

SWITCH BUILDING

STAGE 4 ACOUSTIC REPORT

Project no. P1237
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Revision P02

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REVISION HISTORY

Date	Revision	Notes
08/07/2024	P01	For information
04/12/2024	P02	Updated 1 st floor slab buildup

EXEC SUMMARY

This report sets out the key acoustic design issues, performance criteria and proposed acoustic design solutions for the proposed new SWITCH Harbourside building to be constructed on a site adjacent to Harbour Way, Port Talbot.

ACOUSTIC BRIEF AND CRITERIA

The acoustic design of the building is not required to comply with any acoustic-related legislative documents (e.g. Approved Document E, Building Bulletin 93 (BB93) or HTM 08-01) however the guidance in those documents has been used alongside discussions with the client team to set appropriate acoustic criteria for the scheme. In general the acoustic brief is to:

- 1) Ensure ambient noise levels are suitable for the intended use of each room.
- 2) Ensure internal sound insulation is high enough to minimise disturbance from noisy process equipment and to achieve levels of privacy between the rooms which require it (i.e. meeting rooms)
- 3) Ensure adequate quantities of acoustic absorption are provided to support the use of each room (e.g. speech communication, control of reverberant noise levels or to provide a comfortable acoustic environment for working)

Our understanding of the client brief and associated acoustic criteria in Section 2 were provided in the Stage 3 report and we understand that the client accepts them as the basis for the design.

ACOUSTIC DESIGN STRATEGY

Section 4 of the report covers the soundscape at the site, which is dominated by intermittent road traffic on Harbour Way and to a lesser extent, distant traffic noise from the trunk roads/M4 to the north of the site. The site soundscape is suitable for natural ventilation but a mechanical ventilation strategy has been adopted for non-acoustic reasons. No building envelope acoustic upgrades are required.

Sections 5 and 6 set out the acoustic design strategy for internal sound insulation and room acoustics. During Stage 4 we have worked with the architect to develop a detailed strategy for partitions, doors, internal glazing, floors, ceilings and other acoustically absorptive finishes. The acoustic absorption strategy set out in Section 6 has been refined during Stage 4 in collaboration with the architect, to coordinate with the M&E services layouts and with the interior design strategy.

Section 7 covers building services noise control. During Stage 4 we have finalised the extent of screening for external plant and have provided recommendations for crosstalk attenuation. The mechanical sub-contractor will need to finalise the design and specification of plant and attenuators in order to meet the acoustic criteria for the project.



1 INTRODUCTION

Formant has been appointed by Morgan Sindall to advise on the acoustic design of the proposed new South Wales Industrial Transition from Carbon Hub (SWITCH) in Port Talbot. The project comprises the provision of a new-build construction housing workshops, offices and associated support spaces.

Buildings of this nature are not covered by the requirements of the Building Regulations Approved Document E (ADE) and although the building is associated with Swansea University, it is not a teaching facility therefore the guidance in Building Bulletin 93 (BB93), which would normally be adopted for university buildings, is not necessarily appropriate. Instead, this report sets out a set of bespoke acoustic criteria based on our understanding of the intended use of each space.

This report details:

- 1) Our understanding of the client brief for the project,
- 2) The performance criteria which apply to the development and
- 3) Outline acoustic design advice for members of the design team to incorporate into their work during RIBA Stage 3 onwards.

2 CLIENT ACOUSTIC BRIEF

This section was provided in the Stage 2 Acoustic Report for client review. It was discussed with the client team during workshops in Stage 3 and forms the basis upon which the acoustic design has been developed.

There are no legislative documents (i.e. Building Regulations) which provide acoustic requirements for a building of this nature, therefore the acoustic criteria are based on guidance provided in the following documents:

Type of space	Relevant guidance documents
Office spaces and meeting rooms	BS 8233 (all building types) BB93 (education buildings) RIBA Commercial Offices Handbook (offices)
Labs	BB93 (education buildings) HTM 08-01 (healthcare buildings)
Workshops	BS 8233 (all building types)

Table 1: Acoustic guidance documents used to set criteria for each type of space

2.1 VIBRATION

The site is not expected to be affected by significant levels of groundborne vibration from external sources therefore the key issues will be to protect vibration sensitive equipment from internal sources of vibration (e.g. mechanical equipment and footfall noise).

