

Prospect House

Acoustic Design Specification

Interserve Construction Ltd

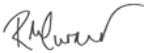
Job No: 1021291
Doc Ref: FS0831-CDL-XX-XX-SP-AS-45301
Revision: B
Revision Date: 14 November 2019

Project title	Prospect House	Job Number
Report title	Acoustic Design Specification	1021291

Document Revision History

Revision Ref	Issue Date	Purpose of issue / description of revision
—	02 August 2019	First Issue
A	05 November 2019	Revised following TA comments
B	14 November 2019	Revised following TA comments

Document Validation (latest issue)

14/11/2019	14/11/2019	14/11/2019
		
X	X pp	X pp
Principal author	Checked by	Verified by
Signed by: Everett, Simon	Signed by: Everett, Simon	Signed by: Everett, Simon

Contents

1.0	Introduction	1	7.2	Indicative plant noise calculations	23
1.1	Design Standards	1	7.3	Plant vibration isolation	24
1.2	Limitations	1	Appendix I	Acoustics Derogation Schedule	26
2.0	Acoustic Design Criteria	3	Appendix II	Service Penetrations	27
2.1	Internal ambient noise levels	3	Appendix III	Recommendations for boxing out columns & beams	29
2.2	Rain impact noise	3			
2.3	Airborne sound insulation	4			
2.4	Reverberation control	5			
2.5	Reverberation control in corridors, entrance halls and stairways	5			
3.0	Baseline Noise Conditions	7			
3.1	ECUS environmental noise survey	7			
4.0	External Building Fabric	11			
4.1	Glazing strategy	11			
4.2	Ventilation strategy	11			
4.3	External Walls	13			
4.4	Roof	13			
5.0	Internal Partitions	15			
5.1	General partition guidelines	15			
5.2	Doorsets	16			
5.3	Internal glazing	17			
5.4	Moveable partitions	17			
5.5	Services penetrations	17			
5.6	Services / SVPs	17			
5.7	Mechanical ventilation systems	18			
5.8	Isolation of steelwork	18			
6.0	Reverberation Control	20			
6.1	In entrance corridors and halls	21			
7.0	Plant Noise and Vibration	23			
7.1	External plant noise limiting levels	23			

1.0

Introduction

1.0 Introduction

Cundall has been commissioned by Interserve Construction Ltd. to carry out a review of the RIBA Stage 4 architectural and design proposals for Prospect House School.

The purpose of this strategy document is to advise on internal acoustic requirements for the proposed new school.

This document refers to particular manufacturer's data, e.g. plasterboard types, absorptive panels, etc. Alternative products and manufacturers could be used, if an equivalent or better specification is provided.

1.1 Design Standards

The school is being designed to meet with the requirements of BB93:2014 "Acoustic design of schools: performance standards".

This document considers the following elements of school design:

- acoustic criteria to be achieved;
- sound insulation of external building elements;
- sound insulation performance between adjacent noise-sensitive spaces;
- internal acoustic performance, such as reverberation control, to allow clear communication of speech between teacher and student to be achieved.

This Specification should be read in conjunction with the following marked-up Cundall acoustic design strategy drawings, showing partition and door attenuation values, internal ambient noise levels, reverberation time and impact noise criteria:

- FS0831-CDL-XX-00-DR-AS-45001 Acoustic Design Strategy Ground

The following drawing presents recommended acoustic properties for absorptive ceiling treatments:

- FS0831-CDL-XX-00-DR-AS-45002 Proposed Reverberation Control Strategy

1.2 Limitations

Details within this specification are believed to be accurate at the time of writing. It is strongly recommended however, and considered good practice, that confirmation should be sought from specific manufacturers to see that the minimum performance requirements, as stated within this document, will be achieved by the chosen system / product / installation method.

2.0

Acoustic Design Criteria

2.0 Acoustic Design Criteria

Acoustics in schools and educational establishments play a pivotal role in delivering spaces which maximize student potential and provide calm conditions for teaching staff. Research shows that good acoustic environments aid pupil concentration and reduce staff stress and vocal strain.

The acoustic design strategy for the project is based on achieving the minimum performance requirements set out in 'BB93 Acoustic Design of Schools' (BB93). This document provides performance standards for various acoustic descriptors which are summarised in the following subsections:

2.1 Internal ambient noise levels

BB93 stipulates maximum indoor ambient noise level (IANL) criteria for all teaching and student spaces based on the use of each space. Criteria relevant to Prospect House are reproduced in Table 1 below. The external building fabric and the ventilation strategy will provide sufficient sound reduction such that these IANL criteria are maintained, except where specifically stated.

Room type	Upper limit for the indoor ambient noise level (dB L _{Aeq,30mins})
Teaching space intended specifically for students with special hearing and communication needs, including: Primary classroom, Primary food room, Primary library, Small group room, Nursery / Reception classroom, Calm room, Therapy room, Sensory room, Soft play room	30
Hall (PE / Assembly)	35
Head's office, General office, Admin office, Office (SEN), Office / Meeting, Conference / Meeting room, Office / Workroom, Staff room, Staff work room, Parents room, Hygiene room, Physiotherapy, SEN Therapy / MI room*	40
Circulation, Dining areas	45
Hydrotherapy pool, School kitchen prep & servery, Changing area, Toilet	50
* Criteria based on the understanding that this space will operate as a medical room rather than a specialist SEN teaching area.	

Table 1 - Relevant BB93 indoor ambient noise level criteria

For rooms ventilated using natural or mixed mode / hybrid systems, IANLs up to 5 dBA above the values required for the associated space are permitted for noise total noise break-in (i.e. for a space intended specifically for students with special hearing and communication needs, the internal IANL would be ≤ 35 dBA, as opposed to ≤ 30 dBA). However, noise from mechanical elements of hybrid systems will not exceed the IANL limits presented above.

During the summertime, natural or hybrid ventilation under control of teachers to prevent overheating during the hottest 200 hours of the year will be designed such that the indoor ambient noise level does not exceed 55 dB L_{Aeq} inside non-SEN rooms types. For spaces intended specifically for students with special hearing and communication needs, no change in the IANL limit is applied during the hottest 200 months.

The IANL excludes contributions from teaching activities (including noise from staff/students and playgrounds), equipment used in the space (such as computer equipment, etc.) and rain noise.

2.2 Rain impact noise

Although rain noise is excluded from the general IANL criteria, roofs and roof glazing will be designed to provide suitable control of rain noise reverberant sound pressure level in a space, such that during 'heavy' rain fall, the IANLs are not be more than 25 dB above the appropriate IANL specified in Table 1.

2.3 Airborne sound insulation

2.3.1 Between adjacent teaching / learning spaces

The minimum airborne sound insulation performance of internal partitions and floors between adjacent teaching spaces is dictated by the activity noise level in the source room and the noise tolerance of the receiving room.

