MACH GROUP

CVL - FORMER PONTLLANFRAITH COMPREHENSIVE SCHOOL

Acoustic Design Report

Caerphilly County Borough Council

MACH Acoustics Ltd

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1.0 PROJECT OVERVIEW

1.1 Project Summary

This report is for the proposed development of proposed Centre for Vulnerable Learners on the former Pontllanfraith Comprehensive School site, for KS3 and KS4 students. This project includes the refurbishment of an existing school building, comprising of teaching spaces and group areas, library and resource areas, music spaces, dining areas, staff offices, and various supporting ancillary spaces. The development also includes the construction of a new-build sports hall building, including a main hall, changing rooms and ancillary spaces.

1.2 Performance Standards

The table below outlines the various performance standards and guidance documents which have formed the basis of the acoustic design. Any standards which have been included in the table below, but are not marked mandatory, have been referred to for guidance only.

Document	Mandatory to demonstrate compliance with		
	Building Regulations	ERs	BREEAM 2018
BB93	Yes *	-	Yes **

Table 1.1: Performance Standards

* As the development of the teaching block concerns an existing school building where the refurbishment includes no material change of use, BB93 is not mandatory. However, it has been used as the primary design guidance for this report. BB93 is mandatory for the development of the sports hall.

** BREEAM compliance is only applicable to the new sports hall building.

2.0 SUITABLY QUALIFIED ACOUSTICIAN

All design work for this project has been completed or reviewed by a suitably qualified acoustician (SQA) as per BREEAM requirements. The SQA detail has been presented in the table below:

Suitably Qualified Acoustician	
Name	Max Reynolds
Degree	BSc Hons - Music Systems Engineering
Institute of Acoustic Membership	Member of Institute of Acoustics
Total Years of Relevant Experience	9 Years (2012 – Present)
Total Years of Relevant Experience in previous 5 Years	5 Years

Table 2.1: Suitably Qualified Acoustician

Note: Mach Acoustics Ltd is also registered with the Association of Noise Consultants (ANC)

3.0 INDOOR AMBIENT NOISE LIMITS

Building Bulletin 93 – Acoustic Design of Schools: Performance Standards (2015) specifies maximum indoor ambient noise levels in terms of an $L_{Aeq,30min}$, where these noise limits are dependent on specific room classifications and ventilation method. These levels are seen to be the overall noise levels constitutes the sum of both building services noise and external noise ingress and any other noise sources present within the unoccupied, fully operational building. BB93 also sets a maximum "L1" noise level of 60 dB $L_{A1,30min}$ in teaching spaces and is used to assess short transient noise levels associated with aircraft, railways and other similar sources. This is achieved by default for spaces with indoor ambient noise levels up to 40 dB $L_{Aeq,30min}$, but requires assessment in spaces with indoor ambient noise level targets of 45dB $L_{Aeq,30min}$ or above.

These classifications and criteria have been applied to each room within this development and are presented in APPENDIX A.

3.1 BB93 Relaxations

3.1.1 Natural/Hybrid Ventilation

Where a natural ventilation strategy is to be employed, the indoor ambient noise limits can be relaxed by 5dB $L_{Aeq,30min}$ where the "normal condition" is achieved. However, this does not apply to spaces with an indoor ambient noise limit of 45dB $L_{Aeq,30min}$ or higher. For hybrid ventilation systems, the mechanical system noise component must comply with the limits set out in Table 1 of BB93, however the overall noise limit can also be relaxed by 5dB $L_{Aeq,30min}$.

BB93 states that the normal condition for a natural or hybrid ventilation mode is defined as when the system is operating to limit the daily average CO_2 concentration to no more than 1,500 ppm with the maximum concentration not exceeding 2,000 ppm for more than 20 consecutive minutes on any day. This would normally equate to a minimum ventilation rate of approximately 5 l/s per person.

3.1.2 Summertime/Intermittent Boost Ventilation

BB93 also permits a further relaxation during the summertime. Summertime is defined as the hottest 200 hours in peak summertime. During summertime, natural and hybrid ventilation systems are permitted to relax indoor ambient noise limits to an upper limit of 55 dB $L_{Aeq,30min}$. The ventilation must be under the local control of the teacher so that the noise level can be reduced to normal levels when needed. Mechanical ventilation systems are permitted to relax indoor ambient noise limits by 5dB $L_{Aeq,30min}$. However, this does not apply to spaces with an indoor ambient noise limits of 45 dB $L_{Aeq,30min}$ or higher. Summertime noise limit relaxation does not apply to classrooms intended specifically for students with special hearing and communication needs, or to speech therapy rooms.

The peak summertime condition is defined as the 200 hottest hours that occur using the design summer year (DSY) weather file during normal daily school operating hours including the summer holiday period. Thermal modelling and assessment of acoustic performance should be carried out as if the school were occupied through the summer holiday period. This corresponds to a much lower number of hours during normal term time (equivalent to typically 40 teaching hours in a school year) as most of the hottest hours occur during the holiday period.

4.0 NOISE CLIMATE

To establish the existing environmental noise levels on site, a noise survey was conducted between 10:45 on the 14/03/2022 and 17:15 on the 15/03/2022. For more information on the methodology of this survey, site information and survey data, see APPENDIX A.

4.1 Site Description

The site is located at the former Pontllanfraith School and is situated in the urban area of Blackwood, Wales. Noise levels are generally quiet with road traffic contributing to the main source of noise. The site in relation to its surroundings is as presented below.

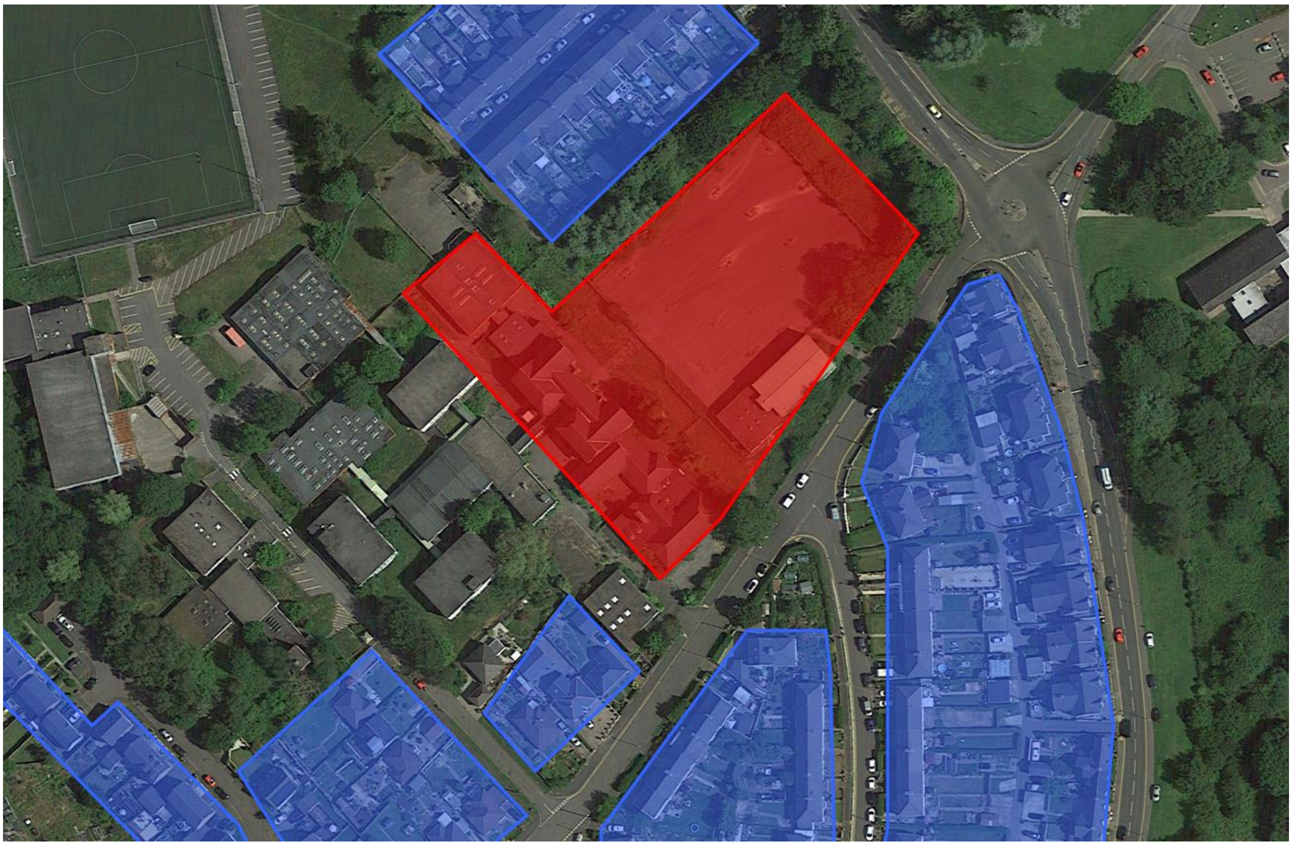


Table 4.1: Site Boundary (Red) and Nearest Noise Sensitive Receivers (Blue)

4.2 Noise Sources

Noise Type	Noise Characteristics	Sources
Dominant	A primary contributor of noise levels on the site.	Road traffic from Blackwood Road B4251.
Other Noise Contributions	Contributors to the remainder of the noise climate on site.	Birdsong

Table 4.2: Subjective Summary of Noise Sources

4.3 Summary of $L_{Aeq,30mins}$ Noise Levels

Based on the results of the environmental noise survey, the $L_{Aeq,\ 30mins}$ noise levels representative of the local noise climate has been produced by means of logarithmically averaging the fixed measurement data to fit this time period as shown in the table below.

Location	Date	Start	End	Duration	$L_{Aeq,30min}$ (dB)
Fixed Microphone Location 1	14/03/2022	10:45	11:15	00:30:00	49
		11:15	11:45	00:30:00	47
		11:45	12:15	00:30:00	50
		12:15	12:45	00:30:00	50
		12:45	13:15	00:30:00	45
		13:15	13:45	00:30:00	45
		13:45	14:15	00:30:00	45
		14:15	14:45	00:30:00	44
		14:45	15:15	00:30:00	46
		15:15	15:45	00:30:00	46
		15:45	16:15	00:30:00	46
		16:15	16:45	00:30:00	46
		16:45	17:15	00:30:00	45
	15/03/2022	09:00	09:30	00:30:00	48
		09:30	10:00	00:30:00	47
		10:00	10:30	00:30:00	46
		10:30	11:00	00:30:00	50
		11:00	11:30	00:30:00	46
		11:30	12:00	00:30:00	46
		12:00	12:30	00:30:00	44
		12:30	13:00	00:30:00	45
		13:00	13:30	00:30:00	47
		13:30	14:00	00:30:00	46
		14:00	14:30	00:30:00	46
		14:30	15:00	00:30:00	48
		15:00	15:30	00:30:00	47
		15:30	16:00	00:30:00	46
		16:00	16:30	00:30:00	48
		16:30	17:00	00:30:00	47

Table 4.3: Summary of $L_{Aeq,\ 30mins}$ Noise Levels

As shown in the table above, 50 dB $L_{Aeq,\ 30mins}$ is the highest measured $L_{Aeq,\ 30mins}$ noise level at the fixed measurement position.

4.4 Summary of Background Noise Levels, L_{A90}

The table below presents the typical measured noise levels of the L_{A90} values measured on site. These will be discussed further in the plant noise impact assessment to ensure a representative value will be used in relation to the proposed operational hours.

Date	Location	Period, T	Average	L_{A90} (dB)
05/04/2022	Fixed Position 1	Daytime (16 hour)	Mode	40
		Night time (8 hours)	Mode	32

Table 4.4: Summary of Fixed Location Measurement

5.0 EXTERNAL NOISE BREAK-IN ASSESSMENT

5.1 Design Target

The most onerous internal ambient noise level target provided by BB93 for the teaching block is ≤35 dB $L_{Aeq,30min}$. With the additional natural ventilation relaxation of +5dB, that means the most onerous indoor ambient noise level requirement for this building is 40 dB $L_{Aeq,30min}$.

The most onerous internal ambient noise level target provided by BB93 for the sports hall building is ≤40 dB $L_{Aeq,30min}$ (no natural vent relaxation as mechanical ventilation Is to be used).

5.2 Proposed Ventilation Strategy

The proposed ventilation strategy is understood to be natural ventilation via simple openable windows in the teaching block, and mechanical ventilation in the sports hall.

5.3 Façade Noise Levels

5.3.1 $L_{Aeq,30min}$ Assessment Noise Levels

The fixed measurement position is seen to be representative of most onerous façade levels at the teaching block. The Spot 3 position is seen to representative of most onerous façade levels at the sports hall. The spot measurements have been compared with the fixed measurements taken synchronously as shown in the table below:

Time	Position	$L_{Aeq,5mins}$ dB	Position	$L_{Aeq,5mins}$ dB	Difference
16:47 – 16:50	Spot 3	61	Fixed 1	46	+15
16:50 – 16:55	Spot 3	61	Fixed 1	46	+15
16:55 – 17:00	Spot 3	61	Fixed 1	47	+14

Table 5.1: Comparison of Spot Measurement Results and fixed measurement results.

The difference in measured noise levels between the fixed measurement position and the spot measurement positions have been presented in the table below, which has been used as corrections to derive the representative façade noise levels.

Location	Fixed Microphone Correction L_{Aeq}, dB
Sports Hall (Spot 3)	+15

Table 5.2: Corrections Derived from Difference Between Fixed and Spot Measurements

As shown in Table 4.3, 50 dB $L_{Aeq,\ 30mins}$ is the highest measured $L_{Aeq,30mins}$ noise level at the fixed measurement position. This has been used in the table below to derive the predicted façade noise level.

Assessment Period	Façade	Measured Noise Level, dB $L_{Aeq,30min}$	Correction, dB	Predicted Façade Noise Level, dB $L_{Aeq,30min}$
Daytime (07:00 – 23:00)	Teaching Block	50 (Fixed F1)	+0	50
	Sports Hall	50 (Fixed F1)	+15	65

Table 5.3: Façade Noise Level Calculation

5.4 Teaching Block Natural Ventilation Feasibility Assessment

An open window typically provides between 10 to 15 dBA of sound attenuation and has been referenced within PPG24 and other documents. MACH Acoustics typically take 13 dBA as the sound attenuation provided by an open window ventilation strategy. Subtracting this figure from the predicted façade noise level gives a predicted internal noise level.

	Highest $L_{Aeq,T}$ (dB)
Design Target	≤40
Highest Measured Noise Level at the Façade	50
Open window attenuation	-13
Predicted Indoor Ambient Noise Level	47

Table 5.4: Predicted Indoor Ambient Noise Level

The predicted internal noise level does not exceed the most onerous internal noise limit therefore, the spaces within the teaching block can be naturally ventilated through simple openable windows.

5.5 Minimum Façade Specification

MACH understands that the teaching block existing façade is to remain. If any element of the existing façade is to be replaced, the new construction should comply with the following specification.

Regarding the new sports hall, MACH understands the sports hall façade is to be a mixture of blockwork up to approximate 3m, with SFS above. Exact construction systems have not been provided. The proposed façade systems should achieve he is following sound reduction indices.

	Sound Reduction Indices (Octave Band Centre Frequency, Hz)						Weighted (R_w dB)
Element	125	250	500	1000	2000	4000	
Teaching Block							
External Wall	No specific spectral requirements						43
Window	No specific spectral requirements						32
Roof	No specific spectral requirements						35
Sports Hall							
External Wall	24	34	40	45	49	49	43
Roof	21	26	33	33	35	35	34
Door	20	25	27	28	32	32	30

Table 5.5 - Minimum SRI For Facade Elements

If the above specification is met, the façade construction will be suitable to mitigate against external noise break in.

5.6 Rain Noise

5.6.1 Criteria

The criteria stated in the table below shall be demonstrated through laboratory test and/or calculation, and includes any glazing, or lightweight structure. Any repairs to existing roofs are exempt from this requirement, however, any new roofing elements must comply.

A roof construction with a surface mass less than 150 kg/m^2 is considered to be lightweight.

Rain Type (as defined by BS EN ISO 140-18)	Rain Noise Limit (dB $L_{Aeq,30min}$)
Heavy Rainfall	≤ Indoor Ambient Noise Limit + 25 dB

Table 5.6: Rain Noise Limits

5.6.2 Rain Noise Assessment

MACH understands the roof of the existing teaching block is to remain unchanged, therefore this is seen to be outside the scope of this assessment. The below applies to the new build sports hall.

There is not always test data available for lightweight roofs under heavy rain conditions, therefore, for the purposes of assessment a similar system with test data must be used. The table below outlines the proposed roof constructions, and any alternatives which have been substituted into calculations.

Proposed Roof Construction	Roof Construction Used In Calculations
Aluminium standing seam roof covering system	Kalzip Liner Roof (E) - 0.9mm Aluminium, 160mm compressed to 155mm mineral wool, 0.7mm steel (TR35/200) liner sheet

Table 5.7: Roof Construction(s) Used

Room	Internal Ambient Noise Limit (dB $L_{Aeq,30min}$)	"Heavy" Rain Noise Limit (dB $L_{Aeq,30min}$)	Calculated "Heavy" Rain Noise Level (dB $L_{Aeq,30min}$)
sh11 Sports Hall	40	65	62
Sh03/04 Changing Room	50	75	66

Table 5.8: Rain Noise Calculation Results

As can be seen from the table above, the proposed roof construction is sufficient and indoor ambient noise levels will not be exceeded by more than 25 dB(A) during “Heavy” rainfall.

