



Environmental Equipment Corporation Ltd
Richmond House, Churchfield Road
Walton on Thames
Surrey, KT12 2TP
t: 01932 230940
f: 01932 230941
e: info@eec.co.uk

Project:

**Tower of London Schools and
Communities Facilities Project**

Title:

Reveller Acoustic Design Report

Stage 4

R2



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Undertaken and prepared by		David Fernleigh	
Checked by		Tim Meed	
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Table 1. Author and Qualifications

Report	Signed	Name and Position	Relevant Qualification
Undertaken and Prepared By		David Fernleigh Principal	MIOA
Checked By		Tim Meed Director	BSc(Hons) MIOA

This report has been prepared with all reasonable skill and care for the Client named. Calculations and estimates made in this report are based on reasonable assumptions and good industry practice that, by their nature, involve uncertainties that could cause future on site results to differ materially from those predicted. No guarantee or warrant of any calculation or estimate can be made. The information contained herein is the property of, and confidential to, the Client. Any third-party information required and/or provided for the completion of this report should not be considered as verified by ourselves, unless otherwise stated.

1.0 INTRODUCTION

- 1.1 The Reveller development area lies at the south-east corner of the Tower of London site and is included in the Schools and Communities Facilities redevelopment. EEC Ltd have undertaken internal ambient noise level measurements (IANL), airborne sound insulation tests and mid frequency reverberation time measurements (Tmf) in a sample of areas to be retained.
- 1.2 An acoustic measurement and test report for engineering field tests has been issued at Stage 3.
- 1.3 This report concerns the results of a detailed design assessment and includes acoustic specifications and advice deemed necessary to meet the various criteria.
- 1.4 Detailed mechanical, structural, H,S&E and conservation considerations are beyond the expertise of this practice and should be dealt with by the relevant professional service provider.

2.0 SUMMARY

- 2.1 Our assessment of the adopted Criteria from BB93 for both “New Build” and “Refurbishment” has been detailed and the adopted criteria marked up on a general arrangement drawing.
- 2.2 In certain circumstances alternative criteria have been proposed.
- 2.3 The targeted and alternative criteria should be agreed by stakeholders.
- 2.4 These criteria then form the basis of the BREEAM HEA05 requirements.
- 2.5 An acoustic assessment of the proposals has been undertaken and specifications and advice provided.
- 2.6 In general, the assessment indicates the adopted criteria should be achievable.
- 2.7 Areas where achieving applicable criteria is not expected, or at risk, have been identified.
- 2.8 At times when groups of children are present and close by, the internal ambient noise levels are predicted to be temporarily exceeded for varying periods (depending upon the presence and activity levels of the group or groups). This is due to the proximity of school visit arrivals and movements and the limitations of the sound insulation of the internal and external building fabric of the Reveller.

3.0 GUIDANCE

- 3.1 Building Bulletin 93: Acoustic of Schools sets out the current minimum acoustic standards for school buildings. The requirements are drawn from a series of tables in section 1 of BB93 that are reproduced in the appendix for reference purposes.
- 3.2 The guidance given in BB93 is not mandatory for the teaching and communities facilities at the Tower. However, it is considered the closest and most relevant source for appropriate acoustic performance standards applicable to the current redevelopment.
- 3.3 Criteria are given for both new build and refurbished development and should be achieved in the completed and unoccupied building.
- 3.4 In mechanically ventilated spaces the limits should ideally be achieved with the building services in operation. As such, these limits relate to the combined internal noise level from both external environmental noise break in and internal building services serving the space.
- 3.5 In many instances it has been possible to adopt the better/more onerous criteria for new build development. However, in some instances even the lower refurbished criteria may not be practicable. Where limitations exist alternative criteria to the minimum given in BB93 can be adopted, provided it is in the full awareness of the various stakeholders.
- 3.6 The tables below present our understanding of the applicable and adopted criteria:

Table 2. Internal Ambient Noise Levels Upper Limit

Space	L _{Aeq,T} dB Upper Limit		Adopted
	New Build	Refurbishment	
Reveller Studio	35	40	35
Reception	35	40	40
Community	35	40	35
Quiet Room/SEN	30	35	30
Breakout	40	45	40
Office	40*	45*	40*
Toilets	50	55	50
Corridor/ Stairwell	45	55	50

NB: BB93 criteria for Rain Noise is the above values +25dB and only applies to new roofing elements in a refurbishment

*Ancillary Space, criteria optional

Table 3. Internal Airborne Sound Insulation for Flank Walls not containing Doors

Adjacency		D _{nt,w} dB Minimum		Adopted
		New Build	Refurbishment	
Reveller Studio	Reception	55	50	50
Community	Toilets	50	45	45
Community	Quiet Room/SEN	50	45	45
Quiet Room/SEN	Office	45	35	45

Table 4. Internal Airborne Sound Insulation for Front Walls containing Doors

Space	Rw dB Minimum			Adopted
	New Build	Refurbishment	Doorset	
Community	40	35	30	35wall/30doorset
Quiet Room/SEN	45	40	35	40wall/35doorset
Office	40*	35*	30*	35wall/30doorset

* Ancillary Space, criteria optional

Table 5. Mid Frequency Reverberation Time Upper Limits

Space	Mid Frequency Reverberation Time Tmf (s) Maximum		Adopted
	New Build	Refurbishment	
Studio (movable wall closed)	0.8	1.0	1.0
Reception (movable wall closed)	1.5	2.0	1.0
Studio Reception (moveable wall open)	0.8-1.2	0.8-1.5	0.8-1.5
Community	0.8	1.0	0.8
Quiet Room/SEN	0.4*	0.4	0.4
Office	1.0	1.2	1.0
Toilets	1.5	2.0	1.5
Circulation / Corridors	As per ADE	As per ADE	As per ADE