A specification has been provided by the client for a vibration-sensitive microscope, however the required specification is so onerous that it would require a significant redesign of the building, the cost of which is beyond the client's budget. We understand that the microscope is currently operating successfully at the client's existing building, in a similar location to where it is proposed in the new building. Therefore the vibration criteria in the documentation are not deemed to be a requirement for this project and instead, the design for vibration-sensitive equipment will be based on a qualitative approach to achieving good practice levels of vibration (e.g. avoiding lightweight floors with long spans and providing structural separation between the equipment and vibration sources e.g. M&E plant, lifts and workshops, etc.), rather than on achieving any specific on-site performance figures.

2.2 INDOOR AMBIENT NOISE LEVELS (IANL)

IANL criteria will be based on the guidance in Table 1. In areas where speech privacy is an issue, we will propose an upper and lower limit for building services noise in order to assist with meeting the speech privacy criteria (see Section 1.5 for details). Although some of the equipment specifications provided by the client set out room noise requirements, the figures in the specification are not realistically achievable therefore the noise criteria are based on the above industry standard guidance documents instead.



2.3 NOISY EQUIPMENT

In addition to the guidance documents in Table 1, we have reviewed the spreadsheet list of equipment for the building as provided by the client, and have used this to gain an understanding of the expected internal noise levels. The noise data in the spreadsheet does not stipulate if it is sound power or sound pressure, nor what the measurement conditions would be, therefore we have assumed the data represents the A-weighted sound pressure level (L_{Aeq}) at the operator position (notionally 1 m from the equipment).

The building operator will be required to comply with the Control of Noise at Work Regulations 2005 and although a detailed assessment is beyond the scope of this report, it is important that the design takes measures where possible to mitigate the noise exposure of staff and to avoid the need for hearing protection. A summary of the key noise data and the design implications is as follows:

Type of space	Highest equipment noise level	Design implications
Pilot	100 dB Lewis (strip) mill ≤80 dB (other equipment)	Noise levels could exceed the Noise at Work thresholds for hearing protection if multiple items of noisy equipment run for long exposure times. Acoustic absorption recommended to reduce noise levels. Consider attenuating/screening the noisy mill.
Workshop and Welding & Jointing	100 dB (multiple items)	Likely to exceed the Noise at Work thresholds throughout the room. All practicable measures, including significant quantities of acoustic absorption, should be taken to reduce noise exposure.
SINTEC & RAW MAT Prep	No data	N/a – we understand these rooms should be treated as laboratory spaces and will not contain any significantly noisy process equipment.
Material Characterisation	No data	This room is listed as containing potentially noise-sensitive equipment (e.g. microscopes/ultrasonic testers) and potentially noisy equipment (e.g. grinders). We have requested noise data from the client who have confirmed that there is no significant noise from the process equipment.
Mechanical testing	85 dB (Instron 300DX Tensile Testing machine) ≤80 dB (other equipment)	Noise levels could exceed the Noise at Work thresholds for hearing protection if multiple items of noisy equipment run for long exposure times. Acoustic absorption recommended to reduce noise levels.

Table 2: Acoustic guidance documents used to set criteria for each type of space

2.4 SPEECH PRIVACY AND CONFIDENTIALITY

Speech privacy between spaces is affected by two design factors: the **sound insulation (D_w)** between the two spaces and the **background noise (NR)** level in the listening room. The *Speech Privacy Factor (SPF)* is defined as $SPF = D_w + NR$. For “speech at normal voice levels”, the RIBA Commercial Offices Handbook describes the SPF as:

Subjective description for speech at normal voice levels	SPF
Intelligible	<65
Audible, could be intelligible if the speaker/subject is well known	65-70
Audible but not intelligible	70-75
Just audible	75-85
Inaudible	>85

Table 3: Subjective descriptions of different Speech Privacy Factors

Based on the project brief, we recommend **SPF ≥75-85 (just audible)** for private meeting rooms and **SPF ≥70-75 (audible but not intelligible)** for other spaces requiring basic privacy (e.g. offices). The spaces to which these criteria apply are:

- **Private:** Between meeting rooms and adjacent spaces (excluding moveable walls)
- **Basic privacy:** Other work areas and offices

2.5 INTERNAL SOUND INSULATION

The airborne sound insulation requirements for each room will be based on the required SPF and on whether there is a risk of noise disturbance from noisy equipment in adjacent spaces. The proposed design strategy does not aim to achieve inaudibility between adjacent spaces, as this is not a practical design target, but the level of sound insulation should reduce noise transfer to an acceptable level.