6.0 INTERNAL SOUND INSULATION

6.1 Airborne Sound Insulation Criteria

The onsite acoustic performance criteria for the airborne sound insulation of walls and floors are dependent on the room classification of the source and receiving room. The two tables below present the minimum performance standards required between rooms based upon the Activity Noise and Noise Tolerance of each room. Table 6.1 presents the sound insulation requirements for new builds (sports hall), Table 6.2 is for conversions and refurbishments of existing buildings (teaching block)

Minimum $D_{nT,w}$ (dB)		Activity Noise in source room			
		Low	Average	High	Very High
Noise Tolerance in receiving room	High	n/a	35	45	50
	Medium	40	45	50	55
	Low	45	50	55	55

Table 6.1: New build performance standards for airborne sound insulation between spaces

Minimum $D_{nT,w}$ (dB)		Activity Noise in source room			
		Low	Average	High	Very High
Noise Tolerance in receiving room	High	n/a	30	35	45
	Medium	30	40	45	45
	Low	35	40	50	50

Table 6.2: Refurbishment performance standards for airborne sound insulation between spaces

Each room classification has an Activity Noise and Noise Tolerance rating. These classifications and criteria have been applied to each room within this development and are presented in APPENDIX A.

6.1.1 Exceptions Allowable Within BB93

Exception	Scenario	Element(s)	Sound Reduction
1	Interconnecting doors between teaching spaces	Doorset	≥ 35 dB R_w
		Composite sound reduction (wall, door and glazing)	≥ 45 dB R_w
2	Doors and service hatches between kitchens and multi-purpose halls (not dining spaces)	Serving hatch	≥ 18 dB R_w [1]
3	Folding partitions between teaching spaces and halls	Operable wall	≥ 40 dB $D_{nT,w}$ [2]
4	Vision panels between multi-purpose halls, music rooms and control room requiring visual communication only	Solid vision panel	≥ 45 dB R_w
		Separating partition	≥ 55 dB R_w
5	Vision panels between multi-purpose halls, music rooms and control room requiring visual and audio communication	Sliding vision panel	N/A
		Separating partition	≥ 45 dB R_w

[1] Adjacency should be avoided where possible, or a servery included between kitchen and hall, recommend timetabling use of dining hall so noise sensitive activities, e.g. exams, do not take place in the hall when the kitchen is in use.
[2] Performance of operable wall may not facilitate simultaneous independent use of adjacent spaces

Table 6.3: Allowed Sound Insulation Exceptions

6.1.2 Walls to Circulation Spaces

Where there is a door in a separating partition between noise sensitive and shared circulation spaces, the below targets are applicable. These classifications and criteria have been applied to each room within this development and are presented in APPENDIX A.

<table>
<tr><th rowspan="2"></th><th rowspan="2">Area</th><th colspan="3">Requirements</th></tr>
<tr><th>Wall & Glazing
(dB R_w)</th><th>Doorset
(dB R_w)</th><th>Ventilators *
(dB $D_{n,e,w}$ – 10LogN [1])</th></tr>
<tr><td rowspan="7">New Build</td><td>Secondary School Music Room</td><td rowspan="5">≥ 45</td><td rowspan="5">≥ 35</td><td rowspan="5">≥ 37</td></tr>
<tr><td>Control Room for Recording</td></tr>
<tr><td>Drama Room</td></tr>
<tr><td>Multi-Purpose Hall</td></tr>
<tr><td>Teaching space specifically for students with special hearing or communication needs</td></tr>
<tr><td>Primary Music Room</td><td rowspan="2">≥ 40</td><td rowspan="2">≥ 30</td><td rowspan="2">≥ 32</td></tr>
<tr><td>All other rooms used for teaching or learning</td></tr>
<tr><td rowspan="7">Refurbished</td><td>Secondary School Music Room</td><td rowspan="5">≥ 40</td><td rowspan="5">≥ 35</td><td rowspan="5">≥ 37</td></tr>
<tr><td>Control Room for Recording</td></tr>
<tr><td>Drama Room</td></tr>
<tr><td>Multi-Purpose Hall</td></tr>
<tr><td>Teaching space specifically for students with special hearing or communication needs</td></tr>
<tr><td>Primary Music Room</td><td rowspan="2">≥ 35</td><td rowspan="2">≥ 30</td><td rowspan="2">≥ 32</td></tr>
<tr><td>All other rooms used for teaching or learning</td></tr>
<tr><td colspan="5">[1] Where N is the number of ventilators with airborne sound insulation Dn,e,w
* Please note that in any instance where the wall and door performance has been increased to 45 dB R_w and 35 dB R_w respectively to mitigate noise transfer into teaching space that the ventilator specification should also be increased to 37 dB D_{new}, such to not compromise the sound insulation specified.”</td></tr>
</table>

Table 6.4: Sound Insulation Requirements to Circulation Spaces

6.2 Separating Wall Requirements

Room 1	Room 2	Minimum On-site Requirement (dB D_{nTw})	Calculated SRI Requirement for Partition (dB R_w)	Simplified SRI Requirement for Partition (dB R_w)
Ground Floor				
03 Hall	04 Kitchen	Exception (Service Hatch)	40 dB R_w Surrounding Wall / 18 dB R_w Service Hatch	
03 Hall	14 Music	≥ 50	57	60
03 Hall	16 Café	≥ 50	47	50
14 Music	06 Change	≥ 50	59	60
15 Music Practice	13 Circ	≥ 40	52	55
14 Music	16 Café	≥ 50	56	60
14 Music	15 Music Practice	Exception (Interconnecting Doors - See Section 6.3.1)	55 dB R_w Wall / 40 dB R_w Door	
16 Café	17 Food Room	Exception (Service Hatch)	40 dB R_w Surrounding Wall / 18 dB R_w Service Hatch	
12 Parents	21 Head	≥ 30[1]	50[1]	50
21 Head	22 Group	≥ 30	50	50
22 Group	23 Group	≥ 30	49	50
23 Group	18 Circ	≥ 40	49	50
23 Group	27 WC	≥ 40	46	50
18 Circ	25 Library	≥ 40	36	40
25 Library	26 Classroom	≥ 40	46	50
27 WC	28 Group	≥ 40	48	50
28 Group	29 Classroom	≥ 40	48	50
26 Classroom	33 Stair	≥ 40	45	45
26 Classroom	31 Staff	≥ 30	36	40
31 Staff	32 Switch	≥ 40[1]	50[1]	50
33 Stair	34 Gen Office	≥ 40[1]	49[1]	50
38 Circ	43 Classroom	≥ 40	45	45
42 Meeting	43 Classroom	≥ 30	36	40
43 Classroom	47 Group	≥ 40	47	50
47 Group	48 Prep	≥ 30	48	50
44 Stairs	45 Classroom	≥ 40	45	45
45 Classroom	51 Science	≥ 40	46	50
51 Science	52 WC	≥ 40	41	45
First Floor				
57 Classroom	58 Classroom	≥ 40	51	55
57 Classroom	60 Classroom	≥ 40	50	50
60 Classroom	33 Stair	≥ 40	43	45
63 Therapy	62 Circ	≥ 40	48	50
67 Classroom	68 Classroom	≥ 40	51	55

Room 1	Room 2	Minimum On-site Requirement (dB D_{nTw})	Calculated SRI Requirement for Partition (dB R_w)	Simplified SRI Requirement for Partition (dB R_w)
68 Classroom	69 PPA	≥ 30	34	40
69 PPA	70 Classroom	≥ 30	35	40
70 Classroom	44 Stairs	≥ 40	43	45
Sports Hall				
sh11 Sports Hall	sh14 Workshop	≥ 50	54	55
[1] Considered administration or ancillary, therefore, guidance only				

Table 6.5: Separating Wall Requirements

6.3 Existing Wall Construction

Sound insulation test results of the existing walls are presented in APPENDIX C. Many of the existing walls underperformed during the testing due to vandalism, usually to the corridor walls, thus the dominant path of sound transmission occurred via the adjoining corridors. The tests results show that the performance of the walls that are in a good state of repair comfortably exceed the most onerous performance target of > 50 dB D_{nTw}. MACH predict that the existing wall construction is adequate to achieve performance requirements, assuming all damaged partition are repaired to the original construction standard.

6.3.1 Existing Music Classroom / Music Practice Construction

BB93 contains an exception for teaching spaces linked via interconnecting doors, specifying a 35 dB door and 45 dB wall. Due to the use-case of these linked music spaces, MACH strongly recommends an uplift to this specification. The performance of the existing construction appears to be sufficient to achieve the requirements outlined in Table 6.5, assuming repairs are made. See APPENDIX C for further details. It is essential the separating door is well sealed.

6.4 Internal Doors

BB93 provides guidance on typical door constructions capable of achieving different levels of sound insulation.

R_w 30 doors typically have a minimum surface density of 27kg/m^2 and are at least 44mm thick.
R_w 35 doors typically have a minimum surface density of 29kg/m^2 and are at least 54mm thick.

Both doors would typically have the following features:

- Solid core, or laminate, door leaf,
- Perimeter seals, including the threshold
- A latching mechanism ensuring adequate compression of all door seals, and gentle contact with the door frame, devoid of noise, or structural impact

Where vision panels can be installed in doors, the size of the glazing and performance of the glazing must be such that it has an equal performance to that of the door slug.

6.5 Internal Glazing

Where there is internal glazing, the composite sound insulation performance of the internal wall and the glazing must achieve equal or better than the overall wall performance that the glazing has been set within.

The table below provides example of glazing configurations for different R_w requirements. Constructions provided are based on data published by Saint Gobain, but other manufacturers may provide similar systems.

R_w Rating	Description
35 dB	4mm Glass / 20mm Void / 6mm Glass
40 dB	6mm Glass / 27mm Void / 10mm Glass
45 dB	10mm Glass / 16mm Void / 8.4mm Laminated Glass
50 dB	8.8mm Laminated Glass / 24mm Void / 12.8mm Laminated Glass

Table 6.6: Glazing Configurations and Corresponding R_w Ratings

6.6 Example Lightweight Wall Constructions – New Walls

Construction	Thickness (no skim) (mm)	Tested Laboratory Rating (dB R_w)	Suitable for Walls Rated to Achieve; (dB R_w)
1 x 12.5 mm Wallboard (8.0 kg/m²) 70 mm Metal Studs (600 mm centres), 50 mm mineral wool (min. 10 kg/m²) 1 x 12.5 mm Wallboard (8.0 kg/m²)	97	42	40
1 x 15 mm Soundbloc (12.6 kg/m²) 70 mm Metal Studs (600 mm centres), clear cavity 1 x 15 mm Soundbloc (12.6 kg/m²)	102	42	
1 x 12.5 mm Soundbloc (10.6 kg/m²) 70 mm Metal Studs (600 mm centres), 50 mm mineral wool (min. 10 kg/m²) 1 x 12.5 mm Soundbloc (10.6 kg/m²)	97	45	45
1 x 15 mm Soundbloc (12.6 kg/m²) 70 mm Metal Studs (600 mm centres), 50 mm mineral wool (min. 10 kg/m²) 1 x 15 mm Soundbloc (12.6 kg/m²)	102	47	47
2 x 12.5 mm Soundbloc (10.6 kg/m²) 70 mm Metal Studs (600 mm centres), 50 mm mineral wool (min. 10 kg/m²) 2 x 12.5 mm Soundbloc (10.6 kg/m²)	120	52	52
2 x 12.5 mm Soundbloc (10.6 kg/m²) 70 mm Metal AcouStuds (600 mm centres), 50 mm mineral wool (min. 10 kg/m²) 2 x 12.5 mm Soundbloc (10.6 kg/m²)	124	58	57
2 x 15 mm SoundBloc (12.6 kg/m²) 146 mm Metal Studs (600 mm centres),50 mm mineral wool (min. 10 kg/m²) 17 mm resilient bar 2 x 15 mm SoundBloc (12.6 kg/m²)	147	62	62
2 x 12.5 mm Soundbloc (10.6 kg/m²) Twin Metal stud with Acoustic Braces, 100 mm mineral wool (min. 21 kg/m²) 2 x 12.5 mm Soundbloc (10.6 kg/m²)	300	67	65

Table 6.7: Example Wall Constructions & Corresponding R_w Ratings

6.7 Separating Floors

6.7.1 Sound Insulation Requirements

		Minimum On-site Requirements		Calculated Laboratory Ratings	
Room 1	Room 2	(dB $D_{nT(Tmf,max)w}$)	(dB L'_{nTw})	(dB R_w)	(dB L_{nw})
70 Classroom	45 Classroom	≥ 40	≤ 65	47	65
58 Classroom	31 Staff	≥ 30	≤ 65	37	63

Table 6.8: Separating Floor Requirements

6.7.2 Existing Floor Construction

Sound insulation test results of the existing walls are presented in APPENDIX C. The results show the performance of the existing floor is adequate to achieve the requirements.

6.8 Impact Sound Insulation

6.8.1 Criteria

BB93 requires a degree of impact sound insulation performance across separating floors. Impact isolation is the reduction of sound resulting from noise being generated through direct impacts to the building structure, for example footfall and chair scrapes.

The impact sound insulation criteria for each classification have been applied to each room within this development and are presented in Appendix A.

6.8.2 Existing Floor Construction

Impact test results of the existing walls are presented in APPENDIX C. The results show the performance of the existing floor is adequate to achieve the requirements.

6.9 Hand Dryers

Noise from hand dryers has the potential to cause disturbance to nearby spaces. Fixing hand dryers directly to separating partitions should be avoided and the exact placement of the hand dryers should be considered to reduce noise disturbance.

Should there be particular concern over noise from hand dryers, low velocity hand dryers should be specified to reduce noise generation at the expense of longer drying times.

6.10 Riser Doors

Riser doors should be at least 44mm thick and formed from a solid or laminate core. Acoustic compressions seals should be installed between the door leaf and rebated frame around the entire perimeter. There are no acoustic requirements relating to these doors, however, MACH Acoustics should be informed whenever a riser links two teaching spaces, as there is a risk of sound transfer through the riser which may require mitigation measures.

6.11 Building Services

Any mechanical plant with moving parts needs to be fixed to the structure using resilient anti vibration mounts, to minimise reradiated noise into dwellings through structural vibration. The manufacturer should be able to advise appropriate mounts or mitigation methods.

Noise limits have been imposed upon building services rooms, based upon the proposed surrounding constructions, such that internal noise level targets in adjacent spaces are met. Note, the values given below are the total sum of all plant units and any noise build-up due to reverberation.

Source Room	Limiting Adjacency	Surrounding Construction(s)	Source Room Noise Limit
55 Plant Room (Teaching Block)	52 F.WC	55 dB Rw Wall (Existing)	NR 58
sh15 Plant Room (Sports Hall)	Circulation	60 dB Rw Wall 50 dB Rw Floor	NR 59

Table 6.9: Building Services Noise Limits

6.11.1 Cross Talk Attenuators

Any interconnecting duct work has the potential to compromise the overall sound insulation between spaces. It is therefore seen to be the responsibility of others to ensure that the correct level of acoustic separating is provided by the selected cross talk attenuators.

6.12 Penetration Detailing

6.12.1 Cable Trays and Trunking

No service penetrations should be made through separating floors, i.e. between occupied spaces, and all services should enter the room via a corridor, and not pass directly from room to room. The table and figures below outline ways to maintain the acoustic integrity. For each figure, the upper half of each image should be used for penetrations within lightweight constructions, and the lower half for masonry.