The on-site performance standards for airborne sound insulation between spaces are provided in terms of minimum BB93 Weighted Standardised Level Difference $D_{nT,w}$. The sound insulation performance required by BB93 which are relevant to the proposed school are detailed in Table 2 and Table 3 below.

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 2 - BB93 new build performance standards for airborne sound insulation between spaces

BB93 also specifies airborne sound insulation requirements for the corridor wall between occupied spaces and circulation spaces, where a corridor door and/or ventilators are to be incorporated. The following performance criteria are applicable to Prospect House School:

Room type	Minimum composite R_w of wall and glazing with no ventilator (dB)	Minimum R_w for doorset (dB)
Teaching space intended specifically for students with special hearing and communication needs	45	35
Multi-purpose hall		
Interconnecting doors between adjacent teaching spaces		
All other spaces used for teaching or learning	40	30

Table 3 - BB93 performance standards for airborne sound insulation between occupied spaces and circulation spaces

The values of airborne sound insulation for dividing partitions are shown on the acoustic strategy drawings.

Where it is deemed essential to link a teaching space with another occupied room via an interconnecting door for operational or safety purposes, a doorset should be used with a rating of at least 35 dB R_w and the surrounding wall containing the doorset should have a sound insulation of at least 45 dB R_w .

Where these occur on the project, these are rating accordingly on the acoustic strategy drawings.

Whilst performance criteria above are given in terms of $D_{nT,w}$ (a site performance), manufacturers typically specify their systems in terms of R_w (a laboratory test rating). Because of the inevitable depreciation between quoted laboratory ratings and the required in-situ performance (due to site constraints, workmanship and flanking), an allowance needs to be made between these two values.

The following table summarises the in-situ and laboratory ratings for each partition type. These are also marked up on the acoustic strategy drawings (note: colours refer to marked up drawings).

BB93 performance criteria for partitions	Cundall mark-up colour	Equivalent laboratory rating
40 dB R_w		40 dB
45 dB R_w		45 dB R_w
35 dB $D_{nT,w}$		42 dB R_w
40 dB $D_{nT,w}$		47 dB R_w
45 dB $D_{nT,w}$		52 dB R_w
50 dB $D_{nT,w}$		57 dB R_w
55 dB $D_{nT,w}$		62 dB R_w

Table 4 - Comparison between in-situ and laboratory performance values of partitions

2.4 Reverberation control

2.4.1 For occupied spaces

BB93 sets out maximum reverberation times for different teaching and learning areas, these are provided on the Acoustic Design Strategy drawings. The reverberation time criteria are for rooms that are finished, furnished for normal use, but unoccupied.

The reverberation time for standard classrooms is quoted in terms of mid-frequency reverberation time (T_{mf}) which is the arithmetic average of the reverberation times in the 500 Hz, 1 kHz and 2 kHz octave bands. However, as the majority of spaces in this school are intended for the use of students with special hearing or communication needs, BB93 requires reverberation times to be achieved in octave bands from 125 Hz to 4 kHz.

Space	Mid frequency reverberation time, T_{mf} (seconds)
Primary classroom, Primary food room, Primary library, Small group room, Nursery / Reception classroom, Calm room, Therapy room, Sensory room, Soft play room	$T \leq 0.4$ averaged from 125 Hz to 4kHz octave band centre frequencies and $T \leq 0.6$ s in every octave band in this range.
Head's office, Conference / Meeting room, Staff work room, Parents room	≤ 0.8
Dining areas, General office, Admin office, Office / Meeting, Office / Workroom, Office (SEN), Staff room, Hygiene room, Physiotherapy, SEN Therapy / MI ^[1]	≤ 1.0
Hall (PE / Assembly)	≤ 1.2
Hydrotherapy pool, School kitchen prep & servery, Changing area, Toilet	≤ 1.5
^[1] Criteria based on the understanding that this space will operate as a medical room rather than a specialist SEN teaching area.	

Table 5 - Relevant BB93 reverberation time criteria

2.5 Reverberation control in corridors, entrance halls and stairways

The objective is to absorb sound in corridors, entrance halls and stairwells to reduce the level of transmission into teaching spaces.

The BB93 requirement is to provide sound absorption coverage as calculated in accordance with ADE, Section 7. This section of the ADE describes two calculation methods, A and B, for controlling reverberation in the common internal parts of domestic buildings. One of these methods should be used to determine the amount of absorption required.

It should be noted that corridors and stairwells that do not give direct access to teaching spaces are not covered by this requirement.

3.0

Baseline Noise Conditions

3.0 Baseline Noise Conditions

The figure below shows the approximate site red line boundary along with proposed location of the new building.



Figure 1 – Site location plan (image source: Google Maps)

The proposed site is bound by Bank House Road to the south, residential dwellings on Bank House Road to the west, a vacant Police Station to the east and Tweddle Common public open green space to the north. The site was previously occupied by Camberwell Park School but is now vacant.

3.1 ECUS environmental noise survey

An environmental noise survey at the proposed development site has been undertaken by ECUS Environmental Consultants in order to assist with the initial feasibility study for the development. Details of the methodology, weather conditions and full noise data have been outlined within their report Ref: 11024, issued in March 2018, and are reproduced in the following subsections, where relevant.

3.1.1 Measurement locations

Noise measurements have been undertaken at the locations identified in the figure below;

