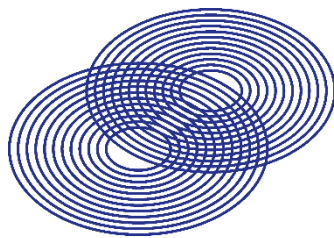


ADNITT ACOUSTICS
The Distillery
The Whisky Bond
2 Dawson Road
Glasgow G4 9SS

T: +44 (0)141 255 0200
F: +44 (0)845 127 5121
E: enquiry@adnitt.com
W: www.adnitt.com



adnitt
acoustics
scotland

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Project **Broadway 2 Hotel**
Glasgow

Title **Stage 3 Report**
Sub Title

Client ES Renfield Ltd
100 George Street
London
W1U 8NU

Case No

Author Graham Shaw BSc(Hons) MSc
MIOA MInstP

Checked Chris Turner BSc(Hons) MSc MIOA
MInstP

Revision	Reason	Checked	Signature

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List of Attachments

Appendix A: GLOSSARY OF ACOUSTIC TERMS

Figure 2045/ SP 1 : Site Plan Showing Measurement Locations

Figure 2045/ TH 1 : Time History for Automated Measurement Position 1

Figure 2045/ TH 2 : Time History for Automated Measurement Position 2

Figure 2045/ TH 3 : Time History for Automated Measurement Position 2 - Theatre Loading Survey

Façade Mark-Up

1. INTRODUCTION

1.1 Adnitt Acoustics have been appointed by ES Renfield Ltd to undertake a Stage 3 acoustic assessment for the proposed Dalata Hotel at Broadway 2, Glasgow.

1.2 The report summarises the following:

- Acoustic Assessment Criteria;
- Ambient Noise Measurements;
- Internal Building Fabric Assessment;
- External Building Fabric Assessment;
- External Mechanical Plant Assessment;
- Groundborne Vibration Assessment;

1.3 As this is a technical report it will be necessary to make use of technical terms. To assist the reader, a glossary has been included in Appendix A.

Statement of Qualification

1.4 The assessment was undertaken by Graham Shaw BSc(Hons) MSc MIOA MInstP for and on behalf of Adnitt Acoustic Services Ltd.

1.5 Graham has a BSc(Hons) in Physics with Music from the University of Edinburgh (2010) and an MSc (Distinction) in Architectural and Environmental Acoustics from London South Bank University (2012).

1.6 He has over seven years post-graduate experience as an Acoustical Consultant working as a Consultant for Adnitt Acoustics since January 2012.

1.7 Graham is a corporate member of both the Institute of Acoustics and Institute of Physics.

2. ASSESSMENT CRITERIA

2.1 The acoustic requirements are taken from the following sources:

- Local Authority Requirements;
- Building Standards Requirements;
- Dalata Hotel Requirements;

Local Authority Requirements

2.2 Planning permission has been granted with conditions. The relevant condition is as follows:

Condition 10

“Noise from or associated with the completed development (the building and fixed plant) shall not give rise to a noise level, assessed with windows closed, within any dwelling or noise sensitive building in excess of that equivalent to Noise Rating Curve 35 between 0700 and 2200, and Noise Rating Curve 25 at all other times.”

Building Standards Requirements

2.3 Hotels are classed as non-domestic buildings under the Scottish Building Standards.

2.4 There are two Mandatory Standards relating to sound insulation in the Non-Domestic Building Standards 2017, 5.1 and 5.2 and both are applicable to the proposed development.

Standard 5.1

Every building, which is divided into more than one area of different occupation, must be designed and constructed in such a way to limit the transmission of source noise from normal domestic type activities, between such areas, to a level that will not threaten the health of, or cause inconvenience to the building occupants.

Limitation:

This standard only applies to a building in different occupation incorporating:

- a. attached dwellings
- b. attached residential buildings, or
- c. a roof, walkway or access deck located directly above an area that is either a dwelling or a residential building.

2.5 The following scope is taken from the Technical Handbook - Non-Domestic.

“Airborne sound insulation should be provided where any separating wall or separating floor is formed between areas in different occupation. For example:

- *between rooms that are intended to be used for sleeping and other buildings*
- *between rooms that are intended to be used for sleeping and other parts of the same building, such as bedrooms and a communal hall.*

Impact sound insulation should be provided where any separating floor is formed between areas in different occupation. For example:

- *between rooms intended to be used for sleeping. The lower room should be protected from sound emanating from the upper room*
- *between rooms intended to be used for sleeping and other parts of the same building. The room below should be protected from sound emanating from other parts of the building above*
- *between rooms intended to be used for sleeping and other parts of the same building directly above e.g. common stair or corridor, communal lounge, or car parking garage*
- *a roof, walkway or access deck located directly above rooms intended to be used for sleeping and to which there is access, other than where it meets the conditions of (c) or (d) below.*

Impact sound insulation need not be provided for:

- (a) *a roof above a non-habitable space, such as a roof space*
- (b) *a separating floor between a residential building and any other non-domestic building directly below*
- (c) *a roof, walkway or access deck located directly above rooms intended to be used for sleeping to which there is access for maintenance purposes only*
- (d) *a roof, walkway or access deck located directly above rooms and to which there is access, where it is for the sole use of the residents of the residential building.”*

2.6 The design performance levels to show compliance with Standard 5.1 are as follows:

Design Performance	New build and conversions not including traditional buildings	Conversion of traditional buildings
Minimum airborne sound insulation	≥ 56 dB $D_{nT,w}$	≥ 53 dB $D_{nT,w}$
Maximum impact sound transmission	≤ 56 dB $L'_{nT,w}$	≤ 58 dB $L'_{nT,w}$
Table S18012/T1 - 5.1 Post Completion Performance Levels		

2.7 The scope of Standard 5.1 for non-domestic buildings means that the airborne sound insulation requirements *do not apply between hotel bedrooms.*

Standard 5.2

Every building, must be designed and constructed in such a way to limit the transmission of source noise from normal domestic type activities, through a wall or floor, between a room and internal space where noise is likely to occur, to a level that will not cause inconvenience to the building occupants.

Limitation:

This standard only applies to a wall or floor forming an apartment in a dwelling and a room in a residential building which is capable of being used for sleeping; other than:

- a. a wall between an en-suite bathroom and the apartment or room it serves
- b. a hospital
- c. a place of lawful detention.

2.8 The design performance levels to show compliance with Standard 5.2 are as follows:

Design Performance	Minimum airborne insulation level (Laboratory rated performance)
Internal Walls	≥ 43 dB R_w
Intermediate Floors	≥ 43 dB R_w

Table S18012/T2 - 5.2 Laboratory Rated Performance Levels

Dalata Hotel Specification

2.9 The hotel operator is Dalata and the acoustic requirements are understood to be as follows based on the standard Dalata Design Brief supplied by the client.

External Noise Break-In

2.10 The external noise break in criteria.

Location	Internal Noise Level
Guest Bedroom	40dB L_{Aeq} , 1hr (daytime, 0700-2300)
	35dB L_{Aeq} , 1hr (night time, 2300-0700)
	55dB L_{AFmax} , (night time, 2300-0700)
Reception	40dB L_{Aeq} , 1hr (daytime)
Circulation	45dB L_{Aeq} , 1hr (daytime)
Meeting Room	35dB L_{Aeq} , 1hr (daytime)
Banqueting Suite/Conference Room	40dB L_{Aeq} , 1hr (daytime)
Fitness Facilities (e.g. Gym, Pool)	45dB L_{Aeq} , 1hr (daytime)
Restaurant/Bar	45dB L_{Aeq} , 1hr (daytime)
Office	40dB L_{Aeq} , 1hr (daytime)

Table S18012/T3 - Dalata Internal Break-In Noise Requirements

“The term “Ambient Noise” refers to the totality of intrusive noise from all sources external to the space under consideration, e.g. building services plant (including that serving the room), plant rooms, bars/restaurants within the hotel, adjacent demises, road/rail traffic and aircraft flyovers.

The values in Table 1 must be achieved whilst also ensuring compliance with the limit values for mechanical services noise as set out in terms of NR (Noise Rating) in the specification for the mechanical and electrical services installation.

The values in Table [S18012/T3] must be achieved with windows closed, trickle vents open and any ventilation operating at its typical design duty”.

Reverberation Time

- 2.11 The mid frequency reverberation time, T_{mf} , has been specified for the following locations:

Location	Maximum Permissible T_{mf} (s)
Meeting Room / Office / Banqueting Suite / Conference Room	0.8
Reception / Restaurant / Bar	1.0
Fitness Facilities (e.g. Gym, Pool)	1.5
Table S18012/T4 - Dalata Reverberation Time Requirements	

- 2.12 Circulation spaces adjacent to guest bedrooms shall have a carpet with a minimum NRC of 0.4.

Sound Insulation

- 2.13 The following matrix for airborne sound insulation performance has been provided:

	Guest Bedroom / Ensuite Bathroom	Reception / Circulation	Housekeeping / Store	Plant Room	Meeting Room / Office	Banqueting / Conference Room / Restaurant / Bar	Fitness Facilities (e.g. Gym, Pool)
Guest Bedroom / Ensuite Bathroom	50	50	55	60	50	55	60
Reception / Circulation	50	50	45	60	50	55	60
Housekeeping / Store	55	45	n/a	n/a	50	50	n/a
Plant Room	60	60	n/a	n/a	60	60	60
Meeting Room / Office	50	50	50	60	50	55	60
Banqueting / Conference Room / Restaurant / Bar	55	55	50	60	55	55	60
Fitness Facilities (e.g. Gym, Pool)	60	60	n/a	60	60	60	50

Table 3 Design goals for airborne sound insulation performance (dB $D_{nT,w}$)

- 2.14 Doors leading from Guest Bedrooms to Corridors or any other kind of circulation space shall be selected on the basis of airborne sound insulation performance not less than 29dB R_w (where R_w is the Weighted Sound Reduction Index as per BS EN ISO 717-1: 2013).
- 2.15 Connecting doors between Guest Bedrooms shall comprise a pair of back-to-back doorsets, each offering 29dB R_w . One doorset in each pair should be fitted with an automatic drop threshold seal.
- 2.16 The performance requirement for a plant room envelope is subject to compliance with the design goals for ambient noise as set out in Table 1. Sound insulation performance of plant room envelope constructions may need to be increased if high noise levels are anticipated. Plant room doors shall be selected based on an airborne sound insulation performance not less than 45dB R_w .
- 2.17 Separating floors between bedrooms shall achieve a minimum impact sound insulation performance of 58dB $L'_{nt,w}$ and 63dB $L'_{nt,w}$ in all other locations in the matrix above.