Penetration type	Detailing	Figure ref
Cable tray & trunking	Tightly pack rockwool fire pillows into opening Insert plasterboard lining under tray Seal with non-hardening mastic	Figure 6.1
Penetration with < 5 mm clearance	Seal with non-hardening mastic	Figure 6.2
Penetration with 5 – 20 mm clearance	Pack gap between wall and penetration with insulation Reduce gap around penetration to ≤ 5 mm with plasterboard Seal remaining gap with non-hardening mastic	Figure 6.2
Penetration with > 5 mm clearance	Pack gap between wall and penetration with insulation Reduce gap around penetration to ≤ 5 mm with plasterboard collar Seal remaining gap with non-hardening mastic	Figure 6.2

Table 6.10: Penetration Detailing

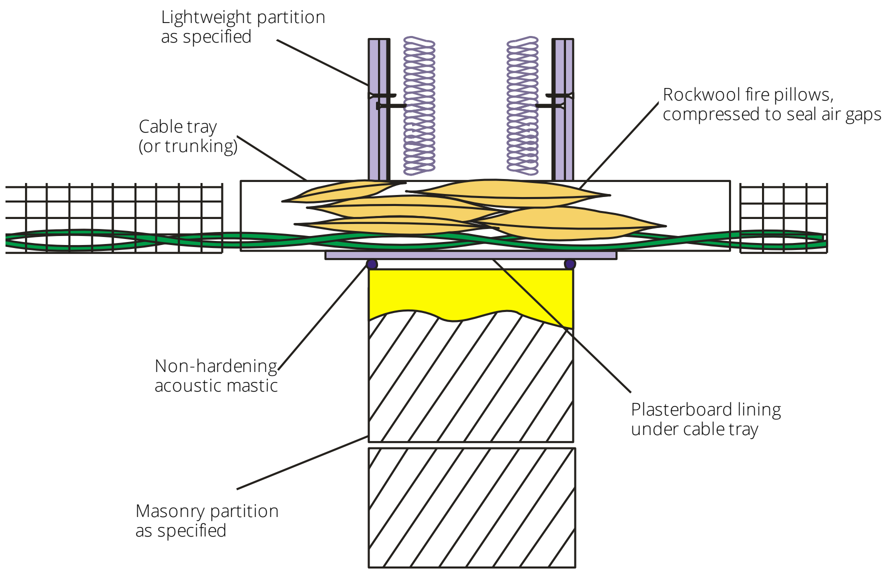


Figure 6.1: Cable Tray and Trunking Detailing

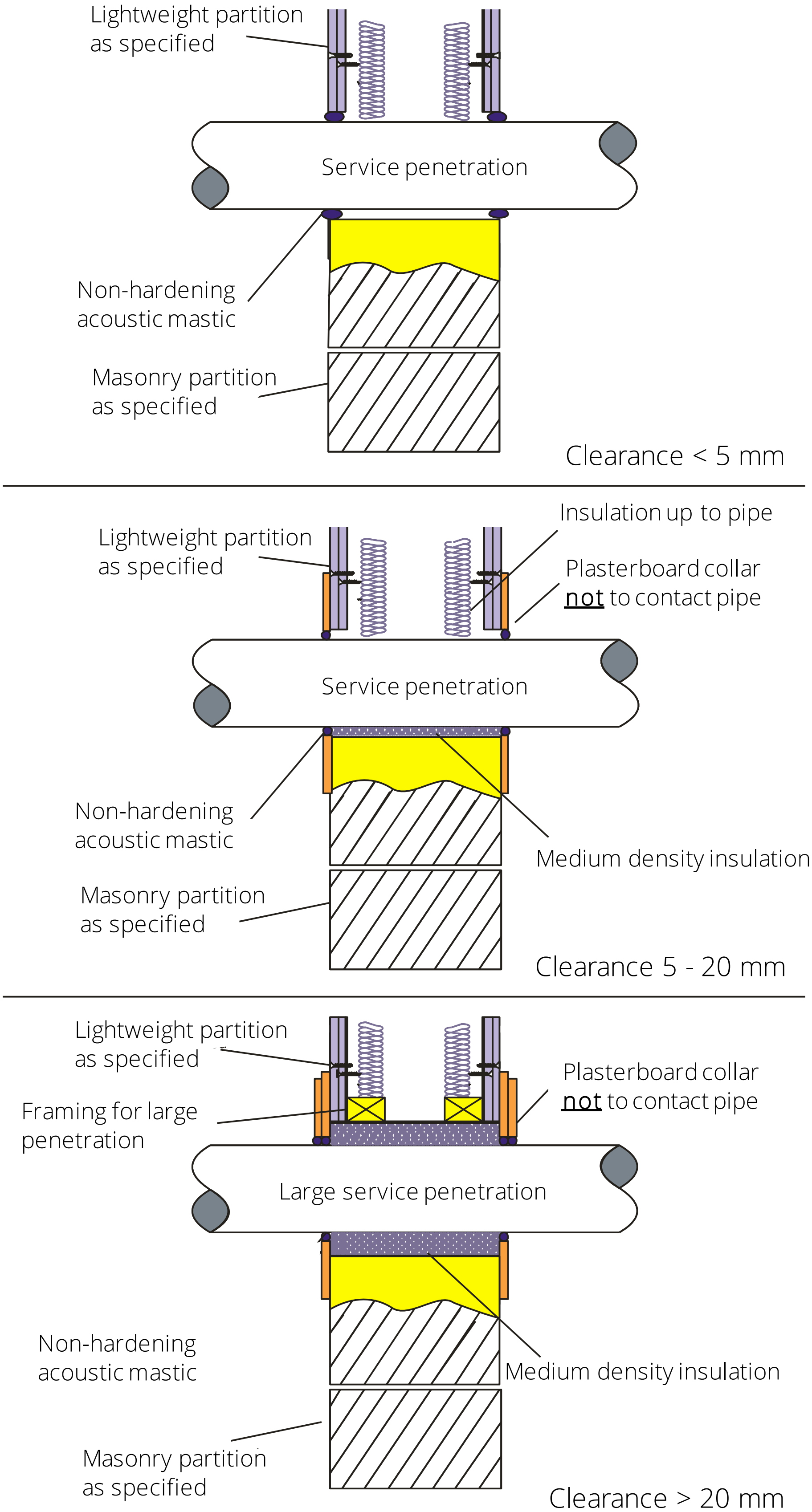


Figure 6.2: Service Penetration Detailing

6.12.2 Recessed Sockets and Switches

The architectural details indicate that there are recessed plug sockets located back-to-back either side of separating walls, which may compromise the sound insulation of the partition.

Instead, all sockets and switches should be staggered by 150 mm and be detailed and sealed in such a way that the acoustic integrity of the separating partition is not compromised.

The table below outlines possible options to maintain the acoustic integrity.

Separating Wall Scenario	Detailing Options
Sound insulation requirement ≤ 45 dB R_w	Putty Pad, note, any gaps or openings around a putty pad compromise the sound insulation performance. Acoustic Back Box Plasterboard backing, as per Robust Standard Details guidance, see Figure 6.3
Sound insulation requirement > 45 dB R_w	Acoustic Back Box Plasterboard backing, as per Robust Standard Details guidance, see Figure 6.3
Sockets/switches back to back, or < 150mm apart	Plasterboard backing, as per Robust Standard Details guidance, see Figure 6.3

Table 6.11: Recessed socket/switch detailing

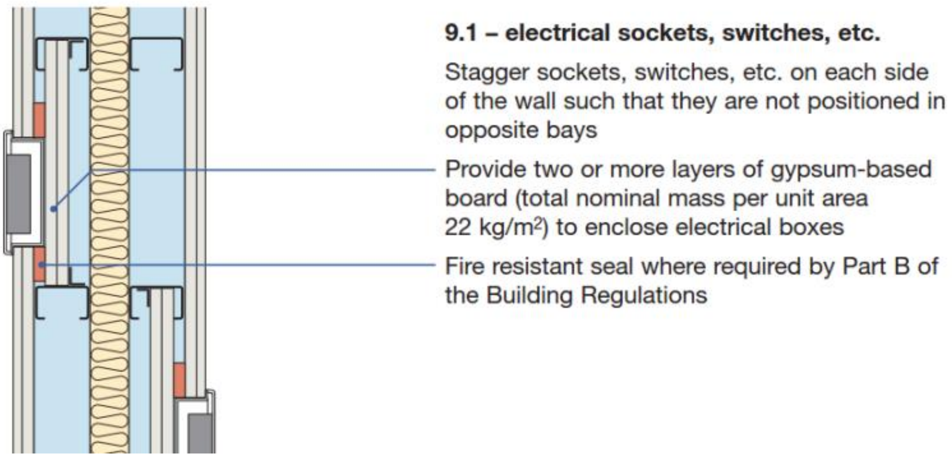


Figure 6.3: RSD Plan Plasterboard Backing Detailing

7.0 FLANKING

This section will examine the potential sound transmission paths derived from limitations of the existing/proposed construction and provide information as to the mitigation measures required to minimise the flanking risks. As there are a number of areas with potentially high flanking risks, which would result in shortfalls of achieving the targeted sound insulation performance, it is crucial that the mitigation strategies outlined within this section are taken forward and implemented. A number of construction details have been provided within this report. However, please note that they are not exhaustive and only indicative.

7.1 Flanking Sound

Flanking sound can be described as the transmission of sound which does not pass through the main separating element such as a separating wall or separating floor, where the sound flanks around the main separating element. BS EN 12354-1:2000 'Estimation of acoustic performance of buildings from the performance of elements' demonstrates the contributions to the sound transmission within a room and various flanking paths as shown in the figures below.

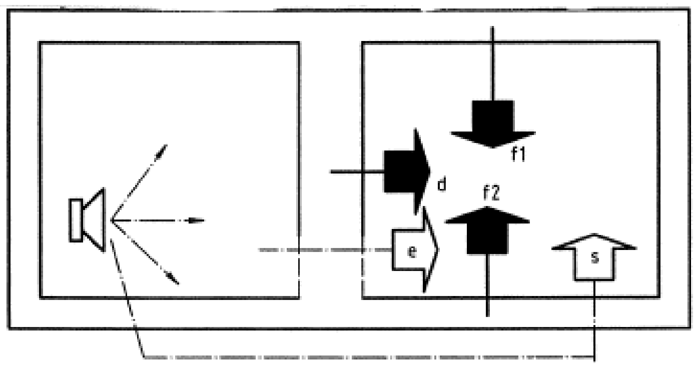


Figure 7.1: Illustration of the different contributions to the total sound transmission to a room: d- radiated directly from the separating element, f1 and f2 – radiated from flanking elements, e – radiated from components in the separating element, s – indirect transmission.

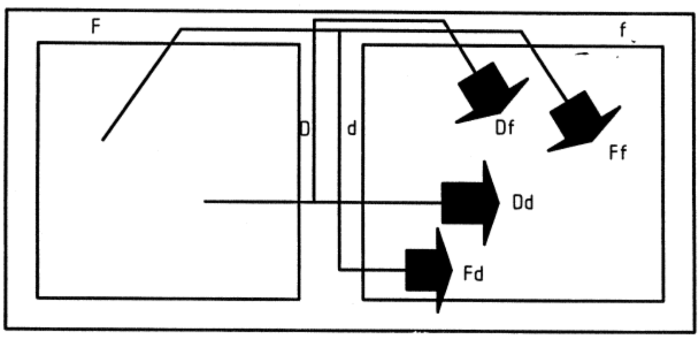


Figure 7.2: Sound transmission paths between rooms

The above figures can be treated as a section or plan view indicating flanking around the side of a partition between rooms or over the top/under a partition into a neighbouring room.

7.2 Foot Details

Flanking through the floor construction may degrade the sound insulation of a separating partition if not properly controlled. Floors have the potential to cause problems due to the continuous structure which runs directly under separating walls.

7.2.1 No Screed / Bonded Screed

A continuous power floated concrete screed may only be used if it is to be fully bonded to the structural slab and is guaranteed not to become unbounded over time.

In the case of directly power floating the structural slab, this is sufficient.

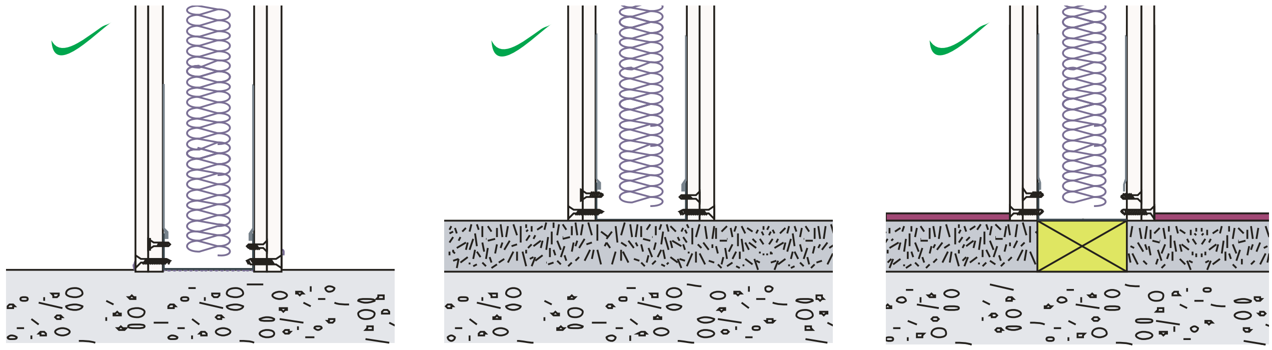


Figure 7.3: Power floated slab / bonded screed detail (section view)

7.2.2 Floating Screed

To limit flanking through the floor, a floating screed should not be continuous underneath the wall partitions as shown in the options below. As per the bottom right image in the figure below, this can be as simple as putting a saw cut in the screed to break the continuous connection (which can be filled with a non-hardening acoustic mastic).

Note: In addition to following the example floating screed foot details below, a resilient layer should be implemented between the floating screed and the timber sole plate/plasterboard. This is advisable and good practice as it reduces the risk of structure-borne flanking significantly.

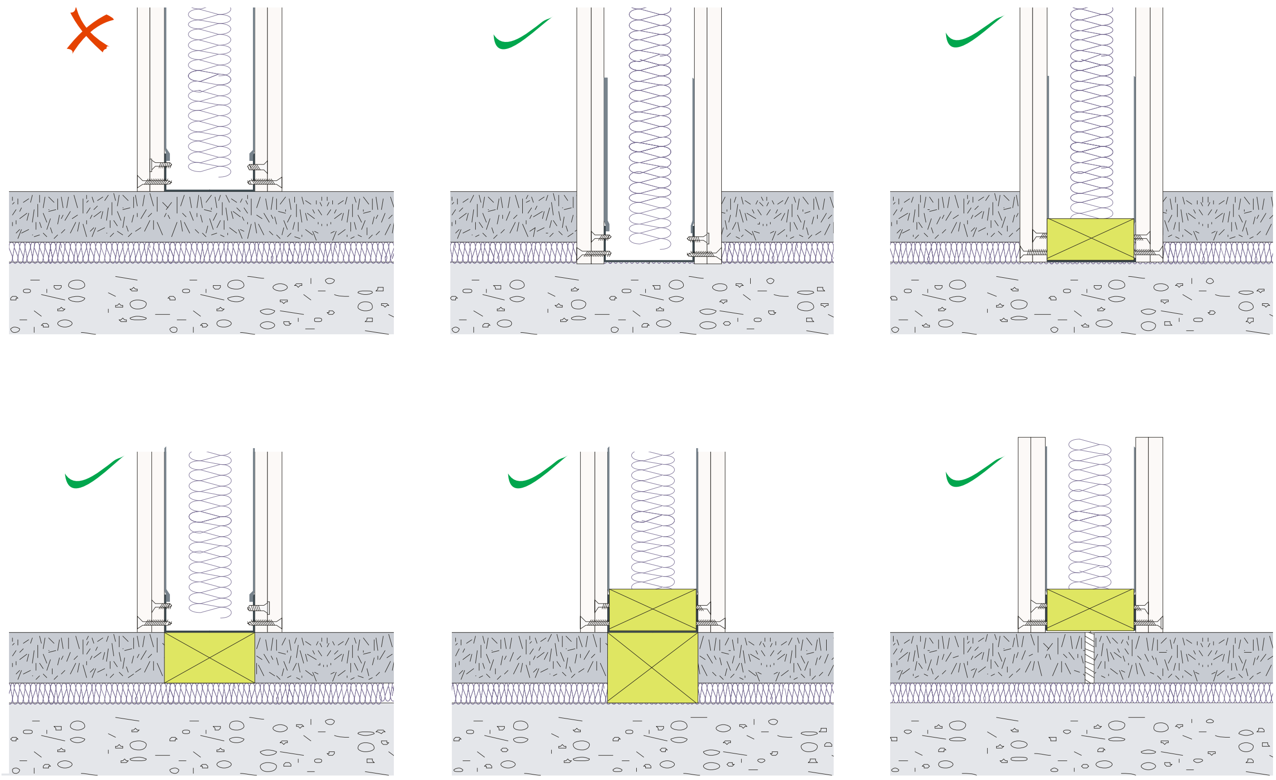


Figure 7.4: Floating screed detail (section view)

7.3 Head details

7.3.1 Flat Soffit

To limit flanking through the head detail, walls must be built all the way up to the soffit, thus the ceiling not being continuous across rooms. The figure below provides suitable head detail that should be followed.