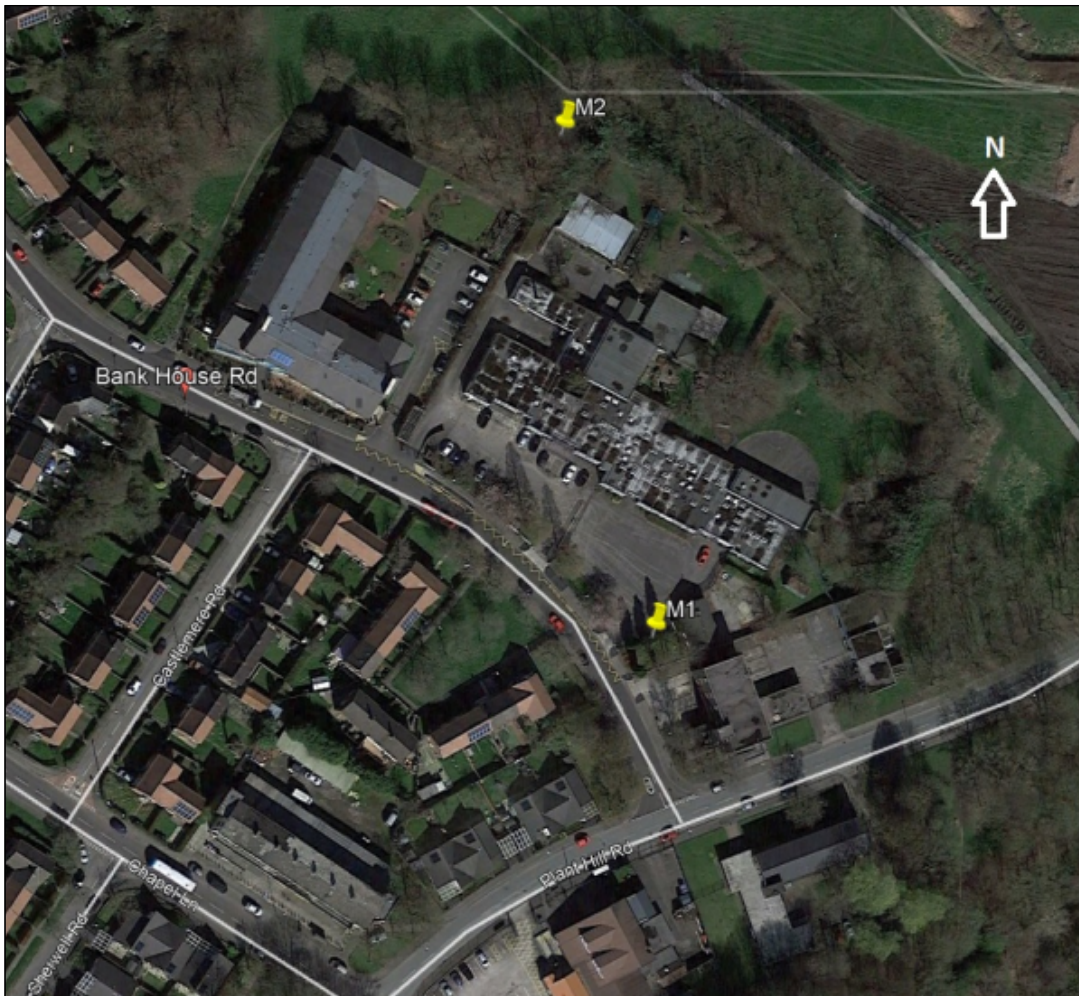


Figure 2 – Figure 4 "Noise monitoring locations" of Ecus' environmental noise survey report (image source: Google Maps)

3.1.2 Environmental conditions

The weather conditions during the survey period undertaken by ECUS are reported as follows;

"Weather conditions during the survey were dry with windspeeds no greater than 5 m/s."

3.1.3 Subjective impressions of noise climate

The following excerpt from the ECUS report provides a subjective assessment of the prevailing noise climate noted during the survey period;

"The main noise source during the noise survey was road traffic noise from Bank House Road to the south and Plant Hill Road to the southeast. Also, there was very occasional noise from residents of the properties opposite the site; pedestrians passing the front of the site and vehicle movements in the adjacent south western school car park."

3.1.4 Summary of noise survey results

A summary of noise measurement results is reproduced below.

Location	Period	dBL _{Aeq} Log-average	dBL _{Aeq,30min} Range	dBL _{A1,30min} Range
M1	11:40-15:00 hrs	56	55-57	69-72
M2	11:25-15:05 hrs	47	45-49	62-71

Figure 3 – Table 3.2 "Noise Survey Results - Free Field Noise Levels"

4.0

External Building Fabric

4.0 External Building Fabric

For the vast majority of traditionally-built façades, the weakest elements of the external elevation are the glazing and any ventilation openings. The specification of these elements is therefore considered to be the primary factor in determining the internal ambient noise level within noise sensitive rooms due to noise ingress from outside.

The extent of noise impact across site have been based on environmental noise surveys on site and subsequent noise modelling methods. Full details on methods for calculating noise levels incident on the proposed development can be found in the Environmental Noise Report (Ref: FS0831-CDL-XX-XX-RP-AS-45201).

4.1 Glazing strategy

The minimum façade sound reduction requirements identified for two worst affected room types at Prospect House are presented below and are based on incident noise levels determined by the noise mapping of the site. As the design progresses, specific schedules of glazing attenuation requirements for all façades will be developed.

Worst case predicted façade noise level (dBA)	Room Type	Most onerous BB93 IANL criterion* (dB L _{Aeq,30mins})	Minimum required facade sound reduction index R _w + C _{tr} (dB)
53	Hall (PE/Assembly Non-Ambulant)	40	≥ 16
	Primary Classroom (Ambulant)	35	≥ 21
* For rooms ventilated using natural or mixed mode / hybrid systems, IANLs up to 5 dBA above the values required for the associated space are permitted for external noise break-in.			

Table 6 - Minimum required facade sound reduction index values

Based on the above, it can be seen that standard thermal double glazing (e.g. 4-12-4 configuration or better) which typically provides 25 dB R_w + C_{tr} would be considered acceptable on all facades from an acoustic perspective.

4.2 Ventilation strategy

4.2.1 Assessment of ventilation strategy – Classrooms and Main Hall

Based on noise levels incident upon the development, the following figure identifies the specific façade conditions applicable to building elevations across the development.

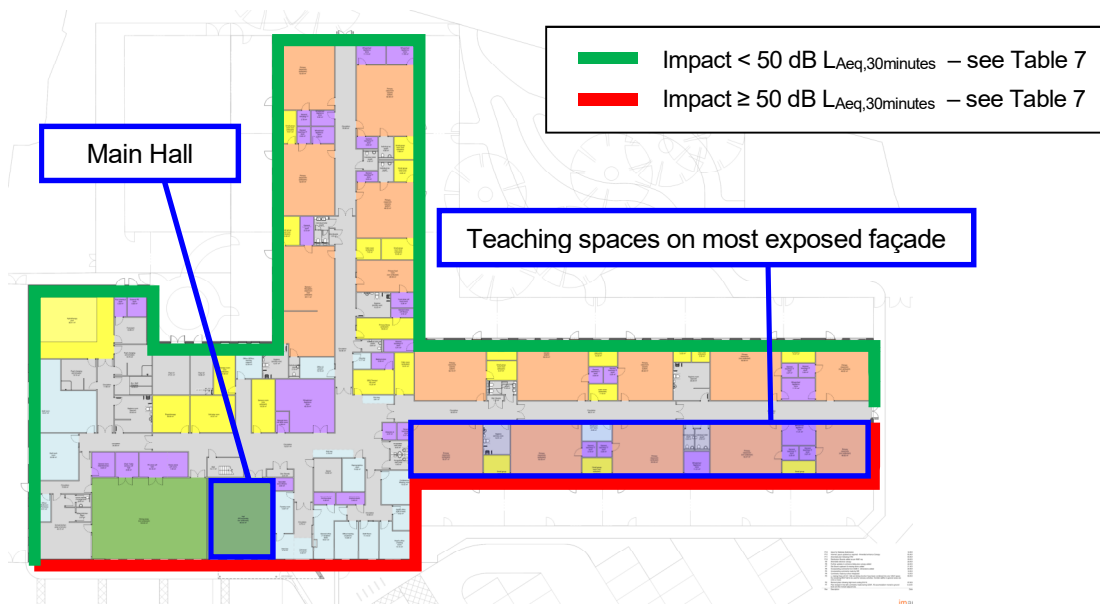


Figure 4 – Façade condition locations

The main ventilation strategies for rooms used for teaching and learning are presented in Table 7, with comments made on the suitability of these strategies in relation to achieving BB93 IANL criteria. Assessment outcomes have been informed by detailed break-in calculations undertaken in accordance with the “more rigorous” methodology presented in Section G.2.2 of BS 8233. A copy of these calculations is available on request.

