

SHARPS REDMORE

ACOUSTIC CONSULTANTS ▪ Established 1990



Report 2

BURMAR-SHR-V2-XX-RP-Y-004

BREEAM 2018 Hea 05
Acoustic Specification
Bury Market & Flexihall

Prepared by

Andrew Newell BSc (Hons) MIOA

Date 27th May 2022

Project No 2120732

North England

Sharps Redmore

The Plex, 15 Margaret Street,
Wakefield, WF1 2DQ

T 01924 586468

E northengland@sharpsredmore.co.uk

W sharpsredmore.co.uk

Regional Locations

North England,
South England (Head Office),
South West England,
Wales, Scotland

Sharps Redmore Partnership Limited

Registered in England No. 2593855

Directors

RD Sullivan BA(Hons), PhD, CEng, MIOA, MAAS, MASA;

KJ Metcalfe BSc(Hons), MIOA;

N Durup BSc(Hons), MSc, PhD, CEng, FIOA, MInstP, MASA, MAES;

GJ King MIOA, MCIEH

Company Consultant

TL Redmore BEng, MSc, PhD, MIOA



Revision Register

Revision	Date	Author	Description of changes
A	27-05-2022	AJN	First issue.

This report has been prepared with all reasonable skill, care and diligence commensurate with an acoustic consultancy practice under the terms and brief agreed with our client at that time. Sharps Redmore provides no duty or responsibility whatsoever to any third party who relies upon its content, recommendations or conclusions.

Contents

1.0	Executive Summary	4
2.0	Introduction	5
3.0	Acoustic Standards and Guidance	6
4.0	Acoustic Survey	8
5.0	Indoor Ambient Noise Levels	13
6.0	Sound Insulation	16
7.0	Reverberation	21
8.0	Vibration	23
9.0	Building Envelope	24

Appendices

A	Survey Time-History Charts
B	Sound Insulation Performance Mark-Ups

1.0 Executive Summary

- 1.1 This report presents the acoustic performance criteria required to achieve the BREEAM 2018 New Construction standards described by Hea 05 for the proposed redevelopment of Bury Market.
- 1.2 It is understood that three BREEAM credits are being sought in the performance areas of *Sound Insulation*, *Internal Indoor Ambient Noise Level*, and *Reverberation*. A single credit is available for each.
- 1.3 Criteria are provided in accordance with the guidance of BREEAM, BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* and the British Council for Offices *Guide to Specification*. Criteria described within CIBSE Guide A has been considered for the specification regarding noise from building services.
- 1.4 Sound insulation mark-ups are provided in Appendix B.
- 1.5 Currently available drawings were reviewed to inform our understanding of the project.
- 1.6 The project is at an early stage of design and as such some details will be developed and evaluated in due course.
- 1.7 Acoustic surveys were carried out by Sharps Redmore between the 13th and 18th January 2022 to determine the existing sound levels at the development site. The results of the survey will be used to advise performance specifications for the building envelope, to control sound ingress and egress. Survey time-history charts are included in Appendix A.
- 1.8 BREEAM require that acoustic assessments are carried out by a suitably qualified acoustician, or 'SQA'. This report has been prepared by Andrew Newell who has nine years' experience as an acoustic consultant, holds a Post-Graduate Diploma in Acoustics and Noise Control and is a corporate member of the Institute of Acoustics (MIOA). The author therefore meets BREEAM prerequisites for an SQA.

2.0 Introduction

- 2.1 Sharps Redmore (SR) has been appointed to provide acoustic advice regarding the Bury Market and Flexi Hall development with a view to achieving sustainability credits in accordance with the British Research Establishment Environmental Assessment Method (BREEAM) 2018.
- 2.2 Three credits are being targeted for meeting the standards specified by Hea 05 *Acoustic Performance*.
- 2.3 The site is situated in the centre of the market town of Bury amongst the existing market north of the A58 *Angouleme Way*. The Bus Station is located directly to the west of the proposed site. The surrounding land use is mixed predominantly with retail /commercial, leisure and some residential. As such the site experiences reasonable high noise levels from road traffic and the bus station.
- 2.4 The development comprises the redevelopment of Bury Market, involving demolition of some existing buildings and roof canopies, and the construction of a new flexible hall space. The *Flexi Hall* building will also include offices, meetings rooms and hospitality facilities.
- 2.5 It is understood that the *Flexi Hall* itself is intended as a multi-purpose performance space and as such requires particular consideration, including control of external noise ingress and noise escape to nearby noise-sensitive locations, and the room acoustic characteristics of the *Flexi Hall* itself such that reverberation and adverse reflections are suitably controlled.

3.0 Acoustic Standards and Guidance

BREEAM Hea 05 Acoustic Performance

- 3.1 BREEAM sets out the manner in which credits may be achieved for meeting standards to ensure the building is capable of providing an appropriate acoustic environment to provide comfort for building users. Performance requirements are specified in the following areas:

- Sound insulation
- Internal indoor ambient noise levels
- Room acoustics

- 3.2 All three BREEAM credits are being targeted and a description of performance requirements for each area are provided below. Specific criteria are identified in Sections 5.0, 6.0 and 7.0.

- 3.3 A programme of pre-completion testing is required to demonstrate compliance with the criteria set out for the performance areas above.

First Credit – Sound Insulation

- 3.4 One credit can be awarded where the sound insulation between rooms and other occupied areas complies with the performance criteria given in Section 7 of BS 8233:2014. Alternatively, propose performance standard based on demonstrably best practice.

- 3.5 An occupied area is defined as “A room or space within the assessed building that is likely to be occupied for 30 minutes or more by a building user.”

Second Credit – Internal Ambient Noise Levels

- 3.6 One credit can be awarded where the internal indoor ambient noise levels comply with the design ranges given in Section 7 of BS 8233:2014.

Third credit – Reverberation

- 3.7 One credit can be awarded for meeting the requirements of Section 7 of BS 8233:2014 relating to sound absorption and reverberation times, where applicable.

Suitably Qualified Acoustician

- 3.8 An individual who has achieved the following requirements can be considered to be ‘suitably qualified’ for the purposes of a BREEAM assessment:

1. Has a minimum of three years relevant experience (within the last five years). Such experience must clearly demonstrate a practical understanding of factors affecting acoustics in relation to construction and the built environment; including, acting in an advisory capacity to provide recommendations for suitable acoustic performance levels and mitigation measures.
2. An individual who holds a recognised acoustic qualification and membership of an appropriate professional body. The primary professional body for acoustics in the UK is the Institute of Acoustics.

- 3.9 Where an SQA is verifying the acoustic measurements or calculations carried out by another acoustician who does not meet the SQA requirements, they must, as a minimum have read and reviewed the report and confirm in writing that they have found it to:

- Represent sound industry practice
- Is appropriate given the building being assessed and scope of works proposed
- Avoid invalid, biased or exaggerated recommendations.

- 3.10 Additionally, written confirmation from the third-party verifier that they comply with the definition of an SQA is required.

BS 8233:2014 Guidance on sound insulation and noise reduction for buildings

- 3.11 BS 8233:2014 provides information for the design of buildings that have internal acoustic environments appropriate to their function, and provides general guidance for many types of buildings as well as more specific advice relating to offices. Section 7.7.6 offers guidance for offices and refers to the British Council for Offices Guide to Specification. In relation to offices BS 8233:2014 provides specific guidance relating to acoustic privacy, sound insulation, noise in open-plan offices, and indoor ambient noise levels.

- 3.12 The Guidance also provides direction on

British Council for Offices Guide to Specification

- 3.13 The British Council for Offices (BCO) provides further guidance on acoustic performance and considerations for offices in the following areas:

- Room finishes
- Rain noise
- Internal sound insulation
- Acoustic privacy
- External noise intrusion
- Building services noise
- Vibration

4.0 Acoustic Survey

- 4.1 Sharps Redmore carried out an environmental survey to determine the current acoustic climate at the site and at nearby noise-sensitive locations. The results of the survey will be used to determine suitable sound insulation requirements for the building envelope, and to assess noise egress to nearby noise-sensitive locations.
- 4.2 The survey was undertaken between the 13th and 18th January 2022 such that sufficient data was obtained to represent the daytime and night-time periods, weekdays and weekends, and days which were or were not market days.
- 4.3 Equipment details are shown in Table 4.1 below. Sound level meters are laboratory calibrated to national standards, and field-calibrated before and after the survey. No significant calibration drift was observed. Calibration certificates are available on request.

Table 4.1 Measurement equipment

Equipment	Description	Serial Number
Norsonic 118	Class 1 sound level meter	31657
Norsonic 1225	Microphone	285495
Norsonic 1206	Preamplifier	30946
Norsonic 1251	Calibrator	31229
Norsonic 140	Class 1 sound level meter	1404434
Norsonic 1225	Microphone	168158
Norsonic 1206	Preamplifier	30747
Norsonic 1251	Calibrator	33001

- 4.4 Multiple parameters were recorded, including the following:
- equivalent sound pressure level ($L_{eq,T}$)
 - maximum sound pressure level (L_{Fmax})
 - background sound pressure level ($L_{90,T}$)
 - the tenth percentile sound pressure level ($L_{10,T}$)
- 4.5 Measurements are recorded in one-third-octave frequency bands, which are adjusted in each frequency band by an 'A' weighting, before summing logarithmically to obtain a single-figure A-weighted value, denoted by the 'A' subscript. The A-weighting represents a normal human's response to sound pressure levels.
- The A-weighted equivalent sound pressure level ($L_{Aeq,T}$) represents an 'average' continuous sound level over a given period T .
 - The A-weighted maximum sound pressure level (L_{AFmax}) is the highest sound pressure level measured with a 'fast' time constant, which is a rise and fall time of 125 milliseconds.
 - The background sound level ($L_{A90,T}$) is the level which is exceeded by 90% of measurements over a given period. As the name suggests this represents a background level of sound without the influence of significant transient sound events.