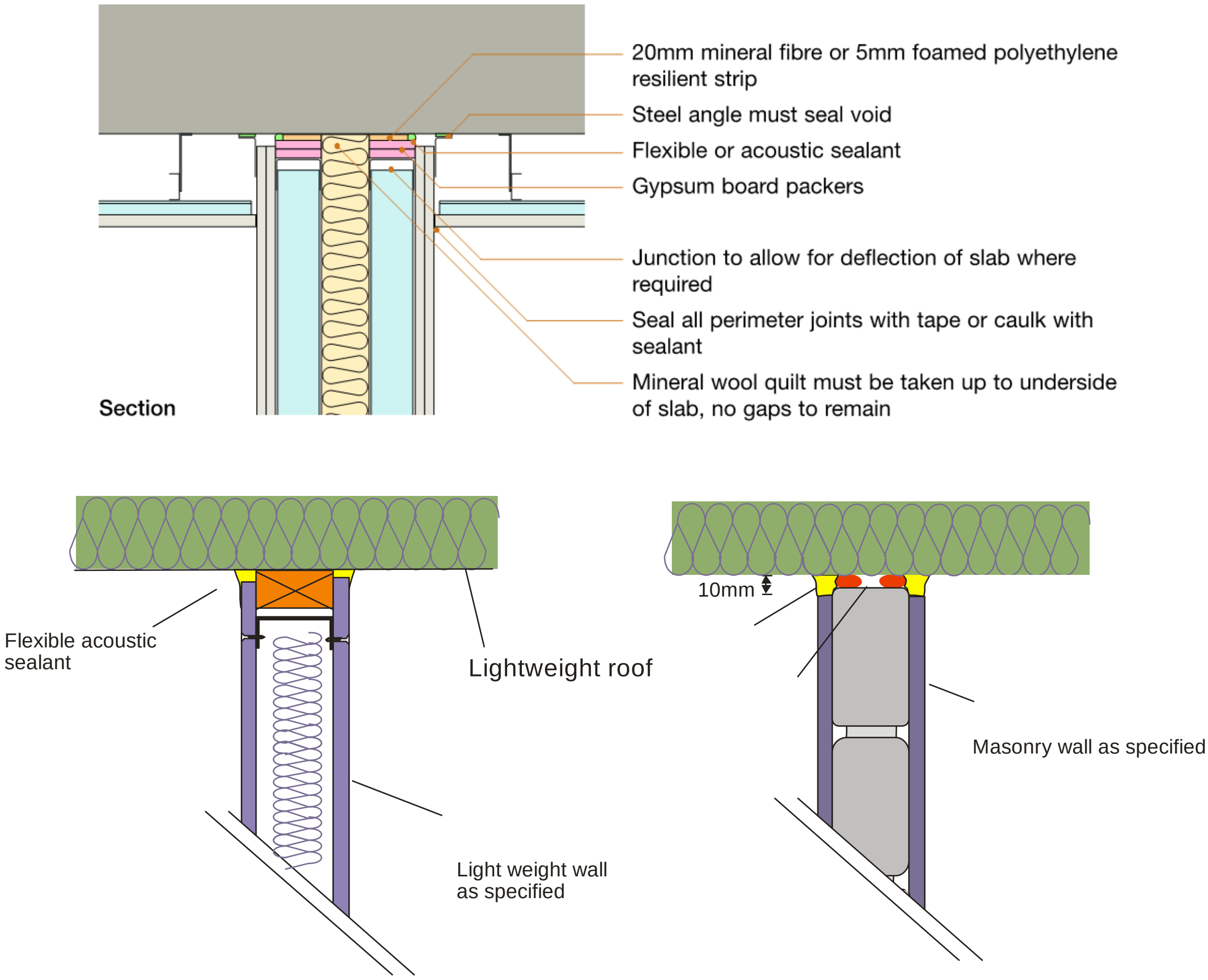


Figure 7.5: Head details for Internal partition – Concrete Soffit

Where exposed soffits are proposed, there is an increased risk of flanking sound over the partition, which may limit performance and cause failures during commissioning. These short falls are typically due to workmanship issues which commonly include:

- Gaps between board packers/head detail sections
- Board packers not taken up to the external wall / gaps at the flanking wall detail.
- Insufficient sealing of interface of deflection head with floor or roof
- Poor cutting of deflection head resulting in gaps between deflection head and wall lining
- Insufficient depth of the deflection head or height of wall linings
- Insufficient sealing of any interface details or gaps or joints with non-hardening mastic.

With the above in mind, it is critical for the partition head detail to be built to a high standard of Workmanship. It is therefore recommended that regular inspection of the workmanship is undertaken by the site team during construction.

The use of metal cloaking angles provides as illustrated within the righthand figure are recommended where there is exposed soffit in both rooms and ensures that the performance of the wall will not be compromised by workmanship issues.

7.3.2 Profiled Metal Deck

It is important that metal decks (both lightweight and concrete metal decks) are treated with care to limit flanking issues. The figure below gives details for when the internal wall runs parallel in the same direction as the deck. MACH Acoustics advise packing one of the troughs in the deck with mineral wool to reduce transmission over the top of the wall.

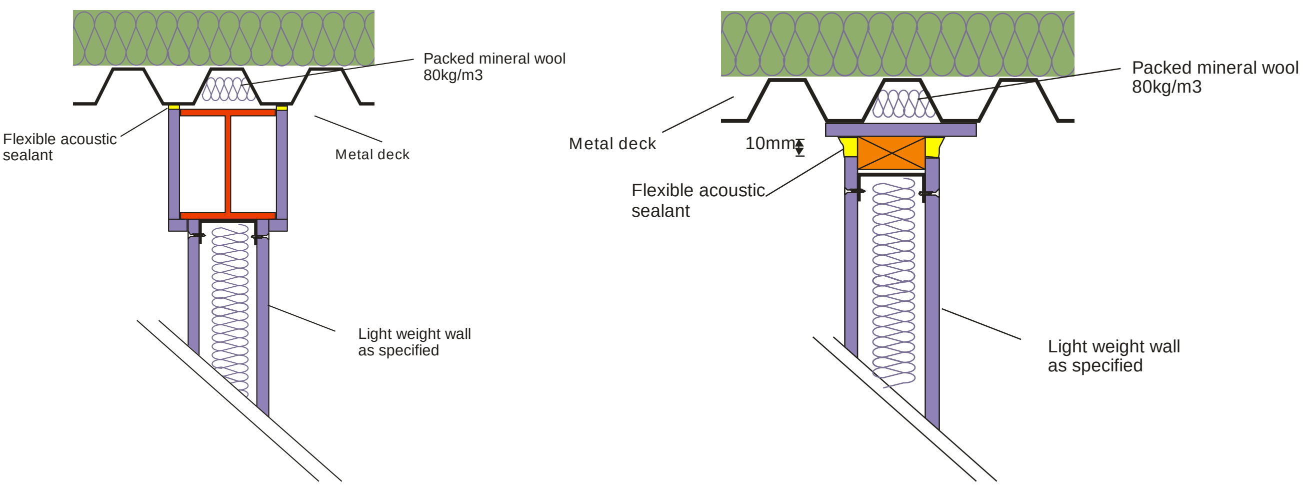


Figure 7.6: Head detail when the lightweight metal deck runs parallel to the wall (section view)

More important is to ensure that there are no large gaps above the wall when the deck runs perpendicular to the wall. It is advised that plasterboard is cut to fit the profile of the deck and sealed with mastic to ensure air tightness. Additionally, rockwool should be placed within the trough between the two layers of board to effectively mimic the wall construction. Failure to follow this detail will lead to drastic underperformance on site.

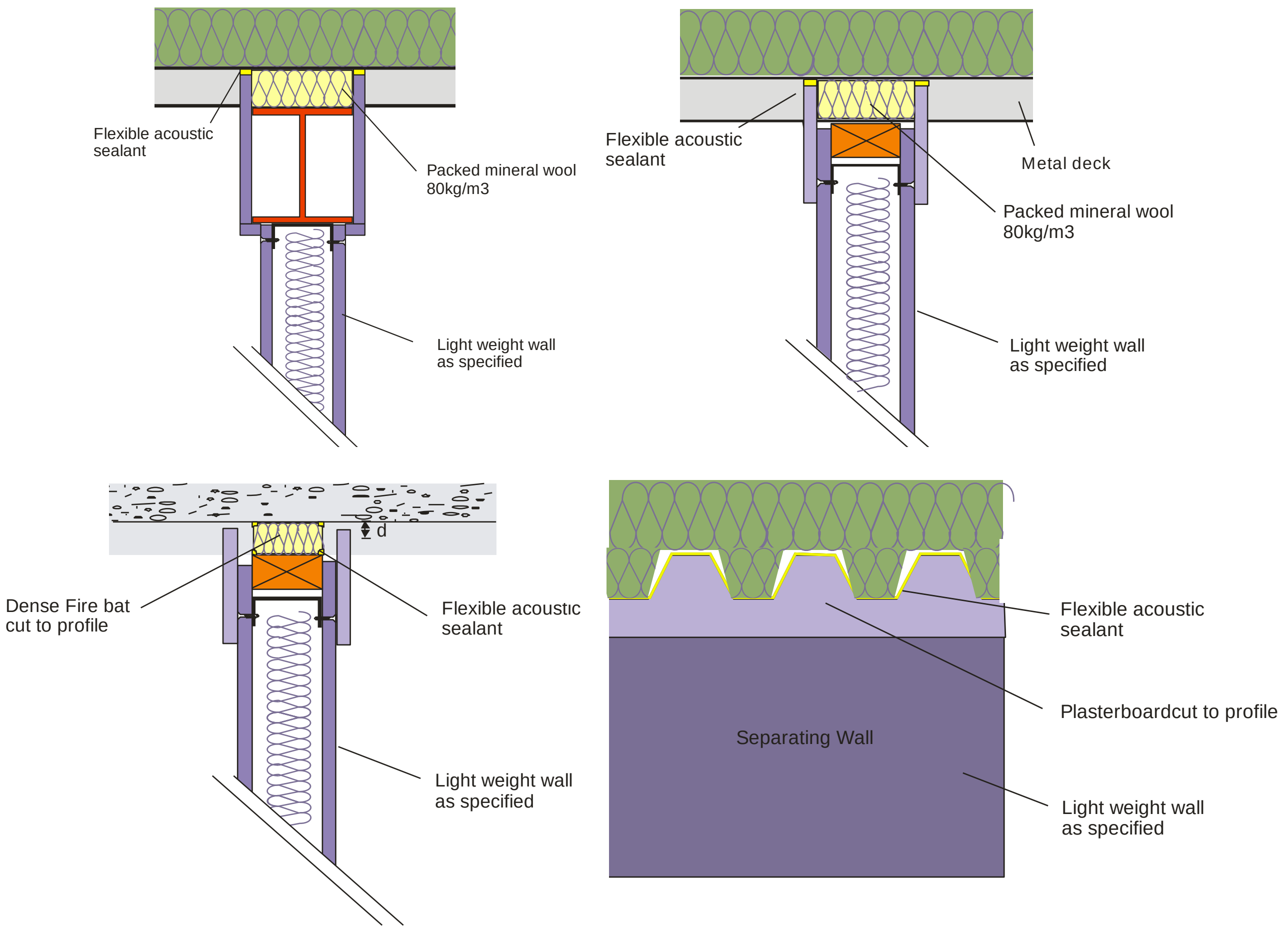


Figure 7.7: Head detail when the metal deck runs perpendicular to the wall (section view)

It is crucial that the profiled metal deck troughs above the walls are filled with mineral wool from above to limit the transmission over the top of the wall when the walls run perpendicular to the profile metal deck.

Note: It is understood from experience that some dryliners follow standard details provided by the drylining manufacturers, thus not implementing the details on site correctly. Therefore, it is crucial that the concepts outlined in this report are considered and implemented correctly to ensure acoustic integrity of the separating partitions are not compromised.

7.3.3 Steel Beams

Flanking through the head detail can degrade the partition, it is important that all steel beams are boxed out in order to not breach the sound insulation, including in areas that contain a suspended ceiling. The figure below gives suitable head details for standard partitions abutting lightweight and concrete soffits.

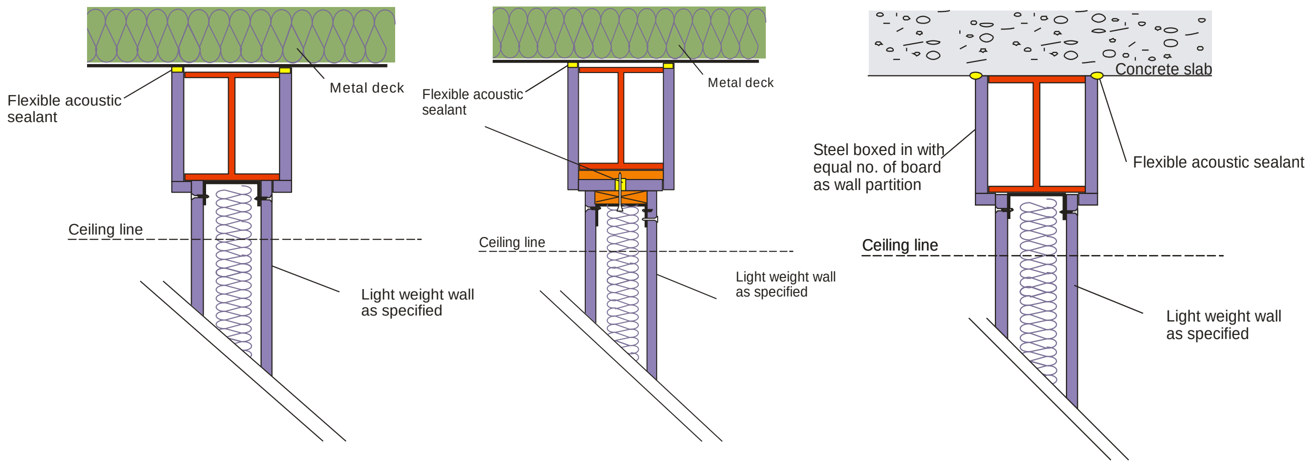


Figure 7.8: Head details where internal walls are directly below steel beams (section view)

However, steel beams along the corridor walls are not required to be boxed as the corridor walls will already have a degraded sound insulation performance through doors. Therefore, boxing the steel beams will not provide a significant improvement for the sound insulation of corridor walls, particularly when a suspended ceiling is installed. It is important however to still box in any potential void between the corridor wall steel and separating walls to avoid flanking transmission, as shown in the figure below.

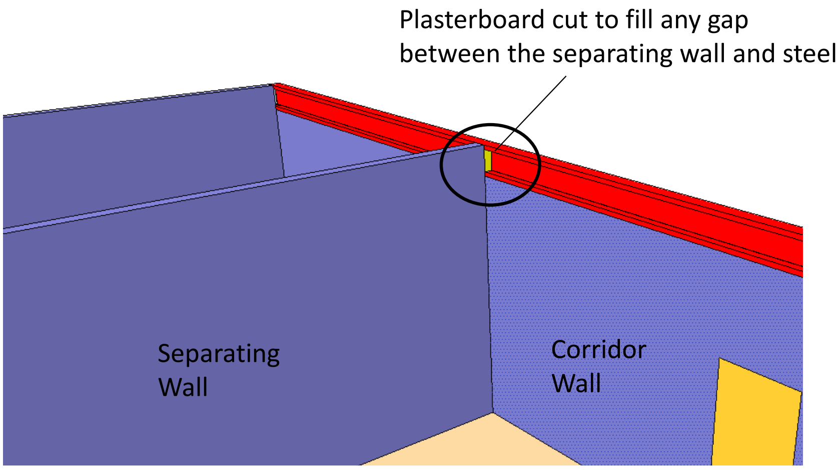


Figure 7.9: Steel flanking detail at corridor wall / separating wall junction

7.4 Blockwork Façade – Internal Wall / External Wall

The figure below gives examples of suitable internal/external wall junctions. Note, there should not be a continuous layer of plasterboard behind the separating partition, as indicated below.

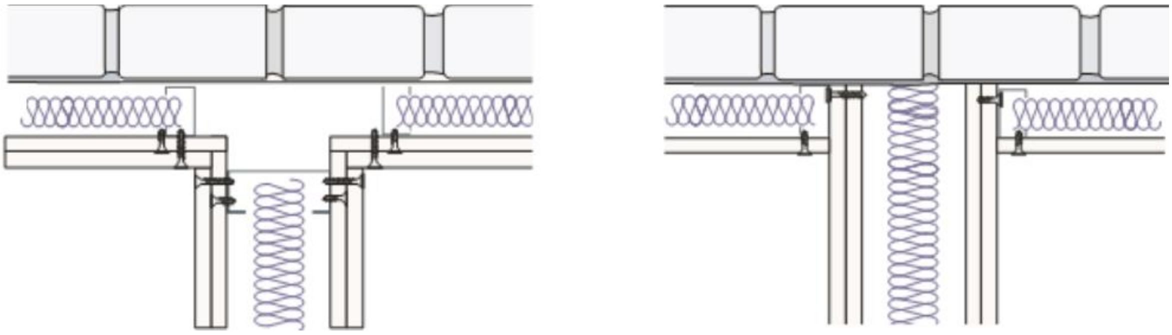


Figure 7.10: Example blockwork façade junction details (plan view)

7.5 Internal Partition to Lightweight External Façade

The figures below show examples of a façade to internal wall junction detail. It is critical that the internal lining of the façade wall is broken where the internal wall intersects with the façade wall.