Vibration

Location	Maximum Permissible Ambient Vibration Level (VDV)
Guest Bedroom	0.20m/s ^{1.75} (daytime, 0700-2300)
	0.13m/s ^{1.75} (night time, 2300-0700)
Table S18012/T5 - Dalata Vibration Requirements	

Mechanical Ventilation

- 2.18 The following table is a summary of the table provided in the standard Dalata specification and assumed to be for design duty ventilation.

Location	Noise Rating (NR) Requirements
Guest Room, Suite	<30
Guest Suite	<30
Guest Bathroom	<35
Corridor	<35
Linen Store	<40
Main Lobby	<35
Reception Lobby	<30
Lounge/Living Room	<30
Offices	<30
Luggage Storage	<45
Public Toilets	<35
Restaurants	<35
Bar	<35
Retail	<35
Pre-function	<30
Meeting Rooms	<30
Business Centre	<40
Housekeeping	<40
Kitchen/Pantries	<45
Bakery/Finishing	<30
Dry Goods Store	<30
Table S18012/T6 - Dalata NR Requirements	

- 2.19 It is the responsibility of the M&E consultant to confirm that the equipment selected can achieve the internal Noise Rating (NR) levels above including suitable mitigation measures if required.

3. NOISE AND VIBRATION SURVEY

Initial Automated Noise Survey

- 3.1 An unattended environmental noise survey was carried out between Tuesday 6th February and Monday 12th February 2018 to obtain daytime and night-time ambient noise monitoring results.
- 3.2 The following two positions were chosen and are indicated on the attached site plan, Figure S18012/SP1.
- (i) Position 1 - Located on the boundary fence close to the corner of Renfrew Street and Renfield Street. The microphone was located 2m above the local ground level and at least 3m from any vertical reflecting surfaces and is therefore considered to be under free-field conditions. It was also located approximately 10m from the centre of Renfrew Street and on the façade line of the proposed building;
 - (i) Position 2 - Located on the boundary fence overlooking the service yard to the west of the site. The microphone was located 2m above the local ground level and at least 3m from any vertical reflecting surfaces and is therefore considered to be under free-field conditions.



Figure S18012/F1 - Automated Measurement Position 1



Figure S18012/F2 - Automated Measurement Position 2

- 3.3 The acoustic parameters L_{Aeq} , L_{A90} and $L_{AF,Max}$ were measured automatically every 15 minutes during the survey including full octave band frequency measurements.
- 3.4 An audio trigger at 80dBA was set up for position 1 on the Friday night to record and identify high noise levels.
- 3.5 Survey measurements were carried out in accordance with guidelines laid down in BS 7445:1991 Part 2 and other relevant standards.

Theatre Royal Loading Noise Survey

- 3.6 Following discussions with the Theatre Royal a follow up survey was undertaken to measure the noise from a typical night time load event for the Theatre.
- 3.7 Based on the information from the Theatre these night time load events happen approximately 2-3 times a month.
- 3.8 The Theatre load event was confirmed for the night time period between 5th and 6th May 2018 therefore automated measurements were undertaken from Thursday 3rd May 2018 to Tuesday 8th May 2018 to cover the load event night.
- 3.9 The microphone was located at position two as described on the previous page.
- 3.10 The acoustic parameters L_{Aeq} , L_{A90} and $L_{AF,Max}$ were measured automatically every 15 minutes during the survey including full octave band frequency measurements and an audio trigger was set up to allow for source identification.
- 3.11 Survey measurements were carried out in accordance with guidelines laid down in BS 7445:1991 Part 2 and other relevant standards.

Attended Groundborne Vibration Survey

- 3.12 An attended vibration survey was undertaken on 30th January 2019 to establish the vibration levels from the Glasgow Subway which passes approximately 60m to the north of the proposed hotel building.
- 3.13 The vibration meter was positioned as follows:

(i) Position V1 - The vibration meter was located on the existing asphalt car park surface at the approximate location of the closest proposed hotel building façade to the subway.

The accelerometer was installed on a weighted baseplate, levelled out and lined up as follows:

- X,Y axes approximately following the proposed building lines;
- Z axis in the vertical direction;



(ii) Position V2 - The vibration meter was located closer to the subway at the far end of the site - just before the base level for the Tesco Bank building - on the existing car park asphalt surface.

The accelerometer was installed on a weighted baseplate, levelled out and lined up as follows:

- X,Y axes approximately following the proposed building lines;
- Z axis in the horizontal direction;



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Equipment and Weather Conditions

- 3.14 The equipment used is detailed in Table S18012/T7 below. The sound level meters were fitted with windshields. A sensitivity check was undertaken on the sound level meters before and after the measurements and the variation was within 0.5dB. Calibration certificates are available on request.

Equipment		Calibration		
Integrating sound level meter	Cirrus Optimus Green CR:171B	G061816B	19/12/2017	255616
Microphone	Cirrus MK224	203483A	19/12/2017	115779
Acoustic Calibrator	Cirrus CR:515	60611	19/12/2017	115776
Integrating sound level meter	Cirrus Optimus Green CR:171A	G061843A	14/07/2016	239864
Microphone	Cirrus MK224	20045639	14/07/2016	106953
Acoustic Calibrator	Cirrus CR:515	64313	14/07/2016	106952
Sound & Vibration Analyser	SvanteK Svan 948	6508	08/02/2019	14011722-2
Triaxial Accelerometer	SvanteK SV84	D4229	08/02/2019	14011722-1
Vibration Calibrator	SvanteK SV110	64403	04/04/2018	-
Table S18012/T7 - Equipment Details				

- 3.15 The weather during both unattended surveys has been assessed using a locally based weather station. The weather was moderately dry with wind speeds below 5m/s for majority of the survey periods.
- 3.16 From analysis of the results it appears that the weather has not adversely affected the measured data.
- 3.17 The weather during the attended vibration survey was dry with minimal wind.

4. NOISE SURVEY RESULTS

Automated Survey

- 4.1 Table S18012/T8 shows the summary of the measurements at each automated survey position for the duration of the survey. The time history graphs for the automated measurements are appended to this report in Figure S18012/TH 1 and Figure S18012/TH 2.

Location	Time Period, T	$L_{Aeq,T}$ (dB)	Typical L_{AFMax} (5 min) (dB)	Typical L_{A90} (15 min) (dB)
Position 1	07:00-23:00	64	85	58
	23:00-07:00	60	82	48
Position 2	07:00-23:00	59	78	55
	23:00-07:00	53	74	49

Table S18012/T8 - Automated Measurement Summary
All values are free-field values

- 4.2 Full octave band frequency measurements were also recorded for the measurement period and are summarised below.

Position	Period, T	$L_{eq,T}$, dB									
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	16kHz
Position 1	07:00-23:00	76	72	65	63	60	60	57	52	47	37
	23:00-07:00	69	67	61	58	55	57	53	47	42	37
Position 2	07:00-23:00	72	68	62	60	56	54	51	44	38	29
	23:00-07:00	64	62	57	54	50	49	45	37	28	23

Table S18012/T9 - Octave Band Measurement Summary
All values are free-field values

Theatre Royal Loading Survey

- 4.3 Table S18012/T10 below shows the results from the automated survey for the load event on the night of the 5th and 6th of May 2018.

Location	Time Period, T	$L_{Aeq,T}$ (dB)	Typical L_{AFMax} (5 min) (dB)	Typical L_{A90} (15 min) (dB)
Position 2	23:00-07:00	57	81	52

Table S18012/T10 - Automated Measurement Summary - Theatre Royal Loading Survey
All values are free-field values

- 4.4 The measurements indicate that the typical maximum noise levels are increased when there is a Theatre load event - most of the maximum noise levels are from equipment hitting the side of the lorries and reversing alarms.
- 4.5 The ambient noise level ($L_{Aeq,T}$) has also increased - however this is more likely to be the mechanical plant equipment associated with the Hotel increasing in noise due to the warmer weather than when the original survey was undertaken.

5. EXTERNAL BUILDING FABRIC ASSESSMENT

- 5.1 An assessment of the required acoustic performance for the external building fabric of the residential properties has been undertaken using the methodology provided in Annex G of British Standard BS 8233:2014 “Guidance on Sound Insulation and Noise Reduction in Buildings”.
- 5.2 Table S18012/11 below shows the criteria used during the assessment as defined in the Dalata Specification

Location	Internal Noise Level
Guest Bedroom	40dB L_{Aeq} , 1hr (daytime, 0700-2300)
	35dB L_{Aeq} , 1hr (night time, 2300-0700)
	55dB L_{AFmax} , (night time, 2300-0700)
Reception	40dB L_{Aeq} , 1hr (daytime)
Circulation	45dB L_{Aeq} , 1hr (daytime)
Meeting Room	35dB L_{Aeq} , 1hr (daytime)
Banqueting Suite/Conference Room	40dB L_{Aeq} , 1hr (daytime)
Fitness Facilities (e.g. Gym, Pool)	45dB L_{Aeq} , 1hr (daytime)
Restaurant/Bar	45dB L_{Aeq} , 1hr (daytime)
Office	40dB L_{Aeq} , 1hr (daytime)
Table S18012/T11 - Dalata Internal Break-In Noise Requirements	

- 5.3 The noise levels presented in Table S18012/T12 have been derived from the measured noise data and are representative of the prevailing noise climate.

Facade	Time Period, T	Parameter	Broadband Level (dBA)	Octave Band Sound Levels (dB)				
				125Hz	250Hz	500Hz	1kHz	2kHz
South and East Façade	Daytime (07:00 - 23:00)	L _{eq,1hr}	69	67	64	61	65	63
	Night-time (23:00 - 07:00)	L _{eq,1hr}	68	62	59	57	66	63
		L _{AFMax, Max}	91	63	65	81	89	85
North Courtyard Façade	Daytime (07:00 - 23:00)	L _{eq,1hr}	61	63	59	56	58	55
	Night-time (23:00 - 07:00)	L _{eq,1hr}	63	63	59	57	62	53
		L _{AFMax, Max} (includes unloading event from the Theatre)	80	84	80	77	74	71
East Side of Courtyard Façade (facing west)	Daytime (07:00 - 23:00)	L _{eq,1hr}	63	61	58	55	59	57
	Night-time (23:00 - 07:00)	L _{eq,1hr}	62	56	53	51	60	57
		L _{AFMax, Max}	85	57	59	75	83	79
Table S18012/T12 - Noise Levels Used in External Building Fabric Assessment								
All values presented are free-field values								

- 5.4 The following parameters have been used in preparing the external building fabric assessment:

Element	Design Parameters
Room Finishes	Plasterboard ceiling; Plasterboard walls; Soft floor finishes and/or soft furnishings within the bedrooms/studios and meeting rooms and restaurants.
Ventilation	<u>The ventilation strategy is full mechanical whole building ventilation.</u> There are no trickle vents and/or through wall ventilation proposed in any of the guest rooms or public areas.
Room/Window Sizes	The room and window sizes have been taken from the latest drawings issued by Consarc Design (issued July 2019).
External wall build up	The external wall constructions have been taken from the façade details issued by Consarc Design (issued July 2019). The internal section of the external wall (from the non-combustible sheathing board/blockwork inwards is the same in all locations.