4.6 The A-weighted tenth percentile sound pressure level ($L_{A10,T}$) is commonly used to represent traffic noise.

Unattended Survey

4.7 A single sound level meter was left unattended to record measurements over the six-day survey period in 5-minute measurement periods.

4.8 The measurement location was chosen to be representative of the closest-noise sensitive flats on Murray Road, whilst being sufficiently safe and secure to leave monitoring equipment unattended. The meter was positioned on the roof of the Market Office building equivalent to first-floor level at the flats. The measurement position is shown in Figure 4.1 and Figure 4.2.

Figure 4.1 Unattended survey position

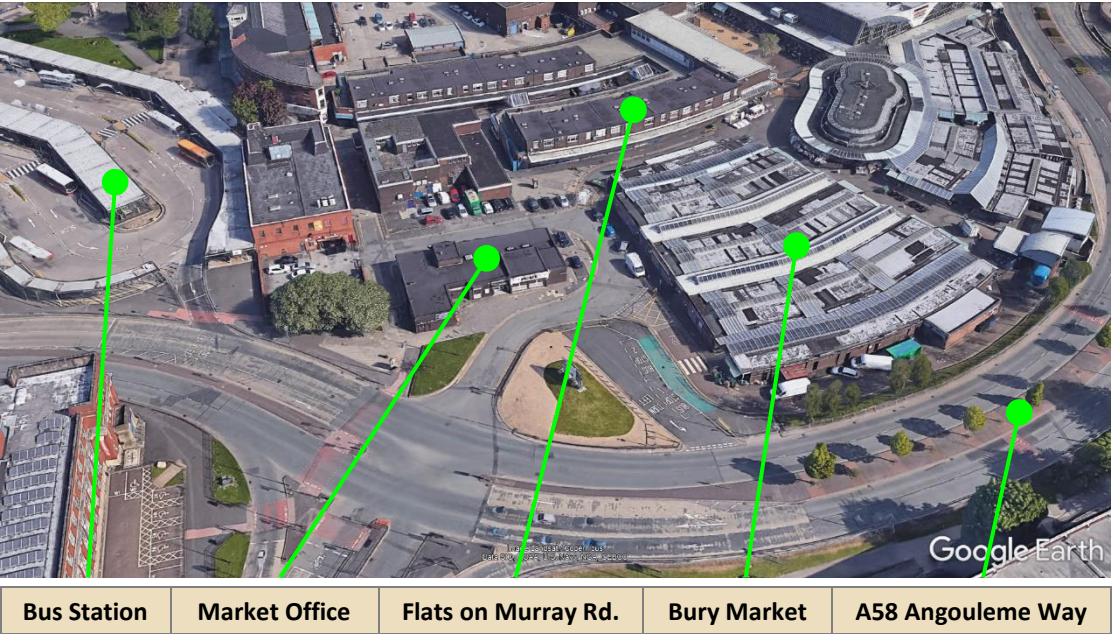


Figure 4.2 Meter location



- 4.9 The weather conditions during the survey have been sourced from www.wunderground.com for the weather station IBURY44 located at 53.566° N, 2.293° W. The data is presented on the survey history charts in Appendix A.
- 4.10 In summary, temperatures ranged between -2°C and 8°C during the daytime and between -2°C and 6°C during the night-time. Wind speeds were low and not considered to have significantly affected measurements. There was a very small amount of precipitation during the survey, and roads may have been damp during some periods, though this is in keeping with typical meteorological conditions at the site.
- 4.11 The dominant noise sources at the site was road traffic noise, predominantly from the A58 Angouleme Way, and from the market access roads close by. There were many pedestrians walking through the market which contributed noise from footfall and from talking/shouting.
- 4.12 A period of comparatively higher sound levels is notable during the night-time on Saturday 15th January, which could be due to the night-time economy and preparation for market day. Overall there was no significant difference in sound levels during the day between market and non-market days.
- 4.13 The results of the unattended survey are presented in the time history charts in Appendix A; detailed measured data are available on request.

Attended Survey

- 4.14 Attended measurements were undertaken on the 18th January 2022 to obtain representative sound spectra at key positions at the site. The positions are intended to represent the following:
- Noise levels at the south façade exposed to road traffic noise from the A58;
 - Noise levels at the west façade by the bus station;
 - Noise levels at the north façade partially shielded from road traffic noise.
- 4.15 The attended survey positions are shown in Figure 4.3 and Figure 4.4. The sound level meter was positioned approximately 1.3 metres above ground level and at a minimum distance of 3 from reflective surfaces, other than the ground.

Figure 4.3 Attended measurement positions

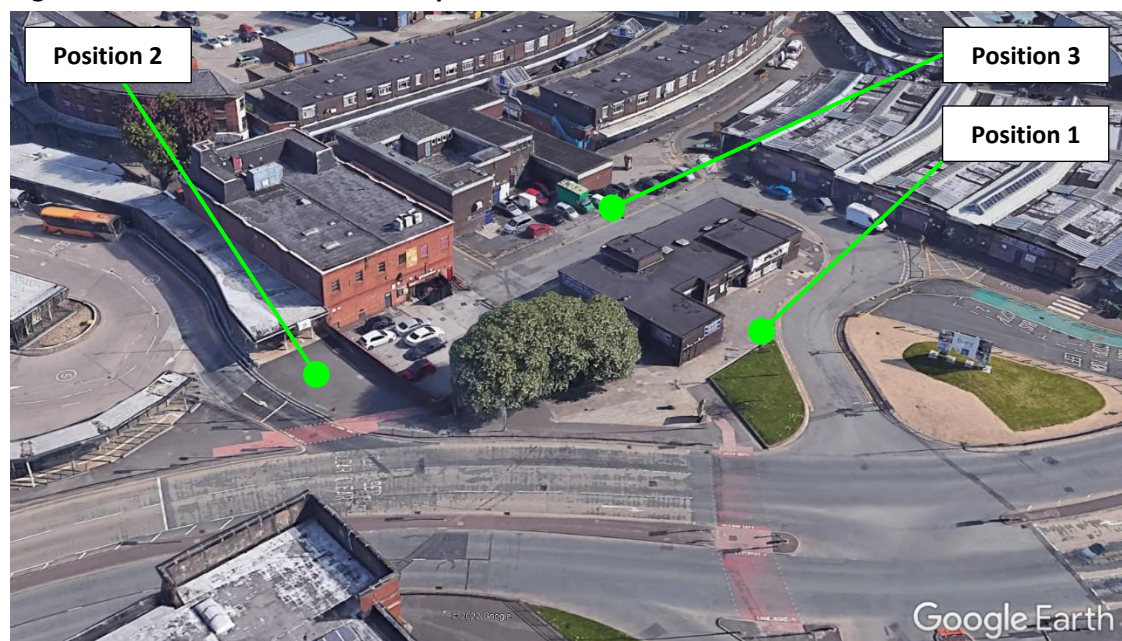


Figure 4.4 Attended measurement positions



4.16 The dominant noise source at all positions was road traffic noise from the A58, although other sources were significant at each of the positions, as follows:

- Position 1 – Road traffic noise from the A58 and junction with Murray Road. There was frequent pedestrian activity including talking and some shouting. Construction noise from the site on the opposite side of the A58 was noted, comprising some continuous low-frequency engine hum and the percussive sound of impact wrenches. Bus movements were also audible.
- Position 2 – Bus movement in the bus station, particularly leaving to join the A58. There was constant pedestrian activity between the pedestrian crossing and the bus station, including loud chatting and some shouting. The construction activity noise was also influential.
- Position 3 – A combination of the noise sources described above, though road traffic noise was at a subjectively lower level.

4.17 The results of the attended measurement are presented in the tables below. The measurement duration T for each measurement in Table 4.2 is 15 minutes. For Table 4.3 and Table 4.4 the duration T is the total measurement duration of 45 minutes.