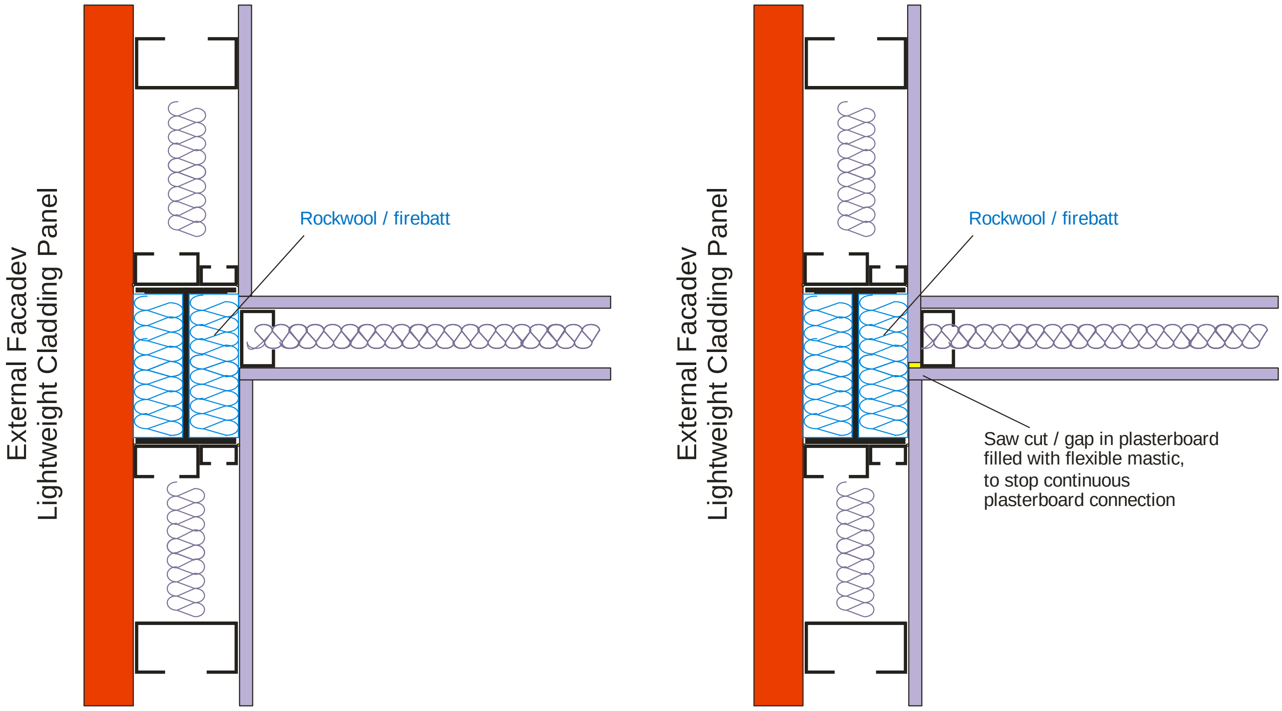


Figure 7.11: External Facade to Internal Wall Junction with Column

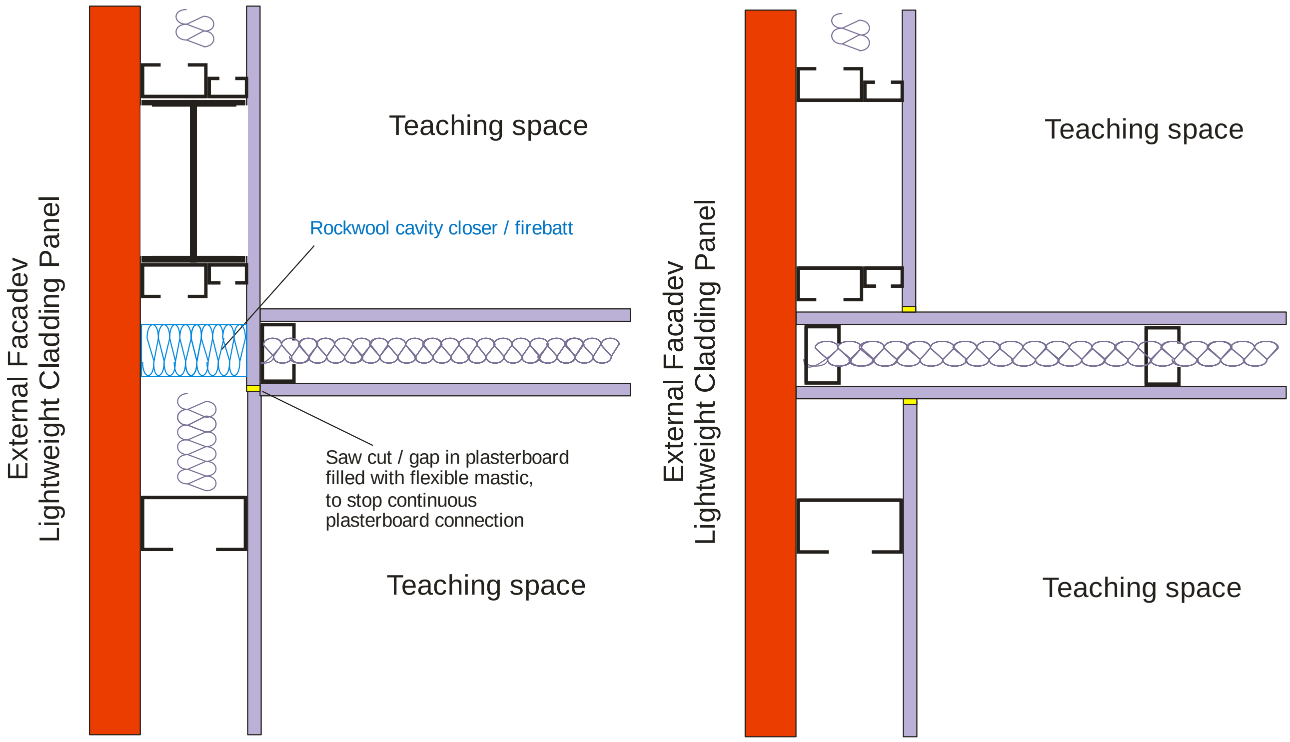


Figure 7.12: External Facade to internal Wall Junction with No Column

7.6 Wall Junctions

Precaution needs to be taken for new partition/ existing wall junctions between acoustically sensitive spaces. As airborne sound insulation performance of existing walls is unknown, it can potentially pose a flanking risk especially in cases where the new partition is a high-performance wall.

In such cases it is imperative to make sure the existing wall is not continuous between two sensitive spaces and may require mineral wool to be inserted into the cavity of the existing lightweight walls. The figure below give examples of suitable internal wall junctions.

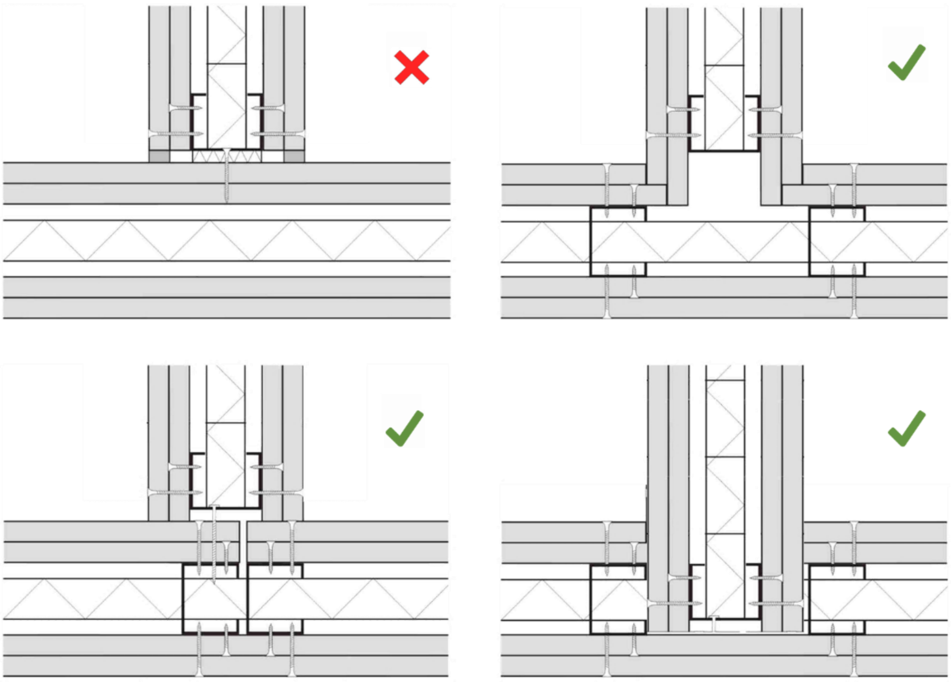


Figure 7.13: Wall junctions – detailed plan (plan view)

7.7 Steel Beams / Columns

Steel beams and columns provide a flanking risk both horizontally and vertically.

As a simple rule to eliminate any risk all beams/columns should be boxed around with plasterboard to prevent this. In some areas where the beams sit above a corridor wall that contains a door, and is hidden by a suspended ceiling on both sides, it may be acceptable to avoid boxing. It is important however to still box in any potential void between the corridor wall steel and separating walls to avoid flanking transmission

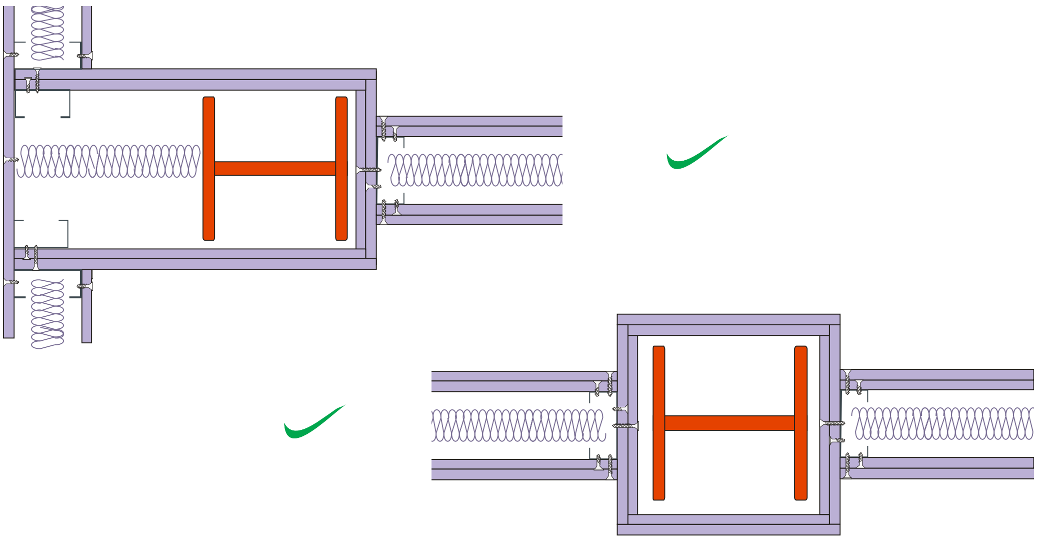


Figure 7.14: Boxing around steel columns

Note that the number of plasterboard layers should be designed to match that of the adjacent separating wall to the horizontal beam. In the case of a vertical column, two layers of board should be used where the column runs between sensitive spaces.

7.8 Moveable/Folding Walls

Where movable walls are proposed to be used in the development, the moveable walls must be lab tested and have a traceable lab test report. It would be the contractor's responsibility to meet the sound insulation (R_w) for moveable partition specified by Mach Acoustics.

Junction details, head details and foot details must be implemented correctly in order to achieve the onsite $D_{ntw.}$ specified. Even with best effort in construction and design, moveable partitions can fail to meet the measured on-site laboratory performance.

Mach recommends choosing moveable partitions via FIS Acoustic Verification Scheme. Further information can be found at https://www.thefis.org/knowledge-hub/specifiers/acoustic-verification-scheme/

7.9 Noise from Rain Water Pipes and Other Water Based Services

Rain water and other water-based services must be boxed in using 2 layers of 12.5mm wallboard, and the void should be filled with 25mm mineral wool. To avoid sound flanking through the services, the gaps around the pipe should also be sealed, as best as possible, prior to the boxing being installed. This may be done using a fire collar as required by other disciplines. Bends within pipe work should also be as gradual as possible, as sudden 90-degree angles will create additional unwanted noise.

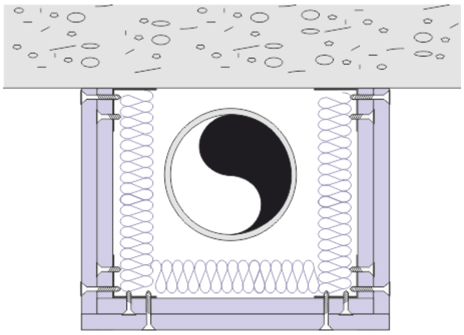


Figure 7.15: Rainwater pipe boarding

7.10 Construction Quality

On-site sound insulation requirements for partitions includes the effect of all potential sound paths between rooms, i.e. flanking paths via the façade, floors, ceiling, services, penetration details, construction quality and all other details. Services installation, architectural details and workmanship, must include any measures required to maintain the sound insulation.

It is the sub-contractor's responsibility to ensure that the build quality of partitions meet the required on-site sound insulation levels. Junctions between different building elements must maintain the continuity of mass and be airtight. It will often be necessary for these junctions to allow movement and in these cases compressible materials will be required.

Products such as mineral wool, non-setting mastic and expanding neoprene foam strip are acceptable. Aerosol-based expanding foam is not. Plasterboard covered plates with gaps at the perimeter sealed with mastic is a common detail that will need to be employed to maintain the required sound insulation.

8.0 REVERBERATION CONTROL

8.1 Teaching & Study Spaces

BB93 sets maximum reverberation limits where the T_{mf} is the arithmetic average of the octave bands 500Hz, 1 kHz and 2 kHz, unless stated otherwise. These have been applied to each room and presented in APPENDIX A.

8.2 Acoustic Treatment Assessment

8.2.1 Cellular Spaces

At the time of writing, the proposed RCP and floor finishes drawings have not been provided. Therefore, the floor finishes have been assumed from indicative information. The ceiling finish is understood to be lay-in-grid throughout the development, for the purpose of this assessment as the product selection is unknown, MACH have assumed a product with a minimum Class C product.

Room	Floor Area (m²)	Height (m)	Floor Finish	Ceiling Finish	T_{mf} Target (s)	Additional Treatment Required				
						Area (m²)			OR	No. Units
						Class A	OR	Class C		Rafts *
Ground Floor										
03 Hall	108.0	5.0	Hard	-	≤ 0.8	See Section 8.3				
04 Kitchen [1]	42.5	2.7	Hard	Class C Ceiling	≤ 1.5	-		-		-
06 Change [1]	3.8	2.7	Hard	Class C Ceiling	≤ 1.5	-		-		-
12 Parents [1]	27.4	2.7	Hard	Class C Ceiling	≤ 1.0	-		-		-
14 Music	33.7	2.7	Carpet	Class C Ceiling	≤ 1.0	-		-		-
15 Music Practice	7.7	2.7	Carpet	Class C Ceiling	≤ 0.6	-		-		-
16 Café	29.6	2.7	Hard	Class C Ceiling	≤ 1.0	-		-		-
17 Food Room [1]	38.5	2.7	Hard	Class C Ceiling	≤ 1.5	-		-		-
20 Group	10.2	2.7	Hard	Class C Ceiling	≤ 0.8	-		-		-
21 Head [1]	29.8	2.7	Carpet	Class C Ceiling	≤ 1.0	-		-		-
22 Group	11.4	2.7	Hard	Class C Ceiling	≤ 0.8	-		-		-
23 Group	10.9	2.7	Hard	Class C Ceiling	≤ 0.8	-		-		-
25 Library	110.8	4.8	Hard	-	≤ 1.0	See Section 8.3				
26 Classroom	45.1	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
28 Group	7.6	2.7	Hard	Class C Ceiling	≤ 0.8	-		-		-
29 Classroom	44.4	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
31 Staff [1]	36.8	3.2	Carpet	Class C Ceiling	≤ 1.0	-		-		-
34 Gen Office [1]	14.9	2.7	Carpet	Class C Ceiling	≤ 1.0	-		-		-
37 Comms [1]	7.0	2.7	Hard	Class C Ceiling	≤ 1.5	-		-		-
42 Meeting [1]	36.2	3.2	Carpet	Class C Ceiling	≤ 1.0	-		-		-
43 Classroom	45.6	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
45 Classroom	45.0	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
47 Group	16.2	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-

Room	Floor Area (m^2)	Height (m)	Floor Finish	Ceiling Finish	T_{mf} Target (s)	Additional Treatment Required				
						Area (m^2)			OR	No. Units
						Class A	OR	Class C		Rafts *
48 Prep [1]	9.8	3.2	Hard	Class C Ceiling	≤ 1.0	-		-		-
50 Change [1]	9.3	2.7	Hard	Class C Ceiling	≤ 1.5	-		-		-
51 Science	54.8	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
First Floor										
57 Classroom	44.7	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
58 Classroom	40.2	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
60 Classroom	43.9	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
63 Therapy	21.7	2.7	Hard	Class C Ceiling	≤ 0.6	-	-	-		-
67 Classroom	42.5	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
68 Classroom	42.6	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
69 PPA [1]	10.7	3.2	Carpet	Class C Ceiling	≤ 1.0	-		-		-
70 Classroom	42.7	3.2	Hard	Class C Ceiling	≤ 0.8	-		-		-
Sports Hall										
sh02 Office [1]	8.0	2.7	Hard	Class C Ceiling	≤ 1.0	-		-		-
sh03 Male Change [1]	54.0	2.7	Hard	Class C Ceiling	≤ 1.5	-		-		-
sh04 Female Change [1]	54.0	2.7	Hard	Class C Ceiling	≤ 1.5	-		-		-
sh11 Sports Hall	630.0	7.0	Hard	-	≤ 1.5	See Section 8.3				
sh14 Workshop	53.0	2.7	Hard	Class C Ceiling	≤ 0.8	-		-		-

[1] Considered administration or ancillary, therefore, guidance only
* Rafts below are based on data for 2400 x 1200 x 40 Ecophon Solo rafts, suspended by 400mm.