* plus no octave band greater than 0.6

3.7 The above adopted criteria have been marked up on the general arrangement drawing below:

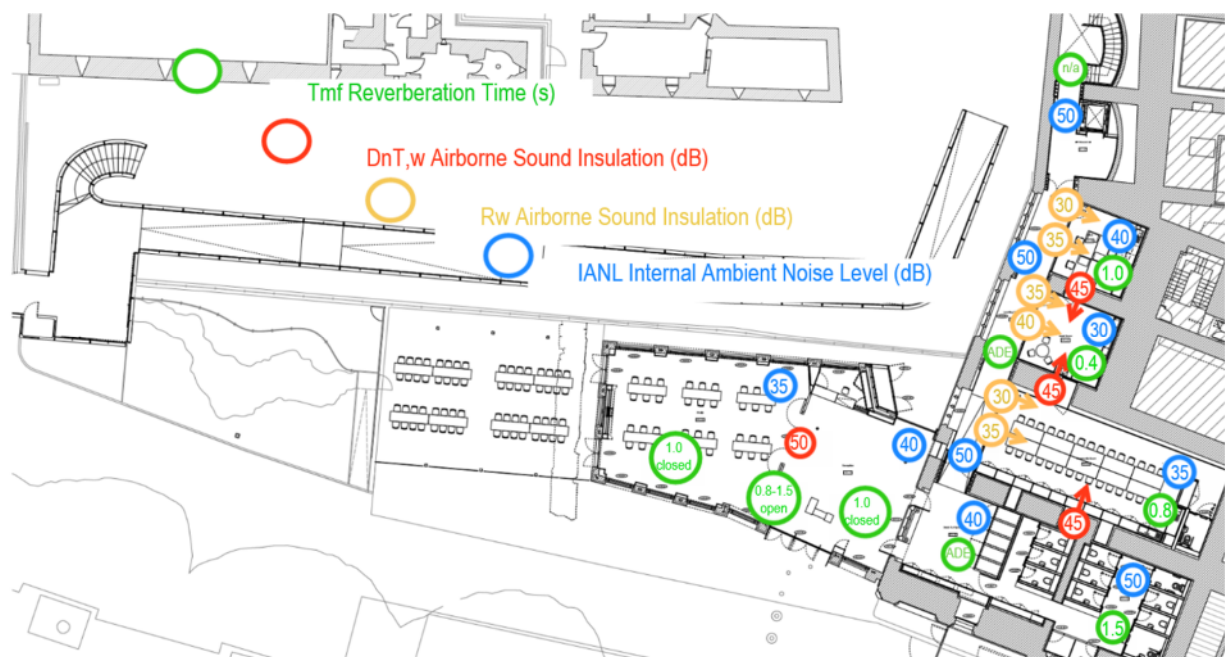


Figure 1. General Arrangement marked up with Adopted Criteria

3.8 The Reveller is to be mechanically ventilated. Where spaces are exposed to existing levels of environmental noise intrusion e.g. Reveller Studio, Reception the NR Criterion for building services noise is set at 8dB below the adopted IANL. Where spaces are not exposed to existing levels of environmental noise intrusion e.g. Quiet Room, the NR Criterion for building services noise is set at 5dB below the adopted IANL. The following table details the NR criteria for each space:

Table 6. NR Criteria for Building Services

Space	Adopted $L_{Aeq,T}$ dB IANL	Building Services NR
Reveller Studio	35	27
Reception	40	32
Community	35	30
Quiet Room/SEN	30	25
Breakout	40	35
Office	40	35
Toilets	50	45
Corridor	50	42
Stairwell	50	45

3.9 Noise from lift operation should not exceed the levels given in the following table:

Table 7. Criteria for Lift Noise

Space	$L_{Amax,fast}$ dB
Lift Car	55
Lift Lobby	55
Offices/Teaching areas	35

3.10 Vibration from lift operation should not exceed an 8 hour vibration dose value (VDV), as defined in BS 6472-1:2008, of $0.36m/sec^{1.75}$.

3.11 Unlike a typical school environment where teaching periods are structured to occur simultaneously, the environment at the Tower of London is such that groups of children come and go independently without a fully coordinated timetable. External areas, corridors and circulation areas can therefore be used at times when other groups may be in a teaching space. At these times when groups of children are present and close by, the internal ambient noise levels are predicted to be temporarily exceeded for varying periods (depending upon the presence and activity levels of the group or groups).

3.12 It is understood that the stairwell and lift lobby will not have absorptive finishes installed due to damp conditions. The purpose of the absorptive finish is to help control reverberation from activity in the areas from disturbing adjacent teaching space. However, these spaces:

- are not expected to be heavily trafficked
- do not provide direct access to teaching space
- are not directly adjacent to teaching space

According to BREEAM alternative criteria can be adopted provided appropriate reasoning is given. In this case, given the conditions listed above it is considered acceptable to omit absorption/reverberation time criteria in the lift lobby and stairwell.