Table 4.2 Summary of attended survey measurements

Position	Date + time	Duration	$L_{Aeq,T}$ (dB)	$L_{Amax,F}$ (dB)	$L_{A01,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
1	18/01/2022 12:19	15 min.	63	77	70	66	58
1	18/01/2022 13:10	15 min.	65	82	74	68	57
1	18/01/2022 13:58	15 min.	64	79	72	67	58
2	18/01/2022 12:36	15 min.	68	88	75	71	61
2	18/01/2022 13:26	15 min.	67	89	73	70	61
2	18/01/2022 14:14	15 min.	68	90	74	70	61
3	18/01/2022 12:54	15 min.	60	82	67	61	53
3	18/01/2022 13:42	15 min.	57	79	65	59	52
3	18/01/2022 14:31	15 min.	58	73	67	60	54

Table 4.3 Attended measurements: equivalent sound pressure level spectra (L_{eq})

Position	Octave-band equivalent sound pressure level, $L_{eq,T}$ (dB)						
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
1	73	66	62	60	60	56	50
2	73	67	64	62	64	61	56
3	67	61	57	55	54	50	44

Table 4.4 Attended measurements: first percentile level (L_{01}) spectra

Position	Octave-band 1 st percentile sound pressure level, $L_{01,T}$ (dB)						
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
1	80	75	71	70	67	65	59
2	81	75	72	71	70	69	65
3	74	69	66	62	62	59	55

5.0 Indoor Ambient Noise Levels

- 5.1 Criteria for the indoor ambient noise level are specified by the BCO *Guide to Specification* and BS 8233:2014. Criteria specified as noise rating (NR) levels are approximately equivalent to 6 dB less than a continuous L_{Aeq} in the absence of strong low frequency contributions.
- 5.2 For certain room uses the criteria of the BCO and of BS 8233:2014 are not fully compatible. An example would be for a room classified as an 'Executive Office' under BS 8233:2014 and cellular office under BCO guidance, where if the recommended BCO noise levels were realised they could then exceed the BS 8233:2014 criterion. Where this occurs, the BCO criterion should be adopted.

BS 8233:2014

- 5.3 BS 8233:2014 provides criteria for indoor ambient noise levels in offices and meeting rooms. Each are expressed as a design range, with the intention to provide sufficient background noise to aid privacy, but without being excessive so as to adversely affect speech intelligibility.
- 5.4 The BS 8233:2014 criteria (shown in Table 5.1 and Table 5.2) include noise contributions from steady noise sources, such as external traffic noise ingress, internal mechanical services noise, or continuously running plant but not including noise from occupants and their activities. This is in contrast to BCO specifications which provides criteria separately for noise ingress and building services noise.

Table 5.1 BS 8233:2014 design ranges for office spaces

Objective	Typical Situations	Design Range, $L_{Aeq,T}$ (dB)
Typical noise levels for acoustic privacy in shared areas	Open plan office	45 – 50

Table 5.2 BS 8233:2014 typical noise levels in non-domestic buildings when unoccupied

Activity	Location	Design Range, $L_{Aeq,T}$ (dB)
Speech or telephone communications	Corridor, circulation space	45 – 55
Study and work requiring concentration	Staff/meeting room, training room; Executive office	35 – 45
		35 – 40

BCO Guidance

BCO criteria for external noise ingress

- 5.5 Noise limits specified by the BCO for external noise ingress are presented in Table 5.3. The criteria are for values when measured over the period of a typical working day, i.e. 0900 hrs to 1700 hrs, and includes noise contributions from road traffic noise. In addition, the BCO criteria for maximum noise levels are also provided.

Table 5.3 BCO criteria for external noise intrusion

Room type	Noise ingress, $L_{eq,T}$ (dB)	Noise ingress, $L_{A01,1-hour}$ (dB)
Cellular offices / meeting rooms	≤ NR 35	≤ 50
Open plan offices	≤ NR 40	≤ 55

- 5.6 Rain noise should be controlled so that it does not exceed 60 dB $L_{Aeq,T}$ during heavy rainfall as defined by BS EN ISO-18:2006.
- 5.7 BCO guidance states that in the case of naturally ventilated buildings, it may be appropriate to accept higher external noise intrusion levels (than shown in Table 5.3 above) in maximum ventilation mode, provided occupants have the choice to open or close windows or ventilation openings. For example, depending on the character of noise, a +5 dB relaxation may be acceptable.

BCO criteria for building services noise

- 5.8 The BCO also specifies criteria for internal building services noise in offices fitted out to Cat A standards. These are presented in Table 5.4 below for room types within this development. It is important that building services are also designed not to fall too far below the values in Table 5.4 as the noise they generate provides an important role in masking general office activities, including conversation, and aiding privacy.

Table 5.4 BCO criteria for internal building services noise

Room type	Building services noise, NR L_{eq} (dB)
Cellular offices	≤ NR 35
Open plan offices	≤ NR 40

- 5.9 If the BCO performance criteria are achieved, indoor ambient noise levels should generally sit within the design ranges identified by BS 8233:2014.

Noise in Open Plan Offices

- 5.10 Noise transfer between workstations can be reduced by having low ceilings with absorbent finishes and screens separating workstations. Screens between workstations can reduce noise transfer in the order of 15-25 dB where workstations are separated by 2.5 m to 3.0 m. Screens should be acoustically absorbent and at least 1.5 m high.

Flexi Hall Space

- 5.11 It is recommended that the Flexihall space is designed to control external noise ingress to achieve ≤ 30 dB $L_{Aeq,30mins}$. A +5 dB relaxation would generally be acceptable when naturally ventilated.
- 5.12 It is recommended that building services are designed to achieve between NR 20 and NR 30 (L_{eq}).

Other areas

- 5.13 Areas which are not considered sensitive to noise includes the toilets, dressing rooms, the kitchen and the café bar/events lobby area. Recommended internal ambient noise level criteria for these spaces are provided as guidance below.

Table 5.5 Recommended building services noise levels for acoustically non-sensitive rooms

Room type	Building services noise, NR L_{eq} (dB)
Toilets / ablutions	35 – 45
Kitchen	40 – 45
Café bar / events lobby	35 – 40

Room type	Building services noise, NR L_{eq} (dB)
Dressing rooms, green room	35
Corridors / circulation	40

Plant Rooms

- 5.14 Noise from plant rooms must be designed to suit the adjacent occupied areas and to comply with Noise at Work Regulations to protect occupants/employees from hearing damage. It is recommended that noise levels do not exceed the Lower Exposure Action Value of 80 dBA for daily personal exposure, $L_{EP,d}$, or weekly personal exposure, $L_{EP,w}$. Hearing protection is not required to be offered by the employer below these noise levels. Peak sound pressure levels must not exceed 137 dB L_{Cpeak} at any time.
- 5.15 It is acceptable for noise levels to exceed 80 dBA if the exposure time is less than the daily reference period of 8 hours. Table 5.6 presents the daily personal exposure limits for shortened time periods.

Table 5.6 Daily personal exposure limits for shortened time periods

Exposure period, T (hours)	Exposure limit $L_{EP,T}$ (dBA)	Personal daily exposure, $L_{EP,d}$ (dBA)
1	89	80
2	86	80
3	84	80
4	83	80
5	82	80
6	81	80
7	81	80
8	80	80

- 5.16 A risk assessment must be undertaken in accordance with the Noise Regulations to assess the risks associated with noise exposure to employees. If the any of the following apply it is likely that measures to control the noise risk to occupants/employees will be required:
- Noise is intrusive – for example, as noisy as a busy road, a vacuum cleaner or a crowded restaurant – or worse than intrusive, for most of the working day.
 - Occupants/employees have to raise their voices to carry out a normal conversation when about 2 m apart for at least part of the day.
 - Occupants/employees use noisy equipment, such as loud sound systems for music playback, for more than half an hour during the day.
- 5.17 Where plant poses a risk of transmitting noise and/vibration to the structure of the building, the plant must incorporate anti-vibration/noise measures, such as resilient fixings, anti-vibration springs, mounts, mats or an inertia base, for example, and physical connections to the plant must include flexible connectors.
- 5.18 Sound insulation calculations and the subsequent acoustic performance specification for partitions between plant rooms and occupied rooms have been based on plant room noise levels no greater than 80 dB L_{Aeq} .

6.0 Sound Insulation

Airborne Sound Insulation

- 6.1 Section 7.5 of BS 8233:2014 offers an example sound insulation matrix to determine suitable levels of sound insulation to control noise between adjacent spaces. The level of sound insulation is dependent on the activity noise of the source room, the noise sensitivity of the receiving room and the overall privacy requirement. The assessment is carried out in both directions with the most onerous requirement taking precedence. The example matrix is reproduced in the following table.

Table 6.1 BS 8233:2014 Example sound insulation matrix (dB $D_{nT,w}$)

Privacy requirement	Activity noise of source room	Noise sensitivity of receiving rooms		
		Low	Medium	Sensitive
Confidential	Very high	47	52	57
	High	47	47	52
	Typical	47	47	47
	Low	47	42	47
Moderate	Very high	47	52	57
	High	37	42	47
	Typical	37	37	42
	Low	No rating	No rating	37
Not private	Very high	47	52	57
	High	37	42	47
	Typical	No rating	37	42
	Low	No rating	No rating	37

- 6.2 The sound insulation criteria is specified as the weighted standardised level difference ($D_{nT,w}$) where T is the receiving room reverberation time. The $D_{nT,w}$ parameter describes the in-situ performance which must be achieved and does not take into account allowances for construction defects or flanking noise transmission.
- 6.3 The sound insulation performance of building elements (e.g. partitions, doors, glazing) is typically specified in terms of the weighted sound reduction index R_w , the calculation for which includes allowances for construction defects, flanking noise transmission, room geometry and room acoustics. In general, an allowance of +7 dB is adequate for these considerations.
- 6.4 For offices, BS 8233:2014 specifies that the minimum sound insulation needs to be approximately 38 dB D_w in order to achieve unintelligible speech between offices, or between an office and an occupied space. Where privacy is important, the minimum sound insulation should be 48 dB D_w .
- 6.5 The equivalent $D_{nT,w}$ values (where the reverberation time is ≤ 0.8 seconds when furnished) is 40 dB $D_{nT,w}$ to achieve unintelligible speech between offices, or 50 dB $D_{nT,w}$ where privacy is important.
- 6.6 In practice 48 dB D_w or 50 dB $D_{nT,w}$ is difficult to achieve without a well-performing partition, careful consideration of detailing, a ceiling, non-continuous floor and excellent workmanship.

