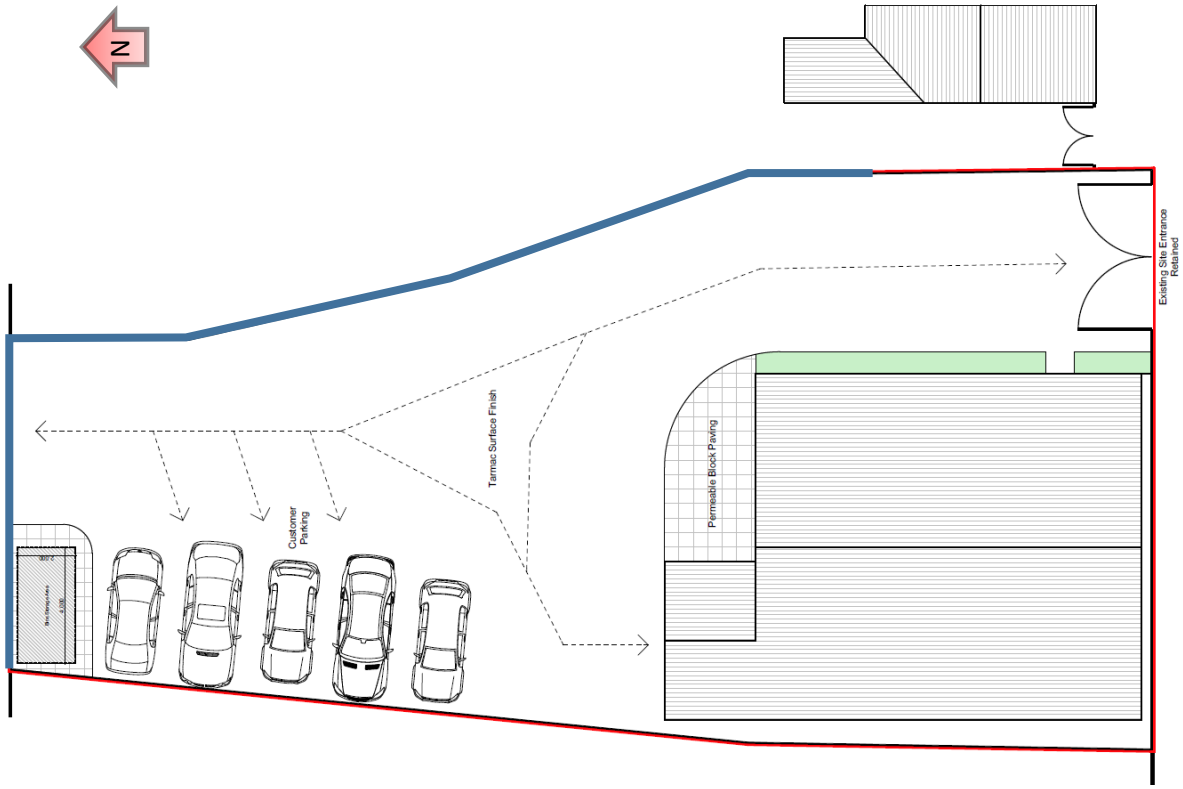
9. Boundary Wall / Acoustic Fence

9.1 Mitigation measures via a 3m masonry wall or acoustic fence to the eastern and northern boundaries is required to lower noise impact. The mitigation measure has been discussed with the client and will be implemented in updated plans, should the mitigation measure be deemed acceptable from a planning perspective.

9.2 It is assumed that the boundary treatment is a 3m high masonry brick wall. Absorptive 3m acoustic fencing will also suffice.

9.3 The recommended boundary treatment is shown below:

Figure 2: Recommended Boundary Treatment, 3m High Masonry Wall or Absorptive Acoustic Fence *(Not to scale)*



3m Masonry Wall or Acoustic Fence

10. Noise Modelling

10.1 The noise sources outlined in section 8 and **Appendix F;** façade models shown in **Appendix G**; perimeter masonry wall outlined in section 9 and receptor locations shown in Figure 1 have been input into industry standard software SoundPLAN. SoundPLAN considers all standard acoustic corrections such as distance, atmospheric absorption, barriers, reflection etc. in accordance with 'ISO9613-2: Attenuation of sound during propagation outdoors.'

10.2 A noise map for the maximum 1hr operational capacity is shown in **Appendix I**.

11. Specific Sound Level

11.1 The Specific Sound Level at the NSR locations is calculated as:

Table 1: Specific Sound Level

NSR	SSL, dB L_{As}
Maximum 1hr Operational Capacity	
NSR_1 North Façade	42.4
NSR_1 South Façade	43.3
NSR_2	44.5
Wheel Gun	
NSR_1 North Façade	43.6
NSR_1 South Façade	44.0
NSR_2	46.2

11.2 It is noted that the Specific Sound Level of the loudest equipment to be used on site, the battery-operated wheel-gun exceeds the typical operation by a small margin of up to 1.7dB.

