

BREEAM COMPLIANCE ASSESSMENT

University of Reading Art School

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REPORT

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EXECUTIVE SUMMARY

The Acoustics team at RPS Environment has been appointed by University of Reading to carry out a range of acoustic assessments in relation to the targeted BREEAM Pol 05 and Hea 05 credits for the University of Reading (UOR) School of Arts Building (SOAB), located on the White Knights Campus off Pepper Lane, Reading, RG2 7DB.

Previous commission testing in relation to Planning Condition 12 and Pol 05 was undertaken by RPS in April 2024. The findings of that testing (reported in JAH03428-REPT-02-R0) identified that the externally sited woodworking extract fans on the most southerly façade of the SOAB failed to meet the requirements of Planning Condition 12, and recommended mitigation works specifically for those plant items.

This assessment therefore specifically addresses the internal testing undertaken to demonstrate compliance with Hea 05, and the mitigated sound levels at the noise sensitive receptor (NSR) closest to the woodworking plant, identified as residential quarters at Leighton Park School, to demonstrate compliance with Pol 05.

Plant associated with the building is not expected to operate during the night-time, therefore this report focuses on daytime noise levels.

The assessment determined that two of the three credits available for BREEAM Hea 05 can be awarded. These are in respect of Internal Ambient Noise Level and Reverberation Time.

The third available Hea 05 credit, for Sound Insulation, cannot be awarded, as two of the walls assessed failed to meet their design criteria.

The assessment determined that the single credit available for BREEAM Pol 05 can be awarded.

Further consideration of Planning Condition 12 will be addressed separately.

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1 INTRODUCTION

- 1.1 The Acoustics Team of RPS Environment (RPS) has been appointed by University of Reading (UOR) to carry out a noise assessment in support of planning granted for the new School of Art building (SOAB), located on the White Knights Campus, off Pepper Lane, Reading, RG2 7DB.
- 1.2 The assessment addresses compliance with Planning Condition 12 and with the requirements of BREEAM Pol 05 and Hea 05 as stated in the BREEAM Technical Manual¹.
- 1.3 Planning Condition 12 states:
- “No mechanical plant shall be installed until a noise assessment of the proposed mechanical plant has been submitted and approved by the Local Planning Authority. The assessment shall be carried out for in accordance with BS4142:2014+A1:2019 methodology. The predicted specific sound level ($L_{Aeq,Tr}$) (with reference to BS:4142) as measured at a point 1 metre external to the nearest noise-sensitive facade shall be at least 10 dB below the pre-existing background sound level, $LA_{90,T}$ when all plant/equipment (or any part of it) is in operation. The predicted rating level, $L_{Ar,Tr}$ (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to the nearest noise-sensitive façade (habitable window of a dwelling) shall not exceed the pre-existing background sound level, $LA_{90,T}$ when all plant/equipment (or any part of it) is in operation. The plant shall thereafter only be installed in accordance with the assessment and shall thereafter be maintained so that it operates to the same standard”*
- 1.4 RPS is a member of the Association of Noise Consultants (ANC), the representative body for acoustics consultancies, having demonstrated the necessary professional and technical competence. The assessment has been undertaken with integrity, objectivity, and honesty in accordance with the Code of Conduct of the Institute of Acoustics (IOA) and ethically, professionally, and lawfully in accordance with the Code of Ethics of the ANC.
- 1.5 The technical content of this assessment has been provided by RPS personnel, all of whom are corporate (MIOA) members, or associate members (AMIOA) of the IOA (the UK's professional body for those working in acoustics, noise and vibration) and are therefore ‘suitably qualified acousticians’ as required by BREEAM Pol 05.
- 1.6 Personnel and individual qualifications are provided within the Quality Management table at the start of this report and in Appendix 1 in accordance with the requirement of Section 12 of BS 4142:2014+A1:2019.
- 1.7 This report has been peer reviewed within the RPS team to ensure that it is technically robust and meets the requirements of our Integrated Management System.

¹ UK Refurbishment and Fit-out 2014 – Non-domestic buildings. SD216 1.1 - 2014

2 GUIDANCE, STANDARDS AND POLICY

2.1 BREEAM UK Refurbishment and Fit-out 2014 - Non-domestic Buildings

- 2.1.1 The Building Research Establishment Environmental Assessment Method (BREEAM) is an environmental assessment credit system for non-domestic buildings within the UK.
- 2.1.2 The credits relevant to this development in terms of acoustics are one available credit for Pollution 05 (Pol 05) and three available credits for Health and Wellbeing 05 (Hea 05). All available credits are being sought by the UOR.

Pol 05: Reduction of Noise Pollution

- 2.1.3 The BREEAM UK Refurbishment and Fit-out 2014 - Non-domestic Buildings Technical Manual (the 'Technical Manual') provides the following assessment criteria in respect of Pol 05:

One credit

1. *Where there are, or will be, no noise-sensitive areas or buildings within 800m radius of the assessed site.*

OR

2. *Alternatively, where the building does have noise-sensitive areas or buildings within 800m radius of the site, one credit can be awarded as follows:*
 - a. *Where a noise impact assessment in compliance with BS74451 has been carried out and the following noise levels measured/determined:*
 - i. *Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background conditions can be argued to be similar.*
 - ii. *The rating noise level resulting from the new noise source (see CN7).*
3. *The noise impact assessment must be carried out by a suitably qualified acoustic consultant holding a recognised acoustic qualification and membership of an appropriate professional body (see Relevant definitions in the Additional information section).*
4. *The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5 dB during the day (07:00 to 23:00) and +3 dB at night (23:00 to 07:00) compared to the background noise level.*
5. *Where the noise source(s) from the proposed site/building is greater than the levels described in criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with criterion 4.*

Hea 05: Acoustic Performance

- 2.1.4 The BREEAM UK technical manual provides the following assessment criteria for the Hea 05 credit:

Up to three credits for Education, Healthcare, Office and Law courts building types

1. *The building meets the appropriate acoustic performance standards and testing requirements defined in the checklists and tables section which defines criteria for the acoustic principles of:*
 - a. *Sound insulation*

- b. *Indoor ambient noise level*
 - c. *Reverberation times.*
- 2. *Where undertaking a partial refurbishment or fit-out, the performance standards and testing requirements defined in the checklist and tables section for the following principles are applicable to each assessment part:*
 - a. *Part 1: criteria for sound insulation and indoor ambient noise levels*
 - b. *Part 2: criteria for indoor ambient noise levels only*
 - c. *Part 3: criteria for sound insulation and indoor ambient noise levels*
 - d. *Part 4: sound insulation and reverberation control*
- 3. *See relevant compliance notes on applicable assessment criteria, where undertaking a partial refurbishment or fit-out for further information on how to apply the appropriate acoustic performance standards and testing requirements defined in this issue.*

2.1.5 Table 2.1 replicates the BREEAM acoustic criteria for Education buildings from Table 21 of the Technical Manual.

Table 2.1 BREEAM acoustic criteria for Education buildings

Education Buildings (three credits)	
First credit – Sound insulation	
Criteria	Achieve the performance standards set out in Section 1 of Building bulletin 93: Acoustic design of schools: performance standards, February 2015 (BB93 ²) relating to airborne sound insulation between spaces and impact sound insulation of floors.
Testing Requirement	A programme of pre-completion acoustic testing is carried out by a compliant test body in accordance with the BB93 requirements and the ANC Good Practice Guide, Acoustic testing of Schools ³ .
Second credit – Internal indoor ambient noise levels	
Criteria	Achieve the indoor ambient noise level standards set out within Section 1 of BB93 for all room types. For lightweight roofs and roof glazing, calculations using laboratory data with 'heavy' rain noise excitation as defined in BS EN ISO 140-183 are required (in accordance with the guidance in BB93) for teaching/learning spaces to demonstrate that the reverberant sound pressure level in these rooms are not more than 25 dB above the appropriate limits presented within Section 1 of BB93, table 1.
Testing Requirement	Indoor ambient noise levels (excluding rain noise): A programme of acoustic measurements is carried out by a compliant test body in accordance with the ANC Good Practice Guide, Acoustic testing of Schools. Rain noise: installation of a specification compliant with the BB93 criteria demonstrates compliance, reference is also made to the notes below.
Notes	For heavyweight roofs, or parts of the roof that are heavyweight, with a mass per unit area greater than 150kg/m ² (including those with sedum planting) that do not have any glazing or rooflights, calculations are not required, as such the credit can be awarded on a default basis of compliance.
Third credit – Reverberation	
Criteria	Acoustic environment (Control of reverberation, sound absorption and speech transmission index (STI)): Teaching and study spaces: achieve the requirements relating to reverberation time for teaching and study spaces set out within table 6 in Section 1 of BB93. Open plan teaching spaces: achieve the performance requirements relating to speech transmission index (STI) set out within Section 1.8 of BB93.

² Building bulletin 93: Acoustic design of schools: performance standards, Department of Education, February 2015

³ ANC Good Practice Guide, Acoustic Testing of Schools, version 1.2, July 2011

Education Buildings (three credits)

	Corridor and stairwells: for those that give direct access to teaching and study spaces, achieve the performance requirements relating to sound absorption.
Testing Requirement	Teaching and study spaces: A programme of acoustic measurements is carried out by a compliant test body in accordance with the ANC Good Practice Guide, Acoustic testing of Schools. Open plan teaching spaces: STI Measurements of the STI should be taken in at least one in ten typical student listening positions in the open plan spaces in accordance with the ANC Good Practice Guide, Acoustic testing of Schools. Corridors and stairwells: Installation of a specification compliant with the BB93 criteria demonstrates compliance. Where this refers to the use of Building Regulations, the country-specific Building Regulations or standards can be applied.
Notes	For heavyweight roofs, or parts of the roof that are heavyweight, with a mass per unit area greater than 150kg/m ² (including those with sedum planting) that do not have any glazing or rooflights, calculations are not required, as such the credit can be awarded on a default basis of compliance.