No impact sound insulation criteria are proposed as there are no ground floor noise-sensitive spaces with a significant risk of disturbance from footfall above.

During Stage 4 we reviewed the potential flanking risk of adopting a perforated roof deck above the single height section of the SINTEC rooms. Following consultation with the client, Morgan Sindall have advised us that the client preference is to take the benefits of a perforated roof deck (in terms of reducing operational noise levels and reverberation times in the SINTEC rooms) and to accept a shortfall in sound insulation/privacy between SINTEC 1/2 and between SINTEC 4/5. Therefore the room-to-room sound insulation criteria in Table 4 do not apply to these pairs of rooms.

2.6 ROOM ACOUSTICS

The reverberation time (RT) is important in spaces where speech communication is important. We have assumed this requirement applies to meeting rooms, offices and labs, and we have therefore set RT criteria for these spaces. These spaces will therefore require acoustically absorptive finishes (e.g. acoustic ceiling tiles) to meet the RT criteria.

No RT criteria are proposed in the workshops or circulation spaces, but absorption will still be recommended to either control noise build-up, minimise the risk of staff noise exposure and/or to create a comfortable acoustic environment.



3 ACOUSTIC CRITERIA

The following table summarises the applicable on-site acoustic criteria:

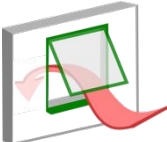
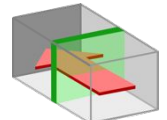
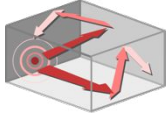
Acoustic issue	Performance standard	Room (and adjacency, if applicable)
 Internal ambient noise level (IANL) L_{Aeq,30 mins}	35 dB	Meeting rooms
	40 dB	Small Offices, Laboratories
	45 dB	Large open plan offices, Break-out, Circulation, Workshops
 Airborne sound insulation (walls and floors) D_{nT,w} (minimum)	43 dB	Between basic privacy spaces (labs and offices generally)
	45 dB	Between private Meeting Rooms
 Reverberation time T_{mf}	0.8s	Meeting rooms
	1.0s	Labs, Open plan offices
 Plant noise emissions Noise Rating, NR (internal) or Rating Sound Level, L _{A,r} (external)	NR28	Meeting rooms
	NR35	Small Offices, Laboratories
	NR40	Large open plan offices, Break-out, Circulation, Workshops
	NR45	Toilets
	43/38 dB	Noise sensitive receptors outside the site (L _{A,r,15mins} day/night)
	45 dB	Nearest openable window within the site (L _{A,r,30 mins} day)

Table 4: Acoustic criteria

Notes on Table 1:

- The IANL limits include contributions from building services noise as well as environmental noise break-in. For naturally ventilated spaces, the total noise level may exceed the IANL limit by up to 5 dB.
- Internal plant noise limits are a target, which should be achieved with a tolerance of ± 3 dBA in all spaces which require a SPF of 75 or higher. The only exception to this is the SEM room, where the M&E services noise should be kept to a minimum to provide the best practicable noise environment for the SEM equipment.

4 ACOUSTIC DESIGN: BUILDING ENVELOPE

4.1 SITE SOUNDSCAPE

The existing soundscape at the site is generally dominated by traffic noise from Harbour Way, which had a fairly constant flow of vehicles, including some HGVs, during the survey. The background soundscape is also affected by distant traffic noise which appeared to come from the north, possibly from the M4. No significant noise from nearby industrial or commercial buildings was noted during the survey although occasional noises were audible at times from industrial buildings to the southeast. Trains passing through the nearby station were audible at times, but did not provide a significant contribution to the soundscape.