Room type	Proposed ventilation strategy	Façade condition / location	BB93 IANL assessment outcome
SEN classroom / teaching space	Façade mounted Breathing Building NVHR units ^[1] This will be supplemented with partially open windows to control summertime overheating.	GREEN façades in Figure 4 Teaching spaces located at façades shielded from road traffic impacts with predicted facade impacts of < 50 dB $L_{Aeq,30minutes}$	It is expected that internal ambient noise levels will be fully compliant with the requirements of BB93, even during periods when windows are partially open to control overheating.
		RED façades in Figure 4 Teaching spaces located at façades more exposed to road traffic impacts with predicted facade impacts of ≥ 50 dB $L_{Aeq,30minutes}$	It is expected that internal ambient noise levels will be fully compliant with the requirements of BB93 when open windows are not required for cooling. During periods when windows are partially open to control summertime overheating, an exceedance of the BB93 IANL criterion is expected.
Hall	Two S1500 Breathing Building Windcatchers ^[2] with acoustic louvres ^[3] at low level covering up to 20 percent of the façade area (<i>no requirement for opening windows</i>)	RED façades in Figure 4 Main hall located toward west of development facing Bank House Road and subject to facade impacts of ≥ 50 dB $L_{Aeq,30minutes}$	It is expected that internal ambient noise levels will be fully compliant with the requirements of BB93

Notes on table:

^[1] Breathing Building NVHR units rated at 25 dB $D_{n,e,w}$ per unit

^[2] S1500 Breathing Building Windcatchers at 14 dB $D_{n,e,w}$ per unit

^[3] Acoustic louvres rated at 18 dB R_w

Table 7 - Ventilation strategy BB93 outcomes

It can be seen from the table above that whilst full compliance with BB93 IANL criteria is expected in most instances, an exceedance is predicted for SEN Classrooms which are exposed to façade level of ≥ 50 dB $L_{Aeq,30minutes}$ (i.e. fronting towards Bank House Road) during periods when windows could be partially open to control summertime overheating. For such instances, an acoustic derogation has been presented to the Department for Education (DfE) to allow for increased noise limits during periods, when open windows may be required for cooling. This derogation schedule is reproduced in Appendix I of this report.

4.2.2 Assessment of ventilation strategy – Other spaces

Ventilation to the pool, pool changing rooms, and kitchen areas will be provided mechanically by air handling plant. Noise limits from mechanical services in these areas will be designed to not exceed the relevant IANL criteria identified in Section 2.1 of this report.

4.3 External Walls

To control noise break-in from outside, it is considered good practice for the external wall construction to provide a sound reduction at least 10 dB above that of the glazing, i.e. ≥ 35 dB $R_w + C_{tr}$.

The external wall will comprise an SFS system, with the external leaf comprising a mix of air brick and insulated wall panel cladding. This build up should be capable of achieving the minimum acoustic requirements.

To help suitably control potential flanking sound via the external SFS wall cavity, the inner plasterboard lining to all areas of the development will comprise two layers of 12.5 mm plasterboard.

At the junction between internal partitions and the external wall, the following measures will be required to minimise flanking noise:

- Where there is full fill mineral wool insulation (for thermal purposes) no additional acoustic treatment will be required;
- Where there is no insulation within an SFS system, a cavity stop will be required where the internal partition has an acoustic rating of 45 dB D_{nTw} (52 dB R_w) or higher;
- A cavity stop will be required horizontally to minimise flanking noise vertically around the edge of floors – this applies to all areas.

The external wall linings must not be continuous between two adjacent classrooms, i.e. it is broken by the classroom dividing wall.

4.4 Roof

The roof of the proposed development will comprise a lightweight roof with the following general build-up:

- Standing seam roof finish
- Min. 270mm glass wool quilt insulation
- Tata D100 non-perforated roof deck
- Lay-in grid ceiling tile finish to 100% of available ceiling area (see Section 6.0 for recommendations on ceiling tile performance required for different spaces)

This roof build-up is expected to suitably control rain noise ingress to the relevant requirements.

Manufacturers' noise level data for building services plant will be reviewed by Cundall in order to see that plant noise break-in does not compromise internal ambient noise level targets.

5.0

Internal Partitions

5.0 Internal Partitions

This Section should be read in conjunction with the latest marked-up acoustic strategy drawings, where the sound insulation requirements of partitions have been indicated, based on achieving the on-site airborne sound insulation requirements as outlined in BB93.

The build-up and location of different Internal Partition Types has been provided to Cundall by JM Architects (Doc Ref: FS0831-JMA-01-00-DR-A-22-0002 Rev P2). The following table indicates which partition types will satisfy minimum requirements as presented in the acoustic strategy drawings.

Ref.	Stud Type	Typical board linings	Mineral wool in cavity	> 40 dB R_w	> 45 dB R_w	> 35 dB $D_{nT,w}$ [>42 dB R_w]	> 40 dB $D_{nT,w}$ [>47 dB R_w]	> 45 dB $D_{nT,w}$ [>52 dB R_w]	> 50 dB $D_{nT,w}$ [>57 dB R_w]	> 55 dB $D_{nT,w}$ [>62 dB R_w]
IWT_01	Gypframe 70 I 50 I Stud	1 layer 15 mm Gyproc Duraline	25 mm	✓	✓	✓	✓	✗	✗	✗
IWT_02	Gypframe 70 AS 50 Acoustud	2 layers 12.5 mm Gyproc SoundBloc	25 mm	✓	✓	✓	✓	✓	✓	✗
IWT_03	Gypframe 48S50C x 2 (twinframe)	2 layers 15 mm Gyproc Fireline	50 mm	✓	✓	✓	✓	✓	✓	✗
IWT_04	Gypframe 70 I 50 I Stud	1 layer 15 mm Gyproc Duraline	-	✓	✗	✓	✗	✗	✗	✗
IWT_05	Gypframe 48S50 C Stud x 2	1 layer 12.5mm Gyproc Habito and 1 layer 12.5mm Gyproc SoundBloc	25 mm	✓	✓	✓	✓	✓	✓	✓
IWT_06	Gypframe 70S50 C + RB1 Resilient Bar	2 layers 15 mm Gyproc SoundBloc	50 mm	✓	✓	✓	✓	✓	✓	✓
IWT_07	Gypframe 48S50 C Stud x 2	2 layers 15 mm Gyproc SoundBloc	50 mm	✓	✓	✓	✓	✓	✓	✓

Table 8 - Internal partition types

5.1 General partition guidelines

In order to see that acoustic integrity and performance of partitions is maintained and controlled, the following guidance is suggested.