3.13 The following items have been identified as having potential to fall short of the minimum BB93 criteria for refurbishment:

- Reveller studio and reception IANLs
- Reveller movable wall – $D_{nT,w}$ sound insulation
- Breakout Area – absorption
- Toilets - absorption

4.0 BUILDING SERVICES

- 4.1 The internal ambient noise levels (IANL) within teaching spaces include contributions from both external noise ingress and noise from new mechanical ventilation building services.
- 4.2 The IANLs previously measured indicate that the requirements should be generally achievable provided noise from building services is suitably controlled and in the absence of teaching groups.
- 4.3 Steady state anonymous noise, such as that provided by a well-balanced mechanical ventilation system, provides a degree of masking noise that helps reduce the impact of environmental noise intrusion.
- 4.4 The building services proposals still in the process of design and have yet to be assessed by ourselves.
- 4.5 From the stage 4 ventilation drawings we have identified the need for mass barrier ceilings where ceiling mounted AHU are located in the following areas:

Table 8. Mass Barrier Ceilings

Space	Construction
Office	2 x 15mm plasterboard on metal frame with 100mm mineral wool (10kg/m ³), no penetrations, no direct contact with AHU. Returned in reception to form box around AHU
Quiet Room	
Reception (area above desk)	

- 4.6 Similarly, it is expected that crosstalk attenuators located at the partition penetration will be required where ductwork penetrates the separating walls in the following locations:
- Reveller Studio and Reception
 - Toilets and Community WC
- 4.7 Concerning air speeds within ductwork, the following tables provide the recommended maximum velocity:

Table 9. Recommended Maximum Ductwork Velocity - Roomside

Roomside Ductwork Maximum Velocity (m/s) Guidelines (Low Pressure Systems)					
Node	NR40 and above	NR35	NR30	NR25	NR20
Risers	10.0	7.5	6.0	5.0	4.0
Main Branch	6.0	5.0	4.0	3.0	2.0
Ductwork to Grilles	3.0	2.5	2.0	1.5	1.0
Ductwork to Diffusers	2.5	2.0	1.5	1.0	0.8
Extract Stub Ducts	4.0	3.5	3.0	2.0	1.0

Table 10. Recommended Maximum Ductwork Velocity – Atmospherics Side

Atmospheric Grille/Louvre Maximum Velocity (m/s) Guidelines	
Non-acoustics Intake Louvre	2.5
Discharge Louvre	2.0
Acoustic Louvre	1.5
Ductwork to Louvres*	5.0

4.8 The ASHP CU-01 is to be enclosed. Achieving the new build IANL (in relation to building services) is likely to be impracticable. Therefore, the IANL criterion in adjacent spaces has been relaxed to the refurbished standard. We understand that the unit has yet to be selected. Based on a similar sized unit to that shown in the MEP drawings with a sound power level of approximately 86dBA we provide the following advice:

- The reception external wall behind the unit CU-01 should be upgraded to incorporate a skin of 140mm dense concrete block with internal dry lining as required formed to provide 100mm void lined with 100mm mineral wool 10kg/m³.

Without also upgrading the adjacent cladding/windows there is a high risk that noise break in from the external ASHP within and serving the room, will exceed the criterion for refurbishment. Depending upon the final CU-01 selection, the noise break in could be further mitigated as follows:

- The new glazing panel located directly adjacent to the CU-01 enclosure upgraded to high performance double glazing or secondary glazed tbc.
- Increase the moat side external wall of the reception by 1m with an acoustic screen.
- The side vents present in the adjacent existing window (located directly behind the reception desk) should be filled in with a material achieving Rw35dB e.g. firestopping / plywood. The vents then sealed closed. The window should then be secondary glazed tbc.

4.9 Prior to detailed review, the following are generic sketches intended to provide general guidance for building services noise control:

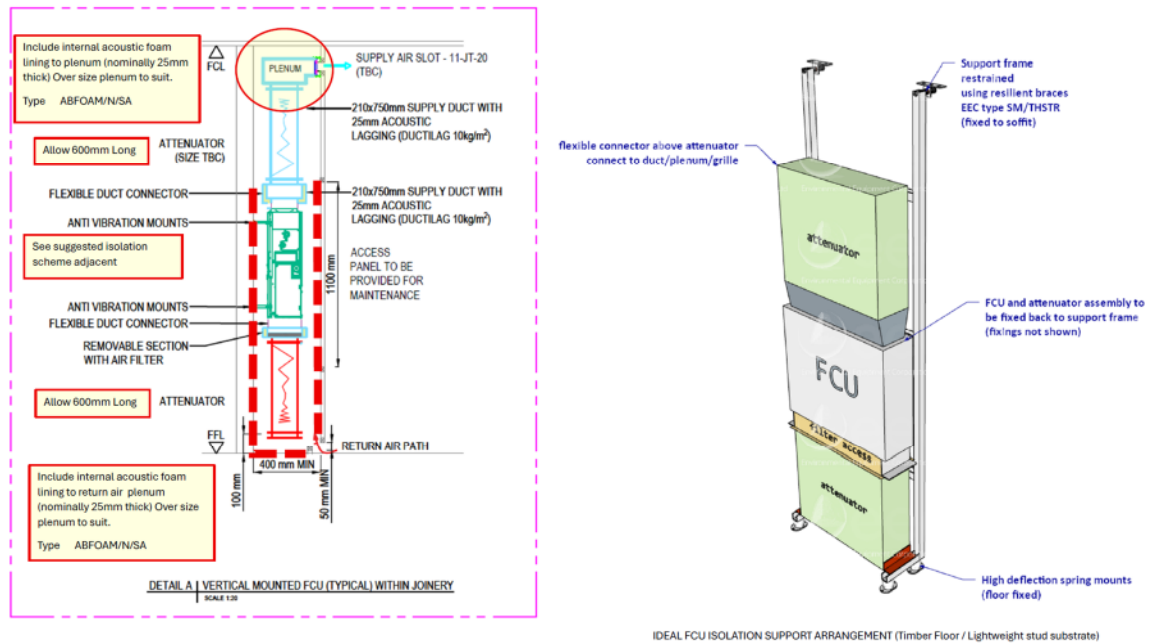


Figure 2. FCU Arrangement General Principles

5.0 EXTERNAL BUILDING FABRIC

- 5.1 The existing internal ambient noise levels within the Reveller is around the upper limit of the BB93 criteria for refurbishment (excluding the noise from children).
- 5.2 The existing $L_{A1,30min}$ noise levels relating to discrete noise events, are within the 60dB upper limit based on the existing sound environment (excluding the noise from children).
- 5.3 Proposals do not include uprating of the external building fabric. However, new elements should not lead to a worsening of the existing performance and where possible and practicable sound insulation can be improved.