12. Background Sound Level

12.1 Background noise levels were measured through an overnight period, 5th – 6th July. The lowest background noise levels occurring within the proposed operating hours of the development (09:00-17:00) were recorded between 09:03 – 10:03 as **43.5dB $L_{A90, 1hr}$.**

12.2 Comparison between the Specific Sound Level and background noise level is shown below:

Table 2: Difference between SSL and Background Noise Level

NSR	Difference, dB
Maximum 1hr Operational Capacity	
NSR_1 North Façade	-1.1
NSR_1 South Façade	-0.2
NSR_2	+1.0
Wheel Gun	
NSR_1 North Façade	+0.1
NSR_1 South Façade	+0.5
NSR_2	+2.7

13. Rating Level

13.1 The Specific Sound Level may be corrected for certain characteristics that make a sound more noticeable *at the NSR location*. Corrections for tonality, impulsivity and intermittency may be applied.

13.2 It is reasoned that penalties may not be applicable due to the Specific Sound Level being similar to the background noise level, thus the characteristics will be hard to distinguish at the NSR locations.

13.3 The largest exceedance is +2.7dB at NSR_2. The background measurement data presented in **Appendix E** demonstrates that the residual, dB L_{Aeq}, noise level typically exceeds the background noise level by 2dB, thus providing a degree of acoustic masking to the Specific Sound Level, thus supporting the reasoning that the characteristic will not be distinguishable at the NSR locations.

13.4 Comparison between the Specific Sound Level of maximum capacity operation and the battery-operated wheel-gun demonstrates that the increase in noise level at the NSR locations can be considered marginal (ie 1.7dB increase) and therefore the intermittent use of the wheel-gun and its impulsive characteristics will not be distinguishable at the NSR locations.

13.5 The source contributions at each NSR location is shown in **Appendix J** and demonstrates that the parking of cars has a much lower contribution to the Specific Sound Level at the NSR locations, therefore application of penalties to the overall Specific Sound Level due to sources of much lower impact would not be appropriate.

13.6 The spectral data at each NSR location does not identify any distinct tonal characteristics within 1/1 octave bands. With this considered and the fact that the Specific Sound Level is similar to the background noise level and even closer to the residual noise level, applying penalties for tonality would not be appropriate.

13.7 The Sound Rating Level remains equal to the Specific Sound Level:

Table 3: Sound Rating Level

NSR	SSL, dB L_{Ar}
Maximum 1hr Operational Capacity	
NSR_1 North Façade	42.4
NSR_1 South Façade	43.3
NSR_2	44.5

14. Rating Level Vs Background

14.1 The rating level is to be compared to the measured background noise level to determine noise impact in accordance with BS4142:2014:

Table 4: Difference between Rating Level and Background Noise Level

NSR	Difference, dB
Maximum 1hr Operational Capacity	
NSR_1 North Façade	-1.1
NSR_1 South Façade	-0.2
NSR_2	+1.0

14.2 The rating level is below the background noise level at NSR_1, classed as Low Impact in accordance with BS4142:2014.

14.3 The rating level exceeds the background noise level at NSR_2.

15. Contextual Considerations

15.1 The rating level exceeds the background noise level by +1dB at NSR_2.

15.2 A +1dB increase is within the perceptibility of the human ear and therefore there is likely to be no noticeable increase of the background noise level at site.

15.3 The internal noise measurement considers a worst-case scenario as a louder compressor was in use at regular intervals throughout the measurement period. The internal noise level at the applicant site will likely be lower.

15.4 Assessment has been made to the lowest measured 1hr background noise level. Higher background noise levels occur regularly throughout the proposed operating hours on site (09:00 – 17:00), as shown in **Appendix E**. It is therefore more common for the Sound Rating Level to be below the background noise level throughout a working day.

15.5 With contextual considerations considered, it is deemed that there will be a ***Low Impact*** at the NSR locations.

16. Recommended Noise Condition

16.1 Due to new equipment being introduced at the applicant site, it is recommended that an internal noise level measurement is conducted early within the operation of the site. A maximum operational scenario should be replicated and should include as a minimum:

- Two mechanics performing maintenance tasks on two cars.
- Idling car engines.
- Use of two vehicle lifts.
- Use of a battery-operated wheel gun.
- Use of hand tools.
- A radio playing music throughout the measurement period.