- 6.7 The BCO specifies that office floors should achieve at least 48 dB $D_{nT,w}$ when fitted out to Cat A standards. This criterion is considered appropriate for the floor between the ground floor hospitality/ablutions areas and the first-floor office/meeting room areas.
- 6.8 Flanking sound transmission across potential partitions locations should achieve a weighted normalised flanking level difference ≥ 45 dB $D_{nf,w}$ when tested in a laboratory. Flanking constructions should be capable of being upgraded in the Cat B fitout to ≥ 53 dB $D_{nf,w}$ to accommodate the potential for high-performance partitions.
- 6.9 To provide a reasonable level of sound insulation between occupied spaces and ancillary areas and, such as toilets and circulation spaces, it is proposed that separating partitions achieve at least 40 dB R_w .
- 6.10 Table 6.2 presents example constructions capable of achieving sound insulation performance criteria for internal partitions.

Table 6.2 Example partition constructions

Required specification	Description	Laboratory tested sound insulation performance
40 dB R_w	One layer of 12.5 mm standard plasterboard (8.0 kg/m ²) to both sides of 70 mm 'C' stud at 600 mm centres, with 25 mm acoustic partition roll in cavity.	42 dB R_w
45 dB R_w	One layer 15 mm standard plasterboard (8.0 kg/m ²) to both sides 70 mm 'C' stud at 600 mm centres, with 50 mm acoustic partition roll in the cavity, with plaster skim.	45 dB R_w
37 dB $D_{nT,w}$	One layer 15 mm standard plasterboard (8.0 kg/m ²) to both sides 70 mm 'C' stud at 600 mm centres, with 50 mm acoustic partition roll in the cavity.	44 dB R_w
42 dB $D_{nT,w}$	Two layers 12.5 mm standard plasterboard (8.0 kg/m ²) to both sides of 70 mm 'C' stud at 600 mm centres, with 25 mm acoustic partition roll in the cavity.	49 dB R_w
47 dB $D_{nT,w}$	Two layers 15 mm dense plasterboard (12.6 kg/m ²) to both sides of 70 mm 'C' stud at 600 mm centres, with 25 mm acoustic partition roll in the cavity.	54 dB R_w
52 dB $D_{nT,w}$	Two layers 15 mm dense plasterboard (12.6 kg/m ²) and a plaster skim to each side of independent staggered 70 mm 'I' studs at 300 mm centres, with 50 mm acoustic partition roll in the cavity.	59 dB R_w

- 6.11 Mark-ups showing the minimum sound insulation performance for internal partitions and doors are presented in Appendix B.
- 6.12 Moderate background noise is critical to mask intruding speech and is generally provided by building services noise which should be designed to meet the ranges for the indoor ambient noise level identified in Section 5.0.

Internal glazing and glazed screens

- 6.13 Acoustically important partitions which contain glazed sections, or which are fully glazed, must also meet the minimum sound required insulation performance as a whole.

Corridor walls

- 6.14 It is recommended that corridor walls which include doors are rated at ≥ 40 dB R_w , or ≥ 45 dB R_w where privacy is important.

Doors

- 6.15 Doors are normally the weakest element where included in a partition and the overall performance of the partition will be limited by the performance of the door, frame and door furniture.
- 6.16 Typically, with good workmanship and detailing a 44 mm timber solid-core door can achieve up to 30 dB R_w and a 54 mm timber solid-core door can achieve up to 35 dB R_w with the appropriate seals and door furniture.
- 6.17 It is recommended that doors to acoustically sensitive rooms (e.g. offices, meetings rooms) are rated at ≥ 30 dB R_w . Where privacy is important doors should be rated at ≥ 35 dB R_w .
- 6.18 To maximise the acoustic performance of a door-set the gap between the frame and surrounding wall must not exceed 10 mm with all gaps packed with mineral wool and sealed with a non-hardening sealant. The door must be well-fitting within a rebated stop (generally around 15 mm) and incorporate seals around the full perimeter of the door including a drop-down or wipe type threshold seal at the bottom.

Folding Partition

- 6.19 The folding partition which separates the first-floor meeting rooms must achieve at least 42 dB $D_{nT,w}$. To achieve this performance, the partition and surrounding detailing must be rated at least 10-15 dB higher in terms of the laboratory performance, i.e. ≥ 52 -57 dB R_w . The supplier of the folding partition will normally be able to advise a suitable product in their range.

Airborne Sound Insulation of Floors

- 6.20 The floor construction must achieve a minimum sound insulation performance of 47 dB $D_{nT,w}$.
- 6.21 The above criteria may be achieved with floor constructions rated at around 54 dB R_w . A concrete slab (min. density 2400 kg/m³) of depth 150 mm is capable of achieving this requirement. Alternative constructions can be reviewed by the acoustician as required.

Impact Sound Insulation

- 6.22 In terms of impact noise control BCO 2014 states 'a carpet is desirable in office areas to control impact noise such as footfall. It also provides additional absorption. Alternative soft floor finishes may be acceptable. Hard floor finishes should be avoided in office areas.' No performance value is given in the 2014 document and therefore the above is considered guidance.
- 6.23 BCO 2019 guidance states:

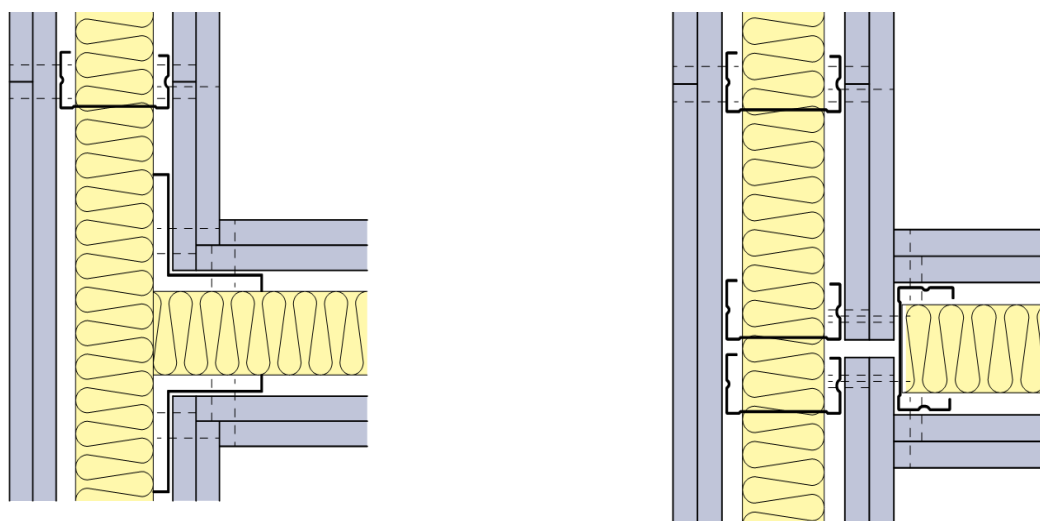
'Impact noise due to footfall in office areas should be controlled. This is normally achieved with carpet, but where hard floor finishes are proposed additional impact sound control will be required both to control sound to adjacent areas and within the space itself. A weighted standardised impact sound pressure level ($L'_{nT,w}$) of ≤ 60 dB is considered a reasonable maximum value for floors over office areas.'

- 6.24 Although the ground floor spaces below offices are not considered acoustically sensitive, it is recommended that an impact resilient floor finish, such as carpet tiles, is utilised on the first-floor to minimise footfall noise transmitted to the ground floor.

Flanking and detailing: Further guidance

- 6.25 Flanking is noise transmitted via indirect noise paths such as through the cavity within a wall, via screeds under a partition, along structural members and through elements of curtain walling, for example. It is imperative to minimise flanking noise as it is likely to limit the sound insulation between spaces. Flanking noise transmission is controlled by careful consideration and design of building elements, as well as excellent standards of construction.
- 6.26 Acoustic walls should be built from slab to soffit and according to the manufacturer's specifications to be capable of achieving the required criteria. Gaps around the perimeter of the partition must be filled and sealed. Where detailing is required to accommodate movement, such as deflection heads, these must be designed to maintain the acoustic integrity of the partition.
- 6.27 Where an acoustically rated partition meets another partition lining (such as perpendicular to corridor walls) the linings must not be continuous across the acoustically rated partition. A break must be incorporated into the lining, and the partition should ideally cut into the lining, as shown in Figure 6.1 below. This is also applicable where a partition meets an external wall lining.