Façade Sound Insulation

5.4 Window Side Vents – Reception and Studio

Mechanical ventilation is to be provided. It is understood that the existing side vents are to be retained.

5.5 High Level Vents in Roof light - Reveller Studio

It is understood these will be closed off. A double layer of board material, either 18mm Plywood or 12.5mm dense plasterboard is recommended, prior to installation of new ceiling.

5.6 New Windows, Doors and Clerestory Specification - Reception

In order to at least maintain current sound insulation, the specification for new windows and clerestory in the Reception is based on matching the existing façade/glazing and should be tested in accordance with BS EN ISO 10140-2:2021 (or BS EN ISO 10140-2:2010) "Acoustics. Laboratory measurement of sound insulation of building elements. Measurement of airborne sound insulation." Testing should be in 1/3 octaves from 100Hz to 5000Hz inclusive, together with suitably converted octave band results from 125Hz to 4000Hz shall be provided for a unit which is representative for the relevant façade/room/application. The complete glazing system (including frames/cladding) should achieve the following minimum sound reduction indices:

Table 11. Acoustic Specification – Reception Windows, Rooflight and Entrance Doors

Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)							
	Example	125	250	500	1k	2k	4k
Windows inc. frames	6/16/6.8	20	27	36	46	46	52
Clerestory inc. cladding	6/16/6.8	20	27	36	46	46	52
Entrance Doors (Rw35)	6/16/6.8	20	25	35	38	40	45

- 5.7 Clerestory Roof - Rain Noise. It is recommended to add 100mm mineral wool 10kg/m³ in the ceiling void. with the proposed standing seam roof it is expected the rain noise criteria should be achieved.
- 5.8 Cladding and Glazing between Reception Desk and External CU01 Plant Area.
The façade in this area will be required to be acoustically uprated locally tbc, as discussed in the previous section.

6.0 INTERNAL BUILDING FABRIC

Internal Sound Insulation of Flank walls (Not Containing Doors)

- 6.1 Where existing walls are solid and exceed 300mm thickness and without holes or penetrations it is expected the requirements should be met.
- 6.2 Infill sections and new walls should be constructed to meet the relevant BB93 requirements or agreed alternative criteria, as a minimum.
- 6.3 The proposed wall infills are shown in the table below, along with our recommendations to achieve the various requirements. The plywood pattsess boarding on walls WT01, WT04 and WT05 are assumed to be partial and/or unsealed:

Table 12. Flank Wall Infills (not containing doors)

Proposed	Target $D_{nT,w}$ dB	Recommendation
WT-03 (AcouStud) Gypframe 70 AS 50 at 600 centres with 25mm mineral wool (APR1200) in the cavity	40	2x12.5mm layers of wallboard each side with 25mm mineral wool (APR1200) in cavity. R_w 49dB(minimum)
	45	2x12.5mm Soundbloc (or similar) each side with 25mm mineral wool (APR1200) in cavity R_w 56dB(minimum)
	50	2x15mm Soundbloc (or similar) each side of a 146 Gyproc AcouStud with 50mm mineral wool in cavity. R_w 62dB(minimum)
	All	Skim finish to both sides

- 6.4 The new wall beside the reception desk located at the northern end of the proposed movable wall is understood to be WT-03, as above. Assuming refurbished criteria for the movable wall the minimum requirement for this wall is detailed below:
- 2x15mm dense plasterboard each side of
 - Gypframe 146 AS 50 AcouStuds with
 - 50mm mineral wool in cavity.
 - R_w 62dB(minimum)
- 6.5 Provided the movable wall closes across it, there is no special acoustic requirement for the section of wall at the southern end of the moveable wall, by the entrance.
- 6.6 Where building services are proposed for location within the existing walls, consideration will also be given to services breakout noise control and acoustically rated access doors will likely be required.

Doors Interconnecting Teaching Space

- 6.7 BB93 suggests that interconnecting doors in walls separating teaching space should be avoided. Where an interconnecting door is deemed necessary it is often the case that a lower acoustic performance should be expected. Interconnecting doors may be employed provided stakeholders are aware of the likely shortfall. Interconnecting doors are proposed between Reveller Studio and Reception, within the movable wall.

Movable Wall

- 6.8 With reference to the BB93 criteria detailed within the Appendix A, the requirements for a movable wall between the Reveller and Reception space have been assessed as follows:
- Reveller noise tolerance equivalent to the BB93 classification of a lecture theatre or multi-purpose hall where audio visual presentations will occur i.e. Low Tolerance
 - Reception activity noise level equivalent to the BB93 classification of a gymnasium/dance studio/drama studio/dining room i.e. High Activity Noise
- 6.9 This indicates a new build criterion of 55 dB, or a refurbishment criterion of 50 dB.
- 6.10 Both the above criteria are very hard to achieve with a single movable wall and may be impracticable. 40-45 dB D_{nTw} is typically the practicable limit of what is usually achievable with a single movable wall. The performance can be further reduced where the movable wall contains a door within it. As such, a reduced performance might need to be tolerated if the movable wall is still desired, with or without a discrete door within. BREEAM does allow for alternative performance criteria to be adopted, although, this should be defined and agreed prior to construction.
- 6.11 In order that the acoustic performance of the movable wall is not compromised it will be necessary to ensure that flanking structures and junction details are suitably designed in co-ordination with the supplier/installer requirements and responsibilities.
- 6.12 An acoustic specification for a movable wall to achieve refurbishment criteria is provided in the appendix. Suitable Movable Wall Supplier:
- <https://londonwall.co.uk/movable-walls/> 020 8391 8750 info@londonwall.co.uk

Internal Sound Insulation of Front Walls (containing doors)