Environmental noise measurements were undertaken at positions MP1 to MP4 (as shown in Figure 1) on 16 May 2023. The ambient sound levels ranged from 51-58 dBL_{Aeq} with higher levels recorded closer to Harbour Way. The background sound levels at the site were fairly high due to the constant traffic noise from the north, with the lowest 30-minute measurement being **48 dBL_{A90}**.

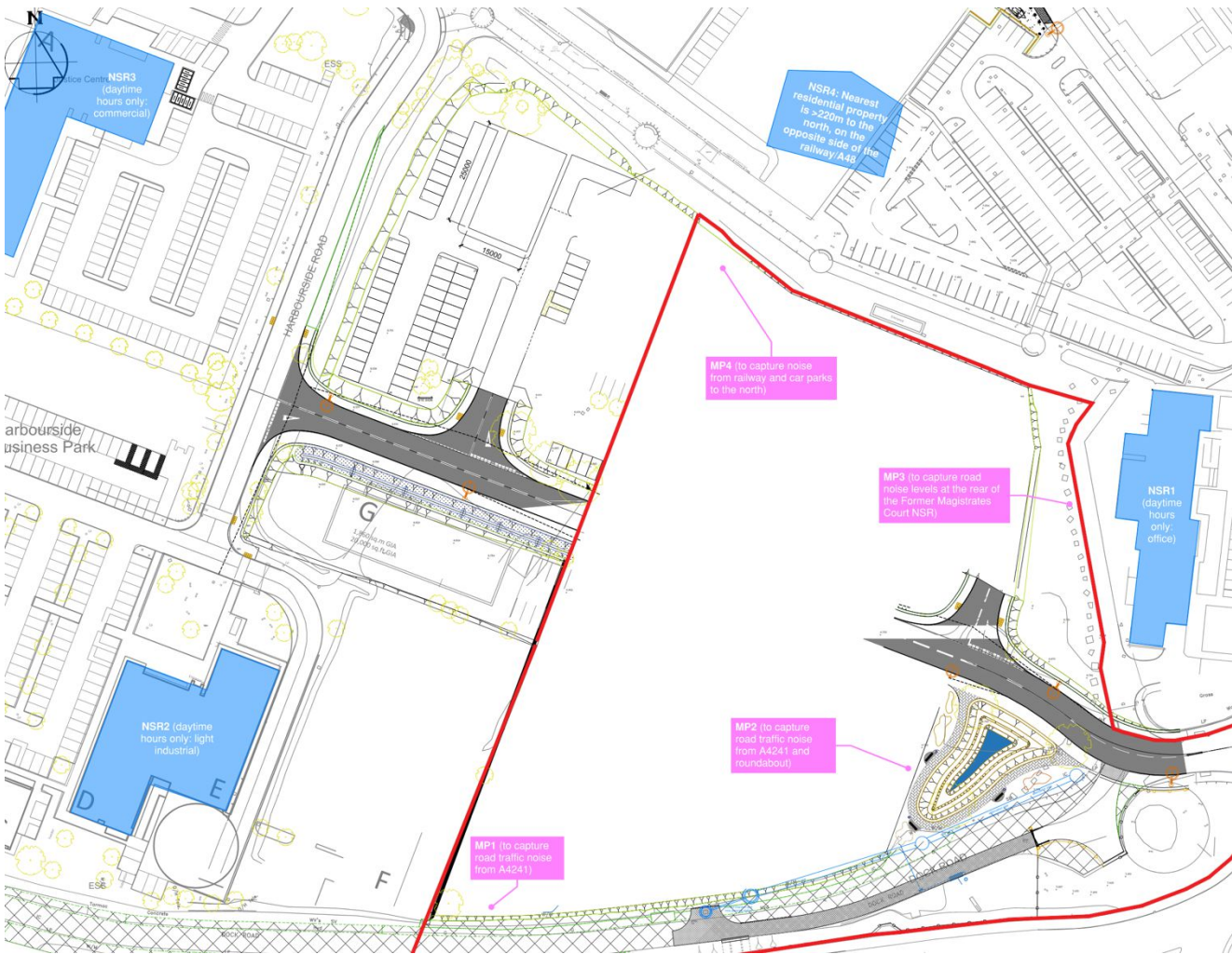


Figure 1: Site location plan showing measurement positions (MP1-4) and nearby NSR locations



The results of the survey at each measurement position are shown in Table 5.