- Partitions should generally be full height, from the structural floor to soffit, and well-sealed. Suitable deflection head details will be necessary to see no loss of performance;
- Partitions having an exposed head will need additional detailing to maintain suitable sound insulation properties;
- Alternative board types could be substituted, providing they equal or exceed the minimum mass per unit area (kg/m^2) of those specified;

- Penetrations for services should be avoided where possible. Where there is no alternative, suitable details will be needed to see acoustic performance is maintained;
- Electrical sockets located in partitions having a sound insulation performance requirement of 40 dB $D_{nT,w}$ or greater should be pattressed or specified with appropriate proprietary socket box covers/infills. Hilti Putty Pads, Firefly Socket Box Covers, or, Knauf Putty Pads or similar would be considered suitable products;
- Where partitions to noise-sensitive spaces meet external walls, suitable flexible cavity closers will be required within external wall cavities [see Section 4.3 above];
- Where double layers of board are used, joints should be staggered. Facing boards should be well sealed with skim finish;
- Partitions surrounding plant rooms have been based on an assumed plant room reverberant noise level no greater than 80 dBA. Once plant room details are confirmed, it may be necessary for the partitions to be re-evaluated;
- Partition to the underside of the trapezoidal roof deck will require careful detailing to maintain suitable sound insulation properties. Typically, the following head details would be considered where partition run parallel or perpendicular to the roof liner tray profiles.

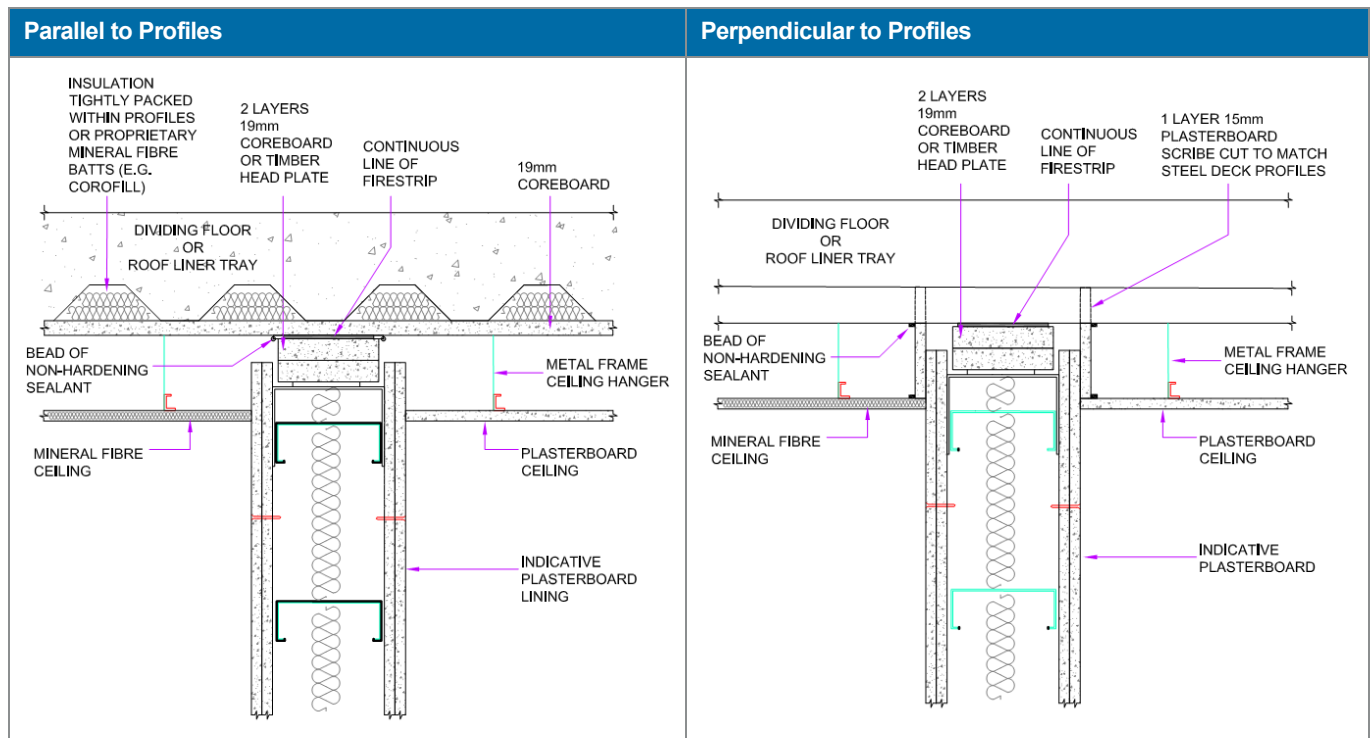


Table 9 – Indicative trapezoidal head details

5.2 Doorsets

The acoustic strategy drawings show the minimum laboratory rated sound insulation for doors throughout the school.

Doorsets in corridor partitions to acoustically sensitive spaces will provide a minimum laboratory airborne sound insulation performance of 30 dB R_w or 35 dB R_w , depending on guidance criteria set in BB93. Where doors are located between adjacent noise sensitive spaces for operational purposes, 35 dB R_w doorsets will be specified.

These ratings will be achieved by a well fitted solid core doorset where the door is sealed effectively around its perimeter within a substantial frame. The following table sets out typical door specification which should be suitable to achieve these rating:

Performance rating, R_w (dB)	Mass per unit area (kg/m ²)	Thickness (mm)
30	27	44
35	29	54

Table 10 - Recommended doorset specifications

In order to maintain their acoustic integrity, acoustically rated doorsets will not be undercut or have grilles for ventilation or any other purpose.

All acoustic doorsets should be of proprietary type, by a specialist manufacturer. The acoustic rating of the doorset should include the door, frame, seals, hinges, any furniture, and any required glazing or vision panels.

For doorsets dividing ancillary spaces to common circulation areas, there is no specific requirement for acoustic insulation. However, it is considered good practice that in potentially noise sensitive locations, such as private offices and meeting rooms, proprietary acoustic doorsets capable of achieving a minimum sound reduction of 30 dB R_w be specified. Where this is considered appropriate, it is marked on the acoustic strategy drawings.