- 6.13 Unlike a typical school environment, it is expected that the circulation space will be commonly used during teaching periods. A proposal to uplift the sound insulation performance for the glazed front walls containing doors has been found impracticable. The refurbishment targets have therefore been adopted.
- 6.14 The table below provides typical constructions commensurate with the refurbishment criteria. The requirements should be achieved by the provision of laboratory tested materials and doorsets:

Table 13. Typical Glazed Constructions to meet Front (Corridor) Wall Requirements

BB93 Refurbished Criteria	Glazed Wall	Glazed Doorset
Office	6.8mm laminated (R_w 35 dB min)	6mm laminated (R_w 30 dB min)
Quiet Room	12.8mm laminated (R_w 40 dB min)	6.8mm laminated (R_w 35 dB min)
Community	6.8mm laminated (R_w 35 dB min)	6mm laminated (R_w 30 dB min)

7.0 FINISHES

7.1 Acoustic absorptive finishes and materials are classified in Classes A, B, C, D etc. Class A is the most absorbing, highest performing. Thus, where surface area available for absorptive finishes is limited, potential results can be optimized using the more highly absorbent Class A. Although, in some instances it may be preferred to install a larger area of a lower Class e.g. where a monolithic finish is required but the criterion is not onerous.

7.2 The lower limit for absorption Classes A, B, C and D are given in the following table:

Table 14. Absorption Coefficient at Octave Band Centre Frequency (Hz)

Class	125	250	500	1k	2k	4k
A	0.5	0.7	0.9	0.9	0.9	0.8
B	0.4	0.6	0.8	0.8	0.8	0.7
C	0.2	0.4	0.6	0.6	0.6	0.5
D	0	0.1	0.3	0.3	0.3	0.2

7.3 In a lecture room type scenario where a speaker is typically at one end of the room it is good practice to ensure that the back wall (i.e. the wall the speaker is facing) is not strongly reflective, this is normally achieved by applying absorption and/or diffusion to this wall. This is important to avoid unwanted echo.

7.4 The following tables gives the proposed amount and location of generic Class A absorption that has subsequently been assessed by ourselves to achieve the given criterion. This should illustrate the approximate areas needed and should be updated with manufacturers laboratory tested absorption coefficients for the final selected materials, when available:

Table 15. Reveller Studio – Areas of Class A Absorptive Finishes

Space	Criteria Tmf (s)	Soffit m ² *	Back wall m ²	Moat side m ²	Wharf side m ²	Floor Finish
Studio	1.0	77*	11	14.5	11.5	Timber

*including vertical section

Table 16. Reception – Areas of Class A Absorptive Finishes

Space	Criteria Tmf (s)	Soffit m ²	Back wall m ²	Moat side m ²	Wharf side m ²	Floor Finish
Reception	1.0	65	0	0	0	Timber

Table 17. Community – Areas of Class A Absorptive Finishes

Space	Criteria Tmf (s)	Soffit m ²	Back wall m ²	Side wall m ²	Side wall m ²	Floor Finish
Community	0.8	80	12	30	21	Marmoleum

Table 18. Quiet Room – Areas of Class A Absorptive Finishes

Space*	Criteria Tmf (s)	Soffit m ²	Back wall m ²	Side wall m ²	Side wall m ²	Floor Finish
Quiet Room	0.4	Plasterboard ¹	5	13	5	Carpet

*includes curtain

¹The room has been predicted to achieve the criterion without absorption on the ceiling, where a Class A absorptive ceiling is provided the criteria should be comfortably achieved.

Table 19. Office – Areas of Class A Absorptive Finishes

Space	Criteria Tmf (s)	Soffit m ²	Back wall m ²	Side wall m ²	Side wall m ²	Floor Finish
Office	1.0	Plasterboard ²	0	8	8	Carpet

²The room has been predicted to achieve the criterion without absorption on the ceiling, where a Class A absorptive ceiling is provided the criteria should be comfortably achieved without any absorption on the walls

Circulation Space and Stairwells

- 7.5 The BB93 guidance for these areas is that they are enhanced with additional absorption calculated in accordance with Section 7 of Approved Document E Method A:

“cover an area equal to or greater than the floor area, with a Class C absorber or better.”

and for stairwells or a stair enclosure:

“calculate the combined area of the stair treads, the upper surface of the intermediate landings, the upper surface of the landings (excluding ground floor) and the ceiling area on the top floor. Either cover at least an area equal to this calculated area with a Class D absorber, or cover an area equal to at least 50% of this calculated area with a Class C absorber or better.”

- 7.6 The table below sets out our assessment of the latest proposals:

Table 20. Circulation

Circulation Space	Absorption Proposed	Assessment	Comment
Breakout	20m ² Class A to walls	Area equivalent to floor area Class C or better NOT provided (30m ² min)	Requirement not met – add 10m ² absorption*
Learning Corridor	38m ² Class A to walls	Area equivalent to floor area Class C or better provided to walls (34m ² min)	Meets requirement
Stairwell /Lift Lobby	No treatments	Impracticable to install	Excluded from Scope

*An alternative criteria to provide 2/3 of the normal ADE requirement would be acceptable provided no teaching is proposed in the breakout area, tbc.

Toilets

- 7.7 The ceiling is currently shown on the architectural drawings as CT-02, plasterboard, which is assessed as inadequate.

Alternately, cover the entire ceiling, including above cubicles an absorption Class C or better. If omitting the ceiling above the cubicles an absorbent Class A acoustic ceiling is recommended in the remaining area to achieve the target requirements.

As an ancillary area the criteria may be omitted, assuming that no teaching is proposed in the adjacent breakout area tbc.