Table 8.1: Reverberation Treatment Requirements for Cellular Spaces

8.2.2 Suspended Treatment

Both the layout and the suspension height(s) of suspended treatment influence their performance. The suspension height should be no less then what has been stated in the treatment table and layouts should ensure that treatment is spaced apart such that gaps between them and any walls on at least two edges is at least the smallest dimension of the treatment. For example, 2400 mm x 1200 mm rafts should be at least 1200 mm from any other rafts or walls, on at least two edges.

8.3 Sports Halls and other large normally unfurnished activity spaces

Method 3 from "Acoustics of Schools: a design guide, November 2015" can be applied to demonstrate compliance with reverberation times set out within BB93 for large, unfurnished spaces. This method provides limits on the distribution of treatment as outlined in the table below, where all three requirements must be met to be BB93 compliant.

Requirement	Treatment Distribution
A	≥ 25% of total required absorption to be applied to the walls*
B	≥ 30% of total required absorption to be applied to the soffit
C	Remaining treatment to be provided on any surface
* Distributed reasonably evenly over at least two non-opposite walls with the absorption located no higher than 75% of the room height above the finished floor level	

Table 8.2: BB93 Method 3 Acoustic Treatment Distribution Requirements

This method has been applied to the following spaces, outlining current treatment proposals along with any additional treatment quantities required to meet all three method 3 requirements.

Room Name	Floor Area (m^2)	Height (m)	T_{mf} Target (s)	Acoustic Treatment Proposals
03 Hall	108	5.0	1.0	108 m^2 Class C Ceiling 24 m^2 Class A wall panels*
25 Library	110	4.8	1.0	14 x Rafts (Ecophon Solo 2400x1200x40 400mm Suspension Height) 58 m^2 Class A wall panels*
Sh11 Sports Hall	630	7.0	1.5	630 m^2 Class C Ceiling 129 m^2 Class A wall panels*
* Distributed reasonably evenly over at least two non-opposite walls with the absorption located no higher than 75% of the room height above the finished floor level				

Table 8.3: Reverberation Treatment Requirements for Large Unfurnished Spaces

Note: including absorption and diffusion within 3m of the floor level can significantly improve the acoustic quality of the space.

8.4 Corridors, Stairwells and Circulation Spaces

The amount of absorption required in corridors, entrance halls and stairwells should be calculated as per Section 7 of Approved Document E (ADE). Method A within Section 7 of ADE states the following.

	Absorption Provision Requirements
Corridors, entrance halls	An area equal to the floor area should be covered with a Class C absorber or better.
Stairwells	An area equal to 50% of the sum of the following areas should be covered with a Class C absorber or better. stair treads, upper surface of intermediate landings upper surface of landings (excluding the ground floor) ceiling area of top floor Alternatively, 100% of the above area may be covered with a Class D absorber.

Table 8.4: Absorption Requirements for Circulation Spaces (Method A)

As shown in the table above, an area equal to the floor area should be covered with a Class C absorber or better is required for corridors and entrance halls.

8.5 Music Spaces

8.5.1 Wall Panes

For all teaching spaces within the music department (Music Classrooms, Practice Rooms, and Recording Studios), it is also recommended that a portion of the total required reverberation control treatment quantities to be applied to the walls as wall panels (approximately >10% of the floor area).

Room Name	Floor Area (m^2)	Recommended Wall Panel Quantities
14 Music	34 m^2	4m^2 Class A wall panels
15 Music Practice	8 m^2	1m^2 Class A wall panels

Table 8.5: Wall Panel Quantities

8.5.2 Parallel Walls

The positioning of the walls, in relation to one another, has a marked effect on reverberation time. For optimum acoustic performance it is generally recommended that parallel walls are avoided as much as possible, as sound repeatedly bouncing between two parallel walls creates an unwanted resonance, or echo, increasing the reverberation time. These acoustic artefacts are common in small rectangular spaces and will negatively affect music practice/performances for both the players and listeners. Typically, an angle difference of 5 degree or greater is advised for two opposite walls in music spaces.

If parallel walls cannot be avoided, it is recommended that sound is diffused within a room as much as possible. Furniture diffuses sound well; however BB93 requirements apply to unfurnished rooms. Diffusive wall treatment is an option here in order to avoid unwanted echoes. A range of treatments are available from reflective to absorptive, with a range of aesthetically pleasing options.

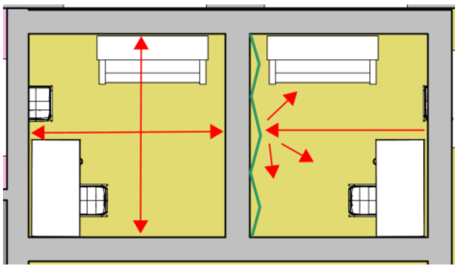


Figure 8.1: Sound paths without (left) and with (right) diffusive acoustic treatment

8.6 Ancillary spaces

As there are no mandatory requirements for the control of reverberation within non-teaching spaces, there is no mandatory requirement to place acoustic absorption within these spaces. However, the given table provides recommended reverberation time targets, and the required levels of acoustic treatment needed for these spaces.

As a minimum MACH Acoustics advises that at least 50% of the proposed levels of treatment are taken forward.

8.7 General Sports Hall Guidance

Introducing acoustic treatment to a sports hall often presents challenges, as the surfaces surrounding the play area have durability and safety considerations. It is often most practical to install treatment at the soffit as it is located away from the occupants and potential activities. However, further treatment is required on the walls, as low as possible in order to achieve the desired reverberation levels. Generic advice on possible ways to achieve this are described below.

8.7.1 Acoustic Blockwork

MACH is unaware of the proposed construction; therefore this advice will only apply is a blockwork construction is being utilised. The use of acoustic blockwork can be an effective way of introducing absorption at low level within a hall without compromising surface durability by integrating treatment into the structure itself.

The surface shape of this blockwork can also be exploited to provide additional diffusion (sound scattering). Greater diffusion will make the installed treatment more efficient and help mitigate some the of challenged presented by large parallel walls in a minimally furnished space.

8.7.2 Low level Treatment

Treatment to improve speech intelligibility will be most effective centred around head height, but as discussed above this comes with durability and safety concerns. Products such as Oscar Acoustic's 'Evo-Panels' are soft and are designed to be durable and impact resistant whilst providing acoustic absorption. Therefore, products of this nature can be installed at low level, resulting in better acoustic conditions in practice.

9.0 NOISE POLLUTION

9.1 Criteria

BS 4142:2014 "Methods for rating and assessing industrial and commercial sound" describes a method of determining the level of noise of an industrial nature, together with the procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity. As such, an assessment to BS 4142 is typically called for within planning conditions.

The likelihood of complaints in response to a noise depends on various factors. BS 4142 assesses the likelihood of complaints by considering the margin by which the noise in question exceeds the background noise level.

9.2 Design Target

It is currently unknown whether the local authority has specific plant noise limits; however, BREEAM 2018 Pol 05 credit is understood to be targeted, the plant noise rating level limit has been set in accordance with BREEAM 2018 Pol 05 credit. The plant noise limit at the nearest receptor is therefore subject to agreement with eh local authority.

As per the BREEAM 2018 Pol 05, the plant noise rating level limit at the nearest noise sensitive receptor has been set to 5dB below the existing background noise levels, L_{A90}. For the purposes of assessment, MACH Acoustics has used the typical daytime and night-time background noise level based on the L_{A90} histogram data in D.5.

Position	Time Period	Assessed Background Noise Level (dB L_{A90})	Plant Noise Rating Level Limit dB $L_{Ar,Tr}$	
			At Nearest Sensitive Receivers	At Nearest Window of Development
Fixed	Daytime (07:00 - 23:00)	40	35	49
	Night (23:00 – 07:00)	32	27	-

Table 9.1: Plant Noise Limits

APPENDIX A ROOM CLASSIFICATIONS

Room	BB93 Classification	Indoor Ambient Noise Limit (dB $L_{Aeq,30min}$)	Services Noise Limit (dB $L_{Aeq,30min}$)	Reverberation Limit (s T_{mf})	Impact Sound Limit (dB L'_{nTw})	Activity Noise	Noise Tolerance	To Circulation		
								Walls & Glazing (dB R_w)	Doors (dB R_w)	Ventilators (dB D_{new})
Ground Floor										
01 Lobby	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
03 Hall	Assembly Hall, Multi-Purpose Hall (Drama, PE, Audio/Visual Presentations, Assembly, Occasional Music)	≤ 35	≤ 32	0.8 - 1.2	≤ 60	High	Low	≥ 45	≥ 35	≥ 37
04 Kitchen	#Kitchen	≤ 50	≤ 47	≤ 1.5	≤ 65	High	High	-	-	-
06 Change	###Changing Area	≤ 50	≤ 47	≤ 1.5	≤ 65	High	High	-	-	-
07 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
08 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
09 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
10 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
11 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
12 Parents	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32
13 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
14 Music	Secondary Music Classroom	≤ 35	≤ 32	≤ 1.0	≤ 55	Very High	Low	≥ 45	≥ 35	≥ 37
15 Music Practice	Small Practice/Group Room (Music) (<30m2)	≤ 35	≤ 32	≤ 0.6	≤ 55	Very High	Low	≥ 45	≥ 35	≥ 37
16 Café	Dining Room	≤ 45	≤ 42	≤ 1.0	≤ 65	High	High	≥ 40	≥ 30	≥ 32
17 Food Room	#Kitchen	≤ 50	≤ 47	≤ 1.5	≤ 65	High	High	-	-	-
18 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
20 Group	Study Room (Individual Study, Withdrawal, Remedial Work, Teacher Preparation)	≤ 40	≤ 37	≤ 0.8	≤ 60	Low	Medium	≥ 40	≥ 30	≥ 32
21 Head	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32
22 Group	Study Room (Individual Study, Withdrawal, Remedial Work, Teacher Preparation)	≤ 40	≤ 37	≤ 0.8	≤ 60	Low	Medium	≥ 40	≥ 30	≥ 32
23 Group	Study Room (Individual Study, Withdrawal, Remedial Work, Teacher Preparation)	≤ 40	≤ 37	≤ 0.8	≤ 60	Low	Medium	≥ 40	≥ 30	≥ 32
24 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-

Room	BB93 Classification	Indoor Ambient Noise Limit (dB $L_{Aeq,30min}$)	Services Noise Limit (dB $L_{Aeq,30min}$)	Reverberation Limit (s T_{mf})	Impact Sound Limit (dB L'_{nTw})	Activity Noise	Noise Tolerance	To Circulation		
								Walls & Glazing (dB R_w)	Doors (dB R_w)	Ventilators (dB D_{new})
25 Library	Libraries: Resource Areas	≤ 40	≤ 37	≤ 1.0	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
26 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
27 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
28 Group	Study Room (Individual Study, Withdrawal, Remedial Work, Teacher Preparation)	≤ 40	≤ 37	≤ 0.8	≤ 60	Low	Medium	≥ 40	≥ 30	≥ 32
29 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
30 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
31 Staff	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32
32 Switch	####Plant: IT, Electrical, Gas + Water	≤ 50	≤ 47	≤ 1.5	≤ 70	Average	High	≥ 40	≥ 30	≥ 32
33 Stair	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
34 Gen Office	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32
35 Reception	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
36 Lift Lobby	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
37 Comms	####Plant: IT, Electrical, Gas + Water	≤ 50	≤ 47	≤ 1.5	≤ 70	Average	High	≥ 40	≥ 30	≥ 32
38 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
39 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
40 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
41 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
42 Meeting	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32
43 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
44 Stairs	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
45 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
46 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
47 Group	Study Room (Individual Study, Withdrawal, Remedial Work, Teacher Preparation)	≤ 40	≤ 37	≤ 0.8	≤ 60	Low	Medium	≥ 40	≥ 30	≥ 32
48 Prep	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32

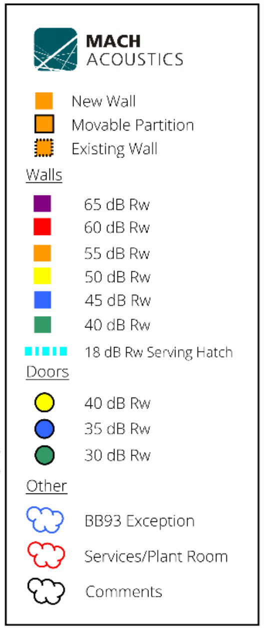
Room	BB93 Classification	Indoor Ambient Noise Limit (dB $L_{Aeq,30min}$)	Services Noise Limit (dB $L_{Aeq,30min}$)	Reverberation Limit (s T_{mf})	Impact Sound Limit (dB L'_{nTw})	Activity Noise	Noise Tolerance	To Circulation		
								Walls & Glazing (dB R_w)	Doors (dB R_w)	Ventilators (dB D_{new})
49 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
50 Change	###Changing Area	≤ 50	≤ 47	≤ 1.5	≤ 65	High	High	-	-	-
51 Science	Science Laboratory	≤ 40	≤ 37	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
52 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
55 Plant	####Plant: Mechanical	≤ 50	≤ 47	≤ 1.5	≤ 70	Very High	High	≥ 40	≥ 35	≥ 32
First Floor										
56 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
57 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
58 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
60 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
62 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
63 Therapy	SEN Calming Room	≤ 35	≤ 32	≤ 0.6	≤ 60	High	Low	≥ 45	≥ 35	≥ 37
65 Lobby	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
66 WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
67 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
68 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
69 PPA	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32
70 Classroom	Secondary School: Classroom, General Teaching Area, Seminar Room, Tutorial Room, Language Laboratory	≤ 35	≤ 32	≤ 0.8	≤ 60	Average	Medium	≥ 40	≥ 30	≥ 32
Sports Hall										
sh01 Circ	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
sh02 Office	#Office, Medical Room, Staff Room	≤ 40	≤ 37	≤ 1.0	≤ 65	Low	Medium	≥ 40	≥ 30	≥ 32
sh03 Male Change	###Changing Area	≤ 50	≤ 47	≤ 1.5	≤ 65	High	High	-	-	-
sh04 Female Change	###Changing Area	≤ 50	≤ 47	≤ 1.5	≤ 65	High	High	-	-	-
sh05 Male WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-

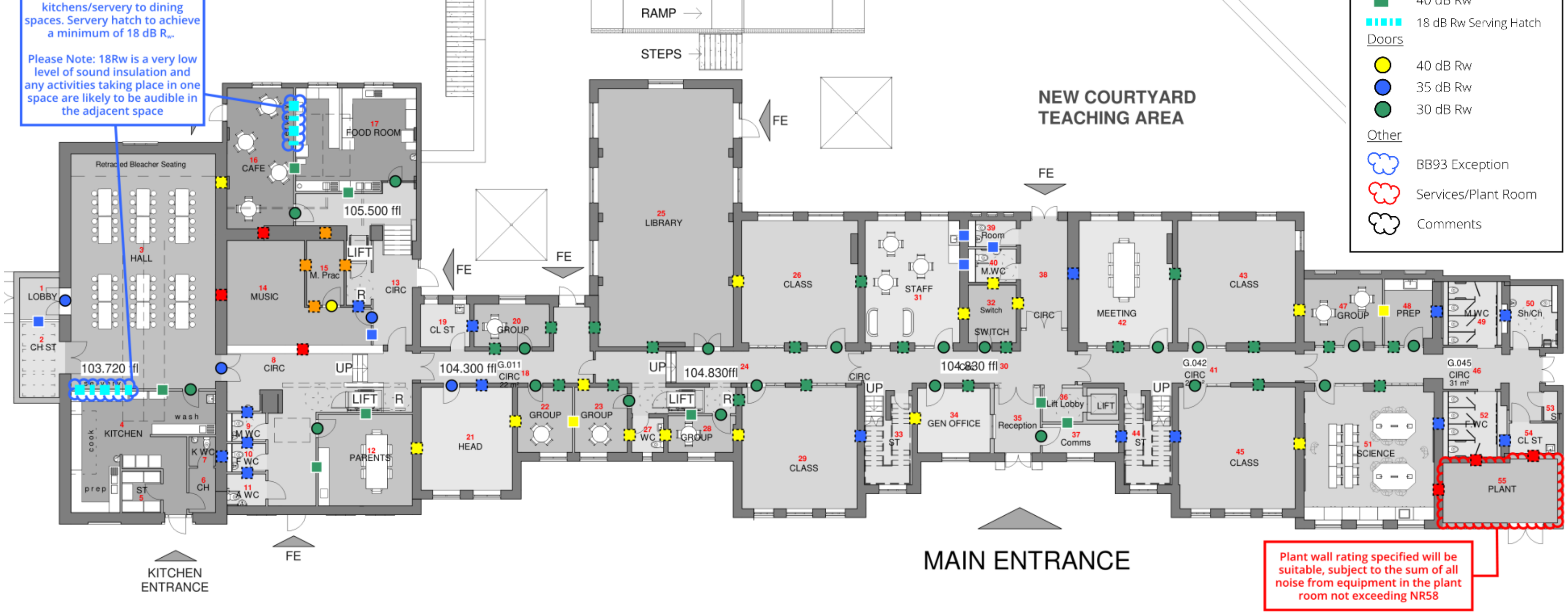
Room	BB93 Classification	Indoor Ambient Noise Limit (dB $L_{Aeq,30min}$)	Services Noise Limit (dB $L_{Aeq,30min}$)	Reverberation Limit (s T_{mf})	Impact Sound Limit (dB L'_{nTw})	Activity Noise	Noise Tolerance	To Circulation		
								Walls & Glazing (dB R_w)	Doors (dB R_w)	Ventilators (dB D_{new})
sh06 Access WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
sh07 Access Shower	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
sh08 Female WC	###Toilet	≤ 50	≤ 47	≤ 1.5	≤ 65	Average	High	-	-	-
sh09 Electrical	####Plant: IT, Electrical, Gas + Water	≤ 50	≤ 47	≤ 1.5	≤ 70	Average	High	≥ 40	≥ 30	≥ 32
sh11 Sports Hall	Sports Hall	≤ 40	≤ 37	≤ 1.5	≤ 60	High	Medium	≥ 40	≥ 30	≥ 32
sh13 Lobby	##Corridor, Stairwell, Coats and Locker Area	≤ 45	≤ 42	-	≤ 65	Average	High	-	-	-
sh14 Workshop	Resistant Materials, CADCAM Areas	≤ 40	≤ 37	≤ 0.8	≤ 60	High	High	≥ 40	≥ 30	≥ 32
sh16 Plant	####Plant: Mechanical	≤ 50	≤ 47	≤ 1.5	≤ 70	Very High	High	≥ 40	≥ 35	≥ 32