Table S18012/T13 - List of Assessment Parameters

- 5.5 The summary of the recommended practicable façade element types is as follows:

Location ¹	Room	Period, T	Predicted Internal Noise Level	External Wall Type	Window Type (Glazing + Frame)	Ventilation Type
Red Area	Bedroom	07:00-23:00	<30dB L _{Aeq,1 hr}	EW1	W1	V1
		23:00-07:00	<25dB L _{Aeq,1hr} 50dB L _{AFMax} Max			
	Meeting Rooms	07:00-23:00	<35dB L _{Aeq,1 hr}	n/a (100% glazing)	W1	V1
Amber Area	Bedroom	07:00-23:00	<30dB L _{Aeq,1 hr}	EW1	W2	V1
		23:00-07:00	<30dB L _{Aeq,1hr} 50dB L _{AFMax} Max			
	Restaurant/Lobby	07:00-23:00	<40dB L _{Aeq,1 hr}	n/a (100% glazing)	W2	V1
Green Area	Bedroom	07:00-23:00	<30dB L _{Aeq,T}	EW1	W3	V1
		23:00-07:00	<30dB L _{Aeq,1hr} <50dB L _{AFMax} Max			

Table S18012/T14 - Summary of the Recommended Practicable Façade Element Types

¹The locations are shown on the attached mark-up

- 5.6 The specified sound reduction values, shown in table S18012/T15, shall be met by the façade element, including all framing and openable elements, such as doors, windows including the framing elements and vents (if specified).
- 5.7 The assessment is based on the current ventilation strategy which is centralised whole building mechanical ventilation with *no* trickle vents or penetrations in the façade. Therefore ventilation is *not* provided by means of openable windows.

Building Element ref.	Single Figure Rating	Octave Band Performance Values (dB)				
		125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
EW1	67dB R_w	53	55	64	65	65
W1 (Glazing + Frame)	46 dB R_w	28	36	43	47	49
W2 (Glazing + Frame)	41 dB R_w	23	29	39	48	47
W3 (Glazing + Frame)	39 dB R_w	20	28	38	44	40

Table S18012/T15 - Minimum Sound Reduction Values

The elements above are required to meet the octave band performance values as well as the single figure rating

- 5.8 ***It is the acoustic performance that is specified, and any construction is indicative only;*** and will be subject to provision of suitable independently verified acoustic performance test data, including all opening windows (including framing elements), doors, and ventilation elements.

Building Element Ref.	Indicative construction for guidance only - does not form part of the specification
EW1	<p>Taken from Consarc drawings and following discussions with Consarc the following construction applies from the sheathing board inwards:</p> <ul style="list-style-type: none"> 12mm Sheathing Board, Calcium silicate board min. density 1200kg/m³ (or equal and approved); 150mm SFS framing system; 150mm mineral wool insulation (33-45kg/m³) (or equal and approved); 2x12.5mm Fireline (or equal and approved); <p>The external cladding is ventilated therefore the acoustic performance of this area is reduced and has not been included in the construction.</p>
W1	10mm/20mm/8.8mm - or equal and approved in a high-performance acoustic framing system
W2	10.8mm lam/16mm cavity/10mm - or equal and approved in a high-performance acoustic framing system
W3	8.8mm lam/20mm cavity/6mm toughened - or equal and approved in a high-performance acoustic framing system
V1	Whole building mechanical ventilation with fresh air drawn from the roof and no penetrations in the façade.

Table S18012/T16 - Indicative Constructions - Does Not Form Part of the Specification

- 5.9 Other façade and ventilation options/configurations could be used to achieve the indoor ambient noise level criteria. If the acoustic performance of the final confirmed façade elements differs from the performance provided in this report an assessment carried out by a suitably qualified acoustic consultant (as defined in BREEAM) must be provided to show *the predicted indoor ambient noise levels* achieve the values stated in Table S18012/T11.
- 5.10 It is the indoor ambient noise levels which show compliance with the requirements of the Hotel Operator and not the acoustic performance of the façade elements alone.

Overheating

- 5.11 Based on the measured external noise levels it is not feasible to mitigate the effects of summertime overheating using an openable window from an acoustic point of view.

Alternative strategies to reduce the effects of summertime overheating should be considered. This is likely to be provided by the whole building mechanical ventilation system that is proposed however coordination with the M&E consultant is required.

- 5.12 However openable windows for short term purge ventilation should be acceptable from an acoustic point of view.

6. INTERNAL BUILDING FABRIC ASSESSMENT

Separating Walls

6.1 The following partition types have been identified in the Dalata Hotel.

Location	Minimum On-site Sound Insulation [$D_{nT,w}$], dB		Minimum Laboratory Rating, [R_w] dB ¹	
	Dalata	Building Standards	Dalata	Building Standards
Hotel room - hotel room	50	n/a	57	43
Bathroom - Bedroom/lobby (same hotel room)	n/a	n/a	n/a	43
Hotel room - meeting room	50	56	57	63
Hotel room - public toilet	50	56	57	63
Corridor - hotel room	50	n/a	57	n/a
Corridor - Corridor / lobby	50	n/a	57	n/a
Lobby - Housekeeping / Store	45	n/a	52	n/a
Corridor - Gym / Plant	60	n/a	67	n/a
Corridor - Corridor / lobby	50	n/a	57	n/a
Gym - Core	60	n/a	67	n/a
Corridor - Core	50	n/a	57	n/a
Hotel room - Core	50	n/a	57	n/a
Housekeeping /Store - Core	45	n/a	52	n/a
Meeting Room - Corridor / Meeting Room	50	n/a	57	n/a
Hotel Room - Gym	60	n/a	67	n/a
Public toilet - corridor	n/a	n/a	n/a	n/a
Public toilet cubicle	n/a	n/a	n/a	n/a
Office - public toilet / corridor / servery	50	n/a	57	n/a
Reception - office or luggage store - office	50	n/a	57	n/a
Reception - luggage store	45	n/a	52	n/a
Circulation - Comms room	50	n/a	57	n/a
Toilets - Circulation/bar or circulation - lift lobby	n/a	n/a	n/a	n/a
Walls within toilet accommodation	n/a	n/a	n/a	n/a
Circulation - Toilets	n/a	n/a	n/a	n/a
circulation (FoH) to circulation (BoH)	50	n/a	57	n/a
Circulation - lobby	50	n/a	57	n/a
Circulation (BoH) - Circulation (FoH)/Bar	50	n/a	57	n/a
Circulation - Restaurant / servery	50	n/a	57	n/a
Circulation - linen	50	n/a	57	n/a

Table S18012/T17 - Dalata Partition Types

¹Where there is an on-site performance this forms the specification and the laboratory rating is for reference only

²The most onerous requirement is highlighted in **bold**

Separating Floors

- 6.2 From the Dalata specification; separating floors between bedrooms shall achieve a [maximum] impact sound insulation performance of 58dB $L'_{nt,w}$ and 63dB $L'_{nt,w}$ in all other locations.
- 6.3 In addition the Building Standards requirement between bedrooms applies which is ≤ 56 dB $L'_{nt,w}$ and is more onerous than the Dalata requirements.
- 6.4 The Building Standards requirement doesn't apply between en-suite bathrooms, therefore, the impact requirement between en-suite bathrooms is ≤ 63 dB $L'_{nt,w}$.
- 6.5 The airborne sound insulation requirement between hotel bedrooms is ≥ 50 dB D_{ntw} from the Dalata specification. There is no Building Standards airborne sound insulation requirement between hotel bedrooms.
- 6.6 Between hotel bedrooms and common areas (restaurants/meeting rooms etc.) the minimum Building Standards airborne sound insulation requirement of ≥ 56 dB D_{ntw} applies in addition to the Dalata requirements in these locations. In most of these locations the Building Standards requirement is more onerous than the Dalata requirement.
- 6.7 The following construction for the separating floor between bedrooms is proposed:
- Floor finish (carpet / tile / vinyl) - thickness varies - assumed max. 10mm
 - Resilient layer under hard floor finishes only (tile, vinyl etc.):
 - Where the requirement is 56dB $L'_{nt,w}$ - 19mm plywood on Pliteq GenieMat FF70 or equal and approved;
 - Where the requirement is 63dB $L'_{nt,w}$ - 3mm min. resilient layer with an impact performance of at least $\Delta 17$ dB L_w
 - Min 225mm concrete slab (min. 2400kg/m³);
 - 100mm (min.) ceiling void;
 - Suspended MF ceiling;
 - 1x12.5mm Wallboard or equal and approved;
- 6.8 For option 2 where there is a hard floor finish (tile, vinyl etc.) and the impact requirement is ≤ 56 dB $L'_{nt,w}$ then a higher performing resilient layer underneath the floor finish would be required - refer to the construction above.
- 6.9 The underlay/resilient layer for the carpet areas will require a label which states that it cannot be removed - and if removed it must be replaced with a layer with an equivalent impact sound insulation performance.

Separating Floor between Bedrooms and Common Areas (restaurants/meeting rooms etc.)

- 6.10 The following construction is proposed between the bedrooms and common areas.
- Floor finish (carpet / tiles in en-suite) - thickness varies;
 - [For hard floor finish (tile etc.) a resilient layer with an impact performance of at least $\Delta 17$ dB L_w is required underneath];
 - Concrete slab - thickness 225mm (min. 2400kg/m³);
 - 200mm min. void;
 - 100mm min. mineral wool insulation (33-45kg/m²);
 - Suspended MF ceiling;
 - 1x 12.5mm Soundbloc.

Separating Floors between Bedrooms and Plant Areas

6.11 The following construction is proposed between bedrooms and plant areas:

- Floor finish (carpet / tiles in en-suite) - thickness varies;
- [For hard floor finish (tile etc.) a resilient layer with an impact performance of at least $\Delta 17\text{dB } L_w$ is required underneath];
- Concrete slab - thickness 225mm (min. 2400kg/m^3);
- 250mm min. void;
- 100mm min. mineral wool insulation ($33\text{-}45\text{kg/m}^2$);
- 2x 15mm Soundbloc on suitable isolation mounts or spring hangers (detail to be developed);

Rooftop Plant Separating Floor to Bedrooms Below

6.12 The floor between the rooftop plant area and the room below should be capable of achieving an airborne sound insulation of at least $\geq 60\text{dB } D_{ntw}$.