8.0 ACOUSTIC DETAILS

- 8.1 Penetrations of structures by ducts, pipework, electrical cables etc. should be adequately sealed acoustically.
- 8.2 Where ducts or pipes penetrate the structure, it is necessary to resiliently line the penetrations to prevent unwanted noise transmission and vibration. This should be done by sleeving penetrations with a 25mm thickness of mineral wool having a density of at least 45kg/m^3 . Any gaps should be fully sealed with a heavy grout, and finished with an application of dense, soft, non-hardening sealant. The following sketches below give a visual indication of suitable methods:
- 8.3 Options for sleeved (right side) and unsleeved (left side) penetration through masonry

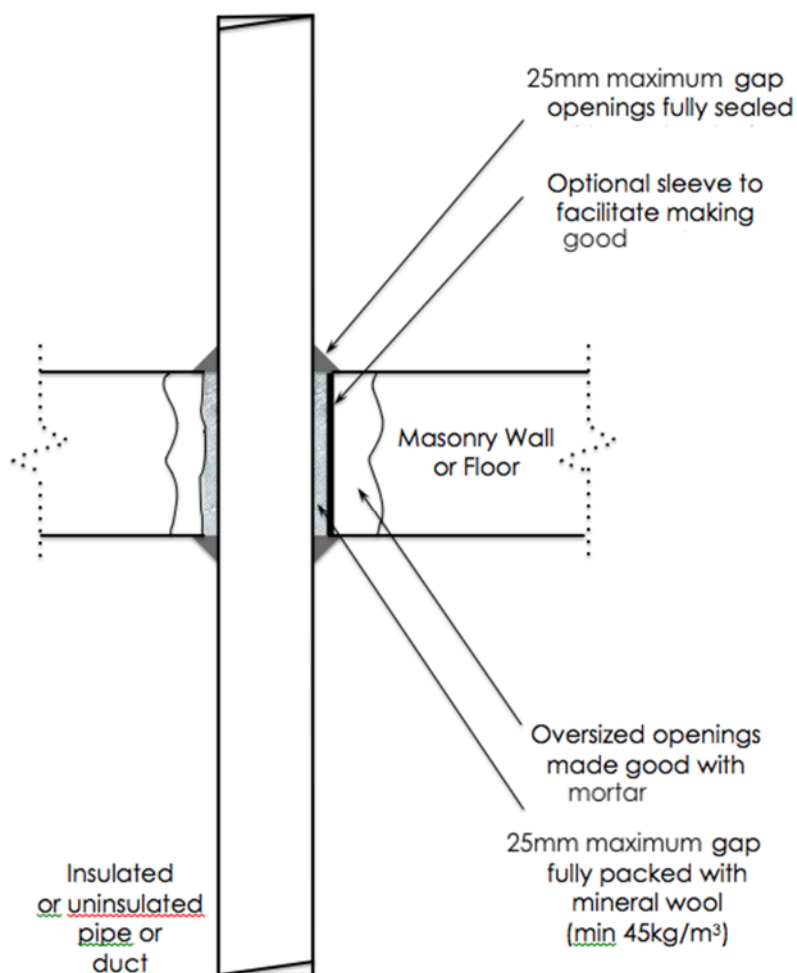


Figure 3. Penetration Details - Masonry

8.4 Sleeved penetrations through drywalls with cover plates:

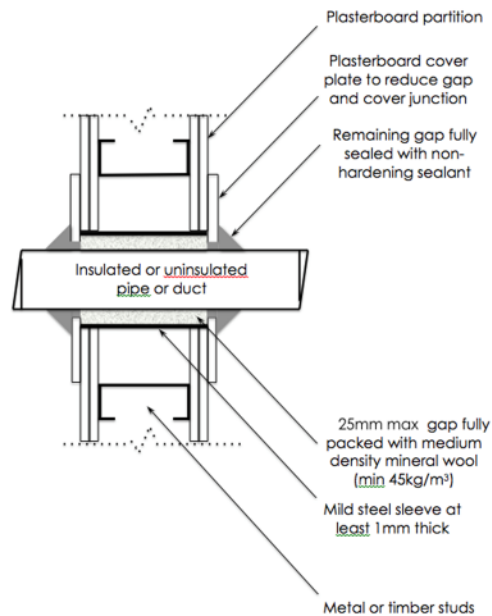


Figure 4. Penetration Details – Dry Walls – with Cover Plates

8.5 Sleeved penetrations through drywall without cover plates:

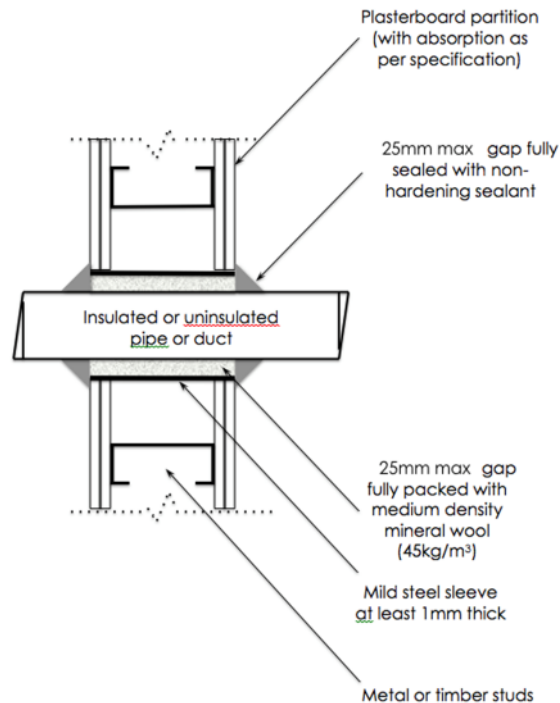


Figure 5. Penetration Details – Dry Walls – without Cover Plates

- 8.6 Wall/Soffit junctions - Walls should be full height and made good to full depth with mortar at the junction with the soffit to avoid noise transmission. Alternative methods may also be acceptable but should be checked and agreed.
- 8.7 Masonry Walls - All masonry walls should have full depth mortar joints and be pointed to a good standard. Blocks (or bricks) at junctions and corners should be fully bonded/interlaced, all holes should be treated, as detailed above, or made good to an equivalent standard to the wall. If brickwork is used the frogs should be laid facing up.
- 8.8 Plaster/Render Finishes - To ensure masonry walls are fully sealed it is good practice to apply a plaster or render finish to masonry walls. Provided walls have full depth mortar joints and are pointed to a good standard a plaster or render finish to one side only (slab to slab) is generally acceptable unless otherwise specified.