Position and description	Parameter	Result	Photo
MP1 South-western corner of the site, close to the A4241 Harbour Way. Background soundscape dominated by steady distant traffic noise which appeared to come from the north, possibly from the M4 or A48. Ambient soundscape dominated by traffic on Harbour Way, with birdsong and some distant industrial noise audible at times.	Time	12:10 hrs	
	Duration	30 mins	
	L _{Aeq}	59 dB	
	L _{Amax}	70 dB	
	L _{A90}	49 dB	
MP2 South-eastern site boundary, close to the attenuation pond. Soundscape as per MP1 but with slightly less contribution from traffic on harbour Way and occasionally audible trains passing through Port Talbot Parkway Station.	Time	12:43 hrs	
	Duration	30 mins	
	L _{Aeq}	54 dB	
	L _{Amax}	72 dB	
	L _{A90}	48 dB	
MP3 North-eastern part of the site, representative of the location of the former Magistrate Building (NSR). Soundscape as per MP2.	Time	13:16 hrs	
	Duration	30 mins	
	L _{Aeq}	52 dB	
	L _{Amax}	64 dB	
	L _{A90}	49 dB	
MP4 North-western part of the site. Soundscape as per MP3 but wind speeds began to increase during the measurement, which may have raised the measured noise levels slightly above 'normal' conditions.	Time	13:51 hrs	[No image]
	Duration	30 mins	
	L _{Aeq}	51 dB	
	L _{Amax}	62 dB	
	L _{A90}	48 dB	

Table 5: Noise survey results summary

4.2 VENTILATION STRATEGY

BB93 provides internal ambient noise level (IANL) criteria for each type of space within education buildings and these are considered appropriate standards to base the design upon. BB93 also permits a +5 dB relaxation to the IANL criteria for naturally ventilated spaces, stating that the IANL criteria can normally be achieved with:

- Single-sided ventilation where external noise levels exceed the IANL criteria by up to 16 dB
- Cross-ventilation where external noise levels exceed the IANL by up to 20 dB.

The following criteria are therefore applicable:

Type of space	BB93 IANL criterion	External noise limit to support single-sided natural vent	External noise limit for natural cross-vent
Teaching spaces/seminar rooms	35 dBL _{Aeq,30mins}	51 dBL _{Aeq,30mins}	55 dBL _{Aeq,30mins}
Study rooms, Workshops (based on resistant materials), Laboratories	40 dBL _{Aeq,30mins}	56 dBL _{Aeq,30mins}	60 dBL _{Aeq,30mins}

Table 6: BB93 IANL limits and associated external noise limits for natural vent

We have reviewed the proposed building location and internal layouts and advise as follows:

- 1) The most noise sensitive rooms (the Meeting Rooms) are located a reasonable distance from Harbour Way and on an elevation where they will benefit from screening. On this basis, it should be possible to achieve the IANL criteria with ventilation provided by open windows, if desirable.
- 2) The Workshops and Sintec rooms are located on the noisiest elevations, but these rooms are more noise tolerant therefore it should be possible to achieve the IANL limits with partially open windows.

We understand that ventilation will be by mechanical means for non-acoustic reasons, therefore the IANL criteria are considered achievable in all rooms, subject to development of a suitable ventilation system design.

4.3 BUILDING ENVELOPE

4.3.1 ENVIRONMENTAL NOISE BREAK-IN

The external noise levels are not sufficiently high to warrant acoustic upgrades to the building envelope sound insulation and the proposed build-ups are considered suitable in terms of noise break-in.