6.13 The following construction is proposed:

- Inverted roof system:
 - 100mm Paving slabs on pedestal system;
 - 180mm PIR type insulation;
- Min. 225mm concrete slab (min. 2400kg/m^3);
- 100mm minimum void;
- MF suspended ceiling;
- 25mm mineral wool insulation in the void ($33\text{-}45\text{kg/m}^3$);
- 1x12.5mm Wallboard or equal and approved

6.14 The proposed rooftop plant separating floor construction is based on typical frequency spectrum expected from the rooftop mechanical plant equipment. This should be reviewed once the equipment manufacturer has been confirmed and the octave band sound spectrum can be obtained.

Services Penetrations

6.15 In order to maintain the acoustic integrity of the separating partition between the bedrooms suites it is strongly recommended that all services entering and leaving a guest-bedroom do so through the partition between the bedroom and the bedroom corridor and, preferably, above the entrance door to the bedroom.

6.16 Any sockets within the separating partitions between the bedrooms should be boxed in with 2 layers of plasterboard or putty pads installed behind the sockets.

6.17 Please refer to attached construction sheet:

- SP1 - Service Penetration 1

Doors

6.18 The minimum Hotel requirement for doors to hotel bedrooms is $29\text{dB } R_w$ when measured in accordance with BS EN ISO 10140-3 Parts 1, 2, 3, 4 & 5 and rated in accordance with BS EN ISO 717-1.

6.19 The doors must have acoustic seals to the head, jambs and threshold (drop seal).

- 6.20 Internal doors within the bedrooms shall be specified to achieve the minimum requirements of the Building Standards 2017 namely a surface mass of at least 25kg/m².

Interconnecting Doors

- 6.21 The interconnecting door set is recommended to have a performance equal to or greater than 55dB R_w.
- 6.22 This can be achieved by using the Huet SAS 52 interconnecting door set (or equal and approved)
- 6.23 It is recommended that this is combined with either a staggered or twin stud construction in those locations.

Flanking Details

- 6.24 The cladding shall incorporate suitable elements on partitioning lines against which partitions can be sealed.
- 6.25 The complete system shall be tested for flanking transmission at a junction with both party and internal walls (between adjoining rooms at the same floor abutting cladding) and with both party floor and internal slabs (between adjoining floors abutting cladding).
- 6.26 Where the separating wall or floor has to achieve an onsite performance of 50dB D_{ntw} (this applies to hotel room walls and floors), the minimum flanking performance of the system shall be 60dB D_{nfw} when tested in a laboratory in general accordance with BS EN ISO 10848-2:2006 and rated in accordance with BS EN ISO 717-1:1997. Junctions with floor slabs shall be tested in the absence of raised floors and suspended ceilings.
- 6.27 In general the flanking performance measured in D_{nfw} shall be 10dB higher than the airborne sound insulation requirement in the area being measured (both vertical and horizontal details)
- 6.28 In addition, the following general design elements will apply:
- Double mullion between rooms;
 - Double transom between the floor levels;
 - Split mullion between floor levels;
 - Flexible cavity barrier and mineral wool insulation batts at the top and bottom;
 - Ceiling is finished up to the transom with a suitable flexible sealant or joint to cover building movement;

- 6.29 It will be the responsibility of the façade contractor to show compliance with the requirements above including providing suitable evidence for the flanking performance which may require an independent acoustic test to be carried out.
- 6.30 Continued design development is required.

Reverberation Time

- 6.31 In accordance with the Dalata specification circulation spaces adjacent to guest bedrooms shall have a carpet with a minimum Noise Reduction Coefficient (NRC) of 0.4.
- 6.32 It will be the responsibility of the carpet supplier to provide suitable independent test data to demonstrate compliance with the absorption requirement, NRC of 0.4.

- 6.33 Provided the carpet achieves the minimum absorption requirement above no additional absorption would be required in these circulation spaces.
- 6.34 The following specific reverberation times are given in the Dalata specification.

Location	Maximum Permissible T_{mf} (s)
Meeting Room / Office / Banqueting Suite / Conference Room	0.8
Reception / Restaurant / Bar	1.0
Fitness Facilities (e.g. Gym, Pool)	1.5
Table S18012/T18 - Dalata Reverberation Time Requirements	

- 6.35 These areas are likely to require additional absorption measures to achieve the reverberation time requirements and an allowance shall be made for this treatment in the areas above.
- 6.36 Different absorption options are available and design development is required to finalise the treatment. This will require coordination with the interior design team.
- 6.37 In these areas the absorption treatment is likely to consist of a combination of the following; acoustic wall panels, acoustic baffles, acoustic rafts and perforated gypsum ceiling such as BG Gyptone (pending a sound insulation assessment).
- 6.38 It is important that absorption treatment is installed evenly across the spaces on walls and ceilings where possible.
- 6.39 The final selection of acoustic treatment will be coordinated with the interior design team.

7. EXTERNAL MECHANICAL PLANT NOISE ASSESSMENT

Local Authority

- 7.1 At the time of this report the final location of the mechanical plant equipment has not been finalised therefore cumulative mechanical plant noise emission limits at the nearest noise sensitive premises will be based on the requirements of Glasgow City council as follows:

“Noise from or associated with the completed development (the building and fixed plant) shall not give rise to a noise level, assessed with windows closed, within any dwelling or noise sensitive building in excess of that equivalent to Noise Rating Curve 35 between 0700 and 2200, and Noise Rating Curve 25 at all other times.”

- 7.2 A single 6mm glazed window into a typical residential room is expected to provide a reduction of around 20dBA for broadband non-tonal noise levels.
- 7.3 The Glasgow City council criteria is approximately equal to the following free-field noise levels at the façade of the nearest noise sensitive buildings for broadband non-tonal noise levels:
- 60dB $L_{Aeq,T}$ - 07:00-22:00;
 - 50dB $L_{Aeq,T}$ - 22:00-07:00

Dalata Hotel

- 7.4 The Dalata requirements are as follows:

Location	Internal Noise Level
Guest Bedroom	≤40dB L_{Aeq} , 1hr (daytime, 0700-2300)
	≤35dB L_{Aeq} , 1hr (night time, 2300-0700)
	≤55dB L_{AFmax} , (night time, 2300-0700)
Reception	≤40dB L_{Aeq} , 1hr (daytime)
Circulation	≤45dB L_{Aeq} , 1hr (daytime)
Meeting Room	≤35dB L_{Aeq} , 1hr (daytime)
Banqueting Suite/Conference Room	≤40dB L_{Aeq} , 1hr (daytime)
Fitness Facilities (e.g. Gym, Pool)	≤45dB L_{Aeq} , 1hr (daytime)
Restaurant/Bar	≤45dB L_{Aeq} , 1hr (daytime)
Office	≤40dB L_{Aeq} , 1hr (daytime)
Table S18012/T19 - Dalata Internal Break-In Noise Requirements	

“The term “Ambient Noise” refers to the totality of intrusive noise from all sources external to the space under consideration, e.g. building services plant (including that serving the room), plant rooms, bars/restaurants within the hotel, adjacent demises, road/rail traffic and aircraft flyovers.

The values in Table 1 must be achieved whilst also ensuring compliance with the limit values for mechanical services noise as set out in terms of NR (Noise Rating) in the specification for the mechanical and electrical services installation.

The values in Table [S18012/T18] must be achieved with windows closed, trickle vents open and any ventilation operating at its typical design duty”.

- 7.5 The above noise levels include external mechanical plant equipment, therefore the following noise levels which are 3dB below the values in Table S18012/T18 should be used to allow for some headroom in the calculation for other noise sources.

Location	Internal Noise Level
Guest Bedroom	≤37dB L _{Aeq} , 1hr (daytime, 0700-2300)
	≤32dB L _{Aeq} , 1hr (night time, 2300-0700)
Reception	≤37dB L _{Aeq} , 1hr (daytime)
Circulation	≤42dB L _{Aeq} , 1hr (daytime)
Meeting Room	≤32dB L _{Aeq} , 1hr (daytime)
Banqueting Suite/Conference Room	≤37dB L _{Aeq} , 1hr (daytime)
Fitness Facilities (e.g. Gym, Pool)	≤42dB L _{Aeq} , 1hr (daytime)
Restaurant/Bar	≤42dB L _{Aeq} , 1hr (daytime)
Office	≤37dB L _{Aeq} , 1hr (daytime)
Table S18012/T20 - Dalata External Mechanical Plant Target Levels	

- 7.6 The mechanical plant equipment shall be designed to achieve the above noise levels. Design development is required once the equipment has been finalised.

Consolidated Requirements

- 7.7 Taking the most onerous requirements the following consolidated internal ambient noise level requirements apply assuming the mechanical plant equipment is running for 24 hours per day.

Location	Internal Noise Level ¹
Guestroom (Dalata)	≤NR25 (L _{Aeq,T})
Other Adjacent Noise Sensitive Buildings	≤NR25 (L _{Aeq,T})
Table S18012/T21 - Consolidated External Mechanical Plant Requirements	
¹ Measured with the windows closed	

- 7.8 The mechanical plant equipment shall be designed to achieve the internal noise levels above. Design development is required once the mechanical plant selection and locations have been finalised.

8. GROUNDBORNE VIBRATION ASSESSMENT

Re-radiated noise assessment

- 8.1 The main concern with the vibration from the Subway is re-radiated noise within the guest bedrooms.
- 8.2 We understand that there is no specific requirement from the proposed hotel operator, Dalata, regarding re-radiated noise levels in the guest bedrooms.
- 8.3 There is currently no British Standard for the assessment of re-radiated noise from underground trains.
- 8.4 Crossrail in London has set a re-reradiated noise level target of $\leq 40\text{dB } L_{\text{ASMax}}$ in the residential properties above the line (although $\leq 35\text{dB } L_{\text{ASMax}}$ where this is practicable) and other London boroughs have also set similar targets.
- 8.5 Therefore, in lieu of any operator guidance we would propose aiming for a target level of $\leq 35\text{dB } L_{\text{ASMax}}$ and no greater than $40\text{dB } L_{\text{ASMax}}$ in the hotel guest bedrooms.
- 8.6 The re-radiated noise assessment has been undertaken using the 1/3 octave band frequency vibration data.
- 8.7 This assessment makes use of the methodology in the FTA (Federal Transit Administration) 'Transit Noise and Vibration Impact Assessment' and the Association of Noise Consultants guidance document 'Measurement and Assessment of Groundborne Noise and Vibration'.
- 8.8 The methodology makes several assumptions and therefore the associated uncertainty is at least $\pm 10\text{dB}$.
- 8.9 The following method was used on the 1/3 octave band data to determine the predicted internal ambient noise levels:
- RMS Vibration level in m/s;
 - Conversion to L_v using reference level of 10^{-9} m/s;
 - Conversion from L_v to L_p (unweighted); -28dB (taken from the FTA guidance);
 - A-weighting applied to each 1/3 Octave Band;
 - Building transfer function applied based on 1/3 band reductions in FTA Figure 11-5 (2006 version), Figure 6-14 (2018 version) - Large Masonry Building on piles;
 - Floor reduction applied (-1dB , pessimistic approach);
 - Floor amplification applied centred around 25Hz for a concrete frame based on FTA model (Section 11 2006, Section 6 2018);
 - 1/3 octave band values then summed to get broadband dBA
- 8.10 The following internal ambient noise levels have been predicted at the proposed hotel building.