2.1.6 Information regarding demonstrating compliance with the BREEAM acoustic requirements is presented in Section 4.

2.2 British Standard 4142:2014+A1:2019 ‘Methods for rating and assessing industrial and commercial sound’

- 2.2.1 BS 4142:2014+A1:2019 primarily provides a numerical method by which to determine the significance of sound of an industrial nature (i.e. the ‘specific sound’ from the proposed development) at residential Noise Sensitive Receptors (NSR). The specific sound level may then be corrected for the character of the sound (e.g. perceptibility of tones and/or impulses), if appropriate, and it is then termed the ‘rating level’, whether or not a rating penalty is applied. The ‘residual sound’ is defined as the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
- 2.2.2 The specific sound levels should be determined separately in terms of the $L_{Aeq,T}$ index over a period of $T = 1$ -hour during the daytime and $T = 15$ -minutes during the night-time. For the purpose of the Standard, daytime is typically between 07:00 and 23:00 hours and night-time is typically between 23:00 and 07:00 hours.
- 2.2.3 BS 4142:2014+A1:2019 requires that the background sound levels adopted for the assessment be representative for the period being assessed. The Standard recommends that the background sound level should be derived from continuous measurements of normally not less than 15-minute intervals, which can be contiguous or disaggregated. However, the Standard states that there is no ‘single’ background sound level that can be derived from such measurements.
- 2.2.4 BS 4142:2014+A1:2019 states that measurement locations should be outdoors, where the microphone is at least 3.5 m from any reflecting surfaces other than the ground and, unless there is a specific reason to use an alternative height, at a height of between 1.2 m and 1.5 m above ground level. However, where it is necessary to make measurements above ground floor level, the measurement position, height and distance from reflecting surfaces should be reported, and ideally measurements should be made at a position 1 m from the façade of the relevant floor if it is not practical to make the measurements at least 3.5 m from the facade.
- 2.2.5 With regards to the rating correction, paragraph 9.2 of BS 4142:2014+A1:2019 states:
“Consider the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention.”

- 2.2.6 The commentary to paragraph 9.2 of BS 4142:2014+A1:2019 suggests the following subjective methods for the determination of the rating penalty for tonal, impulsive and/or intermittent specific sounds:

“Tonality

For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a rating penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.

Impulsivity

A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.

NOTE 2 If characteristics likely to affect perception and response are present in the specific sound, within the same reference period, then the applicable corrections ought normally to be added arithmetically. However, if any single feature is dominant to the exclusion of the others then it might be appropriate to apply a reduced or even zero correction for the minor characteristics.

Intermittency

When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. ... If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Other sound characteristics

Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.”

- 2.2.7 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level of the specific sound. In the context of the Standard, adverse impacts include, but are not limited to, annoyance and sleep disturbance. Typically, the greater this difference, the greater is the magnitude of the impact:
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context,
 - A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context,
 - The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.
- 2.2.8 Whilst there is a relationship between the significance of impacts determined by the method contained within BS 4142:2014+A1:2014 and the significance of effects described in the PPG-N, there is not a direct link.
- 2.2.9 The significance of the effect of the noise in question (i.e. whether above or below SOAEL and LOAEL) should be determined on the basis of the initial estimate of impact significance from the BS 4142:2014+A1:2014 assessment with reference to the examples of outcomes described within the PPG-N and after having considered the context of the sound. It is necessary to consider all pertinent factors, including:
- the absolute level of sound,

- the character and level of the residual sound compared to the character and level of the specific sound, and
- the sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
 - facade insulation treatment; and
 - ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation.

2.2.10 Definitions of some of the key terms from this standard, and used in this report, are provided in Table 2.2.

Table 2.2 Definitions of BS4142 acoustic terms.

Terminology	Definition
Rating Level, L_{Ar,T_r}	The specific sound level plus any adjustment for the characteristic features of the sound.
Background Sound Level, $L_{A90,T}$	The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T , measured using fast time-weighting, F , and quoted to the nearest whole number of decibels.
Ambient Sound Level, $L_{Aeq,T}$	The steady sound level which, over a period of time T , contains the same amount of A-weighted sound energy as the time varying sound over the same period. Also known as the equivalent continuous sound pressure level. <i>NOTE The ambient sound level is a measure of the residual sound and the specific sound when present.</i>
Specific Sound Level, L_{Aeq,T_r}	The equivalent continuous A-weighted sound pressure level produced by the specific noise source at the assessment location over a given reference time interval, T_r .

2.3 Local Planning Policy

Noise-related planning conditions

2.3.1 Planning Condition 12 in relation to mechanical plant noise is as follows:

“No mechanical plant shall be installed until a noise assessment of the proposed mechanical plant has been submitted and approved by the Local Planning Authority. The assessment shall be carried out for in accordance with BS4142:2014+A1:2019 methodology. The predicted specific sound level (L_{Aeq,T_r}) (with reference to BS:4142) as measured at a point 1 metre external to the nearest noise-sensitive facade shall be at least 10 dB below the pre-existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation. The predicted rating level, L_{Ar,T_r} (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to the nearest noise-sensitive façade (habitable window of a dwelling) shall not exceed the pre-existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation. The plant shall thereafter only be installed in accordance with the assessment and shall thereafter be maintained so that it operates to the same standard.”

REASON: To safeguard the amenities of the adjoining premises and the area generally, in accordance with Policy CC8 and EN17 of the Reading Borough Local Plan 2019.”

3 SITE DESCRIPTION

3.1 Site Description

- 3.1.1 The UOR SOAB consists of an extension to the existing Central Kitchen building (located close to Pepper Lane on the UOR White Knights Campus) to form a new School of Art.
- 3.1.2 The SOAB is not expected to operate during the night, so this assessment is limited to the daytime period.
- 3.1.3 A floorplan is provided in A.3.

3.2 Plant Description

- 3.2.1 Plant located internally on the first floor of the SOAB has already been assessed and its confirmed compliance reported in JAH03428-REPT-02-R0.
- 3.2.2 The plant under consideration comprises two woodworking extract fans located within enclosures externally at ground floor level on the southernmost façade of the UOR SOAB.
- 3.2.3 Photographs of the external plant enclosures are presented in Appendix 3.

3.3 Noise Sensitive Receptors

- 3.3.1 The nearest Noise Sensitive Receptors (NSRs) are the Leighton Park School buildings, several of which appear to be residential in nature, approximately 60 m to the south of plant location.
- 3.3.2 The location of the development and the nearest noise sensitive receptor are indicated in Figure 3-1 below.



Figure 3-1 Site Plan showing closest Noise Sensitive Receptor (NSR)

4 BREEAM COMPLIANCE

4.1.1 This section presents compliance requirements and evidentiary details that will facilitate the BREEAM assessor in confirming that compliance has been achieved.

4.1.2 Section 1.3 of the ANC Schools Good Practice Guide 2015 (SGPG) states:

“at least one in four rooms intended for teaching and study purposes should be tested for sound insulation, reverberation time and ambient noise levels. It is not recommended that speech intelligibility is measured, but if there is a requirement to do so, at least one in ten student positions in open plan spaces should be tested. At least one in four teaching / study rooms below a separating floor should be tested.

A representative sample of each different construction type and acoustic performance requirement should be tested.

It is suggested that the total number of rooms or spaces for teaching and learning is determined, and divided by four (rounding up) to calculate the number of wall (and floor, where appropriate) airborne sound insulation, reverberation time and ambient noise level tests required.

Breakout areas that are used for teaching / study may also be counted as “rooms”, and may be tested if appropriate.

A representative sample of each construction type and acoustic performance requirement would typically include tests of different room types, i.e. including assembly and sports halls as well as room types that occur with greater frequency.”

4.1.3 A total of eleven rooms intended for teaching and study purposes has been identified from the supplied floor plan and confirmed by University staff, as presented in Table 4.1. The Room Type has been taken from BB93 Table 1, along with source activity noise level and receiving noise tolerance for each space.

Table 4.1 Identified teaching spaces with BB93 Room Type and activity / tolerance classification

Identified Teaching Spaces				
Room Number	Room Name	BB93 Room Type	Source Activity Noise Level	Receiving Noise Tolerance
G02	Long Gallery	Art	Average	Medium
G04	Studio	Art	Average	Medium
G05	Wood Workshop 2	Resistant Materials	High	High
G06	Wood Workshop 1	Resistant Materials	High	High
G07	Metal Workshop	Resistant Materials	High	High
G09	2D Screen Printing	Art	Average	Medium
G11	3D Ceramics Workshop	Art	Average	Medium
G13	Group Studio	Art	Average	Medium
G14	Dark room	Art	Average	Medium
G15	Spray Booth	Art	Average	Medium
G16	AV Studio	Audio/Visual Presentations	High	Low

4.1.4 In accordance with the SGPG guidance, a minimum sample size of three has been determined. It is noted that the SGPG does not stipulate any testing other than in rooms that are used for teaching and learning, stating in section 5.2: *“Rooms to be tested will normally be teaching and learning spaces, when seeking to demonstrate compliance with the Building Regulations. Where appropriate, however, tests may be carried out in ancillary spaces, but not usually corridors, stairwells or hallways.”*

4.1.5 Testing has been supervised and reported by Jonathan (Jonty) Stewart, MSc MIOA, who is Registered Tester number 182/1 under the ANC Registration Scheme, and who meets the BREEAM definitions of *Suitably Qualified Acoustician* and *Compliant Test Body*. Assisting with the

testing was Ben Gray AMIOA who holds the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control and meets the BREEAM definition of a *Suitably Qualified Acoustician*.

- 4.1.6 Details of equipment used are presented in Table 4.2. Calibration certificates are available for inspection upon request.

Table 4.2 Instrumentation used

Instrument Type	Make / Model	Serial No.	Next Calibration Due	Calibration Certificate No.
Sound Level Meter	Norsonic 140	1406177	20/12/2024	U42804
Class 1 Measurement Microphone	Norsonic 1225	52345	20/12/2024	42803
Preamplifier	Norsonic 1209	12810	20/12/2024	U42804
Sound Level Meter	Norsonic 140	1403343	20/12/2024	U42811
Class 1 Measurement Microphone	Norsonic 1225	79693	20/12/2024	42810
Preamplifier	Norsonic 1209	12796	20/12/2024	U42811
Class 1 Acoustic Calibrator	Brüel & Kjær 4231	2292411	03/01/2025	06544/1
Broadband Loudspeaker	Norsonic 270H	31814	N/A	N/A
Power Amplifier	Norsonic 280	2803775	N/A	N/A
Graphic Equaliser	Behringer FBQ3102	S0732840166	N/A	N/A

4.2 Hea 05: Acoustic Performance

First Credit – Sound insulation

Requirements

- 4.2.1 Section 1 of BB93 presents performance requirements for sound insulation that relate to the activity level in the source room and the noise tolerance in the receiving room. Table 3b of the document presents the refurbishment performance standards for airborne sound insulation, as shown in Figure 4-1.