Figure 6.1 Example junction details to optimise acoustic performance and reduce flanking sound transmission



- 6.28 It is common for walls to be built from a screed which is continuous between spaces. A continuous screed is likely to limit the performance of a separating partition to around 40 dB $D_{nT,w}$, and increasing the performance of the partition will not significantly improve the overall sound insulation. Where partitions are rated at 50 dB R_w or above, the screed or floating floor must not be continuous.
- 6.29 Where partitions are rated at 50 dB R_w or above, the screed or floating floor must not be continuous. Breaks can be achieved by either building partitions directly from the base slab and pouring the screed after partitions are built, or by incorporating shuttering or timber battens under the locations of the partition floor channel. Construction details can be reviewed by the acoustician as necessary.

- 6.30 Partitions rated ≤ 45 dB R_w may be built from a raised access floor where the gap under the floor is fully closed. Intumescent fire pillows, for example, can be useful to fill gaps around cable trays running under raised access floors. Non-acoustic partitions or those rated ≤ 40 dB R_w can be built directly from a raised access floor.
- 6.31 Services should not penetrate partitions directly between acoustically sensitive spaces. Services would ideally be routed along circulation routes and penetrate into rooms from there. Where services must penetrate a partition between acoustically sensitive spaces the penetration must be appropriately designed and ventilation ductwork is likely to require a cross-talk attenuator.
- 6.32 Where services pass through an acoustically rated partition, the penetration opening must be minimised, ideally scribing or cutting the plasterboard lining as close to the services as possible. Gaps must be packed with mineral wool and sealed with flexible acoustic mastic. For gaps around service of more than 25 mm, additional layers of plasterboard must be cut/scribed and overlaid to within 10 mm of the services, again with all gaps packed with mineral wool and sealed.
- 6.33 Any soil or rainwater pipes which pass through sensitive areas should be lagged with 25 mm unfaced mineral wool and should be within an enclosure of minimum surface mass 15 kg/m², this being equivalent to two layers of standard plasterboard.
- 6.34 Risers which open directly to sensitive areas will require particular consideration. If these are open vertically (at the floor slab) then the most straightforward method of maintaining the sound insulation performance between floors would be to install a floor in the riser and effectively close off the vertical path. Alternatively, acoustic door-sets can be installed to the risers themselves with performance at least 45 dB R_w including seals and frame.
- 6.35 Where recessed back boxes are used they should not be located back-to-back, no closer than 450 mm, and enclosed at the rear with the same lining as is being penetrated. Prefabricated acoustic socket boxes and putty liners are also suitable.

7.0 Reverberation

- 7.1 The control of reverberation is critical to providing a suitable acoustic environment to enable clear speech communication and listening conditions, and to reduce the build-up of noise in rooms and transfer of noise to other areas. Excessive reverberation will contribute to increased noise levels and a reduction in speech intelligibility.
- 7.2 It is particularly important to consider the effects of reduced speech intelligibility for voice alarms systems.
- 7.3 The British Council for Offices recommend a Class A ceiling in open plan offices covering all areas except lights, grilles and plasterboard margins. The use of hard flooring as a final floor finish in offices should be avoided.
- 7.4 For other spaces the reverberation time criteria shown in Table 7.1 are recommended.

Table 7.1 Reverberation time criteria

Room type	Reverberation criteria, T_{mf} (seconds)
Office / Registrar's room	≤ 0.8
Meeting rooms	≤ 1.0
Shared office	≤ 1.2
Tech booth	≤ 0.5

- 7.5 Criteria are presented as the mid-frequency reverberation time T_{mf} , which is the mean average of the reverberation time in the 500 Hz, 1kHz and 2 kHz octave frequency bands.

Flexihall

- 7.6 It is important that the Flexihall incorporates sufficient absorption such that performances are complimented rather than affected detrimentally.
- 7.7 The reverberation time is the key measure of absorption within a room and should be specified with consideration of the end-use. The appropriate reverberation time varies considerably depending on the use and/or musical programme.
- 7.8 Typically, for speech or amplified music the reverberation time should be reasonably short to maintain intelligibility and avoid 'muddying' of the sound, but not too long such that speech requires excessive effort. For unamplified performances, such as orchestral or choral music, reverberation can have a huge effect on the music, influencing clarity and spectral balance, for example.
- 7.9 It is understood that the space would need to be sympathetic to a number of uses, though it is not possible to satisfy all requirements without being able to vary the acoustics of the room, which is expensive and likely to be impracticable.
- 7.10 It is anticipated the primary use would be for speech and amplified music, and as such it is recommended that the Flexihall is designed to achieve a mid-frequency reverberation time (T_{mf}) of between 1.0 and 1.5 seconds.
- 7.11 The reverberation time will typically reduce with increased occupancy. As such this should be accounted for in acoustic calculations when determining the quantity of absorption required in the room.

- 7.12 Initial calculations indicate that, in addition to typical surface finishes, around 600 m² of Class A absorption (when rated in accordance with BS 11652) would be required. This may seem like a lot, but an absorbent perforated liner tray to the ceiling would contribute significantly to this.
- 7.13 Absorption and/or diffusers should also be placed on non-glazed walls where possible to minimise adverse reflections. Heavy theatrical curtains would also be beneficial to the sides and rear of the stage.
- 7.14 Further advice can be provided once the design has progressed.

8.0 Vibration

- 8.1 Where necessary, all vibration generating plant must incorporate measures to control transmission of noise/vibration to the building structure and to achieve the above criterion, such as resilient fixings and/or mounts, for example. Ductwork and/or connecting services should include flexible connections to vibration generating plant.
- 8.2 Vibration-generating equipment should not be fixed directly to partitions where there is an adjacent sensitive room use.

9.0 Building Envelope

External Noise Ingress

- 9.1 Initial external noise ingress calculations have been undertaken based on the drawings and information currently available.
- 9.2 It is calculated that standard thermal double-glazed windows (e.g. 4 mm/12 mm/6 mm) are capable of achieving the criteria specified in Section 5.0 for meeting rooms and offices. Calculations assume standard trickle vents for ventilation.
- 9.3 The acoustic performance of façades will need to be reviewed as the design develops, particularly to take into account any passive or natural ventilation requirements, and the external wall build-up itself.

Internal Noise Egress

- 9.4 The assessment of noise escape from music and entertainment has been carried out and reported in Sharps Redmore report *TN2-18.05.22-Bury Market & Flexihall Facade Review-2120732-AJN* (ref: BURMAR-SHR-V2-XX-RP-Y-0003).
- 9.5 The nearest noise-sensitive locations have been identified to be residential flats above commercial premises on Murray Road and Princess Walk. These are approximately 20 metres from the closest façade of the development.
- 9.6 Criteria have been identified based on typical planning policy for noise levels external to the development and internal to the nearest noise-sensitive locations.
- 9.7 Calculations have been carried out, including computer noise modelling, to predict noise levels just outside and inside the flats based on an example sound insulation performance for the curtain walling as shown in Table 9.1 below.
- 9.8 The acoustic performance must be achieved by the window unit as a whole, including glazing, frame, seals and any opening mechanisms. Other façade elements, such as the cladded walls, ventilators and the roof, would need to perform significantly better than the windows.

Table 9.1 Example curtain walling specification

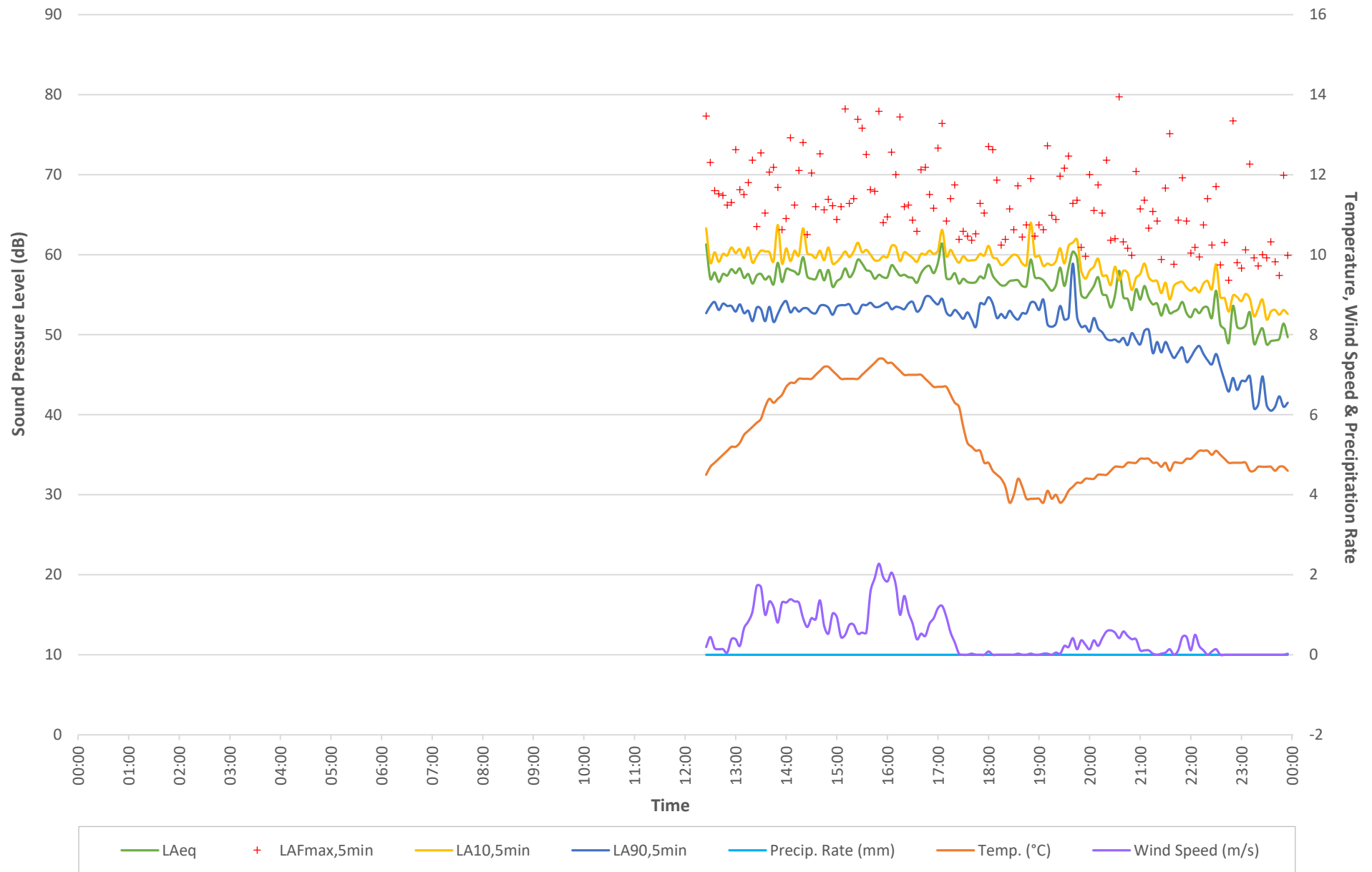
Description	Octave band sound reduction index, SRI (dB)						
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
10.8 mm laminated pane (16 mm cavity) 16.8 mm laminated pane	24*	35	41	48	53	55	65
* SRI value at 63 Hz is estimated.							