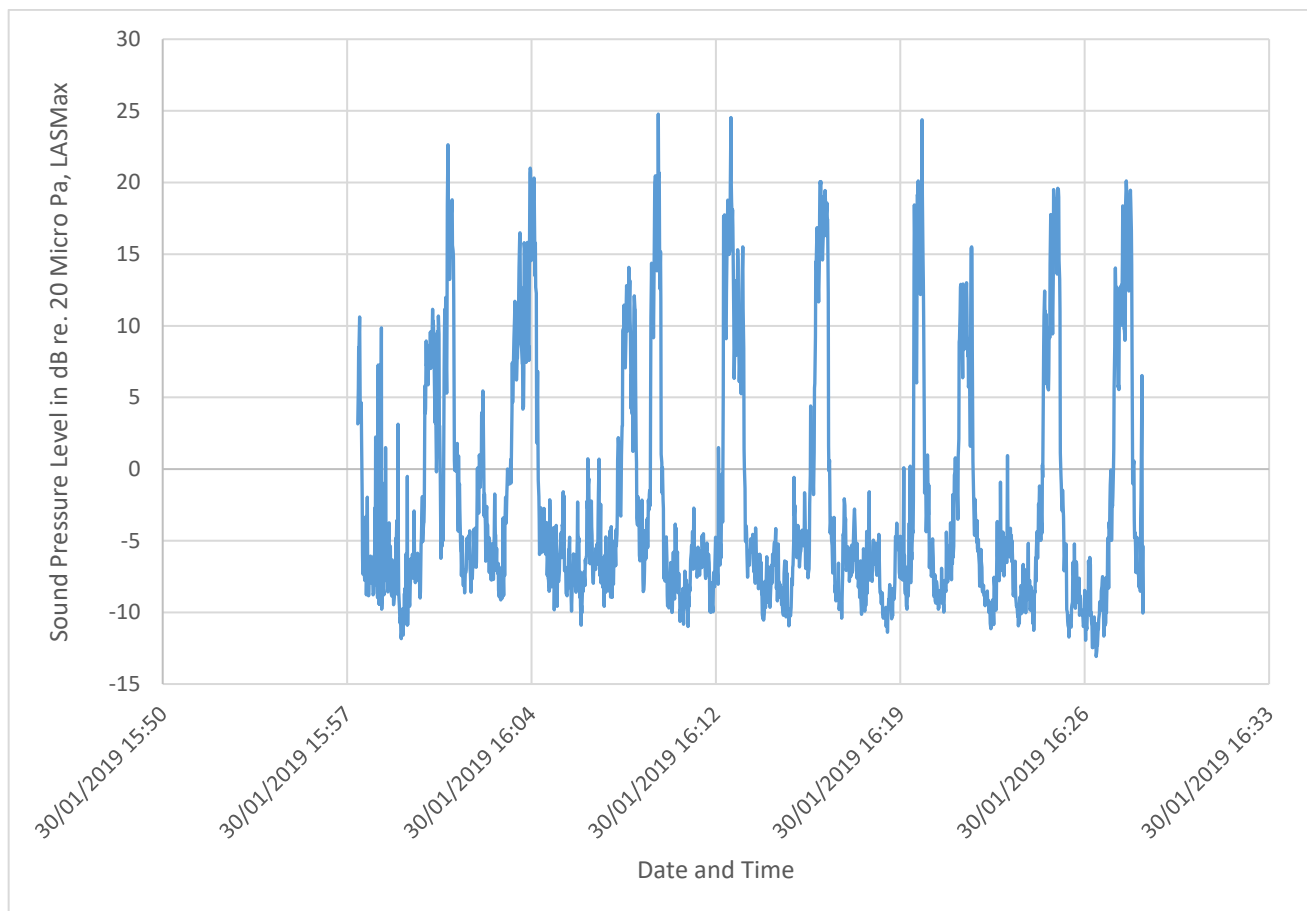


Chart 1 - Predicted Re-Radiated Noise Levels, Level 1 - Proposed Hotel

- 8.11 The predicted re-radiated noise levels at level 1 in the proposed hotel building are between 20-25dB L_{ASMax} .

Building Level	Predicted Re-Radiated Noise Levels, dB L_{ASMax}
Level 1	20-25
Level 2	19-24
Level 3	18-23
Level 4	17-22
Level 5	16-21
Level 6+	<20

Table S18012/T22 - Summary of Predicted Re-Radiated Noise Levels - Level 1 Proposed Hotel

- 8.12 We understand that the proposed new building is to be constructed off a series of piles. No test piles had been constructed at the time of the survey and the test bore holes had been backfilled with earth rather than concrete.
- 8.13 Therefore, we have assumed for this initial assessment that the vibration levels measured on the ground surface are comparable to the vibration levels in the proposed piles.

- 8.14 However, from our experience this assumption can vary depending on the soil composition, depth of the piles and distance to the vibration source (in this case the subway).
- 8.15 Follow up vibration measurements will be required on early test piles to confirm the assumptions above.
- 8.16 This initial assessment also assumes that the hotel and the proposed office building to the north of the site will be constructed as two separate structures. If this is not the case then a further assessment would be required.

Vibration dose, VDV, assessment

- 8.17 A screening assessment regarding the vibration dose levels, VDV, has been undertaken for completeness.
- 8.18 We understand that the proposed hotel operator, Dalata, has the following criteria regarding VDV levels:

Ambient Vibration

The design goals for ambient vibration are specified in terms of Vibration Dose Value (VDV), a cumulative measurement of vibration over an 8 or 16 hour period.

Table 2 below lists the maximum permissible levels of ambient vibration.

Location	Maximum Permissible Ambient Vibration Level (VDV)
Guest Bedroom	Daytime (07:00hrs to 23:00hrs) – $0.20\text{m/s}^{1.75}$ Night-time (23:00hrs to 07:00hrs) – $0.13\text{m/s}^{1.75}$

Table 2 Design goals for ambient vibration

The term "Ambient Vibration" refers to the totality of intrusive vibration from all sources external to the space under consideration.

- 8.19 The predicted VDV levels in the proposed hotel are as follows:

Time Period	VDV, $\text{ms}^{-1.75}$		
	X	Y	Z
Day, 07:00-23:00	<0.01	<0.01	0.01
Night, 23:00-07:00	<0.01	<0.01	0.01

Table S18012/T23 - Summary of Predicted VDV Levels - Level 1 Proposed Hotel

- 8.20 The VDV levels are predicted to achieve the Dalata criteria.
- 8.21 As with the re-radiated noise assessment, follow up vibration measurements will be required on early test piles to confirm that the vibration levels in the piles are comparable to the vibration levels on the existing car park asphalt.

- 8.22 However, at this distance from the subway it is considered unlikely that the VDV levels will exceed the criteria in the proposed hotel building

Overall Discussion

- 8.23 The initial vibration assessment indicates that additional anti-vibration mitigation measures are unlikely to be required for the proposed hotel.
- 8.24 There remains some uncertainty regarding the vibration measurements and follow up vibration measurements will be required on early test piles to confirm the assumptions in this report.
- 8.25 This initial assessment also assumes that the hotel and the proposed office building to the north of the site will be constructed as two separate structures. If this is not the case then a further assessment would be required.

9. CONCLUSION

9.1 Adnitt Acoustics have undertaken a Stage 3 acoustic assessment for the proposed Dalata Hotel at Broadway 2, Glasgow.

9.2 The report summarised the following:

- Acoustic Assessment Criteria;
- Ambient Noise Measurements;
- Internal Building Fabric Assessment;
- External Building Fabric Assessment;
- External Mechanical Plant Assessment;
- Groundborne Vibration Assessment;

Internal Building Fabric Assessment

9.3 Advice and guidance has been provided on the following items:

- Sound insulation of the separating walls/floors;
- Doors
- Services Penetrations
- Reverberation time in common areas;
- External Wall Flanking

External Building Fabric Assessment

9.4 External façade acoustic performances have been proposed to achieve the Dalata requirements.

External Mechanical Plant Assessment

9.5 The proposed mechanical plant equipment has not yet been finalised at the time of writing this report.

9.6 Cumulative plant noise limits have been proposed based on the requirements of the planning conditions and the hotel operator.

Ground borne Vibration Assessment

9.7 The initial vibration assessment indicates that additional anti-vibration mitigation measures are unlikely to be required for the proposed hotel.

9.8 There remains some uncertainty regarding the vibration measurements and follow up vibration measurements will be required on early test piles to confirm the assumptions in this report.

9.9 This initial assessment also assumes that the hotel and the proposed office building to the north of the site will be constructed as two separate structures. If this is not the case then a further assessment would be required.