16.2 Any additional equipment on site should also be used to replicate a maximum operational scenario.

16.3 Should the 1hr internal noise measurement exceed **78.0dB $L_{Aeq,1hr}$** mitigation measures should be implemented to lower the internal noise level to within 78.0dB $L_{Aeq,1hr}$.

17. Uncertainty

17.1 Uncertainty can arise when a calculated method, such as distance correction and noise level summation, is used to determine an overall noise level at a NSR location, however it is an accepted method when the noise sources in question are not in situ.

17.2 The monitoring equipment is subject to a 1dB error margin, however calibration before and after measurements allows the drift within the margin to be monitored and thus demonstrates that minimal drift occurred throughout the measurements.

17.3 The noise model has been calibrated to give sound pressure levels equal to that as measured on site, therefore further propagation of the sound to the NSR receptors can be considered representative to that as will occur on site.

APPENDIX A - Measurement Details					
Measurement	Kit	Start Date	Start Time	End Date	End Time
M1	A2	05/07/16	13:28	06/07/16	13:13
M2	A1	27/03/17	09:34	27/03/17	10:51

APPENDIX B - Equipment Details					
Kit	Equipment	Make	Model	Class	Serial Number
A2	Sound Meter	Svantek	971	1	40305
A2	Pre-Amp	Svantek	SV18	1	41651
A2	Calibrator	Svantek	SV31	1	56663
A1	Sound Meter	Svantek	958	1	34525
A1	Pre-Amp	Svantek	SV12L	1	41651
A1	Calibrator	Svantek	SV31	1	32507

APPENDIX C - Meteorology Details						
Measurement	Temp C	Wind Speed m/s	Wind Direction	Humidity %	Precipitation mm	Cloud Cover (Oktas)
M1	17	4.4	W	57	0	7 / 8

APPENDIX D - Calibration Details					
Measurement	Calibrator Ref Level (dB)	Level Before (dB)	Deviation Before (dB)	Level After (dB)	Deviation After (dB)
M1	114.0	113.50	0.50	113.49	0.51
M2	114.0	114.0	0.0	113.7	0.3