[1] Considered administration or ancillary, therefore, guidance only

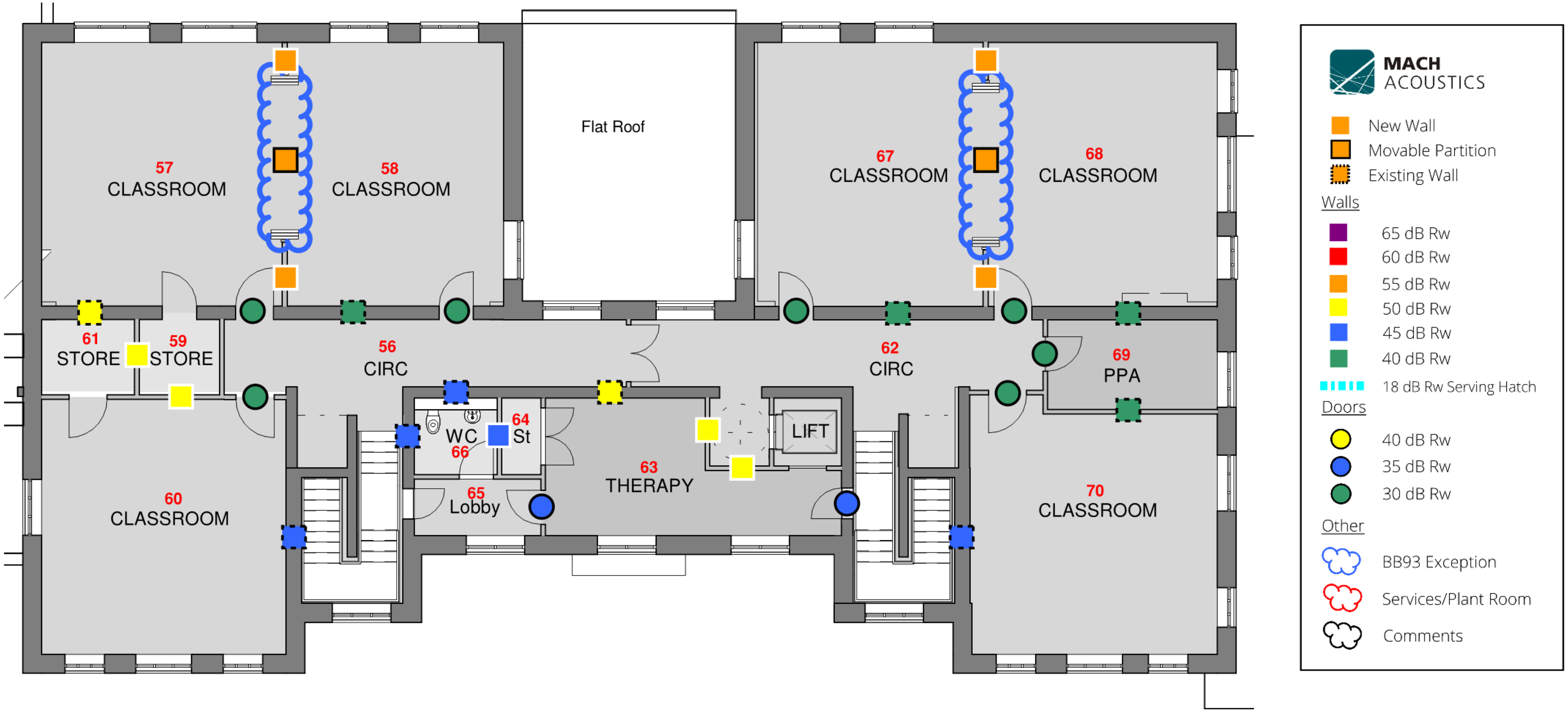
APPENDIX B SOUND INSULATION MARKUPS

Teaching Block Refurbishment – Ground Floor

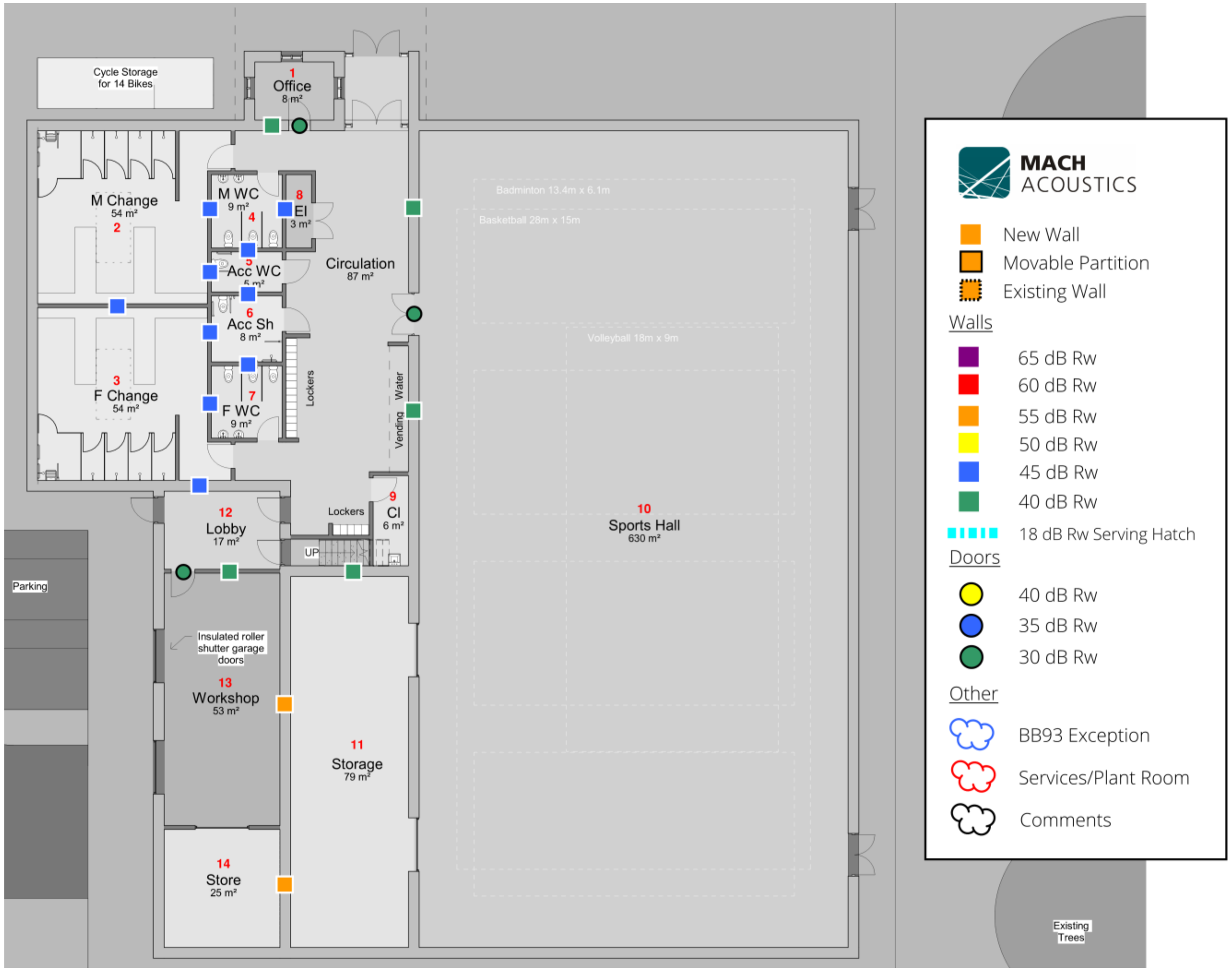


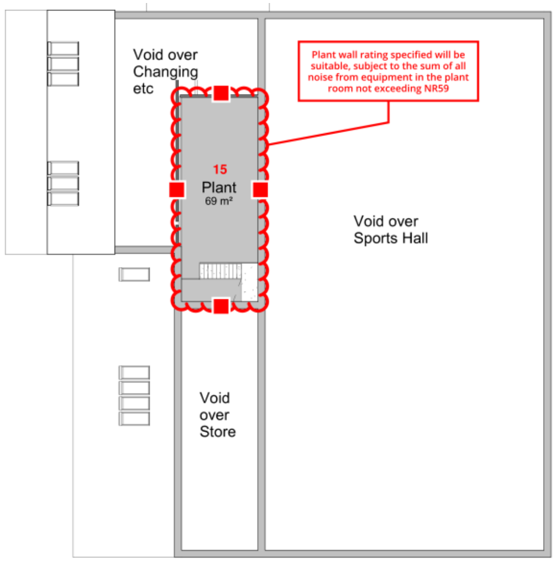


Teaching Block – First Floor



Sports Hall





SPORTS HALL FF
1 : 200

DRAFT LAYOUT
For Approval

APPENDIX C SITE INSPECTION

MACH were engaged to carry out a site inspection and sound insulation testing to determine the performance of existing constructions at Pontllanfraith Comprehensive Site.

The results of the tests are presented in the sections below.

C.1 Airborne Wall Sound Insulation Test Results

Table shows the results of airborne wall tests carried out.

Test	Source Room	Receiver Room	Separating Element	Measured, dB $D_{nT,(Tmf,max),w}$	Notes
ABW 1	Classroom 45	Science 51	Wall	62	N/A
ABW 2	Classroom 43	Group 47	Wall	53	N/A
ABW 3	Library 25	Classroom 26	Wall	42	Please see C.2
ABW 4	Hall 3	Music 14	Wall	56	N/A
ABW 5	Music Practice 15	Circulation 13	Wall	47	Please see C.3
ABW 6	Music Practice 15	Music 14	Wall	50	N/A

Table C.1: Results of airborne sound insulation wall testing.

C.2 ABW 3

Wall partition lacked in sound insulation performance; this was due to the glazing being smashed between spaces. Overall performance of wall partition was sufficient, the hole in the glazing is shown in Figure C.2.

Figure C.2: Glazing smashed of Classroom 26

C.3 ABW 5

Sound insulation performance between music practice space and Circulation space achieved 47 D_{nTw}, this was due to holes in the wall partition. This is shown in Figure C.3.

Figure C.3: Hole in partition between Music Practice 15 and Circulation 13

C.4 Airborne Floor Sound Insulation Test Results

Table shows the results of airborne floor tests carried out.

Test	Source Room	Receiver Room	Separating Element	Measured, dB $D_{nT,(Tmf,max),w}$
ABF 1	Classroom 70	Classroom 45	Floor	47

Table C.4: Results of airborne sound insulation floor testing.

Airborne floor sound insulation shows that the results achieved 47 D_{nTw}, this shows that the floor construction is sufficient in meeting BB93 requirements.

C.5 Impact Sound Insulation Test Results

Table shows the results of tests carried out.

Test	Source Room	Receiver Room	Measured, dB $L_{nT,(Tmf,max),w}$	Notes
IMP 1	Therapy 63	Comms	41	N/A
IMP 2	Classroom 68	Classroom 43	64	Please see C.6

Table C.5: Results of impact sound insulation testing

Impact sound insulation shows that the results achieved 64 D_{nTw}, this shows that the floor construction is sufficient in meeting BB93 requirements.

C.6 IMP 2

Results show that a higher level of sound was transmitted through the floor partition between Classroom 68 and Classroom 43, this was due to the exposed hard floor finish (shown in Figure C.6).

Figure C.6: Floor build up in Classroom 68

APPENDIX D ENVIRONEMNTAL NOISE SURVEY

To establish the existing environmental noise levels on site, a noise survey was conducted between 10:45 on the 14/03/2022 and 17:15 on the 15/03/2022.

This site assessment was undertaken by Aaron Andrews of MACH Group.

D.1 Site Description

The site is located at the former Pontllanfraith School and is situated in the urban area of Blackwood, Wales. Noise levels are generally quiet with road traffic contributing to the main source of noise.

D.1.1 Subjective Noise Climate (On-site)

Noise Type	Noise Characteristics	Sources
Dominant	A primary contributor of noise levels on the site.	Road traffic from Blackwood Road B4251.
Other Noise Contributions	Contributors to the remainder of the noise climate on site.	Birdsong

Table D.1.1 - Subjective Summary of the Noise Sources

D.1.2 Non-Representative Noise Sources

During the survey, no noise events occurred which would be deemed as atypical of the site location.

D.2 All Measurement Locations

To help with the understanding of the site and measurement locations all the measurement positions are presented on the map below. Photos of the locations in situ are in the following sections.

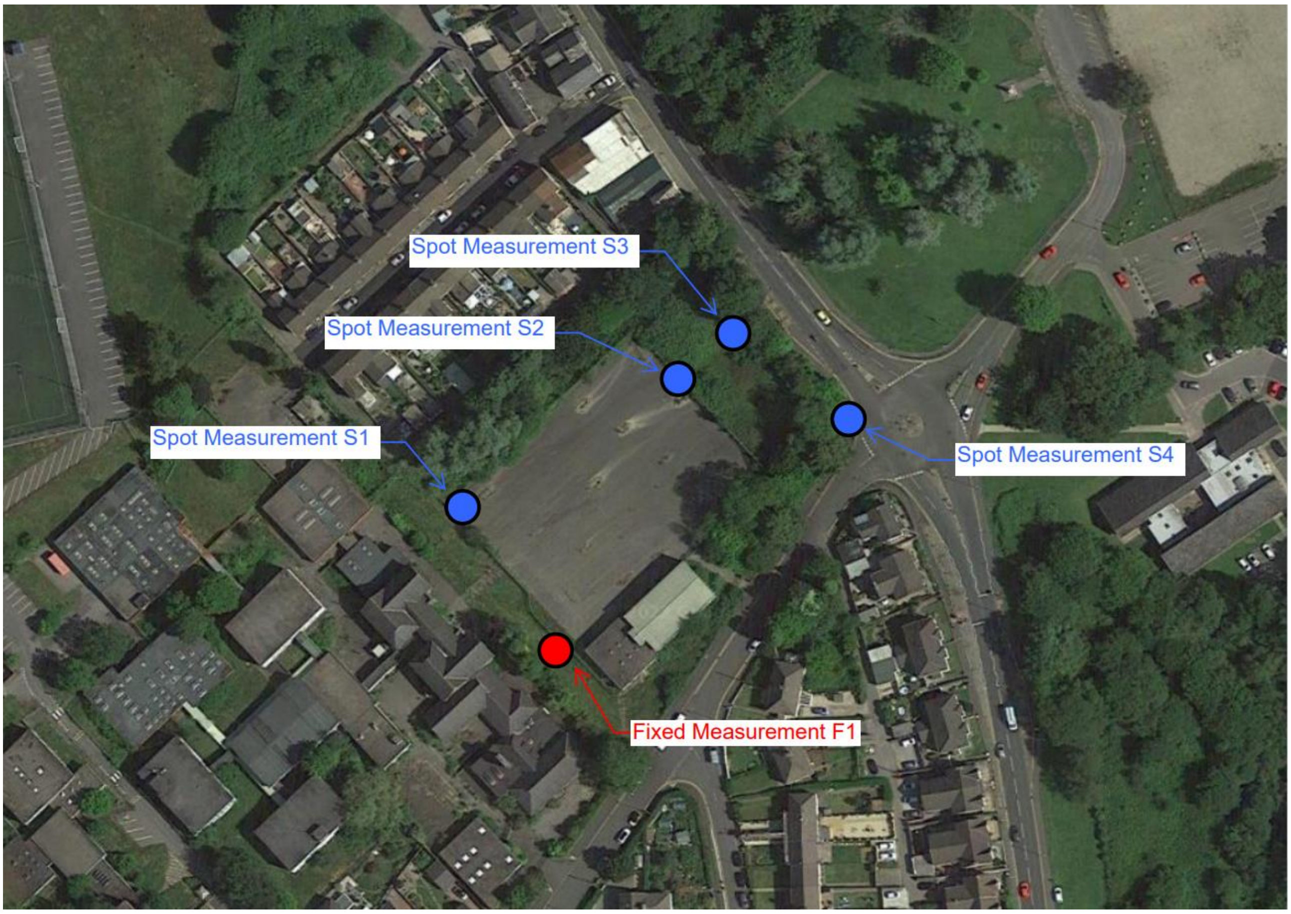


Figure D.2 - All Measurement Locations on a Map

D.3 Fixed Measurement

A fixed microphone position was used to record noise levels between 10:45 on the 14/03/2022 and 17:15 on the 15/03/2022, where the fixed long-term meter was set to measure consecutive 'A' weighted 5-minute time samples. Measurements have been taken in free field conditions.