9.0 BREEAM HEA05

- 9.1 Sound Insulation: provided the sound insulation advice contained herein is adopted the target criteria should be achieved. There is a risk associated with the movable wall. As such, this BREEAM point might be achieved.
- 9.2 IANLs: in relation to environmental noise ingress IANLs are expected to be achieved with the exception of periods where school groups are passing/present. In relation to building services, with suitably attenuated internal equipment, it is expected that the targets can be met. However, the IANL target is at risk of being exceeded in the Reveller reception due to noise ingress from the external ASHP CU-01 tbc.
- As such, this BREEAM point is not expected to be achieved.
- 9.3 Room Acoustics: provided the absorptive finishes advice contained herein is adopted the target criteria should be achieved. The current drawings/information indicate no absorption in the Toilets and inadequate absorption in the Breakout area. Depending upon the proposed use of the Breakout area alternative criteria could be adopted or more absorption added as advised. As such, this BREEAM point could be achieved.

10.0 CONCLUSION

- 10.1 Our assessment of the adopted Criteria from BB93 for both “New Build” and “Refurbishment” has been detailed and the adopted criteria marked up on a general arrangement drawing.
- 10.2 In certain circumstances alternative criteria have been proposed.
- 10.3 The targeted and alternative criteria should be agreed by stakeholders.
- 10.4 These criteria then form the basis of the BREEAM requirements for the project.
- 10.5 An acoustic assessment of the proposals has been undertaken and specifications and advice provided.
- 10.6 In general, the assessment indicates the adopted criteria should be achievable.
- 10.7 Areas where achieving applicable criteria is not expected, or at risk, have been identified.
- 10.8 At times when groups of children are present and close by, the internal ambient noise levels are predicted to be temporarily exceeded for varying periods (depending upon the presence and activity levels of the group or groups). This is due to the proximity of school visit arrivals and movements and the limitations of the sound insulation of the internal and external building fabric of the Reveller.

Report end

EEC Ltd

APPENDIX A – BB93 CRITERIA TABLES

The following tables detail the criteria for teaching and auxiliary spaces as listed in BB93:

Table 1: Room classification for airborne sound insulation and upper limit for indoor ambient noise level (IANL)				
Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving)	New build	Refurbishment
Nursery school rooms <i>Primary school:</i> classroom, class base, general teaching area, small group room <i>Secondary school:</i> classroom, general teaching area, seminar room, tutorial room, language laboratory	Average	Medium	35	40
<i>Open plan:</i> (See also section 1.8) Teaching area Resource/breakout area	Average	Medium	40	45
Primary music room	High	Medium	35	40
Secondary music classroom ¹ Small and large practice/group room ¹ Performance/recital room ¹	Very high	Low	35	40
Ensemble room ¹ Recording studio ¹	Very high	Low	30	35
Control room - for recording ¹ Control room - not for recording	High Average	Low Medium	35	40
Lecture room	Average	Medium	35	40
Teaching space intended specifically for students with special hearing and communication needs ²	Average	Low	30	35
SEN calming room	High	Low	35	35
Study room (individual study, withdrawal, remedial work, teacher preparation)	Low	Medium	40	45
<i>Libraries:</i> Quiet study area Resource area	Low Average	Medium Medium	40 40	45 45
Science laboratory	Average	Medium	40	45
<i>Design and technology:</i> Resistant materials, CAD/CAM area Electronics/control, textiles, food, graphics, design/resource area, ICT room, art	High Average	High Medium	40 40	45 45
Drama studio, assembly hall, multi-purpose hall (drama, PE, audio/visual presentations, assembly, occasional music)	High	Low	35	40
Atrium, circulation space not intended for teaching and learning	Average	Medium	45	50
Sports hall Dance studio Gymnasium/Activity studio	High	Medium	40	45
Swimming pool	High	High	50	55
Meeting room, Interviewing/counselling room, video conference room	Low	Medium	40	45
Dining room	High	High	45	50
<i>Administration and ancillary spaces:</i>				
Kitchen	High	High	50	55
Office, medical room, staff room	Low	Medium	40	45
Corridor, stairwell, coats and locker area	Average	High	45	55
Changing area	High	High	50	55

Table 2: Summary of ventilation condition, system type and associated IANL tolerance		
Normal - ventilation for normal teaching and learning activities	Mechanical	Table 1 value
	Natural	Table 1 value + 5 dB
	Hybrid	Mechanical system noise:
		Total noise level: Table 1 value + 5 dB
Summertime - ventilation under local control of teacher to prevent overheating – allowable during the hottest 200 hrs of the year	Mechanical	Table 1 value + 5 dB
	Natural or Hybrid	≤55 dB
Intermittent boost – 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	Mechanical	Table 1 value + 5 dB
	Natural	≤55 dB
Process - extract can be automatic ventilation for safety and/or under local control of teacher	Mechanical and/or natural	See IoA/ANC guide for operational noise levels

Table 3a: New build 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	35	45	50
	Medium	40	45	50	55
	Low	45	50	55	55