Appendix E – Noise Measurement Details

Figure A1: Measured Background Noise Levels, Graph: 5th – 6th July 2016

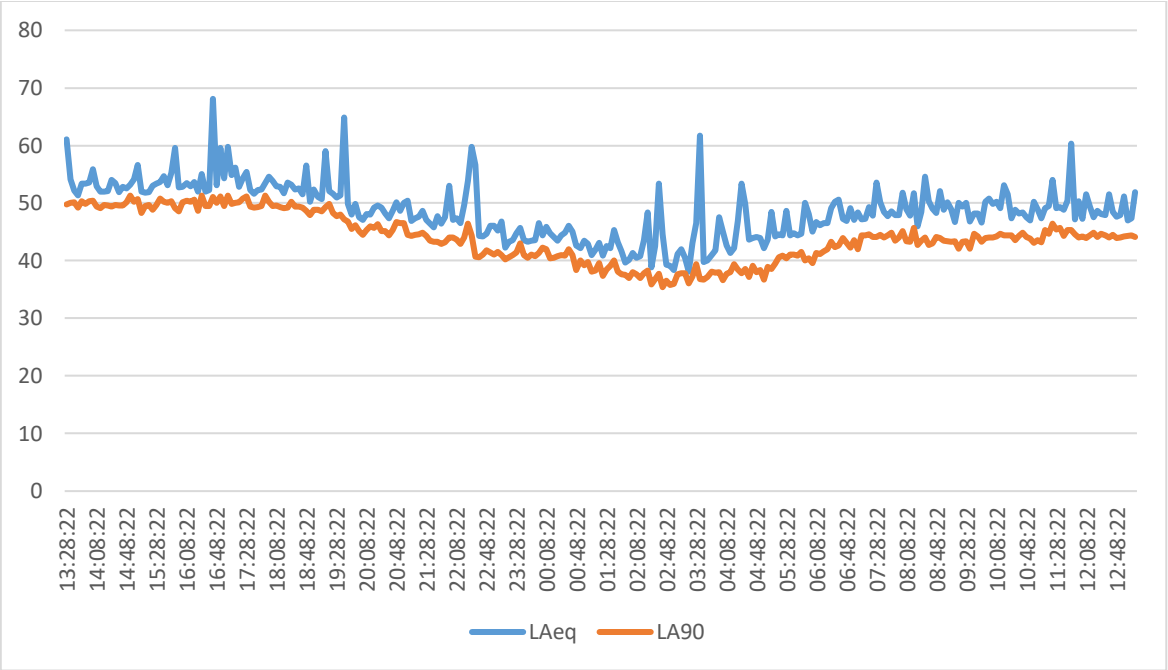


Figure A2: Background Noise Level Occurrences, dB $L_{A90,5min}$

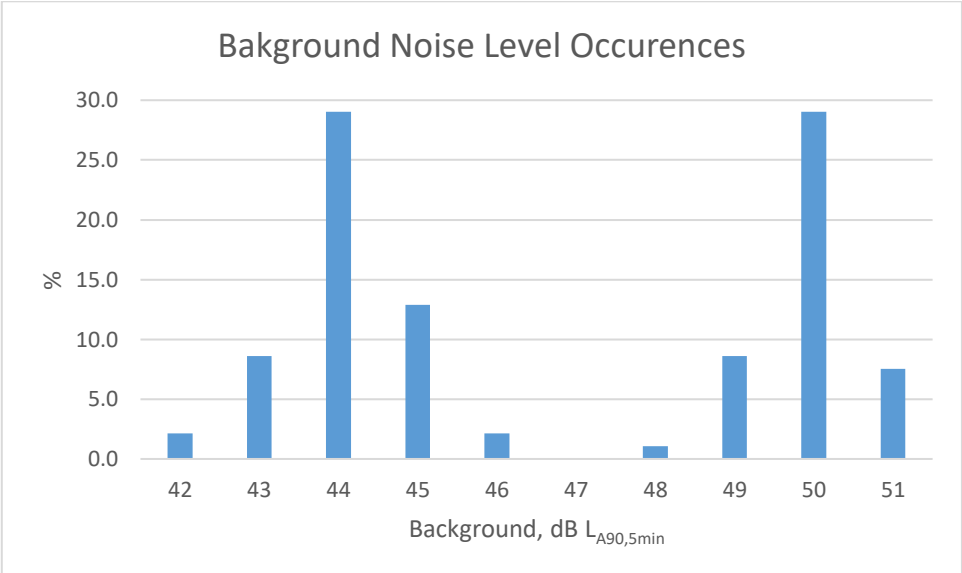
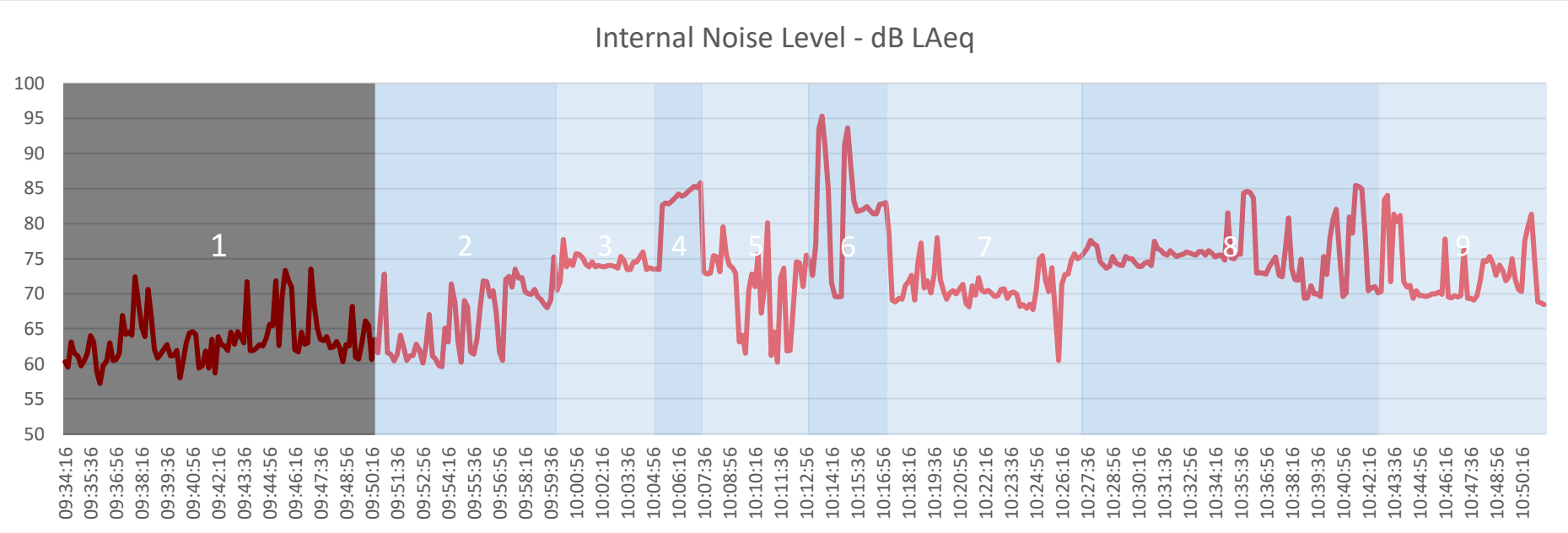


Figure A3: Measured internal noise level – 27th April 2017



Noise levels of a radio and workers conversing/laughing etc. is included throughout the measurement period

1 Omitted from assessment to give a 1hr period in accordance with daytime noise assessment. General use of hand tools.

2 General hand tool usage (changing EGR pipe). Engine car starter motor turning over. Use of vehicle lift. Hand drill into piece of metal.