5.3 Internal glazing

5.3.1 Vision panels adjacent to doors

If glazed screens are to be located to the side of doors and would be considered a part of the doorset itself, these screens should have the same rating as the associated door, i.e. 30 / 35 dB R_w depending on the door specification.

All glazed screens immediately adjacent to doors which divide standard teaching spaces from circulation should be rated at 30 dB R_w . This could be achieved with a single 6mm pane of glass.

All glazed screens immediately adjacent to doors with a 35 dB R_w requirement should also be rated at 35 dB R_w . This could be achieved with a single 10mm pane of glass.

5.4 Moveable partitions

It is understood that there are no current proposals for any movable partitions throughout the scheme.

5.5 Services penetrations

Wherever possible, services should not pass through partitions dividing adjacent teaching spaces but be routed via an adjoining corridor or non-teaching space.

Where there is no other option but to pass services through sound-resisting partitions, care must be taken to see that the acoustic integrity of the partition is not compromised. Appendix II gives suggested detailing options for each partition type.

5.6 Services / SVPs

Any pipework passing through noise sensitive / teaching spaces or resulting in openings in partitions should be acoustically sealed. Guidance within Approved Document E states that:

'Pipes and ducts...should be enclosed for their full height. The enclosure should be constructed of material having a mass per unit area of at least 15 kg/m². Either line the enclosure, or wrap the duct or pipe within the enclosure, with 25 mm unfaced mineral wool.'

Boxing out of services should therefore be achieved with two layers of 12.5 mm Wallboard (or alternative boards equivalent or denser). Any boarding option will require 25 mm unfaced mineral wool insulation within. Any access doors or hatches to risers within teaching spaces should provide the same level of acoustic performance and be well sealed when closed.

Boarding should be full height, taken from structural floor up to the soffit, and sealed at top and bottom using a bead of non-hardening sealant.

5.7 Mechanical ventilation systems

Areas that are to be mechanically ventilated should be designed such that the upper indoor ambient noise levels marked on the acoustic strategy drawings will not be exceeded, when measured in conjunction with noise break-in from external sources.

Crosstalk attenuators will be required where different rooms are supplied or extracted via common ventilation systems.

5.8 Isolation of steelwork

Any structural columns or bracing should be either independently boxed out or be incorporated within walls/floors.

Suggested means of boxing out columns / beams are summarised in Appendix III. These recommendations below apply to any steelwork either side of the partition.

It is recommended that the above principles apply to steelwork that occurs within teaching spaces, but that does not occur on partition lines. i.e. the boxing out detail should match the acoustic rating of the partition the steel member passes. The majority of cases will be from classrooms into communal areas and therefore just require the minimum boxing out above, comprising packing out the webs of the steel and boxing out with Glasroc F Firecase.

Although it is considered that in non-occupied spaces steelwork could be left exposed (i.e. corridors, store rooms etc.), areas that are not occupied, but with high activity noise levels, such as plant rooms should have their steelwork boxed out to prevent lively noise and vibration energy passing into the steel frame.

It is recommended that any suspended equipment (such as drop rods for lighting rigs, loudspeaker fixings, and other specialist items) be fixed to steelwork via suitable resilient mountings or hangers. Alternatively, equipment could be isolated at the lower end of the suspension points, by using suitably load-rated resilient pipe hangers.

6.0

Reverberation Control

6.0 Reverberation Control

The acoustic strategy drawings show the reverberation time criteria for each space (teaching and ancillary).

The following drawing presents recommended acoustic properties for absorptive ceiling treatments:

- FS0831-CDL-XX-00-DR-AS-45002 Proposed Reverberation Control Strategy

Provision of suitable reverberation times enables clear communication of speech between teacher and student, and between students in teaching and study spaces. The design reverberation times are for rooms that are finished and furnished for normal use but unoccupied and are generally determined by room volume and surface finishes.

Reverberation control is a key design factor in providing successful educational facilities. Appropriate reverberation times help to enhance speech intelligibility, reduce noise build up and provide a comfortable atmosphere for users of the building.

A high proportion of spaces throughout the development are required to meet the criteria set out in BB93 for SEN spaces. This requires acoustic treatment greater than typical 'Class A' rated ceiling tiles, particularly in the low frequency range. A common solution to this is to provide additional treatment in the form of Ecophon Extra Bass pads (or equivalent), which sit on top of Class A lay-in grid ceilings and improve the low frequency acoustic performance. This requirement for additional low frequency absorptive treatment will apply to the following spaces;

- Primary classroom
- Nursery / Reception classroom
- Small group room
- Primary food room
- Primary library
- Calm room
- Therapy room
- Sensory room
- Soft play room

For the Dining area and Hall (PE/Assembly) rooms, a 'Class A' ceiling should suffice to control reverberation to the appropriate targets. All other spaces in the development should meet the relevant targets provided a 'Class C' ceiling is used, with the exception of ancillary areas i.e. Toilets and Storage areas, which will require no specific acoustic ceiling.

Table 11 below details the currently proposed floor and ceiling finishes throughout the scheme. Comments have been provided with respect to predicted compliance with the BB93 reverberation time criteria. This strategy has been coordinated with JM Architects and can be read in conjunction with the Ceiling Plan drawing ref 'FS0831-JMA-01-00-DR-A-35-0001'.

NOTE: In addition to reverberation control, the specification of lay-in grid ceilings will also need to see that a sufficient level of sound insulation is provided to help minimise rain noise ingress (see Section 2.2).

Space	Proposed floor finish	Proposed ceiling finish	Comments
Primary Classroom	Vinyl	Ecophon Gedina A with Extra Bass – Class A – K40 115C	Current proposals should see that BB93 reverberation time compliance is achieved.
Nursery / Reception Classroom	Vinyl	Ecophon Extra Bass pads provided directly above ceiling to 100% of the available ceiling area	
Small Group Room	Vinyl	Ecophon Gedina A in conjunction with Ecophon Gedina A with Extra Bass – Class A – K40 115C	
Primary Library	Carpet Tiles		
Calm Room	Vinyl	Ecophon Extra Bass pads provided in a ≤ 600 mm wide band directly on top of ceiling tiles along the perimeter of three walls - see MBS Spec K40/275A	
Therapy Room	Carpet tiles		
Sensory Room	Vinyl		
Soft Play Room	Vinyl		
Primary Food Room	Vinyl		
Dining Area	Vinyl	Armstrong Perla OP DB – Class A – K40 115D	
Hall (PE/Assembly)	Vinyl		
Head’s Office	Carpet tiles	Armstrong Dune EVO - Class C – K40 115A	
Conference/ Meeting Rooms	Carpet tiles		
Staff Work Room	Carpet tiles		
Parents Room	Carpet tiles		
Offices	Carpet Tiles / Vinyl		
Kitchen Areas	Vinyl		
Hydrotherapy Pool	Vinyl	No ceiling installed 23m² Class A Wall Panels to be provided for acoustic absorption purposes.	
Hygiene / Physiotherapy Rooms	Vinyl	Monolithic plasterboard ceilings – K10 220A	Current proposals might see a slight exceedance in these areas – targets in this space are not mandatory however as they are not intended for teaching and learning activities.
Toilets / Changing Areas	Vinyl		

Table 11 - Comments on current surface finishes proposals

6.1 In entrance corridors and halls

Absorption should be providing within corridors and entrance halls, so that unwanted sound is absorbed and does not interfere with teaching areas. Approved Document E, Section 7, provides a method for calculating the amount of absorptive material required to comply.