Graham Shaw BSc(Hons) MSc MIOA MInstP

for ADNITT ACOUSTICS

APPENDIX A: GLOSSARY OF ACOUSTIC TERMS

Ambient Noise	The noise climate heard over a period of time due to all normal sources, in the absence of extraneous or atypical sounds. Used to describe noise in the absence of the introduced sound, generally.	
Ambient Noise Level	Describes the average noise level of the ambient noise over a stated period of time, e.g. hourly noise	
	Parameter: A-weighted Continuous Equivalent Sound Pressure Level determined over the time period T.	$L_{eq,T}$ or $L_{Aeq,T}$
	Expressed in decibels / A-weighted decibels	dB(A) or dB
Decibel scale dB	A linear numbering scale used to define a logarithmic amplitude scale, thereby compressing a wide range of amplitude values to a small set of numbers	
dB(A)	An electronic filter in a sound level meter, which approximates under defined conditions the frequency response of the human ear.	
$L_{Aeq,T}$	The equivalent continuous sound level. The steady dB(A) level which would produce the same A-weighted sound energy over a stated period of time as the measured sound pressure level.	
L_{Amax}	The maximum dB(A) level measured during a survey period.	
L_{A10}	The dB(A) level exceeded for 10% of the survey period, often used as a quantifier of traffic noise level.	
L_{A90}	The dB(A) level exceeded for 90% of the survey period. Used in BS 4142:1997/2014 as being representative of the background noise level.	
Acoustic screening	Physical barrier to sound formed by fence, wall, building or other structure, which has the effect of reducing the sound transmitted.	
Individual Event Noise	The noise of a distinctive event with the varying noise climate, usually a transient activity, such as a vehicle pass-by, aircraft flyover or similar, rather than an isolated impulsive noise.	
Individual Event Noise Level	Describes the highest noise level during the event as measured under particular conditions of time-weighting	
	Parameter: A-weighted Maximum Sound Pressure Level with FAST or SLOW time weighting	$L_{Amax,FAST}$ or $L_{Amax,F}$ $L_{Amax,SLOW}$ or $L_{Amax,S}$
	Expressed in decibels / A-weighted decibels	dB(A) or dB
Sound Reduction Index R_w	Single number rating used to describe the sound insulation of building elements as defined in BS EN ISO 717 1997.	
Weighted element-normalized level difference $D_{n,e,w}$	Single number rating used to describe the sound insulation of building elements as defined in BS EN ISO 717 1997.	