3 Taxi engine running. Arrival of a third taxi. Shouting amongst workers

4 Compressor and taxi engine running simultaneously

5 Use of air drill and car lift.

6 Use of wheel gun and compressor

7 Car engine idling and hand tools

8 Use of car lift, hand tools and car engine idling.

9 Usage of wheel gun and car lift.

Appendix F – Noise Sources

Table A1: Measured Internal Noise Level, Maximum Operational Capacity

Frequency, Hz	63	125	250	500	1000	2000	4000	Sum
Level dB $L_{Zeq,1hr}$	77.0	67.9	67.8	71.3	73.2	71.3	71.3	80.9
Level dB $L_{Aeq,1hr}$	50.8	51.8	59.2	68.1	73.2	72.5	72.3	78.0

Table A2: Measured Internal Noise Level, Battery Operated Wheel Gun Noise Level

Frequency, Hz	63	125	250	500	1000	2000	4000	Sum
Level dB $L_{Zeq,1hr}$	60.8	60.3	66.5	74.4	75.2	76.7	75.7	81.8
Level dB $L_{Aeq,1hr}$	34.6	44.2	57.9	71.2	75.2	77.9	76.7	81.9

Table A3: Technical Paper from Study of Noise Emissions from Gas Stations (TUV Hessen), Car Starting Sound Power Level

Frequency, Hz	63	125	250	500	1000	2000	4000	Sum
Level dB L_W	93.7	96.1	85.4	85.9	92.9	92.6	90.9	100.8
Level dB L_{WA}	67.5	80.0	76.8	82.7	92.9	93.8	91.9	97.9

Table A4: Technical Paper from Study of Noise Emissions from Gas Stations (TUV Hessen), Car Door Closing Sound Power Level

Frequency, Hz	63	125	250	500	1000	2000	4000	Sum
Level dB L_W	86.8	89.8	91.5	93.0	93.3	89.3	86.6	99.2
Level dB L_{WA}	60.6	73.7	82.9	89.8	93.3	90.5	87.6	97.0

Appendix G – Façade Component Models

Brick and Blockwork Wall

Sound Insulation Prediction (v8.0.9)

Program copyright Marshall Day Acoustics 2015

- Key No. 2539

Margin of error is generally within Rw +/- 3 dB

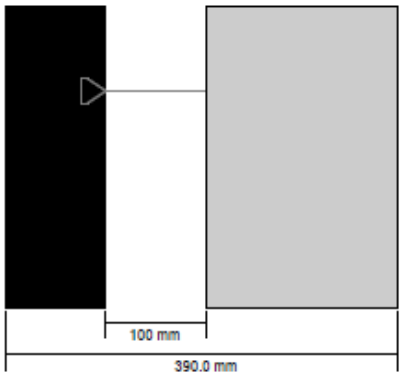
Job Name:

Job No.: Page No.:

Notes:

Date: 8 May 17 Initials:lukeh

File Name: Brick and Hollow Conc. Block.ixl



Rw 54 dB
C -1 dB
C_{tr} -4 dB
D_{nTw} 56 dB

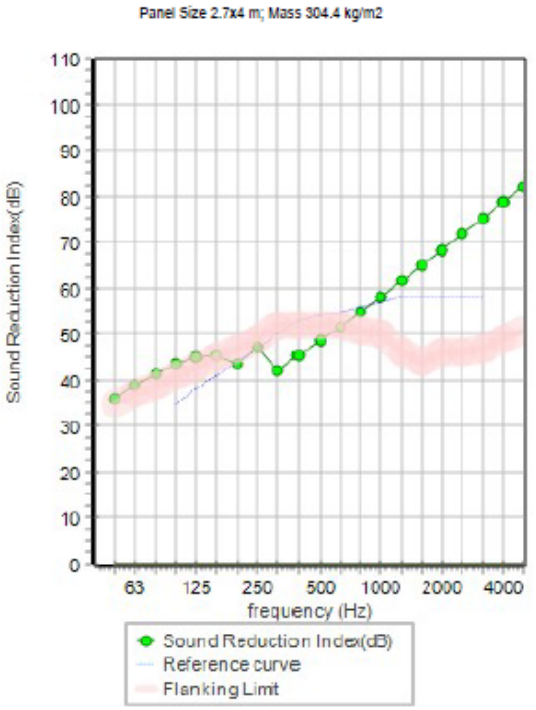
System description

Panel 1 : 1 x 100.0 mm Brick (ρ:1600 kg/m3,E:8.9GPa,η:0.02)