Table 3b: refurbishment performance standards for airborne sound insulation between spaces

Minimum $D_{nT,w}$ (dB)		Activity noise in source room (see Table 1)			
		Low	Average	High	Very high
Noise tolerance in receiving room (see Table 1)	High	Not applicable	30	35	45
	Medium	30	40	45	45
	Low	35	40	50	50

Figure 4-1: Table 3b of BB93

- 4.2.2 Consideration of the floor plan reveals that several of the teaching room adjacencies have interconnecting doors, which are not suitable for in-situ testing. The sample selection is therefore concentrated on those pairs of rooms where the separating partition is solid with no openings.
- 4.2.3 The sample selection also takes into consideration the performance requirements in each direction, based on room uses, with the most sensitive direction selected for the compliance

testing. Where there is no difference in performance requirement, the larger room is selected as the source room in accordance with the SGPG.

Wall Tests

- 4.2.4 Only four testable horizontal adjacencies between teaching spaces were identified, as shown in Table 4.3, so the sample size was increased to include all four. Source and Receiving Rooms for testing are indicated in bold.
- 4.2.5 The wall makeup was 120 mm thick single-skin metal stud, 70 mm channel faced with 2 x 12.5 mm Siniat dB board with insulation infill (unspecified).

Table 4.3 Horizontal airborne sound insulation criteria between adjacent rooms

Wall Sound Insulation Test Sample Set				
Source Room	Activity Noise Level	Receiving Room	Noise Tolerance	Minimum $D_{nT,w}$ (dB)
G09 2D Screen Printing	Average	G11 3D Ceramics Workshop	Medium	40
G11 3D Ceramics Workshop	Average	G09 2D Screen Printing	Medium	40
G16 AV Studio	High	G13 Group Studio	Medium	45
G13 Group Studio	Average	G16 AV Studio	Low	40
G05 Wood Workshop 2	High	G04 Studio	Medium	45
G04 Studio	Average	G05 Wood Workshop 2	High	30
G13 Group Studio	Average	G11 3D Ceramics Workshop	Medium	40
G11 3D Ceramics Workshop	Average	G13 Group Studio	Medium	40

Floor Tests

- 4.2.6 Only one vertical adjacency with a teaching space was identified for airborne and impact sound insulation testing, as shown in Table 4.4. Source and Receiving Rooms for testing are indicated in bold.
- 4.2.7 The floor makeup was concrete beam and block with screed and exposed soffit.

Table 4.4 Airborne and impact sound insulation criteria between adjacent rooms

Floor Sound Insulation Test Sample Set					
Source Room	Activity Noise Level	Receiving Room	Noise Tolerance	Minimum $D_{nT,w}$ (dB)	Maximum $L'_{nT,w}$ (dB)
G16 AV Studio	High	First Floor Storage	High*	35	65
First Floor Storage	Medium*	G16 AV Studio	Low	40	65

*Performance details for storage rooms are not listed in BB93, so worst-case values have been assumed

Results

- 4.2.8 Testing was carried out in accordance with the methodology described in the SGPG and summarised in Appendix 4.
- 4.2.9 The results of the airborne tests are summarised in Table 4.5. The results of the impact tests are summarised in Table 4.6. Test charts for airborne and impact tests are presented in Appendix 5.

Table 4.5 Airborne sound insulation test results

Airborne Sound Insulation Test Results						
Test No.	Type	Source Room	Receiving Room	Minimum $D_{nT,w}$ (dB)	Measured $D_{nT,w}$ (dB)	Result
1	Wall	G09 2D Screen Printing	G11 3D Ceramics Workshop	40	37	Fail
2	Wall	G16 AV Studio	G13 Group Studio	45	50	Pass

Airborne Sound Insulation Test Results						
Test No.	Type	Source Room	Receiving Room	Minimum $D_{nT,w}$ (dB)	Measured $D_{nT,w}$ (dB)	Result
3	Wall	G05 Wood Workshop 2	G04 Studio	45	51	Pass
4	Wall	G13 Group Studio	G11 3D Ceramics Workshop	40	34	Fail
5	Floor	First Floor Storage	G16 AV Studio	40	56	Pass

Table 4.6 Impact sound insulation test results

Impact Sound Insulation Test Results						
Test No.	Type	Source Room	Receiving Room	Maximum $L'_{nT,w}$ (dB)	Measured $L'_{nT,w}$ (dB)	Result
6	Floor	First Floor Storage	G16 AV Studio	65	53	Pass

- 4.2.10 Two of the test results did not comply with the performance requirements of BB93 and therefore the Hea 05 credit for Sound Insulation cannot be awarded.
- 4.2.11 It is considered that the most likely reason for the above test failures was sound flanking through the metal roof construction that is continuous across the partition walls between the rooms tested. Subjectively, all the sound in the receive room appeared to be coming from the very top of the wall under test.

Second credit – Internal indoor ambient noise levels

Requirements

- 4.2.12 BB93 Table 1 provides the upper limit for the IANL for each room type, as indicated in Table 4.7. For all but one of the teaching spaces the limit is 45 dB $L_{Aeq,30mins}$. G16 is the only exception, with a limit of 40 dB $L_{Aeq,30mins}$ specified.
- 4.2.13 The sample selection of rooms to be assessed is indicated in bold. The test sample includes rooms with windows to the north (G02), south (G05) and west (G13) elevations, as well as the room with the lowest IANL requirement, which has no external windows (G16).

Table 4.7 Teaching spaces with BB93 Room Type and IANL Upper Limit

IANL Test Sample				
Room Number	Room Name	BB93 Room Type	Ventilation Type	IANL Upper Limit dB $L_{Aeq,30mins}$
G02	Long Gallery	Art	Natural	≤ 45
G04	Studio	Art	Natural	≤ 45
G05	Wood Workshop 2	Resistant Materials	Mechanical	≤ 45
G06	Wood Workshop 1	Resistant Materials	Mechanical	≤ 45
G07	Metal Workshop	Resistant Materials	Mechanical	≤ 45
G09	2D Screen Printing	Art	Natural	≤ 45
G11	3D Ceramics Workshop	Art	Natural	≤ 45
G13	Group Studio	Art	Natural	≤ 45
G14	Dark room	Art	Mechanical	≤ 45
G15	Spray Booth	Art	Mechanical	≤ 45
G16	AV Studio	Audio/Visual Presentations	Mechanical	≤ 40

- 4.2.14 Naturally ventilated rooms are permitted to exceed the Upper Limit criteria listed in Table 4.7 by up to 5 dB. Mechanically ventilated rooms are permitted to exceed the Upper Limit criteria listed in Table 4.7 by up to 5 dB during the hottest 200 hours of the year (“summertime” mode) or when under “intermittent boost” conditions (ventilation under local control of teacher for dilution of fumes

during practical activities as in practical spaces for science, art, food technology and design and technology).

- 4.2.15 The SGPG recommends that, where natural ventilation is to be used, testing is carried out with the windows open as required to provide adequate ventilation outside the hottest 200 hours of the year, and where mechanical ventilation is used, it should be assessed at “normal” and “summertime / boost” duty.

Results

- 4.2.16 Testing was carried out in accordance with the methodology described in the SGPG and summarised in Appendix 6.
- 4.2.17 G05 and G16 featured natural ventilation and were tested with windows / roof lights open. The installed mechanical systems had no summertime or intermittent boost facility, so for testing they were set at maximum duty to establish worst case.
- 4.2.18 The results of the IANL tests are summarised in Table 4.8. Details of each set of measurements are presented in Appendix 6.

Table 4.8 IANL Test Results

IANL Test Results					
Test No.	Room Number	Room Name	IANL Upper Limit dB $L_{Aeq,30mins}$	Measured IANL dB $L_{Aeq,30mins}$	Result
7	G02	Long Gallery	≤ 45	31	Pass
8	G05	Wood Workshop 2	≤ 45	45	Pass
9	G13	Group Studio	≤ 45	28	Pass
10	G16	AV Studio	≤ 40	27	Pass

- 4.2.19 All test results comply with the performance requirements of BB93 and therefore the credit for Internal Ambient Noise Level can be awarded.

Third credit – Reverberation

- 4.2.20 BB93 Table 6 provides the refurbishment reverberation time requirements for each room type, as indicated in Table 4.9. These relate to the mid-frequency reverberation time T_{mf} , which is the arithmetic average of the reverberation times in the one-third octave bands from 100 Hz to 5 kHz.
- 4.2.21 For all teaching spaces the requirement is that $T_{mf} \leq 1.0$ seconds.
- 4.2.22 The sample selection of rooms to be assessed for reverberation time is the same as that selected for IANL, again indicated in bold.

Table 4.9 Teaching spaces with BB93 Room Type and IANL Upper Limit

IANL Test Sample			
Room Number	Room Name	BB93 Room Type	Reverberation Time T_{mf} seconds
G02	Long Gallery	Art	≤ 1.0
G04	Studio	Art	≤ 1.0
G05	Wood Workshop 2	Resistant Materials	≤ 1.0
G06	Wood Workshop 1	Resistant Materials	≤ 1.0
G07	Metal Workshop	Resistant Materials	≤ 1.0
G09	2D Screen Printing	Art	≤ 1.0
G11	3D Ceramics Workshop	Art	≤ 1.0
G13	Group Studio	Art	≤ 1.0

IANL Test Sample			
Room Number	Room Name	BB93 Room Type	Reverberation Time T_{mf} seconds
G14	Dark room	Art	≤ 1.0
G15	Spray Booth	Art	≤ 1.0
G16	AV Studio	Audio/Visual Presentations	≤ 1.0

Results

- 4.2.23 Testing was carried out in accordance with the methodology described in the SGPG and summarised in Appendix 7.
- 4.2.24 The results of the Reverberation Time tests are summarised in Table 4.10. Details of each set of measurements are presented in Appendix 7.
- 4.2.25 All test results comply with the performance requirements of BB93 and therefore the credit for Reverberation Time can be awarded.