4.3.2 PROCESS EQUIPMENT BREAK-OUT

The Pilot Space and Workshops will contain noisy equipment which has the potential to disturb nearby NSRs. The noise limits for this are the same as those for external mechanical plant (see Section 7.1 for full details). We have used a 3D computer noise model to calculate noise break-out via the proposed Rodeca polycarbonate windows to the Pilot Space because this is the weakest element of the building envelope (R_w 22 dB) and the Pilot Space contains the noisiest equipment. The calculations results show compliance with the limits, but **it is important that the rest of the building envelope (i.e. roof, cladding and external doors) achieve sound insulation performance of at least R_w 30 dB to ensure noise levels do not exceed the limits.**

4.4 RAIN NOISE INSULATION

No rain noise criteria are proposed and for most spaces in the building we assume rain noise would not cause operational issues. We have reviewed the roof build-ups during Stage 4 no significant rain noise risks have been identified with the proposed build-ups.



5 ACOUSTIC DESIGN: INTERNAL SOUND INSULATION

The sound insulation between internal spaces is important to ensure teaching/study spaces are not unduly disturbed and/or to achieve speech privacy, where this is required.

The internal sound insulation requirement between two spaces depends upon:

1. the **noise levels** of activities taking place in one room and
2. the **sensitivity** of activities in the next room to noise disturbance

The minimum sound reduction criteria for typical adjacencies in the proposed building are defined in BB93 in terms of Weighted Level Difference, $D_{nT,w}$. During RIBA Stage 3 we will calculate the laboratory rating (R_w) for each sound insulating element to meet these on-site criteria. For some adjacencies, there are no on-site criteria between rooms, but the element itself (e.g. a door or a corridor partition) must provide a laboratory sound insulation rating (R_w) instead.

5.1 SPACE PLANNING/LAYOUTS

In the Stage 2 report we advised the architect about potential acoustic space planning issues as follows:

Adjacency	Potential acoustic issue at Stage 2	Current status
Meeting rooms above workshop	Noise transfer from workshops to meeting rooms via viewing windows.	Adjacency no longer exists following re-planning.
Meeting rooms moveable wall	The proposed moveable wall between the two meeting rooms will not be capable of achieving high levels of privacy.	The moveable wall is still part of the design. We understand the client is happy to accept a shortfall in privacy in return for the flexibility it provides.
SEM room	The SEM room was adjacent to SINTEC rooms which posed a risk of noise/vibration issues. The SEM did to have a separate machine room to house the compressors and pumps, posing a risk of noise/vibration issues.	SEM Room is no longer adjacent to SINTEC rooms. A machine room has been provided with access via the corridor.

Table 7: Space planning potential acoustic issues.

5.2 INTERNAL DOORS

Minimum R_w 30 dB doors are required to most occupied rooms and workspaces. A suitable R_w 30 dB doorset would be a 44 mm solid core timber door (minimum 27 kg/m²) with effective compression seals around the full perimeter and a suitable threshold seal. **The door supplier shall ensure that all acoustic doors are supplied as a complete doorset, including appropriate seals and ironmongery which maintain the acoustic rating.**

The plans do not currently show any interconnecting doors, with the exception of the workshops, but we understand that no acoustic rating is required for those doors.

Vision panels within doors should not reduce the overall sound insulation performance of the doorset. Acoustic doors should not be undercut or have grilles for ventilation or any other purpose.

5.3 INTERNAL PARTITIONS

During Stage 4, Arcadis have prepared acoustic plans which we have reviewed. A copy of the plans are included in the Appendix to this report showing the rationalised partition ratings (i.e. some of the partition ratings are slightly higher than our minimum recommendations at Stage 3, but this is acceptable acoustically and we have no further comments on the partitions shown on the plans.

As well as the laboratory rating, achieving the on-site sound insulation performance is heavily dependent on good workmanship and suitable detailing of service penetrations and flanking junctions (see Section 5.5). The R_w ratings on the acoustic plans are based on the assumption that the drylining contractor will achieve an on-site apparent sound reduction rating (R'_w) which is at least within 5 dB of the laboratory rating (R_w), i.e:

$$R'_w \geq R_w - 5 \text{ dB}$$

The drylining contractor is responsible for compliance with this assumption.