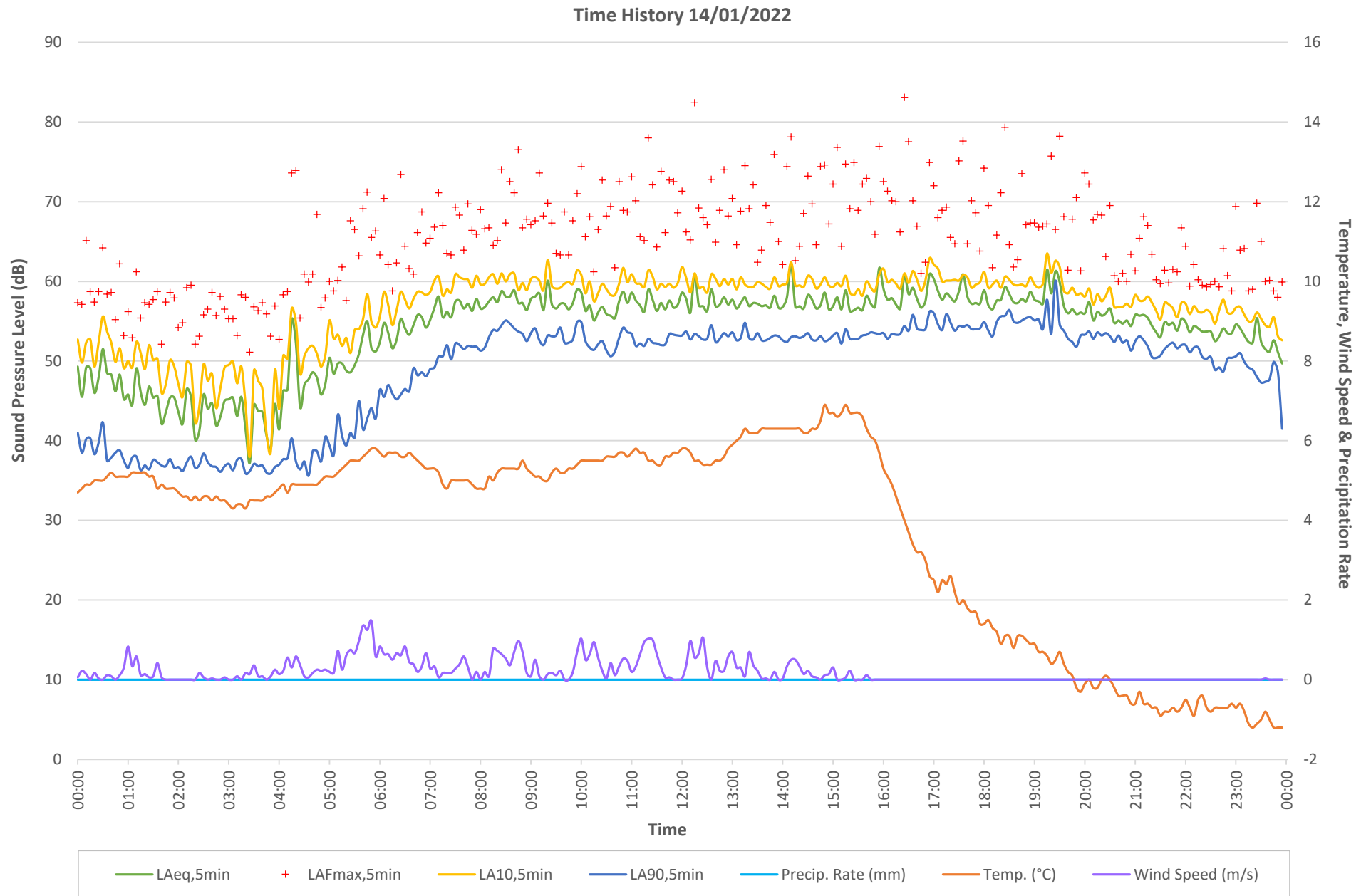
- 9.9 It was concluded that entertainment noise during events within the Flexihall may give rise to external sound levels at nearby noise-sensitive residences which exceed the typical criteria identified. Subjectively, this means entertainment noise could be audible at low frequencies outside.
- 9.10 However, calculations also show that noise levels within dwellings would meet the criteria identified, and would therefore be considered 'inaudible' or 'virtually inaudible' internally. The calculations assumed partially open windows with 100,000 mm² open area.
- 9.11 The design of the façade is ongoing and acoustic advice will be provided going forward.