Table 4.10 Reverberation Time test results

IANL Test Sample					
Test No.	Room Number	Room Name	Maximum Reverberation Time T_{mf} seconds	Measured Reverberation Time T_{mf} seconds	Result
11	G02	Long Gallery	≤ 1.0	1.0	Pass
12	G05	Wood Workshop 2	≤ 1.0	0.5	Pass
13	G13	Group Studio	≤ 1.0	0.5	Pass
14	G16	AV Studio	≤ 1.0	0.7	Pass

4.3 Pol 05 Heading 2: Reduction of Noise Pollution

Single Credit

Requirements

- 4.3.1 The BREEAM UK Refurbishment and Fit-out 2014 - Non-domestic Buildings Technical Manual (the 'Technical Manual') provides the following assessment criteria in respect of Pol 05:
4. The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5 dB during the day (07:00 to 23:00) and +3 dB at night (23:00 to 07:00) compared to the background noise level.
- 4.3.2 Based on the above, this report gives an assessment of noise rating levels against background noise levels at UOR SOAB at the nearest NSR to comply with the requirements of the BREEAM POL 05 guidance.
- 4.3.3 Representative background sound levels for this location were reported in JAH03428-REPT-02-R0. In that report, the receptor was identified as NSR A and the associated survey location was LT1, shown in Figure 4-2.
- 4.3.4 Table 5.5 of JAH03428-REPT-02-R0 summarised the measured background and residual sound levels representative of NSR A, as replicated at Table 4.11.

Table 4.11 Representative Background / Residual Sound Levels

NSR Location	Period	Background Sound Level (dB L _{A90,T})	Residual Sound Level (dB L _{Aeq,T})
A	Daytime (07:00 to 23:00)	53	67

4.3.5 The background noise level for consideration with Pol 05 is therefore 53 dB(A).

Installed Mitigation

4.3.6 Further to the recommendations presented in JAH03428-REPT-02-R0, acoustic enclosures have been constructed around the externally-mounted plant, as shown in Appendix 3. These are professionally constructed and installed to reduce noise breakout from the woodwork extraction units.

Measurements

4.3.7 Attended measurements were taken on 16/08/2024 on the path in front of the receptor, approximately 3.5 m from the building façade, as indicated by the location labelled NSR-A on Figure 4-2 below. Measurements were taken at a height of 1.2 m with both extraction units running, between 11:20 and 11:40.

4.3.8 There was frequent traffic, the sound from which was dominant more than 90% of the time, so the measurement was paused during some of the longer continuous traffic events in an effort to capture as much of the lulls as possible. There were also significant (i.e. dominant) contributions from occasional gusts of wind in nearby trees (though the wind speed at the microphone did not exceed 2 m/s) and from occasional overflying aircraft. The temperature during the assessment was steady at 19 °C and cloud cover was 6 oktas.



Figure 4-2 Site Plan showing survey location relative to NSR

4.3.9 The sound of the extraction units was steady and continuous, and only audible at low level during very infrequent lulls in traffic, when the wind was not gusting and in the absence of overflying

aircraft. The Wood Workshops do not operate after 23:00 or before 07:00, so only the daytime period is relevant for consideration. The daytime reference time period from BS4142 is 1 hour.

- 4.3.10 Note 1 to Paragraph 9.2 of BS4142 states: *“The prominence of tonal or impulsive sound from a source can be masked by residual sound. In many cases the amount of masking varies as the residual sound changes in level and possibly character.”*
- 4.3.11 Taking this into consideration, the sound from the extraction units was subjectively tonal when audible. As the tonality is considered to be just perceptible at receptors, a +2 dB correction for tonality is considered appropriate as worst case. Although the units are only used when there is activity in one or other of the Wood Workshops, intermittency is not considered likely to be readily apparent against the residual acoustic environment, so no penalty for intermittency has been applied.
- 4.3.12 A time history of the measurement is presented in Appendix 8, identifying the measured and paused periods, and displaying the L_{A95} metric (i.e. the level exceeded for 95% of the measured time) that has been used to determine the specific sound level. It is noted that this is considered worst case as there were audible contributions from tree rustle and distant traffic at all times.
- 4.3.13 The time history also serves to demonstrate the dominance of road traffic and other sources at the receptor.
- 4.3.14 The specific sound level is assessed to be 50 dB $L_{Aeq,1 \text{ hour}}$ as a worst case (real-time observation of the live level during the measurement indicated that the contribution from the running plant was below 50 dB(A)) and the rating level is therefore calculated to be 52 dB $L_{Aeq,1 \text{ hour}}$ including the subjective tonality correction.
- 4.3.15 An initial assessment of the plant sound impact with respect to BS4142 shows that the rating level is 1 dB below the assessed background sound level and compliant with the criterion stated at 4.3.1, therefore the credit for Pol 05 can be awarded.
- 4.3.16 The initial assessment shows that the rating level is not compliant with Planning Condition 12. This will be addressed in a separate report.

5 CONCLUSION

- 5.1 The Acoustics Team of RPS Environment (RPS) was appointed by University of Reading (UOR) to carry out a noise assessment to assess compliance with BREEAM credits available for Hea 05 and Pol 05.
- 5.2 The assessment determined that two of the three credits available for BREEAM Hea 05 can be awarded. These are in respect of Internal Ambient Noise Level and Reverberation Time.
- 5.3 The third available Hea 05 credit, for Sound Insulation, cannot be awarded, as two of the walls assessed failed to meet their design criteria.
- 5.4 The assessment determined that the single credit available for BREEAM Pol 05 can be awarded.
- 5.5 Further consideration of Planning Condition 12 will be addressed separately.

Appendix 1 Qualifications of the Assessor

Jonty Stewart, MSc, MIOA – Associate Director, Acoustics

- A.1 Jonty has over twenty years' experience in audio and acoustic engineering, including over a decade of Higher Education lecturing shared between the University of Salford and Solent University, with extensive knowledge and experience across a broad array of sectors, including delivery of the Institute of Acoustics (IOA) Certificate of Confidence in Environmental Noise Measurement (CCENM).
- A.2 A past Chair of the IOA Education Committee, Jonty continues his educational involvement as Chief Examiner for the Certificate of Competence in Building Acoustics Measurement (CCBAM) and Moderator of IOA Diploma exam papers and assignment specifications.
- A.3 Jonty is a long-term member and past Chair of the Association of Noise Consultants (ANC) Registration Committee, involved in quality assuring provision of ANC sound insulation testing in England and Wales, and was instrumental in setting up the Sound Insulation Testing Register (Ireland), an Irish competent person scheme known as SITRI. He is a Registered Tester (no. 182/1) under the ANC Registration Scheme.

Ben Gray, BSc (Hons), AMIOA – Acoustic Consultant

- A.4 Ben is an Acoustic Consultant and joined RPS in 2019 and has been an associate member of the Institute of Acoustics since 2019. Ben completed the IOA diploma in acoustics and noise control in October 2022.
- A.5 Since joining RPS he has undertaken acoustic surveying, assessments, report writing and project management for a number of commercial, residential, and industrial developments - both small and large scale - in addition to assisting more senior members of staff with the undertaking of their responsibilities.
- A.6 He has been involved with the production of BS4142 assessments since 2019 using the current 2014 version of BS4142. He is familiar with the Standard and has received training on it. As such, he is considered competent for BS4142 assessments.
- A.7 He has carried out acoustic surveys, data processing, noise modelling, report writing and project management for, but not limited to: BS4142 Assessments, Vibration Assessments, Insulation testing, Noise at Work Assessments, Noise Impact Assessments and Environmental Impact Assessments, as well as contributing to reports on Building Acoustics. Additionally, he has a Continuous Professional Development Record to support this competency and experience.

Appendix 3 Site Photographs



Figure A3-1 External plant unit prior to mitigation



Figure A3-2 External plant unit post mitigation

Appendix 4 Sound Insulation Test Methodology

Pink noise from the signal generator was amplified and reproduced in the source room using consecutively one of two loudspeaker positions, (L_a and L_b). The output of the generator was set so that the sound pressure level in the receiving room was at least 6 dB higher than the background level in every frequency band between 100 Hz and 3150 Hz. Individual frequency bands where this was not possible are indicated on the graphs in Appendix 5.

The speaker position and frequency spectrum in the source room were adjusted such that there was no difference greater than 8 dB between any adjacent one-third octave bands.

The loudspeaker positions were towards the corners of the room such that the direct radiation on the party element and its associated flanking elements was not dominant. The speaker was placed such that it was at least 0.5 m away from any surface and the positions were on different planes.

The sound pressure levels were measured using one-third octave band filters. Measurements covered all the one-third octave bands having centre frequencies in the range from 100 Hz to 3150 Hz.

Sound pressure levels were measured sequentially in the source and receive rooms using loudspeaker position L_a as the sound source; the voice coils of the speaker were pre-warmed.

Room Measurements:

In the source room, airborne measurements were recorded at five fixed microphone positions using an averaging time of at least six seconds, with the meter paused between each measurement to provide an average level for the room in each one-third octave frequency band.

In the receiver room, airborne measurements were recorded at five fixed microphone positions using an averaging time of at least six seconds, and the average level in each room was calculated on an energy basis in each one-third octave frequency band. Background measurements were then recorded at five fixed microphone positions using an averaging time of at least six seconds, with the meter paused between each measurement to provide an average level for the room in each one-third octave frequency band.

The procedure was repeated with loudspeaker position L_b as the sound source, and the sound levels from each speaker position were averaged logarithmically to determine the average level across the room.

For each set of microphone / loudspeaker positions, the distances separating microphone positions from other microphone positions were greater than 0.7 m, the distances separating microphones and room boundaries were greater than 0.5 m and the distances separating microphones from the sound source were greater than 1 m. The two loudspeaker positions were greater than 1.4 m apart.