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

Table 4a: performance standards for airborne sound insulation between circulation spaces and other spaces used by students, with no ventilator in the wall			
Type of space used by students	Minimum R_w dB		
	Composite R_w of wall, glazing with no ventilator dB		Doorset
	New build	Refurbishment	
Secondary school music room Control room – for recording Drama room Multi-purpose hall Teaching spaces intended specifically for use by students with special hearing or communication needs	45	40	35
Primary music classroom All other rooms used for teaching or learning	40	35	30

Table 4b: performance standards for airborne sound insulation between circulation spaces and other spaces used by students, with ventilators in the wall				
Type of space used by students	Minimum <i>R_w</i> dB		Alternative to composite <i>R_w</i> of wall, glazing and ventilators dB, provided values in Table 4a are provided by wall, glazing and doors	
	Composite <i>R_w</i> of wall, glazing and ventilators dB	Doorset	<i>D_{n,e,w}</i> – 10 lg <i>N</i> dB for ventilators	
	New build	Refurbishment		
Secondary school music room Control room – for recording Drama room Multi-purpose hall Teaching spaces intended specifically for use by students with special hearing or communication needs	38	35	35	37
Primary music classroom All other rooms used for teaching or learning	33	30	30	32

Table 5: performance standards for impact sound insulation of floors		
Type of room (receiving room)	Maximum impact sound pressure level <i>L'_{nT,w}</i> dB	
	New build	Refurbishment
Teaching space intended specifically for students with special hearing or communication needs (See Section 0.4)	55	60
<i>Music:</i> Secondary music room Small and large practice/group room Ensemble room Performance/recital room Recording studio Control room - for recording Control room – not for recording	55	60
Nursery school room <i>Primary school:</i> classroom, music classroom, class base, general teaching area, small group room <i>Secondary school:</i> classroom, general teaching area, seminar room, tutorial room, language laboratory Open plan teaching and resource area Library Lecture room Science laboratory Drama studio Design and technology - resistant materials, CadCam area, electronics/control, textiles, food, graphics, design/resource area, ICT room, art room, Assembly hall, multi-purpose hall (drama, PE, audio/visual presentations, assembly, occasional music) Sports hall Gymnasium/Activity studio Dance studio Meeting room, interviewing/counselling room, video conference room SEN calming room	60	65
Atrium, circulation not teaching and learning Swimming pool Dining room <i>Administration and ancillary spaces:</i> Kitchen Office, staff room, medical room Corridor, stairwell Coats and locker area and changing area Toilet	65	65

APPENDIX B – ACOUSTIC SPECIFICATION FOR MOVABLE WALL

Acoustic Specification
Moveable Wall with an On-Site Performance of
50dB ($D_{nT,w}$)

Rated with a reference reverberation time of 1second

Commensurate with the requirements for BB93 “Refurbishment”

The moveable wall installation separating the Reveller Studio and the Reception shall comply with the following acoustic specification unless specifically advised to the contrary.

On Site Performance:

The moveable wall supplier shall guarantee achieving a minimum in-situ Weighted Standardized Level Difference ($D_{nT,w}$) across the partition, between 100Hz and 3150Hz octave bands, of 50dB on site, where the reference reverberation time is 1 second

Testing shall be undertaken in accordance with BS EN ISO 140-4:1998 “Acoustics – Measurement of sound insulation in buildings and of building elements – Part 3. Field measurements of airborne sound insulation between rooms” and rated in accordance with BS EN ISO 717-1:1997. “Acoustics – Rating of sound insulation in buildings and of building elements – Part 1. Airborne Sound Insulation”.

The acoustic performance shall be achieved across the partition as a whole. The moveable wall package is therefore to include not only the moveable wall, but frames, tracks, flank walls, infil panels, doors, floor void barriers, ceiling void barriers and services penetration details as required to achieve the given criterion.

The moveable wall supplier shall ensure that the design and installation of these and any other elements are compatible with achieving the requisite composite sound reduction performance.

Laboratory Performance:

Laboratory acoustic performance (R_w) should not be confused with Weighted Standardized Level Difference acoustic performance ($D_{nT,w}$) which is an on-site value. It should be noted that to account for the normal loss in performance expected outside of laboratory conditions, the laboratory performance of the proposed movable wall will typically need to be significantly higher than the above on-site performance

APPENDIX C - DEFINITION OF TERMS

$L_{Aeq,T}$: Defined in WHO as exposure to noise for the duration of a given time interval T (a 24-hour period, a night, a day, an evening) is expressed as an equivalent sound pressure level (measured in dB(A)) over the interval in question.

L_{Amax} : Defined in WHO as the maximum outdoor sound pressure level associated with an individual noise event.

L_{Afmmax} : Defined in WHO as the maximum outdoor sound pressure level associated with an individual noise event, measured with fast time constant option.

L_{A90} : The background sound level as defined in BS4142: 2014 as 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 time weighting F and quoted to the nearest whole number of decibels.

L_{A10} : The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 10% of a given time interval, T , measured using time weighting F and quoted to the nearest whole number of decibels.

L_{A1} : The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 1% of a given time interval, T , measured using time weighting F and quoted to the nearest whole number of decibels.

T_{mf} : The BB93 criteria τ_{mf} is the arithmetic average of the measured reverberation time in the common speech frequencies 500Hz, 1kHz and 2kHz.

L_{day} : is the A-weighted long-term average sound level as defined in ISO 1996-1: 2016, determined over all the day periods of a year.

$L_{evening}$: is the A-weighted long-term average sound level as defined in ISO 1996-1: 2016, determined over all the evening periods of a year.

L_{night} : is the A-weighted long-term average sound level as defined in ISO 1996-1: 2016, determined over all the night periods of a year.

L_{den} : is an average sound pressure level over all days, evenings and nights in a year (EEA, 2010), a compound indicator of the above mentioned L_{day} , $L_{evening}$, and L_{night} .

Measurement time interval, T : The total time over which each individual measurement is taken.