The recommended minimum absorptive finishes for entrance halls, corridors and hallways, are for an area equal to or greater than the floor area to be covered in a Class C absorber (as defined in BS EN ISO 11654: 1997) or better.

7.0

Plant Noise and Vibration

7.0 Plant Noise and Vibration

7.1 External plant noise limiting levels

To see that noise from proposed building services plant does not adversely affect the level of amenity enjoyed at nearby dwellings, it is typical for noise emissions from external plant to be limited to 5 dB below the existing background noise levels when measured at 1 m from the nearest noise sensitive receptor. However, where existing background levels are very low, BS 4142 advises that achieving this criterion may be overly onerous. On this basis, the following table provides recommended limiting plant noise levels based upon measured background level.

Time period	Existing background noise level dB L_{A90}	Plant noise rating level limit dB $L_{Ar,Tr}$
Daytime (07:00-23:00 hrs)	42 ^[1]	37
^[1] Existing background noise value based on modal measured L_{A90} value at location M1 during Ecus noise survey.		

Table 12 – Plant noise limit

The above limit is applicable to the cumulative noise level from all new items of plant when running under normal operation. Where applicable, acoustic feature corrections will be applied to the specific plant noise level to account for any distinguishable acoustic characteristics (e.g. tonality, impulsivity, intermittency).

7.2 Indicative plant noise calculations

Following an initial selection of an external AHU serving the kitchen area (AHU03), an indicative calculation has been undertaken to comment on the suitability of this selection and any necessary mitigation measures. The selection is as follows;

- AHU03 Kitchen Supply – Nuaire ESBHS5-L
- Kitchen Extract – Nuaire SQFA63ES

Manufacturer's data for sound power levels of these units running at required duty is presented below;

Description	Sound Power Level (dB)							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
ESBHS5-L Induct Inlet	93	88	84	85	78	75	69	64
ESBHS5-L Breakout	82	73	71	57	44	41	42	33
SQFA63ES Induct Outlet	83	100	81	75	78	78	76	73
SQFA63ES Breakout	80	93	78	69	65	65	60	50

Table 13 - AHU03 Manufacturer's sound power data

In order to determine the noise propagation from items of plant to the nearest noise sensitive receptor, a model has been produced using SoundPLAN 8.0 acoustic modelling software. This model is capable of accurately determining sound propagation, by taking into account variations in topography, barrier attenuation provided by existing landscaping and buildings, and distance attenuation.

The figure below indicates a grid noise map of the results.

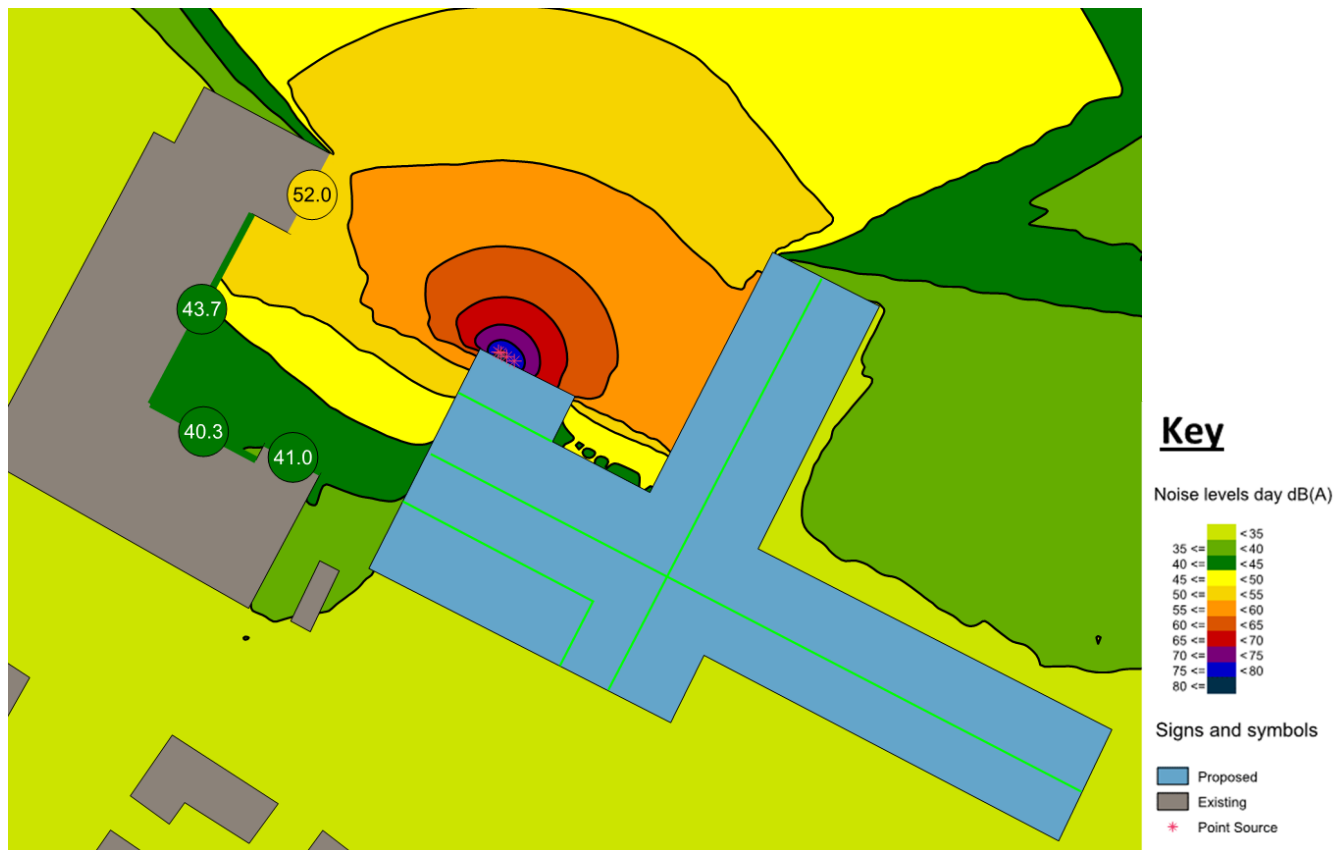


Figure 5 - AHU03 Grid noise map

It can be seen from the noise map above that levels at the nearest noise sensitive receptor as a result of AHU03 are 15 dB above emission limits. The results indicate the AHU inlet and extract fan outlet are the main contributors to this noise, and as such can be adequately mitigated if in-duct attenuators are appropriately specified.