Impact measurements were recorded in the receiver room from two fixed microphone positions for each of four tapping machine positions using an averaging time of at least six seconds with a pre-run time of six seconds, and the average level in each room was calculated on an energy basis in each one-third octave frequency band. Background measurements were then recorded at five fixed microphone positions using an averaging time of at least six seconds, with the meter paused between each measurement to provide an average level for the room in each one-third octave frequency band.

For each set of microphone / tapping machine positions, the distances separating microphone positions from other microphone positions were greater than 0.7 m, the distances separating microphones and room boundaries were greater than 0.5 m and the distances separating microphones from the floor being tested were greater than 1 m.

Reverberation Time measurements were made on the rate of decay of sound in the receiving room. The frequency range from 100 Hz to 3150 Hz was covered in one-third octave bands. An average reverberation time was taken from a single decay at each of three microphone positions using each of two loudspeaker positions. The decays were produced by exciting the room with amplified pink noise and stopping the excitation once the room became saturated (six seconds). The resultant reverberation time, based on T20,

REPORT

was calculated by NorBuild software. All measurements were carried out consecutively to avoid significant changes in relative humidity and temperature that influence air absorption at higher frequencies.

Calibration of the measuring equipment was checked prior to and immediately after testing using a 114 dB (nominal) 1 kHz reference level. No significant difference was indicated.

Testing has been carried in full accordance with the procedures set out in Building Bulletin 93 (BB93)^I and the following standard(s):

BS EN ISO 16283-1: 2014^{II}

BS EN ISO 16283-2: 2018^{III}

ISO 3382-2: 2008^{IV}

The sound insulation ratings were calculated in full accordance with:

BS EN ISO 717-1: 2013^V

BS EN ISO 717-2: 2013^{VI}

The testing procedure was informed by recommendations in the following guidance document:

ANC Good Practice Guide: Acoustic Testing of Schools 2015^{VII}

Appendix 5 Airborne and Impact test charts

Standardized level difference according to BS EN ISO 16283-1 (BB93 Reg E4)

Field measurements of airborne sound insulation between rooms

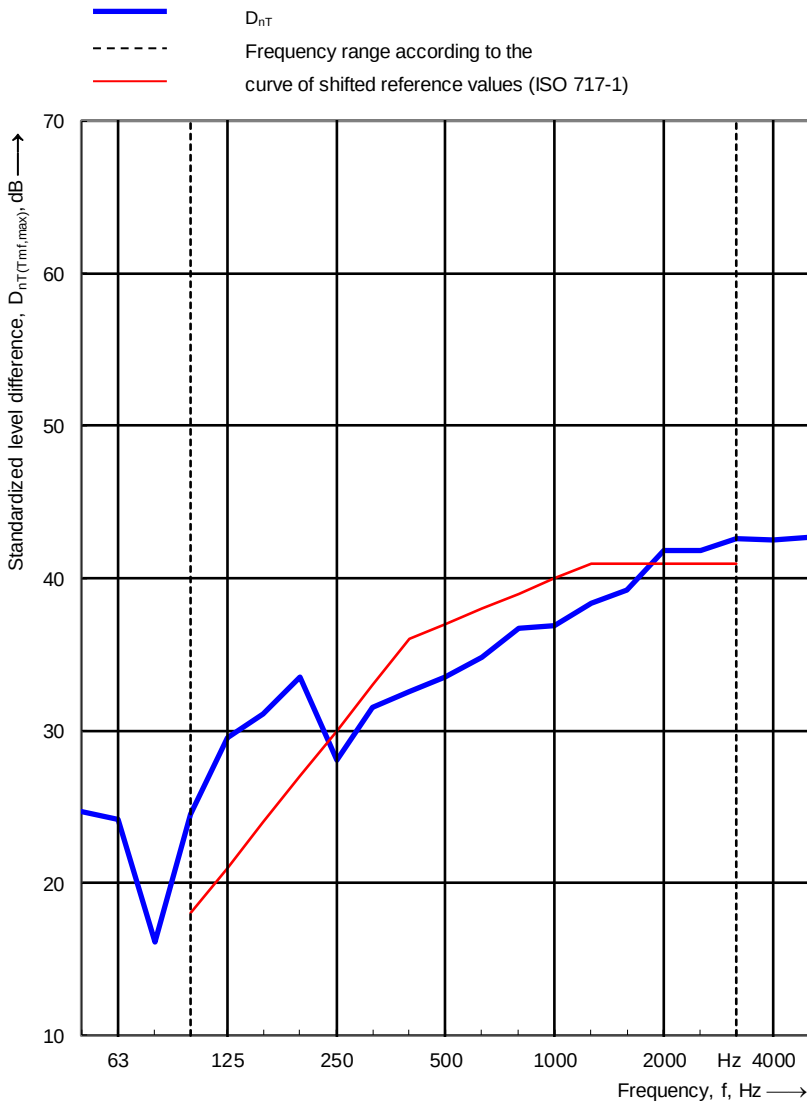
Client: University of Reading
Source: G13 Group Studio
Receive: G11 3D Workshop

Date of test: 15/08/2024

Description: Separating wall between teaching spaces

Tmf, max: 1.0 s
Area of common partition: 37 m²
Source Room Volume: 366 m³
Receive Room Volume: 195 m³

Frequency f [Hz]	D _{nT(Tmf,max)} 1/3 octave [dB]
50	24.7
63	24.2
80	16.1
100	24.5
125	29.5
160	31.1
200	33.5
250	28.1
315	31.5
400	32.6
500	33.5
630	34.8
800	36.7
1000	36.9
1250	38.4
1600	39.2
2000	41.8
2500	41.8
3150	42.6
4000	42.5
5000	42.7



Correct Scale: 15 mm per octave horizontally, 20 mm per decade vertically

Rating according to ISO 717-1

D_{nT(Tmf,max),w}(C;C_{tr}) = 37 (0 ; -2) dB

Evaluation based on field measurements results obtained in one-third-octave bands by an engineering method.

C₅₀₋₃₁₅₀ = 0 dB C₅₀₋₅₀₀₀ = 0 dB C₁₀₀₋₅₀₀₀ = 1 dB

C_{tr,50-3150} = -4 dB C_{tr,50-5000} = -4 dB C_{tr,100-5000} = -2 dB

Company: RPS

No. of test report: 794-ENV-ACO-21021-1

Date: 17/06/2024

Signature:

Standardized level difference according to BS EN ISO 16283-1 (BB93 Reg E4)

Field measurements of airborne sound insulation between rooms

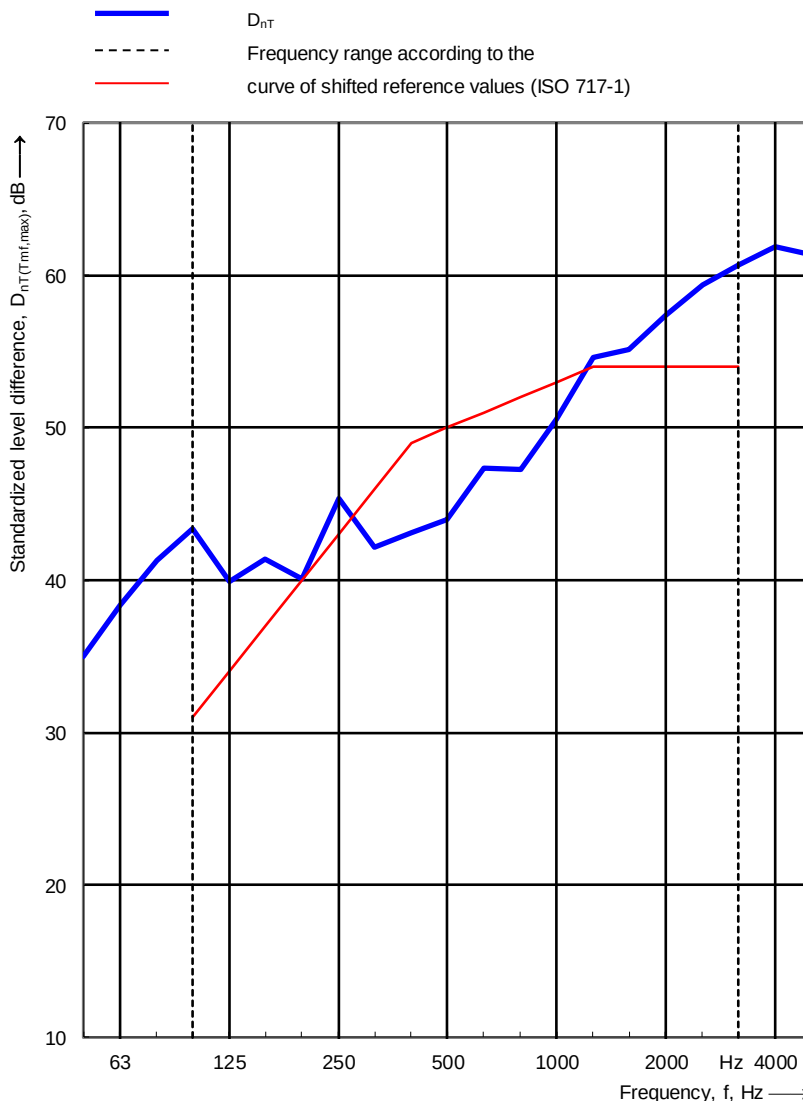
Client: University of Reading
Source: G16 AV Studio
Receive: G13 Group Studio

Date of test: 17/06/2024

Description: Separating wall between teaching spaces

Tmf, max: 1.0 s
Area of common partition: 7 m²
Source Room Volume: 293 m³
Receive Room Volume: 366 m³

Frequency f [Hz]	D _{nT(Tmf,max)} 1/3 octave [dB]
50	35.0
63	38.4
80	41.3
100	43.4
125	39.9
160	41.4
200	40.1
250	45.4
315	42.2
400	43.1
500	44.0
630	47.4
800	47.3
1000	>= 50.6 ¹
1250	>= 54.6 ¹
1600	>= 55.1 ¹
2000	>= 57.4 ¹
2500	>= 59.4 ¹
3150	>= 60.7 ¹
4000	>= 61.9 ¹
5000	>= 61.4 ¹



¹ Denotes limit of measurement

Rating according to ISO 717-1

D_{nT(Tmf,max),w}(C;C_{tr}) = 50 (-1 ; -3) dB

Evaluation based on field measurements results obtained in one-third-octave bands by an engineering method.