To help with the understanding of the site and the measurement locations, the figures below present the location of the microphone position(s) in situ. The results of the environmental noise survey are provided within section D.3.2.

D.3.1 Fixed measurement Location – F1


Figure D.4.1 - Fixed Measurement location in situ

D.3.2 Fixed Measurement Results

The following graph presents the noise levels recorded over the measurement period at the fixed location (F1).

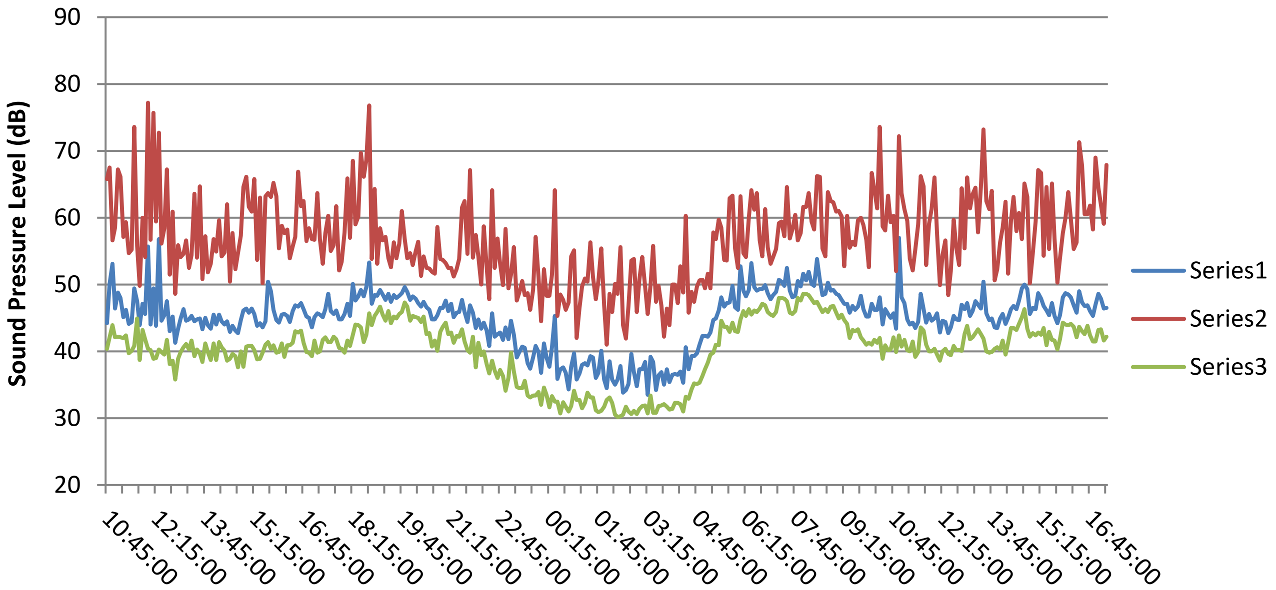


Figure D.3.2 - Sound Pressure Level at fixed location, F1

D.4 Spot Measurement

Spot measurements help quantify existing noise levels at different points around the site.

The figures below present the location of the microphone position(s) in situ.

The results of the measured levels at these location(s) are also presented in section D.6 Table D.6.

D.4.1 Spot Measurement - S1

This spot measurement was taken between 16:25 and 16:35 on 15/03/2022 in free field conditions.

Figure D.4.1 - Spot Measurement S1 in situ

D.4.2 Spot Measurement – S2

This spot measurement was taken between 16:37 and 16:45 on 15/03/2022 in free field conditions.

Figure D.4.2 - Spot Measurement S2 in situ

D.4.3 Spot Measurement – S3

This spot measurement was taken between 16:50 and 17:00 on 15/03/2022 in free field conditions.

Figure D.4.2 - Spot Measurement S3 in situ

D.4.4 Spot Measurement – S4

This spot measurement was taken between 17:05 and 17:15 on 15/03/2022 in free field conditions.

Figure D.4.2 - Spot Measurement S4 in situ

D.5 Measurement Equipment

Item	Serial No.	Last Calibration	Certificate No.	Calibration Due
NTI Precision Sound Analyser XL2 TA	A2A-13174-E0	Sep-21	UK-21-073	Sep-23
NTI Pre-amplifier MA220	8073	Sep-21	UK-21-073	Sep-23
NTI Microphone Capsule MC230A	A14429	Sep-21	UK-21-073	Sep-23
NTI Precision Sound Analyser XL2 TA	A2A-15207-E0	Nov-20	149145	Nov-22
NTI Pre-amplifier MA220	7856	Nov-20	149145	Nov-22
NTI Microphone Capsule MC230A	A16182	Nov-20	149115	Nov-22
Norsonic Sound Calibrator Type 1251	32090	Apr-21	155376	Apr-22

Table D.5 – Measurement Equipment

D.6 All Spot Measurement Results

The L_{Aeq} levels measured from all spot measurements are shown in Table 4.2 below.

Spot Measurement	Start	End	Duration	$L_{Aeq,T}$ (dB)
S1	16:25	16:35	10 Mins	48
S2	16:37	16:45	8 Mins	45
S3	16:50	17:00	10Mins	61
S4	17:05	17:15	10 Mins	71

Table D.6 - Spot Measurement 1 Results Table

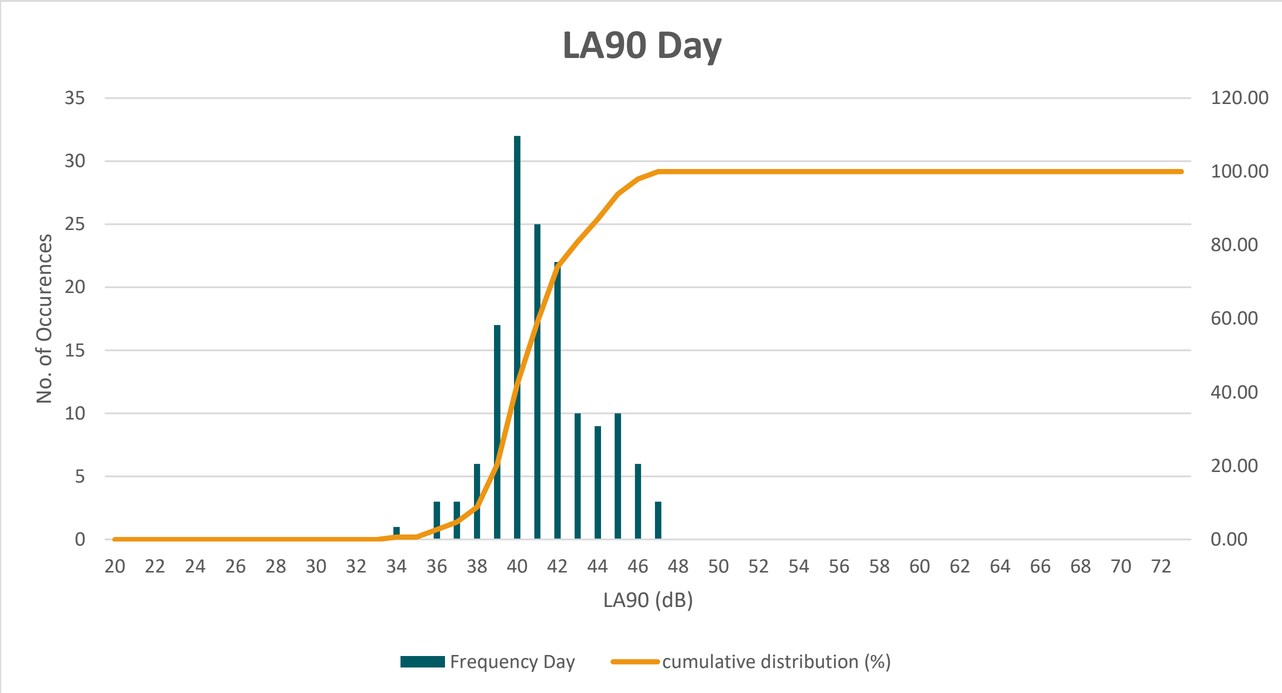
D.7 Meteorological Conditions

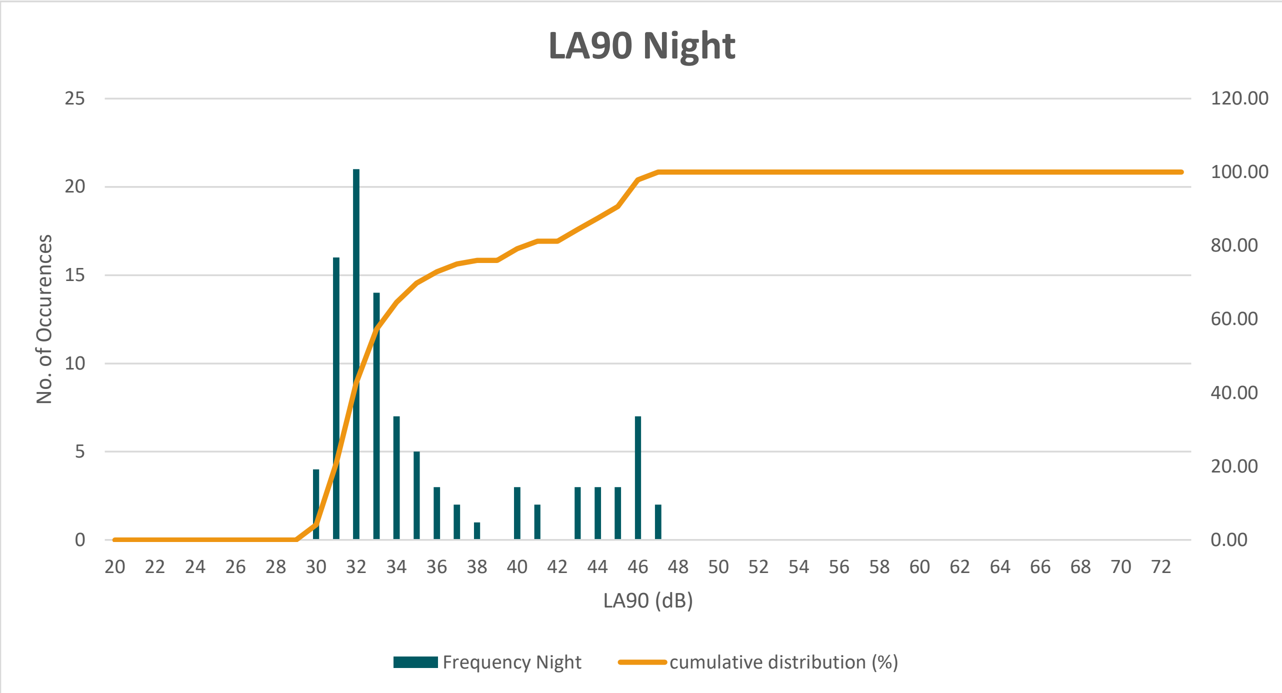
Data Taken from: https://www.timeanddate.com/weather/

Date	Time (hh:mm)	Temperature (High / Low) (°C)	Humidity (%)	Pressure (hPa)	Wind Speed (mph)	Wind Direction	Conditions
14/03/2022	06:00	11/4	91	1023	3	N	Cloudy
	12:00	12/9	64	1024	6	W	Cool
	18:00	8/3	79	1025	3	W	Chilly
15/03/2022	00:00	6/3	96	1023	6	E	Cool
	06:00	11/5	87	1021	8	E	Cool
	12:00	12/10	6	1019	6	E	Cool

Table D.7 - Meteorological Conditions

APPENDIX E HISTOGRAM





APPENDIX F TERMINOLOGY

dB	Decibel. The unit of sound level.
dB(A)	A-weighted decibel. The A-weighting approximates the response of the human ear.
DnT,w	Weighted standardized level difference. A single number rating of the sound level difference between two rooms. DnT,w is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, sound may be transmitted around a wall by travelling up into the ceiling space and then down into the adjacent room.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.
Impact sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor.
LAeq	The equivalent continuous sound level. This is commonly referred to as the average noise level and is measured in dB(A).
LA90	The noise level exceeded for 90% of the measurement period, measured in dB(A). This is commonly referred to as the background noise level.
L'nT,w	Weighted, standardized impact sound pressure level. A single number rating of the impact sound insulation of a floor/ceiling when impacted on by a standard 'tapper' machine. L'nT,w is measured on site. The lower the L'nT,w, the better the acoustic performance.
Ln,w	Weighted normalised impact sound pressure level. A single number rating of the sound insulation of a floor.
NR	Noise Rating. A single number rating which is based on the sound level in the octave bands 31.5Hz – 8kHz inclusive, generally used to assess noise from mechanical services in buildings.
Octave band	Sound, which can occur over a range of frequencies, may be divided into octave bands for analysis. The audible frequency range is generally divided into 7 octave bands. The octave band frequencies are 63Hz, 125Hz, 250Hz, 1kHz, 2kHz and 4kHz.
Reverberation time (T60)	Reverberation time is used for assessing the acoustic qualities of a space. T60 is measured in seconds (s) and describes how quickly sound decays within a space.
Rw	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. Rw is measured in a laboratory. Rw is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Sound absorption	When sound hits a surface, some of the sound energy is absorbed by the surface material. 'Sound absorption' refers to ability of a material to absorb sound.
Sound insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.
Structure-borne transmission	Transmission of sound energy as vibrations inside the structure of a building.

APPENDIX G BREEAM NEW CONSTRUCTION SCHEME

The BREEAM New Construction Scheme is an environmental assessment method for rating and certifying the performance of buildings. The credits available under the scheme, to ensure the building's acoustic performance meet the appropriate standards for its purpose, are as follows.

G.1 BREEEAM 2018

G.1.1 Hea 05 Acoustic performance

No. Credits	Description	Testing Requirement
1	Achieve the performance standards set out in Section 1 of Building Bulletin 93: Acoustic design of schools: performance standards, February 2015 (BB93) relating to airborne sound insulation between spaces and impact sound insulation of floors.	A programme of pre-completion acoustic testing is carried out by a compliant test body in accordance with the BB93 requirements and the Association of Noise Consultants (ANC) Good Practice Guide, Acoustic testing of Schools.
1	Achieve the indoor ambient noise level standards set out within Section 1 of BB93 for all room types.	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.
1	Room acoustics (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 Section 1 of BB93. Open plan teaching spaces achieve the performance requirements relating to reverberation time and STI set out within Section 1 of BB93. Corridor and stairwells, for those that give direct access to teaching and study spaces, achieve the performance requirements relating to sound absorption	Teaching and study spaces: A programme of acoustic measurements is carried out by a compliant test body in accordance with the requirements of BB93 and ANC Good Practice Guide, Acoustic testing of schools. Open plan teaching spaces: A programme of acoustic measurements of reverberation time is carried out within open plan teaching spaces. The measurement is carried out by a compliant test body in accordance with the requirements of BB93 and ANC Good Practice Guide, Acoustic testing of schools. STI testing is not required. To demonstrate compliance the SQA shall undertake measurements of reverberation times to compare against the STI model. The SQA should provide a report confirming that the surface finishes and distribution of sound absorption within the completed space is in line with the design intent implemented within the STI model. Where significant changes or differences are observed, the SQA shall re-model the space accordingly to demonstrate that the STI measurement is met by the completed spaces. Corridors and stairwells: Installation of a specification compliant with the BB93 criteria demonstrates compliance. A site inspection by the developer or SQA is required to confirm that a compliant specification has been installed.
[1] Not applicable to shell and core / shell only developments.		

BREEAM 2018 Available Acoustic Credits – Hea 05

G.1.2 Pol 05 Reduction of noise pollution

No. Credits	Description	Testing Requirement
1	There are no noise-sensitive areas within the assessed building or within 800 m radius of the assessed site.	N/A
	OR	
	Where there are noise-sensitive areas within the assessed building or noise-sensitive areas within 800 m radius of the assessed site, a noise impact assessment compliant with BS 4142:2014 is commissioned. Noise levels must be measured or determined for: Existing background noise levels: at the nearest or most exposed noise-sensitive development to the proposed assessed site including existing plant on a building, where the assessed development is an extension to the building Noise rating level from the assessed building.	The noise impact assessment must be carried out by a suitably qualified acoustic consultant. The noise level from the assessed building, as measured in the locality of the nearest or most exposed noise sensitive development, must be at least 5dB lower than the background noise throughout the day and night. If the noise sources from the assessed building are greater than the levels described above, measures have been installed to attenuate the noise at its source to a level where it will comply.

BREEAM 2018 Available Acoustic Credits – Pol 05