Cavity: Butterfly Tie: Stud spacing 600 mm
Panel 2 : 1 x 190.0 mm Hollow Conc Blocks(760kg/m3) (ρ:760 kg/m3,E:1.8GPa,η:0.02)

Mass-air-mass resonant frequency =21 Hz

frequency (Hz)	R(dB)	R(dB)
50	36	
63	39	38
80	41	
100	43	
125	45	44
160	45	
200	44	
250	47	44
315	42	
400	45	
500	48	48
630	52	
800	55	
1000	58	57
1250	62	
1600	65	
2000	68	68
2500	72	
3150	75	
4000	79	78
5000	82	



150mm Insulated Steel Cladding

Sound Insulation Prediction (v8.0.9)

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- Key No. 2539

Margin of error is generally within Rw +/- 3 dB

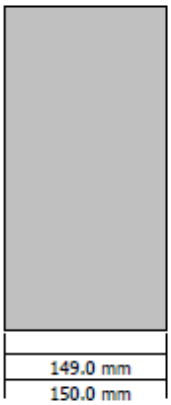
Job Name:

Job No.: Page No.:

Notes:

Date: 8 May 17 Initials:lukeh

File Name: 150mm Insulated Steel Panel.ixl

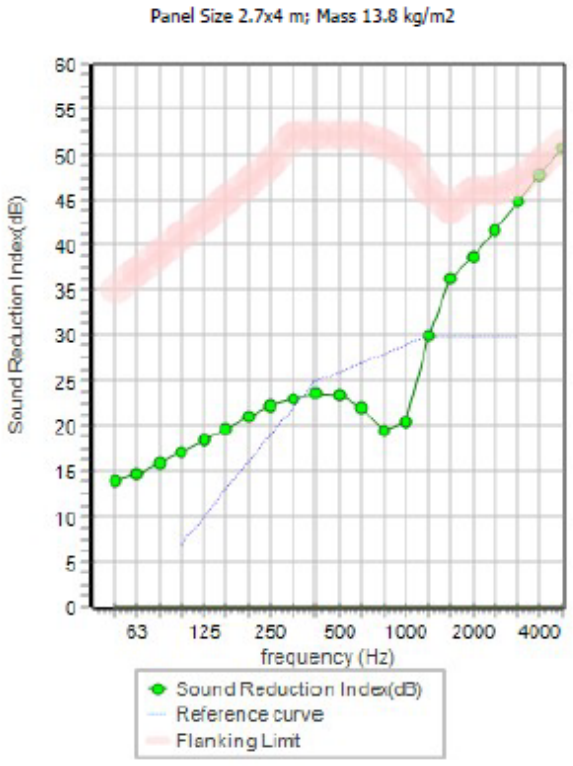


Rw	26 dB
C	-1 dB
C_{tr}	-3 dB
D_{nTw}	28 dB [V:50m3] [A:11m2]

System description

Panel 1 : 1 x 150.0 mm Kingspan K5 1000C5 125/150/200mm (ρ:7800 kg/m3,E:2.1E02GPa,η:0.21)

frequency (Hz)	R(dB)	R(dB)
50	14	
63	15	15
80	16	
100	17	
125	18	18
160	20	
200	21	
250	22	22
315	23	
400	24	
500	23	23
630	22	
800	19	
1000	20	21
1250	30	
1600	36	
2000	39	38
2500	42	
3150	45	
4000	48	47
5000	51	



Double Glazing, 4/12/4mm, Pilkington

Thirdoctaveband Centre Frequency (Hz)	Sound Insulation (dB) for Glass Thickness (mm)											
	4/12/4		6/12/6		6/12/6.4 PVB		10/12/4		10/12/6		10/12/6.4 PVB	
100	25		17		19		23		27		27	
125	24	24	26	20	24	21	28	25	27	26	28	27
160	23		22		21		26		24		26	
200	21		18		19		19		24		26	
250	21	20	18	19	19	20	23	22	29	27	30	29
315	19		24		24		26		31		32	
400	22		27		28		31		33		34	
500	25	25	29	29	32	31	33	33	34	34	36	36
630	30		33		34		36		37		40	
800	33		37		38		39		39		41	
1000	36	35	39	38	40	39	41	40	41	40	42	41
1250	38		39		40		41		41		41	
1600	40		39		39		41		39		41	
2000	41	38	34	36	35	37	45	43	37	38	42	42
2500	35		37		39		45		40		44	
3150	31		42		44		42		43		49	
4000	40	35	47	45	49	47	44	44	47	46	53	52
R_m (dB)	29		30		31		34		34		36	
R_w (dB)	31		33		34		36		38		40	
R_{TRA} (dBA)	25		26		27		29		32		34	