Figure 2045/ SP 1 : Site Plan Showing Measurement Locations

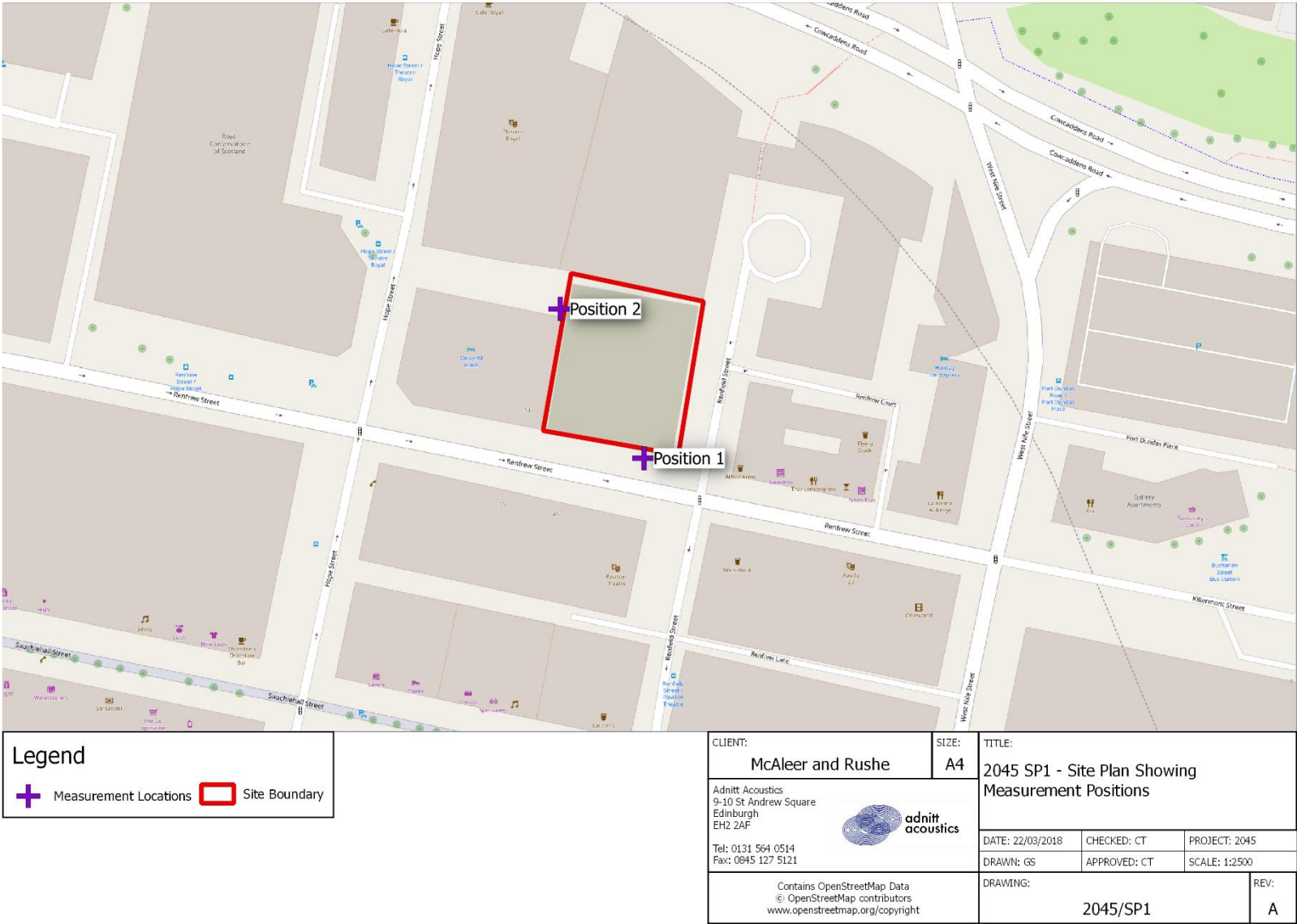


Figure 2045/ TH 1 : Time History for Automated Measurement Position 1

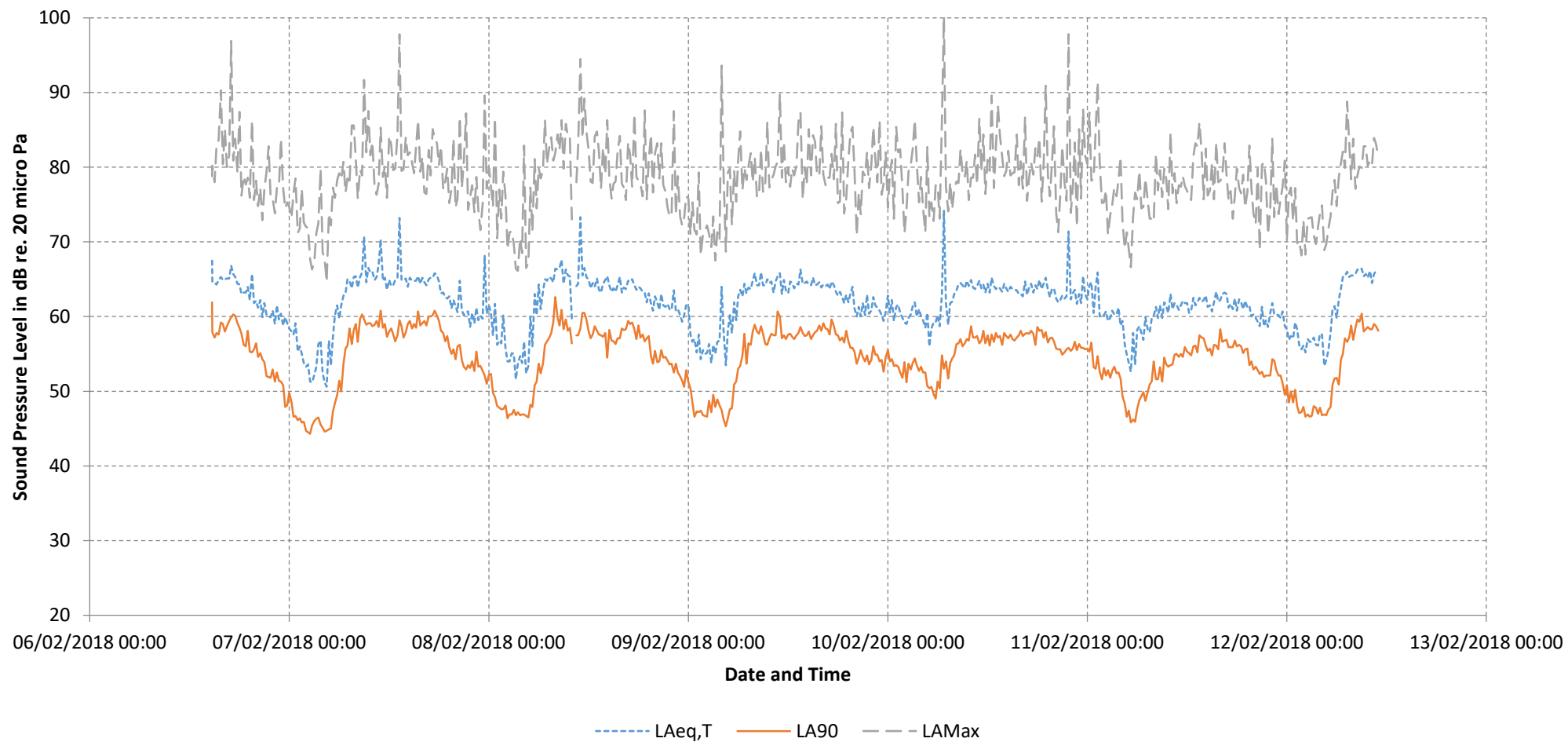


Figure 2045/ TH 2 : Time History for Automated Measurement Position 2

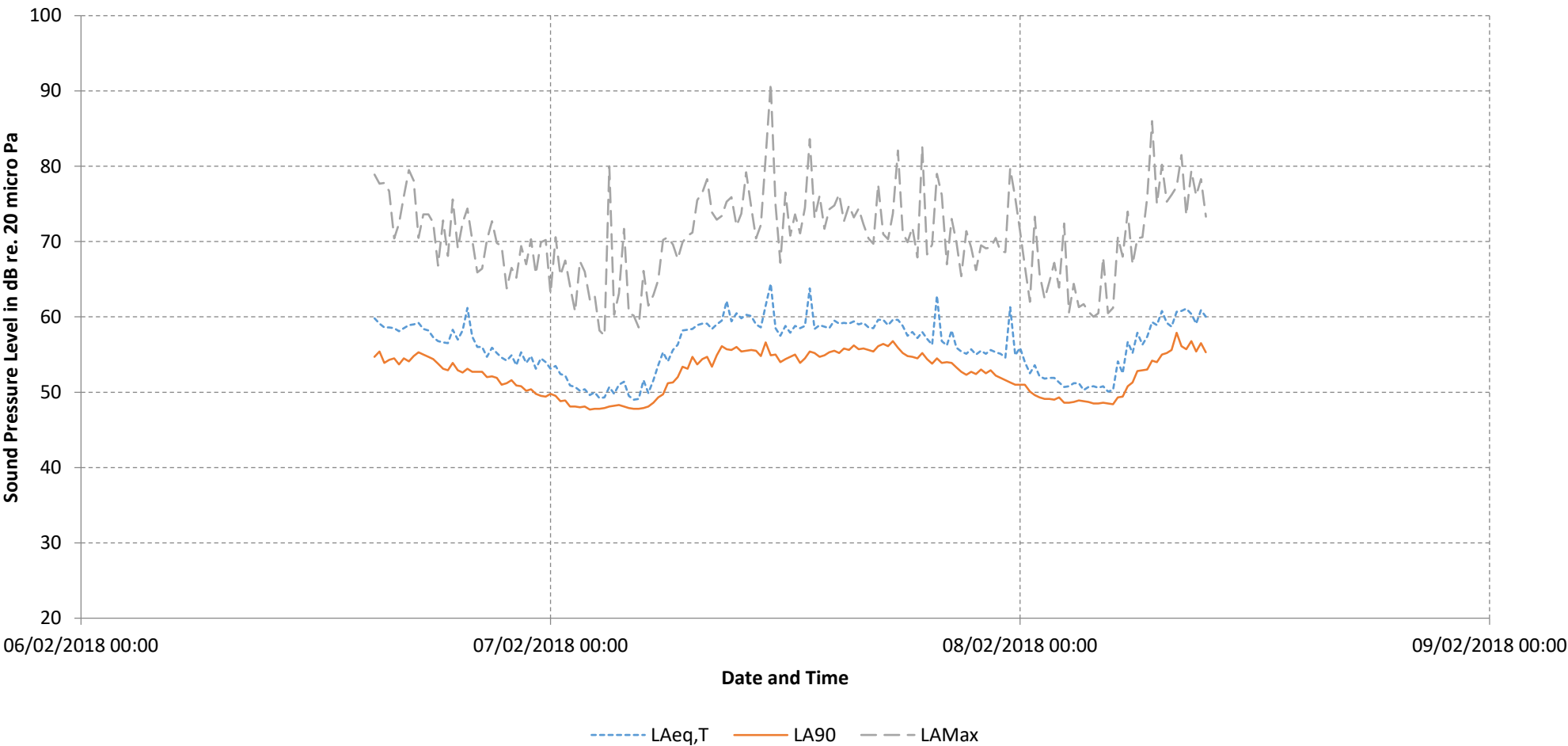
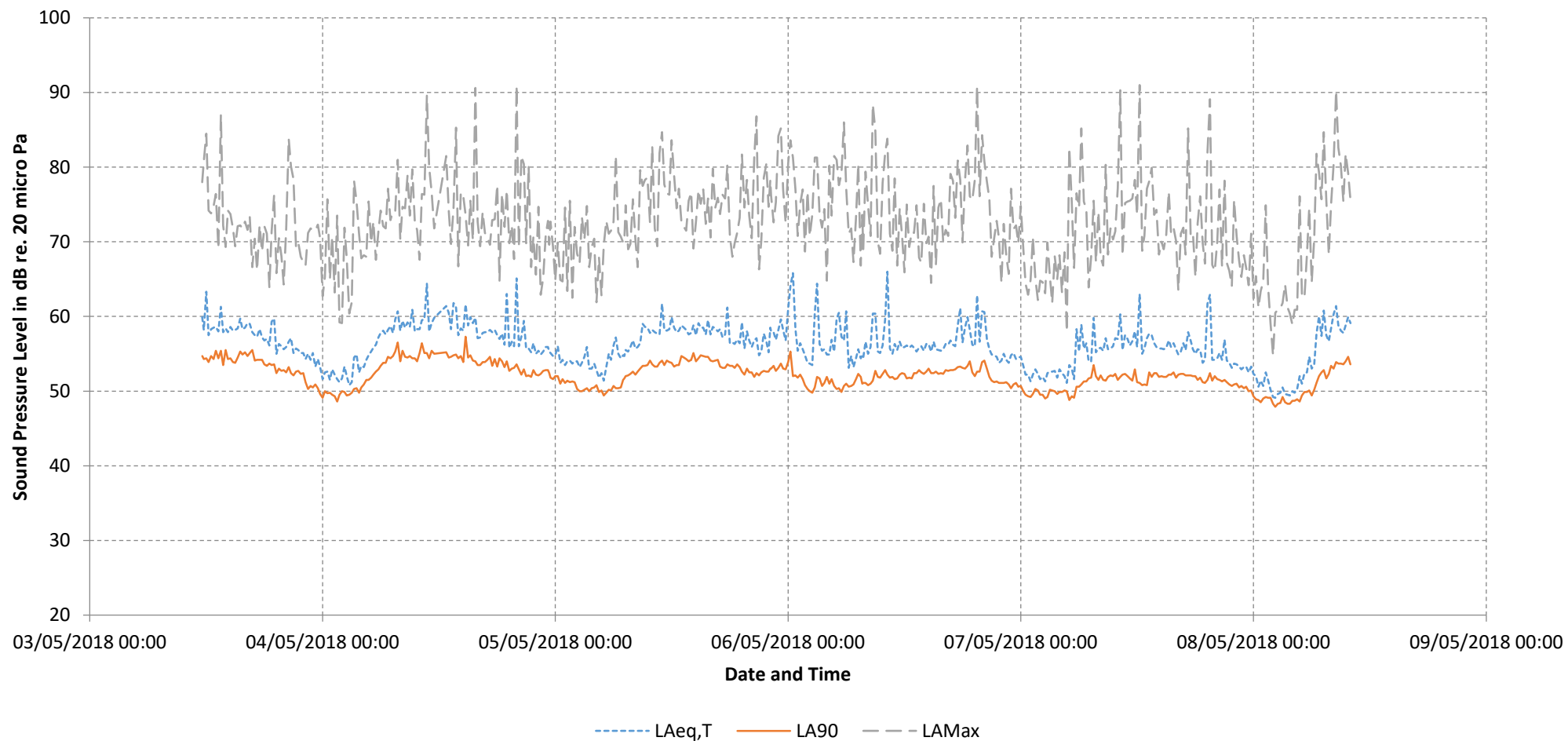
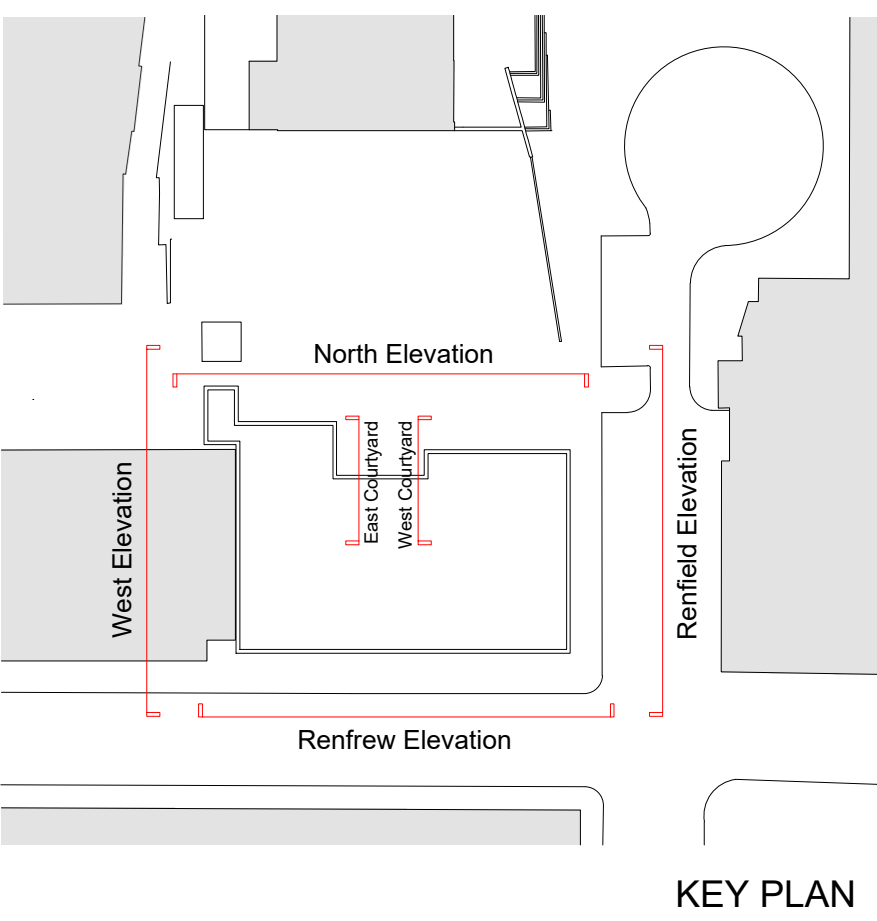
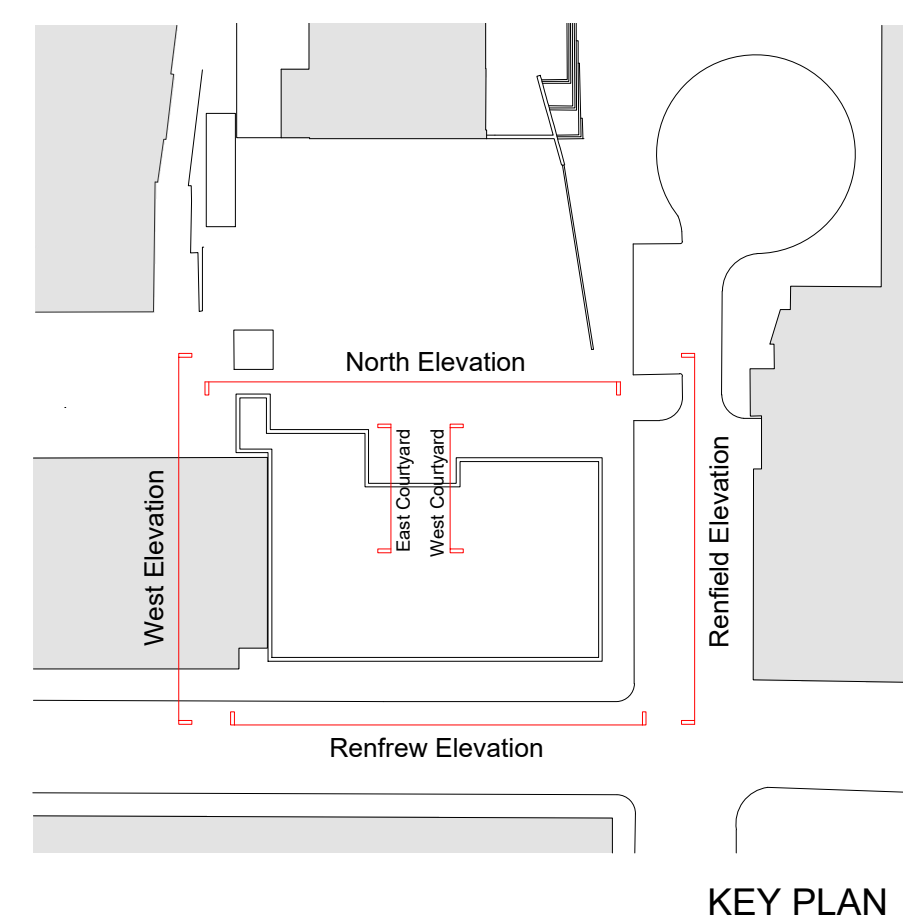