C₅₀₋₃₁₅₀ = -1 dB C₅₀₋₅₀₀₀ = 0 dB C₁₀₀₋₅₀₀₀ = 0 dB

C_{tr,50-3150} = -3 dB C_{tr,50-5000} = -3 dB C_{tr,100-5000} = -3 dB

Company: RPS

No. of test report: 794-ENV-ACO-21021-2

Date: 17/06/2024

Signature:

Standardized level difference according to BS EN ISO 16283-1 (BB93 Reg E4)

Field measurements of airborne sound insulation between rooms

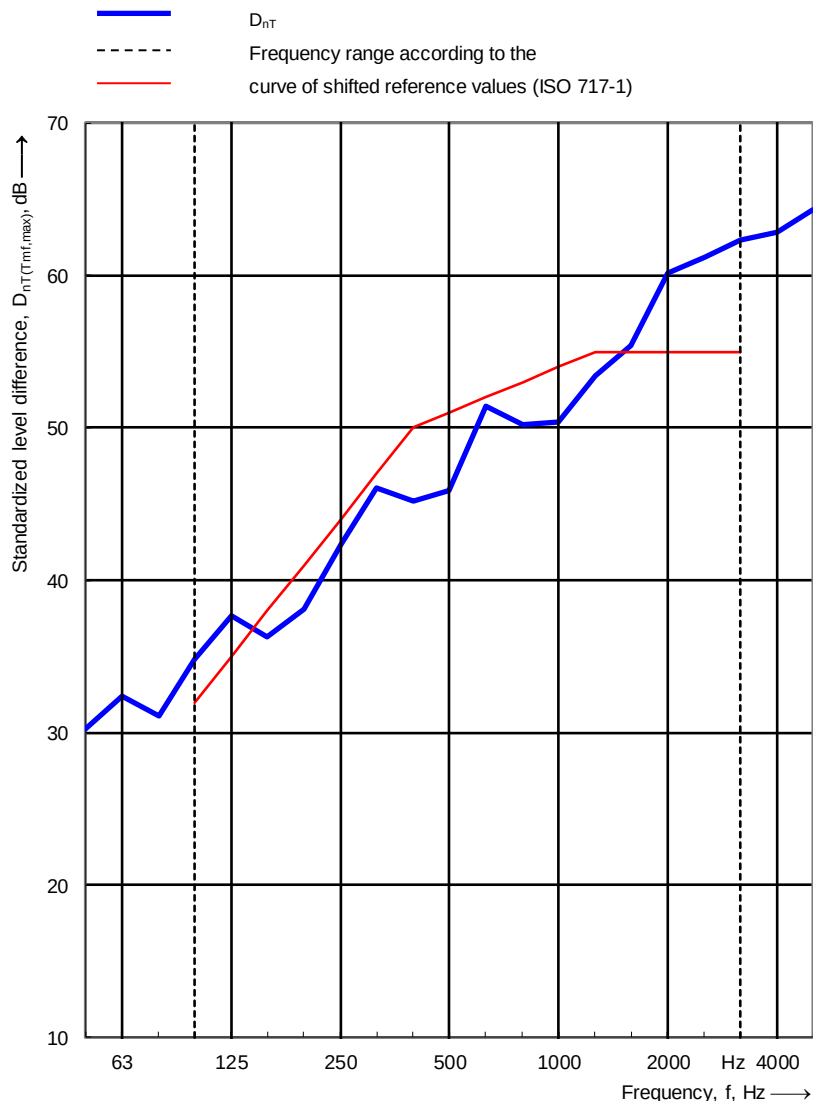
Client: University of Reading
Source: G05 Wood Workshop 2
Receive: G04 Studio

Date of test: 17/06/2024

Description: Separating wall between teaching spaces

Tmf, max: 1.0 s
Area of common partition: 44 m²
Source Room Volume: 459 m³
Receive Room Volume: 515 m³

Frequency f [Hz]	D _{nT(Tmf,max)} 1/3 octave [dB]
50	>= 30.2 ¹
63	>= 32.4 ¹
80	31.1
100	34.8
125	37.7
160	36.3
200	38.1
250	42.3
315	46.1
400	45.2
500	45.9
630	51.4
800	50.2
1000	50.4
1250	53.4
1600	55.4
2000	60.2
2500	61.2
3150	62.3
4000	62.8
5000	64.3



¹ Denotes limit of measurement

Rating according to ISO 717-1

D_{nT(Tmf,max),w}(C;C_{tr}) = 51 (-1 ; -5) dB

Evaluation based on field measurements results obtained in one-third-octave bands by an engineering method.

C₅₀₋₃₁₅₀ = -1 dB C₅₀₋₅₀₀₀ = 0 dB C₁₀₀₋₅₀₀₀ = 0 dB

C_{tr,50-3150} = -6 dB C_{tr,50-5000} = -6 dB C_{tr,100-5000} = -5 dB

Company: RPS

No. of test report: 794-ENV-ACO-21021-3

Date: 17/06/2024

Signature:

Standardized level difference according to BS EN ISO 16283-1 (BB93 Reg E4)

Field measurements of airborne sound insulation between rooms

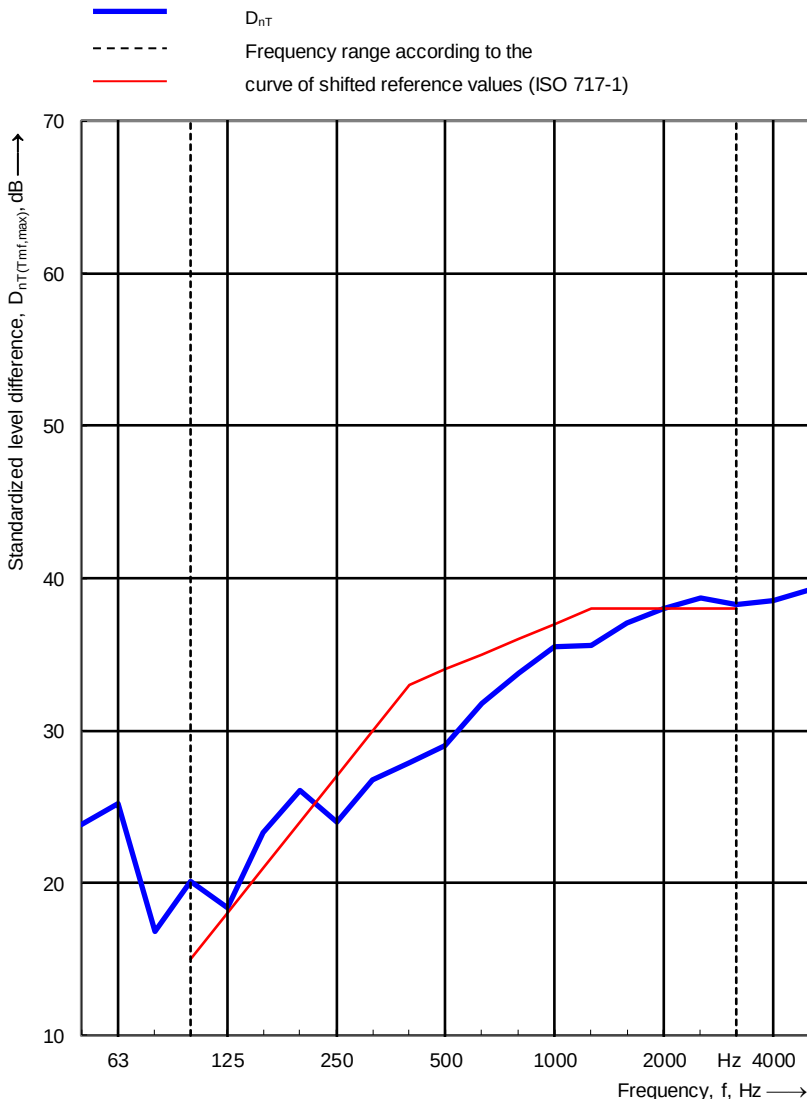
Client: University of Reading
Source: G13 Group Studio
Receive: G11 3D Workshop

Date of test: 15/08/2024

Description: Separating wall between teaching spaces

Tmf, max: 1.0 s
Area of common partition: 37 m²
Source Room Volume: 366 m³
Receive Room Volume: 195 m³

Frequency f [Hz]	D _{nT(Tmf,max)} 1/3 octave [dB]
50	23.8
63	25.2
80	16.8
100	20.1
125	18.4
160	23.3
200	26.1
250	24.0
315	26.8
400	27.9
500	29.0
630	31.8
800	33.8
1000	35.5
1250	35.6
1600	37.1
2000	38.0
2500	38.7
3150	38.3
4000	38.5
5000	39.2



Correct Scale: 15 mm per octave horizontally, 20 mm per decade vertically

Rating according to ISO 717-1

D_{nT(Tmf,max),w}(C;C_{tr}) = 34 (-1 ; -4) dB

Evaluation based on field measurements results obtained in one-third-octave bands by an engineering method.