- Composite sound insulation values are calculated using the following formula:

$$R_{comp} = 10\log\ (\frac{S_1 \times 10^{-R1/10} + S_2 \times 10^{-R2/10} \ \ldots}{S_{Total}})$$

(Where $R_{1,2}$ $S_{1,2}$ is reduction value and surface area of façade component 1,2 etc and S_{Total} is total surface area of the façade facing the NSR)

Composite Sound Reduction - Roof

	63	125	250	500	1k	2k	4k
dB R_w, Brick+Block	38.0	44.0	44.0	48.0	57.0	68.0	78.0
dB R_w, Steel Cladding	15.0	18.0	22.0	23.0	21.0	38.0	47.0
dB R_w, Glazing	16.0	24.0	20.0	25.0	35.0	38.0	35.0
Comp R	-15.0	-18.0	-22.0	-23.0	-21.0	-38.0	-47.0

S m^2 Brick+Block	0
S m^2 Steel Cladding	178
S m^2 Glazing	0
S Total	178

Composite Sound Reduction – Southern Façade

	63	125	250	500	1k	2k	4k
dB R_w, Brick+Block	38.0	44.0	44.0	48.0	57.0	68.0	78.0
dB R_w, Steel Cladding	15.0	18.0	22.0	23.0	21.0	38.0	47.0
dB R_w, Glazing	16.0	24.0	20.0	25.0	35.0	38.0	35.0
Comp R	-38.0	-44.0	-44.0	-48.0	-57.0	-68.0	-78.0

S m^2 Brick+Block	70
S m^2 Steel Cladding	0
S m^2 Glazing	0
S Total	70

Composite Sound Reduction – Eastern Façade

	63	125	250	500	1k	2k	4k
dB R_w, Brick+Block	38.0	44.0	44.0	48.0	57.0	68.0	78.0
dB R_w, Steel Cladding	15.0	18.0	22.0	23.0	21.0	38.0	47.0
dB R_w, Glazing	16.0	24.0	20.0	25.0	35.0	38.0	35.0
Comp R	-17.7	-20.7	-24.7	-25.7	-23.7	-40.7	-49.7

S m^2 Brick+Block	29
S m^2 Steel Cladding	34
S m^2 Glazing	0
S Total	63

Composite Sound Reduction – Northern Façade

	63	125	250	500	1k	2k	4k
dB R_w, Brick+Block	38.0	44.0	44.0	48.0	57.0	68.0	78.0
dB R_w, Steel Cladding	15.0	18.0	22.0	23.0	21.0	38.0	47.0
dB R_w, Glazing	16.0	24.0	20.0	25.0	35.0	38.0	35.0
Comp R	-16.3	-19.5	-22.9	-24.3	-22.6	-39.2	-44.2

S m^2 Brick+Block	9
S m^2 Steel Cladding	26
S m^2 Glazing	2.9
S Total	37.9

Composite Sound Reduction – West Façade

	63	125	250	500	1k	2k	4k
dB R_w, Brick+Block	38.0	44.0	44.0	48.0	57.0	68.0	78.0
dB R_w, Steel Cladding	15.0	18.0	22.0	23.0	21.0	38.0	47.0
dB R_w, Glazing	16.0	24.0	20.0	25.0	35.0	38.0	35.0
Comp R	-17.8	-21.0	-24.6	-25.9	-24.0	-40.8	-46.7