Figure 2045/ TH 3 : Time History for Automated Measurement Position 2 - Theatre Loading Survey



















-
- 46dB Rw - Glazing + Frame
- 41dB Rw - Glazing + Frame
- 39dB Rw - Glazing + Frame
- Refer to report for the required octave band performance

- | FINISHES KEY | |
|---|--|
|  | 1. The brickwork wall construction is to be formed with a 102.5mm wide clay facing brickwork under roof (BS EN 771-1:2014:2015) and 102.5mm/75mm "combed" concrete blockwork under floor where shown on floor plans, or Matspec SF3 Infill Walling system for 102.5mm wide vertical cavity walls. The design and specification is to be submitted to structural engineer for approval prior to commencement of work. |
|  | 2. GRC Reinforced cladding system by specialist facade contractor to include all brackets / cladding rails / fixings / membranes / insulation / fire cavity barriers etc to form a complete rainscreen cladding system. System to be designed and installed by a specialist facade sub-contractor to meet building regulations and all relevant standards including but not limited to BS 8118-2, BS8280, DIN EN 12976 and BS8414-2. (Refer to CGO Metal Rainscreen Specification) |
|  | 3. Solid Aluminium rainscreen cladding system by specialist facade sub-contractor to include all brackets / cladding rails / fixings / membranes / insulation / fire cavity barriers etc to form a complete rainscreen cladding system. System to be designed and installed by a specialist facade sub-contractor to meet building regulations and all relevant standards including but not limited to BS 8118-2, BS8280, DIN EN 12976 and BS8414-2. (Refer to CGO Metal Rainscreen Specification) |
|  | 4. PPC Solid Aluminium panel laser cut with bespoke pattern on support brackets in front of 3. Solid Aluminium Rainscreen Cladding (Refer to Valcan Vitrablock V4370 Brown Anodised Lock sheet) (Refer to CGO Metal Rainscreen Specification) |
|  | 5. PPC Aluminium window system comprising of opening lights, fixed lights, roof access doors, louvers, oblique glazing etc. (Refer to CGO Curtain Wall, Window and Door Specification) |
|  | 6. PPC Aluminium Cantilever Walling Systemcomprising of fixed lights, spandrel/ceramic backed insulation (Face 4 or Face 6), fire rated, fire glazed louvre panels as indicated. (Refer to CGO Curtain Wall, Window and Door Specification) |
|  | 7. Metal Plant Screen Solid Aluminium Rainscreen cladding system by specialist facade contractor to include all brackets / cladding rails / fixings etc to form a complete rainscreen cladding system. System to be designed and installed by a specialist facade sub-contractor to meet building regulations and all relevant standards. (Refer to CGO Metal Rainscreen Specification) |
|  | 8. Stone render system, complete with all necessary sub-structures, anchors, hardcore, insulation, membranes, copings, epdm's, fire insulation, roof lintel fitting to provide a stone rendered system. System to be designed and installed by a specialist facade contractor to meet building regulations and all relevant standards including but not limited to BS 8118-2, BS8280, DIN EN 12976, BS8132 and BS8414-2. (Refer to CGO Metal Rainscreen Specification) |
|  | 11. Rainscreen stone cladding system by specialist facade sub-contractor to include all brackets / fixings / membranes / insulation / fire cavity barriers etc to form a complete rainscreen stone cladding system. System to be designed and installed by specialist facade sub-contractor to meet Building Regulations and all relevant standards including but not limited to BS 8118-2, BS8280, BRE #998 and BRE133 along with full stone test data. FINISH - Moccra Cream Limestone - Polished. |
|  | 12. Blockwork is to be formed with a 102.5mm wide under roof (BS EN 771-1:2014:2015) and 140mm/75mm concrete blockwork in roof where shown on floor plans, include all self-cleaning, vertical cavity walls or / insulation / fire barriers / cavity barriers etc to form a complete rainscreen system. Matspec SF3 Infill Walling system, 102.5mm wide vertical cavity walls, to be Class II elsewhere, 50mm minimum air gap to comply with be manufactured at 28 times. Wall also to be designed to resist dynamic pressure of 1.34kN/m ² (unfactored). Allow for wots leg of 450mm horizontal and 450mm vertical centre and staggered (22.5mm) vertical centres of all window and door reveals and all corners and expansion joints). The design and specification is to be submitted to structural engineer for approval prior to commencement of work. |
| | Tilt and turn bottom hung light |
| | Side hung door |
| | Compartment Fire Screen (CFFB)-120 minutes insulation / 120minute insulation fire barriers suitable for use as a rainscreen facade system allowing passage of air and rainwater. The fire rated fire barriers are located within the rainscreen cladding void at all horizontal and vertical compartmental locations. |
| | Cavity Barrier (CB)- 30 minute insulation / 15 minute insulation cavity barriers to be provided across all horizontal and vertical openings. Standards to maximum limiting length of 20m in any direction and full of all openings. At all Night windows, vertical cavity barrier to meet compartmental barrier at floor level. |
| Vertical expansion joints should be provided at intervals not exceeding 15m. | |
| Horizontal expansion joints should be provided at each floor slab level | |

Notes:

TO BE READ IN CONJUNCTION WITH THE FOLLOWING CDG DRAWINGS

GA-A-L100-114 Floor Plans

GA-A-L702-711 Facade Details

GA-A-L1000-1004 Window, Curtain Wall and External Door Schedules

Brickwork, GRC, Metal Rainscreen, Render, Curtain Wall, Window and Door Specification

Notes:

All external walls to achieve u-value: $0.18 \text{ W/m}^2\text{K}$
All glazing to achieve u-value: $1.6 \text{ W/m}^2\text{K}$

PROJECT			CLIENT		
Broadway 2			ES Renfield Ltd		
Renfrew Street and Renfield Street, Glasgow					
CONTENT					
West Detail Elevation					
SCALE	SIZE	DATE	NORTH	STATUS	
1:100	A1	31.05.2019		FOR INFORMATION	
1:200	A3				
DRAWN	CHECKED	APPROVED	JOB NO.	DRAWING NO.	REVISION
CS	MK	BM	B17-1796	GA-A-L723	B
Paths: D:\2017\B17-1796 Glasgow Two Host Client\1. Design\Drawings\Construction\000\1700\ES\Renfield\GA-A-L723 - Facade Detail Elevations					

CONSARC DESIGN GROUP

THE GAS OFFICE 4 CROMAC QUAY ORMEAU ROAD BELFAST BT7 2JD
consarc-design.co.uk TEL +44 (0)28 9082 8400 mail@consarc-design.co.uk

Figured dimensions to be taken in preference to scaled dimensions. Site dimensions are to be checked prior to commencement of all work and discrepancies reported immediately
DO NOT SCALE THIS DRAWING. All dimensions are in millimetres. © Consarc Design Group Ltd

SP1 - SERVICE PENETRATION 1

To be read together with any comments and qualifying statements in the attached report.

General Description

Independently framed enclosures with plasterboard lining and mineral wool in void.

Construction

The independently framed enclosures should be constructed as follows:

- Timber or metal frame independent from the services;
- Wrap mineral wool around duct work;
- Lining of two layers of plasterboard.

Installation

The service enclosure shall be installed as follows:

- The penetration at the floor / ceiling / wall will need to be oversized by 10mm minimum clearance on each side and the ducts, pipes or conduit;
- All ducts and pipes shall be wrapped in 25 mm unfaced mineral fibre quilt (density 10 kg/m³ minimum) for their entire length, including through the penetrations;
- Minimum of a 48mm timber stud or metal frame spaced at least 10mm from lined ducts and pipes;
- Lining of two layers of plasterboard of with total minimum mass per unit area of 20kg/m² with staggered and sealed joints.

The following points shall be observed:

- It is recommended that all fluid and soil pipes; including RWP, SVP and HW, LTHW and CW supplies, are mounted in resilient pipe clips to minimise noise transmission in the lightweight structure;
- Do ensure that the independent panel and its supporting frame are not in contact with the ducts, pipes or conduit;
- Do leave a nominal gap (approx. 5 mm) between the casing and any floating layer and fill with sealant
- Do seal the perimeter of the casing with tape or sealant.

Performance

To maintain the minimum Approved Document E airborne sound performance requirement of $D_{nt,w}+C_{tr}$ of 43dB.

Coordination

Separating Floor Junctions

The casing should be built off the sub-deck. It must not be built off the floating floor.

The wall lining must be built to the underside of the ceiling.

Maintain clearances and resilient edging strip at floating floor junction.

Party Walls Junctions

The casing must not be continuous through party walls

Service penetrations of party walls shall be avoided wherever possible. Where required they must be located above the ceiling. The penetration opening shall be oversized by at least 25mm and resiliently packed and lined with mineral wool. The face of the penetration shall be closed with a pattressed collar of plasterboard [e.g. 15mm SoundBloc] separated from the pipe, duct or conduit by 5-10mm. All joints shall be liberally sealed with non-hardening sealant.

Products

The following products are approved for use in this application. Alternative products shall have equal or better performances and physical properties; and be approved by the acoustic consultant.

Metal Frame Casing

- British Gypsum GypLyner IWL metal frame system, if in accordance with the construction above.

Plasterboard

- Gyproc Wallboard TEN (10kg/m²)
- 12.5mm Gyproc SoundBloc (10.6kg/m²)
- 15mm Gyproc Fireline (11.7kg/m²)

Mineral wool batts or quilt

- Isowool 1200 APR (10kg/m³)

General Notes

Penetrations through a separating floors and walls by ducts and pipes should have fire protection to satisfy Building Regulation Part B - Fire safety. Fire stopping should be flexible and also prevent rigid contact between the pipe and floor.

Note: There are requirements for ventilation of ducts at each floor where they contain gas pipes. Gas pipes may be contained in a separate ventilated duct or they can remain unducted. Where a gas service is installed, it shall comply with relevant codes and standards to ensure safe and satisfactory operation. See The Gas Safety (Installation and Use) Regulations 1998, SI 1998 No.2451.

It will be necessary to confirm with a structural engineer that the existing structure has the ability to support the proposed construction.