C₅₀₋₃₁₅₀ = -1 dB C₅₀₋₅₀₀₀ = 0 dB C₁₀₀₋₅₀₀₀ = 0 dB

C_{tr,50-3150} = -5 dB C_{tr,50-5000} = -5 dB C_{tr,100-5000} = -4 dB

Company: RPS

No. of test report: 794-ENV-ACO-21021-4

Date: 15/08/2024

Signature:

Standardized level difference according to BS EN ISO 16283-1 (BB93 Reg E4)

Field measurements of airborne sound insulation between rooms

Client: University of Reading
Source: First Floor store room
Receive: G16 AV Studio

Date of test: 17/06/2024

Description: Concrete separating floor above a teaching space

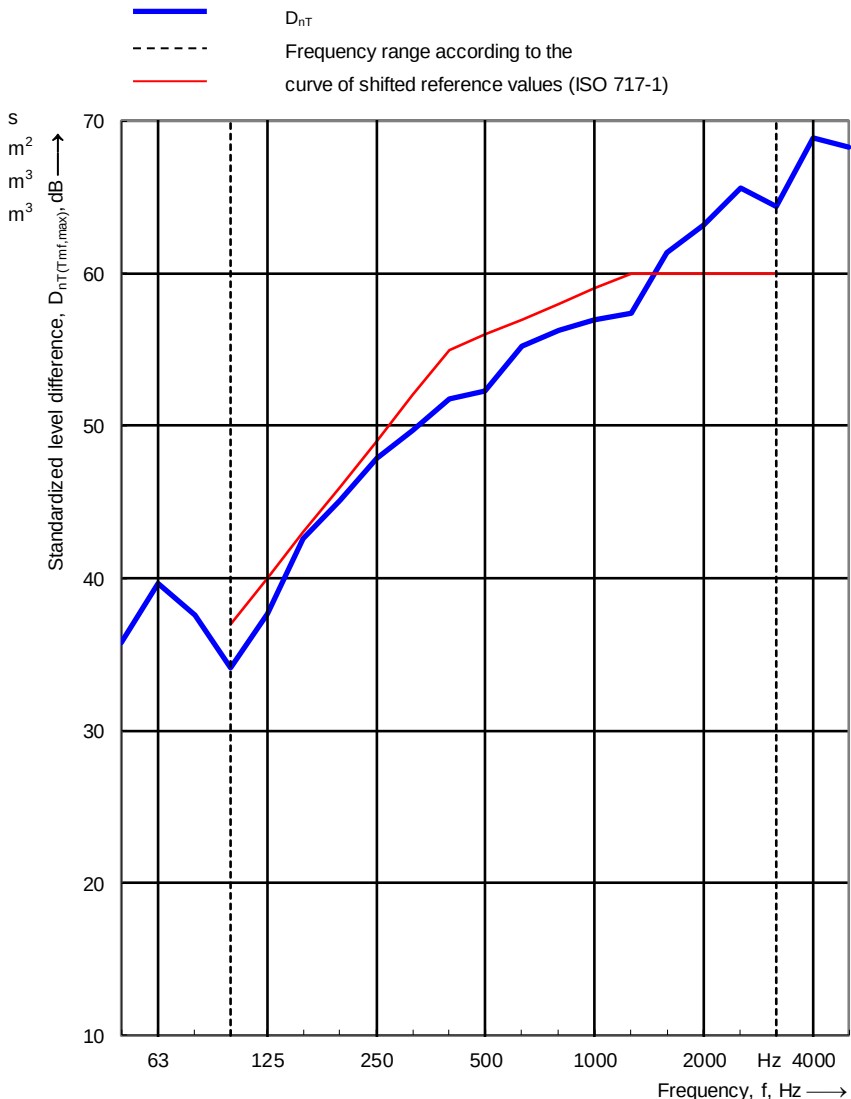
Tmf, max:

Area of common partition:

Source Room Volume: 156 m³

Receive Room Volume: 150 m³

Frequency f [Hz]	D _{nT(Tmf,max)} 1/3 octave [dB]
50	35.8
63	39.7
80	37.6
100	34.1
125	37.7
160	42.6
200	45.1
250	47.9
315	49.7
400	51.8
500	52.3
630	55.2
800	56.3
1000	>= 57.0 ¹
1250	>= 57.4 ¹
1600	61.4
2000	63.2
2500	>= 65.6 ¹
3150	>= 64.4 ¹
4000	>= 68.9 ¹
5000	>= 68.3 ¹



¹ Denotes limit of measurement

Rating according to ISO 717-1

$D_{nT(Tmf,max),w}(C;C_{tr}) = 56$ (-1 ; -6) dB

Evaluation based on field measurements results obtained in one-third-octave bands by an engineering method.

$C_{50-3150} = -1$ dB $C_{50-5000} = -1$ dB $C_{100-5000} = 0$ dB

$C_{tr,50-3150} = -7$ dB $C_{tr,50-5000} = -7$ dB $C_{tr,100-5000} = -6$ dB

Company: RPS

No. of test report: 794-ENV-ACO-21021-5

Date: 15/08/2024

Signature:

Standardized level difference according to BS EN ISO 16283-1 (BB93 Reg E4)

Field measurements of airborne sound insulation between rooms

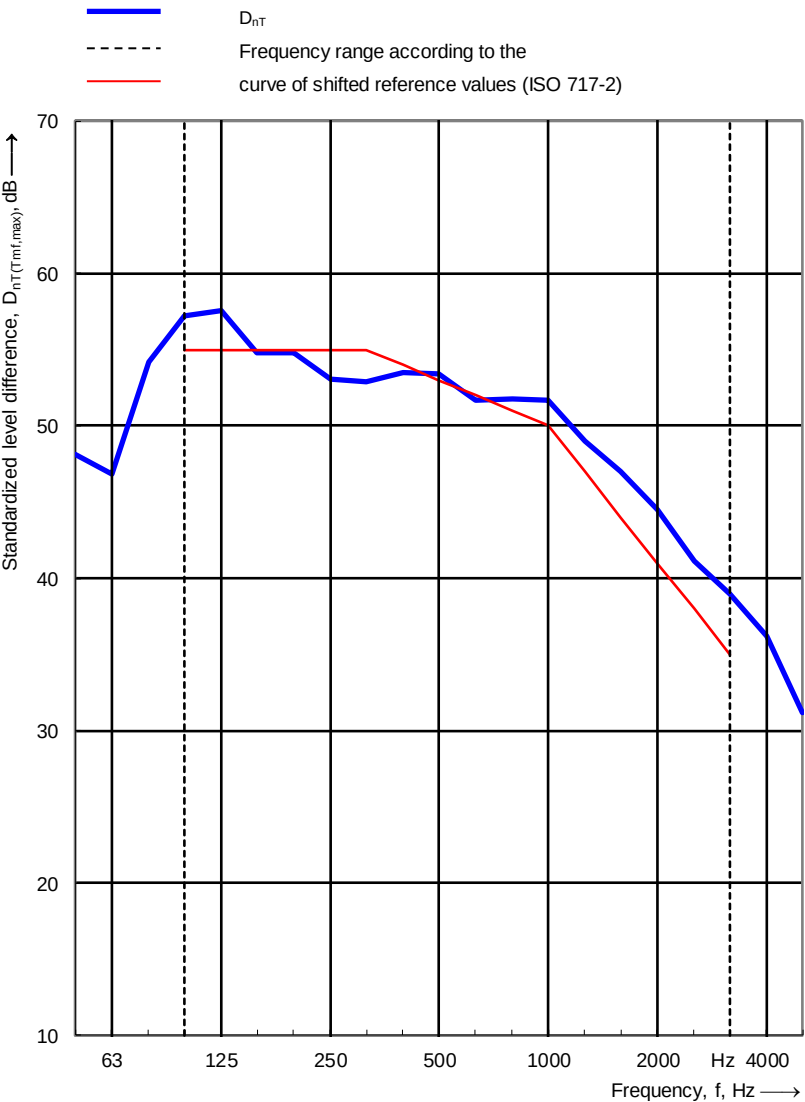
Client: University of Reading
Source: First Floor store room
Receive: G16 AV Studio

Date of test: 17/06/2024

Description: Concrete separating floor above a teaching space

Tmf, max: 1.0 s
Area of common partition: 81 m²
Source Room Volume: 951 m³
Receive Room Volume: 293 m³

Frequency f [Hz]	D _{nT(Tmf,max)} 1/3 octave [dB]
50	48.1
63	46.8
80	54.2
100	57.2
125	57.6
160	54.8
200	54.8
250	53.1
315	52.9
400	53.5
500	53.4
630	51.7
800	51.8
1000	51.7
1250	49.0
1600	47.0
2000	44.5
2500	41.1
3150	39.0
4000	36.2
5000	31.2



Correct Scale: 15 mm per octave horizontally, 20 mm per decade vertically

Rating according to ISO 717-1			
D _{nT(Tmf,max),w} (C;C _{tr}) =	53 (-3 ;) dB	C ₅₀₋₃₁₅₀ =	dB C ₅₀₋₅₀₀₀ = -3 dB C ₁₀₀₋₅₀₀₀ = dB
Evaluation based on field measurements results obtained in one-third-octave bands by an engineering method.		C _{tr,50-3150} =	dB C _{tr,50-5000} = dB C _{tr,100-5000} = dB

Company: RPS
No. of test report: 794-ENV-ACO-21021-6

Date: 17/06/2024
Signature:

Appendix 6 IANL Methodology & Measurements

Measurement results are presented in Table A6.1.

Three measurements were taken in each room at a height of 1.2 m and at least 1 m from any other room surface, at positions normally occupied during teaching activity, including the worst case (i.e. close to an open window or below an active ventilation grille). The representative IANL is the arithmetic average of the three separate room measurements

Table A6.1 IANL Test Results

IANL Test Results			Measured dB $L_{Aeq,5mins}$			Representative IANL dB $L_{Aeq,30mins}$
Test No.	Room No.	Room Name	Measurement 1	Measurement 2	Measurement 3	
7	G02	Long Gallery	25	33	31	31
8	G05	Wood Workshop 2	44	44	46	45
9	G13	Group Studio	28	28	29	28
10	G16	AV Studio	27	27	27	27

All test results comply with the performance requirements of BB93 and therefore the credit for internal ambient noise level can be awarded.

Appendix 7 RT Methodology & Measurements

Measurement results are presented in Table A7.1.

Twelve decays (three from each of four source positions) were taken in each room using interrupted noise, in accordance with the methodology prescribed in ISO 3382-2. The rooms were finished, furnished, and unoccupied for the tests. The T_{20} parameter was used to derive the RT60 values.