S m^2 Brick+Block	38
S m^2 Steel Cladding	40
S m^2 Glazing	2.9
S Total	80.9

Appendix H – SoundPLAN Source Locations

Figure A1: Noise Model Object Locations



Appendix I – Noise Maps

Figure A1: Noise Map @1.5m, Maximum Operational 1hr



Appendix J – Source Contribution and Spectra at NSR Locations

Figure A1: Source Contribution and Spectra NSR_1 North Façade

Source	Source type	LrD dB(A)	LrN dB(A)
Open Door	Area	40.9	40.9
Roof	Area	32.3	32.3
East Wall (Larger Section	Area	31.7	31.7
North Wall (not inc. Open Doo	Area	29.3	29.3
East Wall (Smaller Section)	Area	22.0	22.0
Car Door Closing Bay 5	Point	19.3	19.3
Starting Car Bay 5	Point	19.3	19.3
Starting Car Bay 3	Point	19.3	19.3
Starting Car Bay 4	Point	19.3	19.3
Car Door Closing Bay 3	Point	19.3	19.3
Car Door Closing Bay 4	Point	19.2	19.2
Car Door Closing Bay 2	Point	18.9	18.9
Starting Car Bay 2	Point	18.9	18.9
Car Door Closing Bay 1	Point	18.8	18.8
Car Starting Bay 1	Point	18.8	18.8
West Wall	Area	16.1	16.1
South Wall	Area	-10.9	-10.9

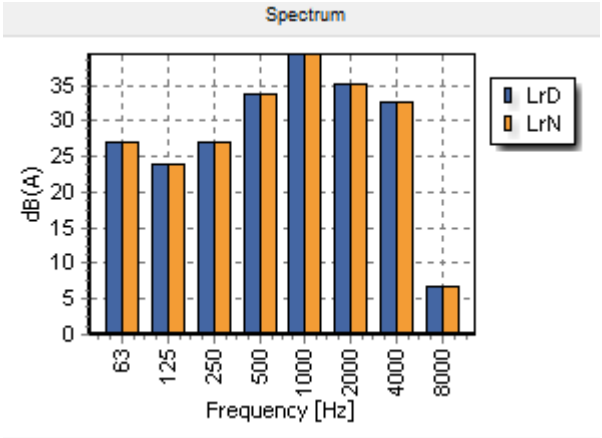


Figure A2: Source Contribution NSR_1 South Façade

Source	Source type	LrD dB(A)	LrN dB(A)
East Wall (Larger Section	Area	40.4	40.4
Open Door	Area	39.1	39.1
Roof	Area	32.6	32.6
West Wall	Area	18.0	18.0
Car Door Closing Bay 4	Point	17.6	17.6
Starting Car Bay 4	Point	17.4	17.4
Car Door Closing Bay 3	Point	15.8	15.8
North Wall (not inc. Open Doo	Area	15.5	15.5
Starting Car Bay 3	Point	15.4	15.4
Car Door Closing Bay 2	Point	14.4	14.4
Starting Car Bay 2	Point	13.8	13.8
Car Door Closing Bay 1	Point	13.4	13.4
East Wall (Smaller Section)	Area	13.4	13.4
Car Starting Bay 1	Point	12.7	12.7
Starting Car Bay 5	Point	10.3	10.3
South Wall	Area	9.2	9.2
Car Door Closing Bay 5	Point	5.5	5.5

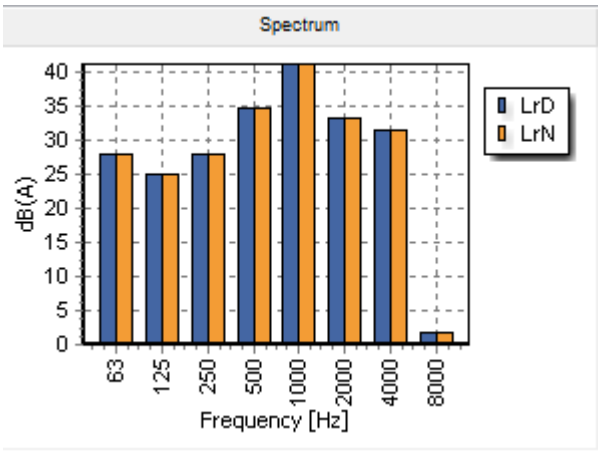


Figure A3: Source Contribution and Spectra NSR_2

Source	Source type	LrD dB(A)	LrN dB(A)
Open Door	Area	44.3	44.3
Roof	Area	24.1	24.1
East Wall (Larger Section	Area	20.8	20.8
North Wall (not inc. Open Doo	Area	19.7	19.7
Starting Car Bay 3	Point	16.8	16.8
Car Door Closing Bay 2	Point	16.6	16.6
Starting Car Bay 2	Point	16.5	16.5
Car Door Closing Bay 5	Point	16.3	16.3
Car Door Closing Bay 4	Point	16.1	16.1
Car Starting Bay 1	Point	16.1	16.1
Starting Car Bay 5	Point	16.1	16.1
Car Door Closing Bay 3	Point	16.0	16.0
Starting Car Bay 4	Point	15.9	15.9
East Wall (Smaller Section)	Area	15.4	15.4
Car Door Closing Bay 1	Point	14.9	14.9
West Wall	Area	9.3	9.3
South Wall	Area	-16.8	-16.8