It is understood from correspondence with Ridge Consultants that the above AHU is a preliminary selection only and is larger than required. A new selection is therefore likely to be smaller and quieter, potentially reducing the inlet attenuator performance requirements. Once final selections of external plant have been made, these should be forwarded onto Cundall for review.

7.3 Plant vibration isolation

To prevent structure-borne noise transfer, any noise generating plant items (e.g. chillers, AHUs and pumps) should be mounted by means of spring mounts or similar isolators on a heavy base/framework and fixed to an inertia slab. Such isolation measures should provide 95% efficiency.

Flexible connections should be employed between isolated plant and non-isolated components such as pipes and ductwork. Plant and / or associated equipment located in the ceiling voids or exposed to potential noise sensitive spaces may need to be acoustically lagged (or boxed in using plasterboard) to mitigate any case radiated noise generated by plant.

Appendices

Appendix I Acoustics Derogation Schedule



Acoustics					
Item	Document	Reference / Paragraph	Description / Guidance	Derogation / Comment	Client Comment
1	BB93: acoustic design of schools - performance standards	1.1.2. Acoustic performance standards	Upper limit for the indoor ambient noise level of 30 $L_{Aeq,30min}$ dB for Teaching space intended specifically for students with special hearing and communication needs	During periods of summertime overheating, classrooms served by a Breathing Building NVHR strategy will be partially reliant on opening windows to provide necessary additional air flows for cooling . For classrooms exposed to environmental façade noise impacts of ≥ 50 dB $L_{Aeq,30min}$ (refer to Figure 2 of 4.4. Acoustic Strategy), it is anticipated that BB93 internal ambient noise levels criteria will be exceeded during periods when partially open windows are required for cooling.	

Appendix II Service Penetrations

The following details assume that the size of penetration is only slightly larger than the service passing through the partition. In the case where larger holes have been made to allow services to pass, they will require additional treatments.

Partition type		R _w 40 / 45 dB or D _{nT,w} 35 dB	D _{nT,w} 40 dB	D _{nT,w} 45 dB	D _{nT,w} 50 dB	D _{nT,w} 55 dB
Mechanical services	Single metal / plastic pipe 15 – 110mm	See table below	A	A	A1	A1*
	Ventilation ducting – circular / rectangular		B	B	C	C*
	Tray with refrigerant lines and cables		D	D	E	E*
Electrical services	Conduit		A	A	A	A*
	Single cable (fire alarm)		A	A	A	A*
	Tray/basket with cables 50 – 300mm		D	D	E	E*
	Trunking with lid and cables 50 – 100mm		D	D	E	E*
	Dado trunking		D	D	E	E*

* Services passing through this partition type should be avoided where possible

Detail #A

- Penetration should be packed with mineral wool and well-sealed with non-hardening mastic

Detail #A1

- Penetration should be packed with mineral wool and well-sealed with non-hardening mastic
- For shared radiator piping, there should be an acoustic break, e.g. a section of flexible piping, a change in medium, such as a small section of plastic pipework, or an acoustic break, i.e. a rubber grommet.

Detail #B

- Penetration should be packed with mineral wool and well-sealed with non-hardening mastic
- Crosstalk attenuator should be fitted where a common duct serves vents in multiple rooms

Detail #C

- Penetration should be packed with mineral wool and well-sealed with non-hardening mastic
- Crosstalk attenuator should be fitted across partition

Detail #D

- Penetration should be packed with mineral wool and well-sealed with non-hardening mastic
- Tray/trunking/basket can pass through partition

Detail #E

- Tray/trunking/basket should be cut either side of partition with no hard contact through penetration.
- Services should be passed via a sleeve through penetration
- Sleeve/partition junction should be well sealed with non-hardening mastic
- Any internal void within the sleeve should be filled with mineral wool

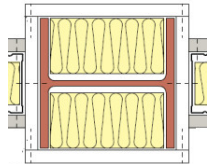
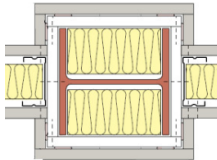
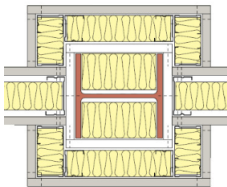
Where pipework services are to be passed through partitions in sleeves, it is recommended that sleeves should be chosen so that pipework fits snugly once installed. Larger diameter sleeves will need to be densely packed with mineral wool once the pipe has been passed through.

Should a penetration be significantly larger than the services passing through the partition (for example, where whole blocks have been removed), additional treatments will be necessary.

Partitions with an R_w rating (principally to corridors) are not required to have their performance tested on site; however it is considered that service penetrations through such partitions should be sealed as followed in order to maintain acoustic integrity:

Room 1	Room 2	Treatment to R_w rated partitions
Classroom	Classroom	2 x 50 mm mineral fibre batt, sealed with non-hardening mastic
Classroom	WC	
Classroom	Corridor	1 x 50 mm mineral fibre batt, sealed with non-hardening mastic
Office	Corridor	
Office	WC	
WC	WC	
WC	Corridor	No acoustic requirement

Appendix III Recommendations for boxing out columns & beams

Construction	Example detail	> 40 R_w (dB)	> 45 R_w (dB)	> 35 $D_{nT,w}$ / 42 R_w (dB)	> 40 $D_{nT,w}$ / 47 R_w (dB)	> 45 $D_{nT,w}$ / 52 R_w (dB)	> 50 $D_{nT,w}$ / 57 R_w (dB)	> 55 $D_{nT,w}$ / 62 R_w (dB)
- Webs of steelwork packed with mineral wool insulation - Beam / column boxed out with Glasroc F Firecase (estimated sound reduction – 50 dB R_w)		✓	✓	✓	✓	✗	✗	✗
- Webs of steelwork packed with mineral wool insulation - Beam / column boxed out with Glasroc F Firecase - Additional layer of 15 mm DuraLine (estimated sound reduction – 55 dB R_w)		✓	✓	✓	✓	✓	✗	✗
- Webs of steelwork packed with mineral wool insulation - Beam / column boxed out with Glasroc F Firecase - Additional Gyproc Duraline on 'C' stud framing, void packed with insulation (estimated sound reduction – 60 dB R_w)		✓	✓	✓	✓	✓	✓	✓

Cundall Johnston & Partners LLP

10th Floor Manchester One Portland Street
Manchester M1 3LD United Kingdom
Tel: +44 (0)161 244 5660

Asia Australia Europe MENA UK and Ireland
www.cundall.com