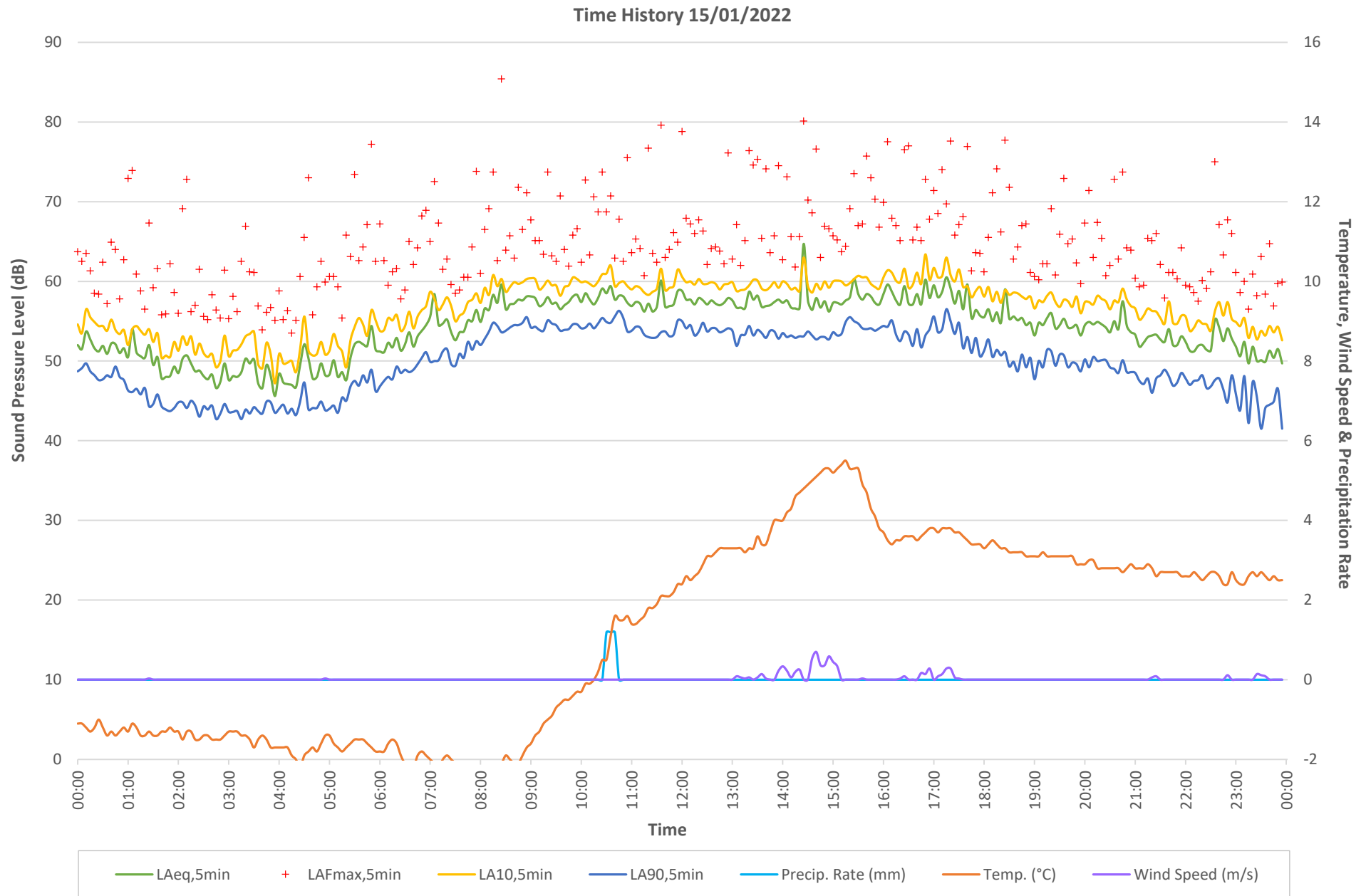
APPENDIX A

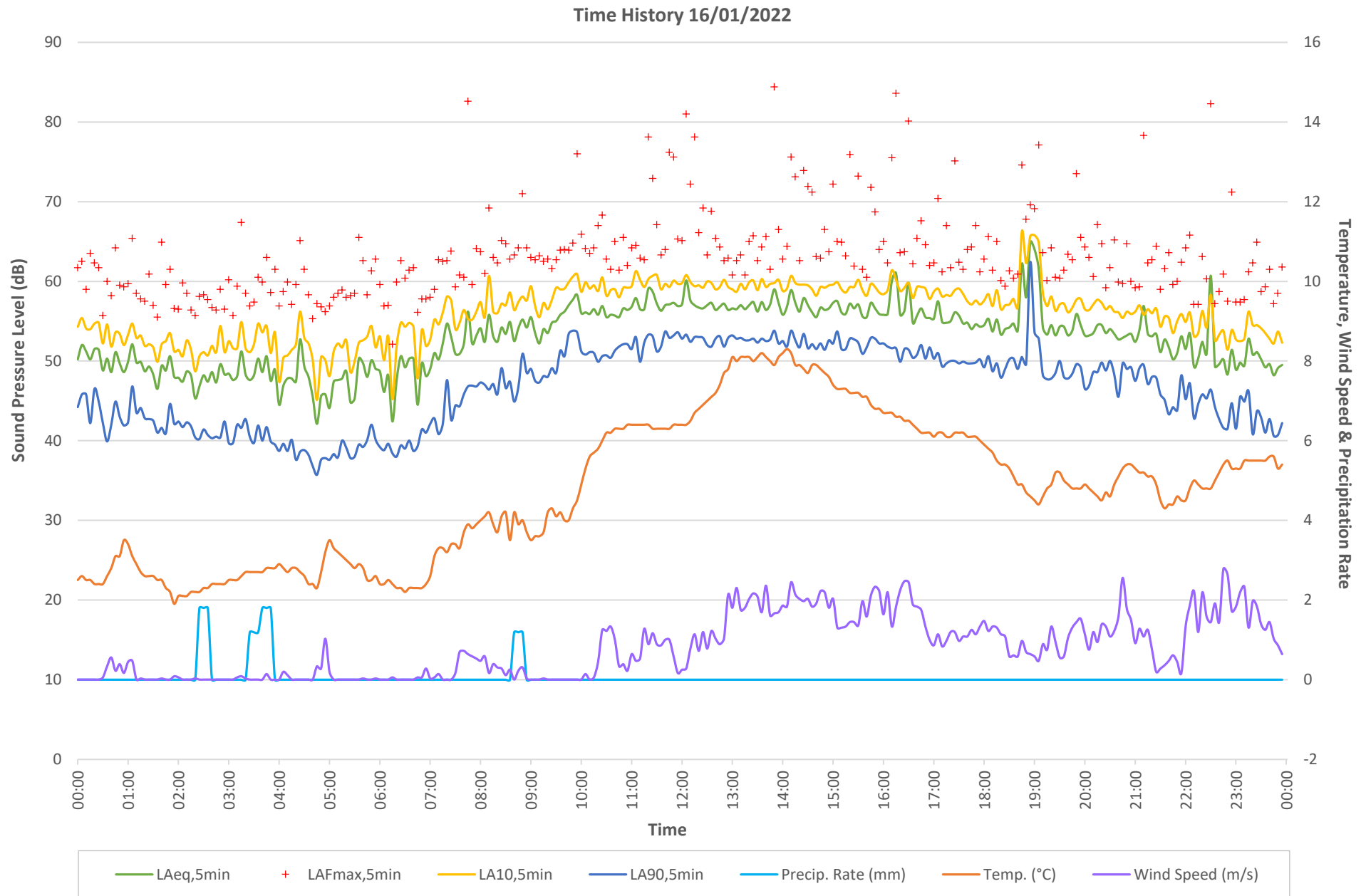
Survey Time-History Charts

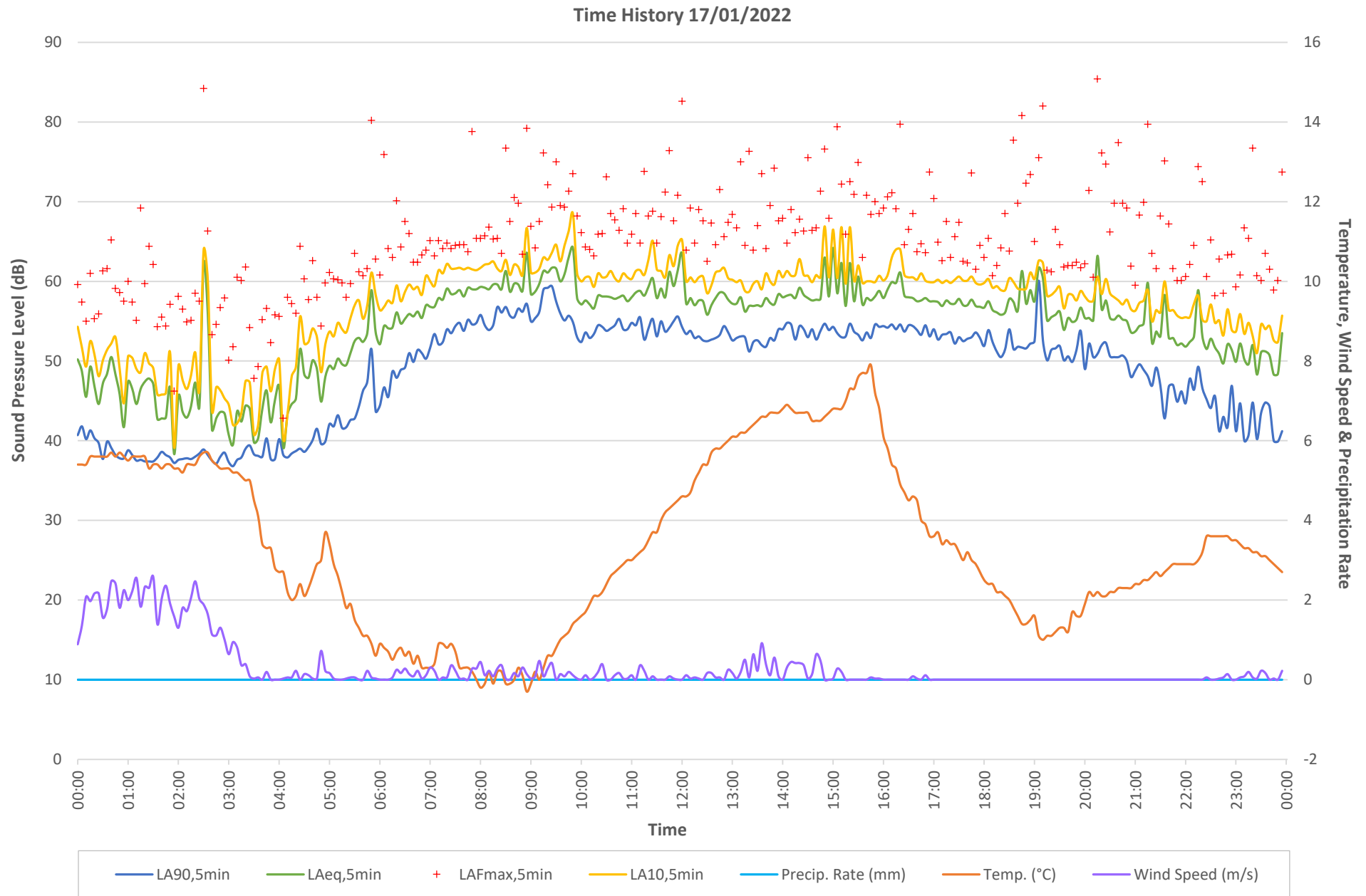
Time History 13/01/2022



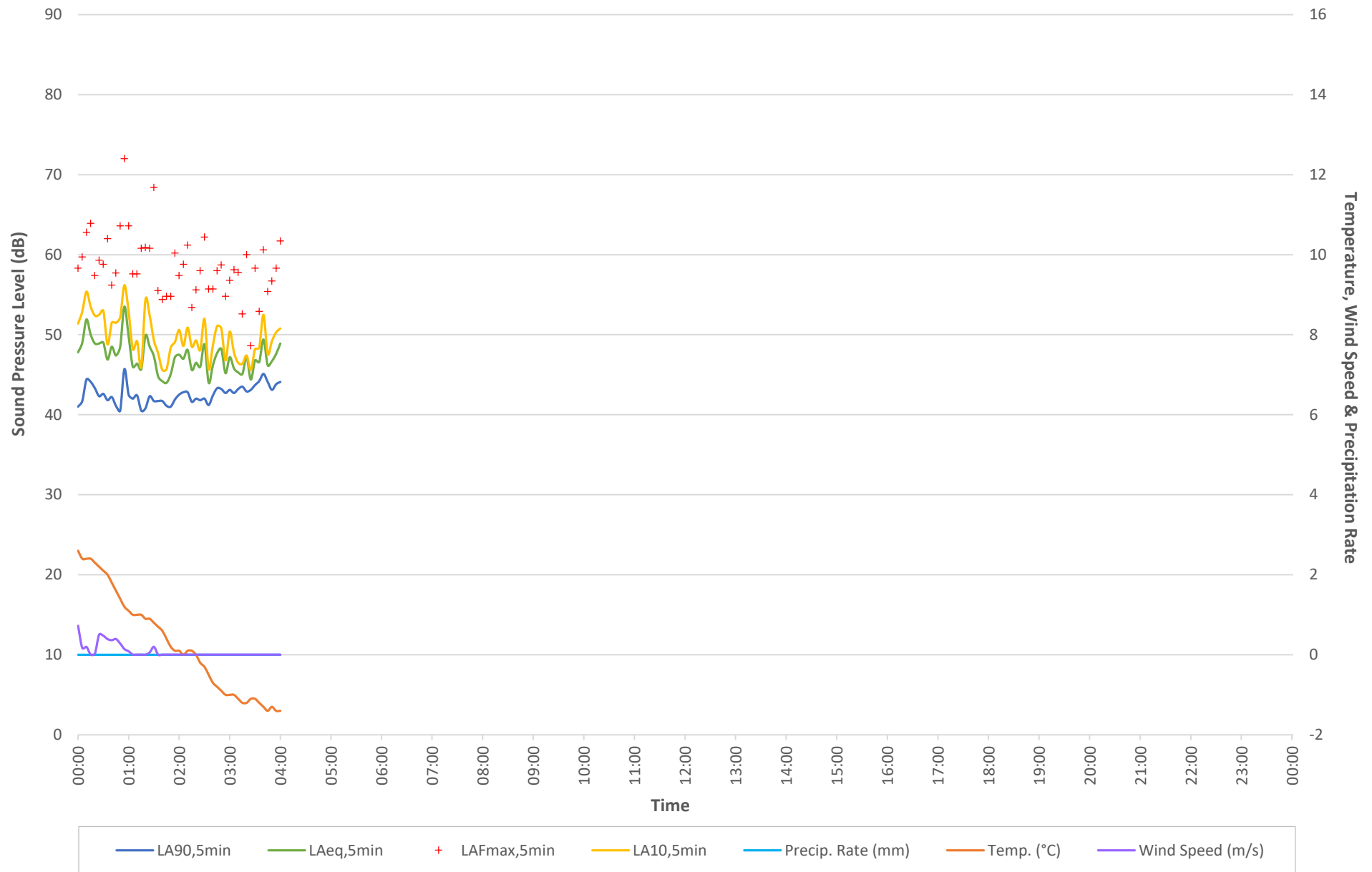








Time History 18/01/2022



APPENDIX B

MARK-UPS: Sound Insulation Performance

PROJECT No: 2120732

DWG TITLE: Acoustics: Internal partitions and doors
GROUND FLOOR

DRAWN BY: AJN

CHECKED BY:

REVISION: A

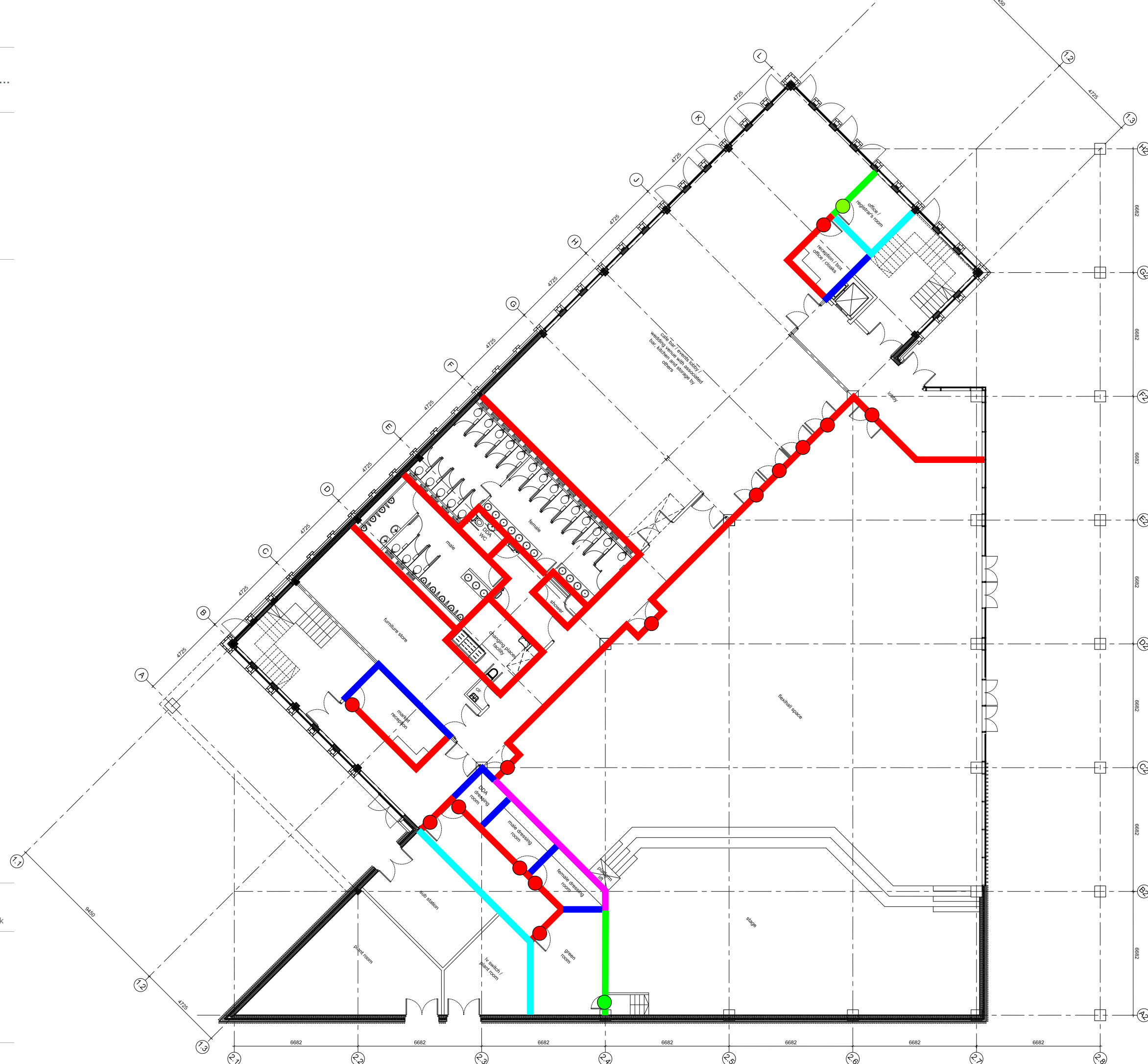
DATE: 20-05-2022

INTERNAL PARTITIONS

	40 dB R_w
	45 dB R_w
	37 dB $D_{nT,w}$
	42 dB $D_{nT,w}$
	47 dB $D_{nT,w}$

INTERNAL DOORS

 30 dB R_w
 35 dB R_w



The Plex, 15 Margaret Street, Wakefield, WF1 2DQ

T 01924 586468 E northernland@sharpsredmore.co.uk W sharpsredmore.co.uk

Sharps Redmore Partnership Limited

Registered in England No. 2593855

Directors

RD Sullivan BA (Hons). PhD. CEng. MIOA. MAAS. MASA

KJ Metcalfe BSc (Hons) MIOA

N Durup BSc (Hons), MSc, PhD, CEng, FIOA, MinstP, MASA, MAES

GJ King MIOA, MCIEH

Company Consultant

TL Redmore BEng. MSc. PhD. MIOA

PROJECT:

Bury Market & Flexihall

PROJECT No:

2120732

DWG TITLE:

Acoustics: Internal partitions and doors

FIRST FLOOR

DRAWN BY:

AJN

CHECKED BY:

REVISION:

A

DATE:

20-05-2022

INTERNAL PARTITIONS

- 40 dB R_w
- 45 dB R_w
- 37 dB $D_{nT,w}$
- 42 dB $D_{nT,w}$
- 47 dB $D_{nT,w}$

INTERNAL DOORS

- 30 dB R_w
- 35 dB R_w