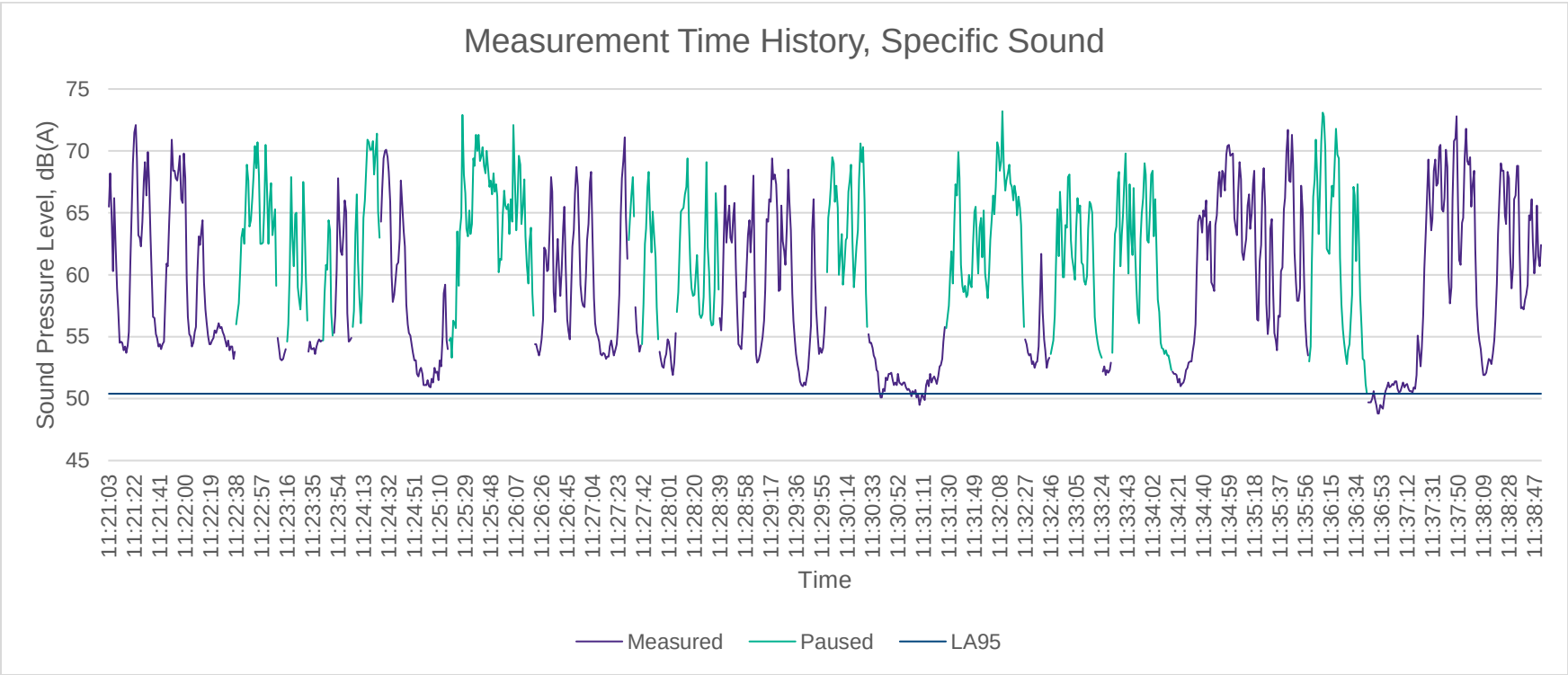
The mid-frequency reverberation time T_{mf} is the arithmetic average of the decay times in the 1/3 octave bands from 400 Hz to 2500 Hz.

Table A7.1 Reverberation RT60 Measurement Results

RT60 data in seconds		1/3 octave band centre frequency Hz									
Room	Decay No.	400	500	630	800	1000	1250	1600	2000	2500	T _{mf}
G02	1	1.01	1.05	1.05	0.99	0.96	0.97	0.98	1.02	0.94	
	2	1.20	0.92	0.92	1.00	0.96	1.01	0.97	1.09	1.03	
	3	1.02	0.91	0.84	1.04	1.01	0.84	1.03	0.96	0.96	
	4	1.02	0.88	0.93	0.87	0.99	0.83	0.91	1.11	1.05	
	5	1.07	0.84	1.17	0.90	0.85	1.04	1.02	1.04	0.98	
	6	1.01	1.11	1.29	0.94	0.86	1.05	1.15	1.08	1.05	
	7	1.17	1.38	0.65	0.83	0.93	0.83	0.87	0.95	1.02	
	8	1.06	0.66	0.90	1.02	0.89	1.00	0.98	1.05	1.00	
	9	1.10	1.08	0.90	1.10	0.98	0.97	0.96	1.03	1.04	
	10	0.98	1.05	1.05	0.82	1.12	0.93	0.90	1.04	1.05	
	11	0.94	1.02	1.27	1.15	0.93	0.98	1.09	1.08	0.94	
	12	0.85	0.89	0.93	0.92	0.82	1.06	1.02	1.10	1.03	
	Average	1.04	0.98	0.99	0.97	0.94	0.96	0.99	1.05	1.01	1.0
G16	1	0.51	0.41	0.44	0.49	0.45	0.45	0.43	0.48	0.40	
	2	0.53	0.48	0.55	0.51	0.47	0.45	0.47	0.42	0.46	
	3	0.86	0.51	0.57	0.60	0.51	0.55	0.42	0.46	0.45	
	4	0.52	0.52	0.44	0.54	0.44	0.56	0.51	0.43	0.44	
	5	0.60	0.46	0.50	0.49	0.52	0.49	0.47	0.45	0.42	
	6	0.53	0.61	0.59	0.50	0.53	0.45	0.41	0.45	0.46	
	7	0.57	0.50	0.55	0.65	0.30	0.40	0.43	0.49	0.49	
	8	0.64	0.54	0.43	0.40	0.61	0.63	0.54	0.48	0.41	
	9	0.47	0.61	0.52	0.56	0.48	0.50	0.55	0.46	0.45	
	10	0.92	0.31	0.55	0.56	0.50	0.51	0.48	0.43	0.45	
	11	0.46	0.54	0.51	0.48	0.51	0.50	0.48	0.57	0.47	
	12	0.48	0.51	0.59	0.47	0.56	0.32	0.53	0.48	0.43	
	Average	0.59	0.50	0.52	0.52	0.49	0.48	0.48	0.47	0.44	0.5
G05	1	0.40	0.51	0.51	0.45	0.41	0.39	0.48	0.48	0.46	
	2	0.44	0.28	0.35	0.44	0.48	0.56	0.45	0.50	0.42	
	3	0.55	0.53	0.47	0.46	0.55	0.68	0.41	0.45	0.44	
	4	0.49	0.58	0.39	0.61	0.46	0.51	0.54	0.48	0.49	
	5	0.46	0.42	0.32	0.53	0.46	0.48	0.45	0.52	0.46	
	6	0.45	0.51	0.51	0.47	0.51	0.50	0.43	0.48	0.49	

RT60 data in seconds		1/3 octave band centre frequency Hz								
Room	Decay No.	400	500	630	800	1000	1250	1600	2000	2500 T _{mf}
	7	0.45	0.38	0.46	0.50	0.40	0.38	0.50	0.51	0.54
	8	0.42	0.42	0.48	0.49	0.42	0.42	0.47	0.49	0.39
	9	0.42	0.36	0.32	0.46	0.46	0.50	0.50	0.51	0.51
	10	0.49	0.40	0.59	0.46	0.39	0.41	0.47	0.48	0.44
	11	0.33	0.47	0.36	0.36	0.38	0.47	0.39	0.44	0.45
	12	0.49	0.47	0.81	0.56	0.41	0.41	0.44	0.44	0.44
	<i>Average</i>	<i>0.45</i>	<i>0.44</i>	<i>0.46</i>	<i>0.48</i>	<i>0.44</i>	<i>0.48</i>	<i>0.46</i>	<i>0.48</i>	<i>0.46 0.5</i>
G13	1	0.90	1.27	0.94	0.85	1.13	0.88	1.02	1.08	0.96
	2	0.64	0.50	0.65	0.66	0.75	0.78	0.69	0.75	0.77
	3	0.63	0.70	0.80	0.67	0.70	0.69	0.63	0.65	0.62
	4	0.55	0.60	0.55	0.51	0.64	0.62	0.63	0.66	0.66
	5	0.53	0.57	0.64	0.77	0.90	0.72	0.62	0.62	0.69
	6	0.61	0.72	0.77	0.73	0.78	0.73	0.65	0.66	0.68
	7	0.68	0.54	0.62	0.86	0.72	0.71	0.67	0.60	0.75
	8	0.67	0.53	0.59	0.60	0.73	0.70	0.62	0.68	0.68
	9	0.62	0.66	0.73	0.72	0.78	0.71	0.63	0.70	0.65
	10	0.89	0.61	0.74	0.63	0.69	0.69	0.60	0.70	0.64
	11	0.62	0.59	0.72	0.57	0.63	0.66	0.63	0.69	0.62
	12	0.37	0.56	0.60	0.74	0.74	0.66	0.71	0.75	0.76
	<i>Average</i>	<i>0.64</i>	<i>0.65</i>	<i>0.70</i>	<i>0.69</i>	<i>0.77</i>	<i>0.71</i>	<i>0.68</i>	<i>0.71</i>	<i>0.71 0.7</i>

Appendix 8 Specific Sound – Measurement Time History



REFERENCES

- ⁱ Building Bulletin 93 - Acoustic design of schools: performance standards, 2014
- ⁱⁱ BS EN ISO 16283-1: 2014 Acoustics – Field measurement of sound insulation in buildings and of building elements. Part 1 – Airborne sound insulation.
- ⁱⁱⁱ BS EN ISO 16283-2: 2018 Acoustics - Field measurement of sound insulation in buildings and of building elements. Part 2: Impact sound insulation.
- ^{iv} BS EN ISO 3382-2: 2008 Acoustics - Measurement of room acoustic parameters — Part 2: Reverberation time in ordinary rooms.
- ^v BS EN ISO 717-1: 2013 Acoustics – Rating of sound insulation in buildings and of building elements. Part 1: Airborne sound insulation.
- ^{vi} BS EN ISO 717-2: 2013 Acoustics – Rating of sound insulation in buildings and of building elements. Part 2: Impact sound insulation.
- ^{vii} ANC Good Practice Guide: Acoustic Testing of Schools. Version 2. 2015