5.4 INTERNAL GLAZING

During Stage 4 the architect has developed a glazed screen schedule with acoustic ratings which have been determined by the glazing supplier, as they selected screen types which meet the minimum fire ratings. The schedule shows that all the internal screens are rated R_w 40 dB.

This is a 'mid-range' acoustic rating, which means:

- If it is located in a partition which contains a door, it is typically around 3 dB better than the rating we would normally recommend
- If it is located in a partition which does not contain a door, it is typically around 3 dB lower than the rating we would normally recommend.

In most cases we do not envisage R_w 40 dB being an operational issue for the client. The only exception to this is the glazed screens between the Ground Floor Mechanical Testing room and the adjacent Breakout space. The client has identified this room as housing some noisy equipment (85 dB Instron 300DX Tensile Testing machine). If this equipment is located close to one of the glazed screens, it may result in clearly audible noise for people sitting by the window in the Breakout space.

The client should confirm whether this is considered a potential problem and if so, the potential mitigation would be:

- a) Upgrade the glazing (likely to require a double or twin-glazed system to go higher than R_w 40 dB) or
- b) Reduce the extent of the glazing (e.g. a 3 dB reduction in noise would arise by halving the size of the window) or remove the windows which are close to the noisiest equipment.



5.5 FLOORS AND CEILINGS SOUND INSULATION

We have reviewed the proposed floors/ceilings and provided the following advice to the design team:

Location	Proposed build-up	Acoustic assessment
Ground floor slab	225mm In-situ cast concrete slab 140mm Insulation	No significant acoustic issues: partitions can be built directly off the slab. For the SEM room we recommend the slab be designed with structural isolation (i.e. a movement joint) from other parts of the building and to have the maximum possible stiffness/mass in order to reduce vibration effects on the SEM equipment.
1 st floor slab	150mm composite concrete slab (assumed to be Comfloor or similar) Exposed soffit in most GF rooms (excluding SEM room which has a mineral fibre ceiling)	AIRBORNE SOUND INSULATION Airborne sound insulation should be in excess of D_{nTw} 45 dB without a continuous ceiling which meets the proposed criteria for all adjacencies. With a continuous mineral fibre ceiling (as recommended in the SEM room) the sound insulation should be around D_{nTw} 55 dB, which is beneficial for reducing airborne noise from above affecting the SEM equipment. IMPACT SOUND INSULATION There is no requirement to meet a specific impact (footfall) noise level in any ground floor rooms, most of which are not sensitive to impact noise with the exception of the SEM room, which would benefit from reduced footfall noise, albeit not targeting a specific figure. With the proposed ceiling in the SEM room and carpet floor in the office above, we would expect the impact noise levels to be around 40-45 $dB_{L_{nT,w}}$, which is well below the recommended limit for education, commercial or domestic buildings. Where GF rooms have exposed soffits and rooms above have vinyl floors, footfall noise may be significantly louder, but we assume this is not an issue in any of the ground floor spaces. FLANKING SOUND INSULATION Flanking sound needs to be managed carefully: acoustic rated partitions should not be built off lightweight screeds, they should be built off the structural slab.
Lightweight roof deck	Exposed metal deck soffit	During Stage 4 we have agreed with the architect that the exposed metal roof deck should not be perforated where it poses a risk of flanking undermining the acoustic partitions to the Level 1 meeting rooms/offices. The lightweight roof deck above the SINTEC and Pilot spaces can be perforated, thus helping to control noise build-up in these spaces and we understand that the client accepts the risk of flanking transmission between rooms in these areas and it is acceptable in lieu of the noise control benefits from the perforated deck. See Section 6 for the acoustic absorption requirements of the perforated roof deck.

Table 8: Sound insulation assessment of for structural floors/ceilings

5.6 FLANKING AND SERVICE PENETRATIONS

It is important that the design of flanking elements and service penetrations does not compromise the sound insulation performance of an acoustically rated partition or floor construction. To achieve this, flanking paths should normally be designed to be 10 dB better than the partition or floor.

We have identified potentially significant flanking issues with the proposed exposed soffit and the screeded floor on Level 1 (see Table 10).

In addition to this, we have reviewed the Stage 4 partition junction details and have identified the following issues which should be addressed by the architect:

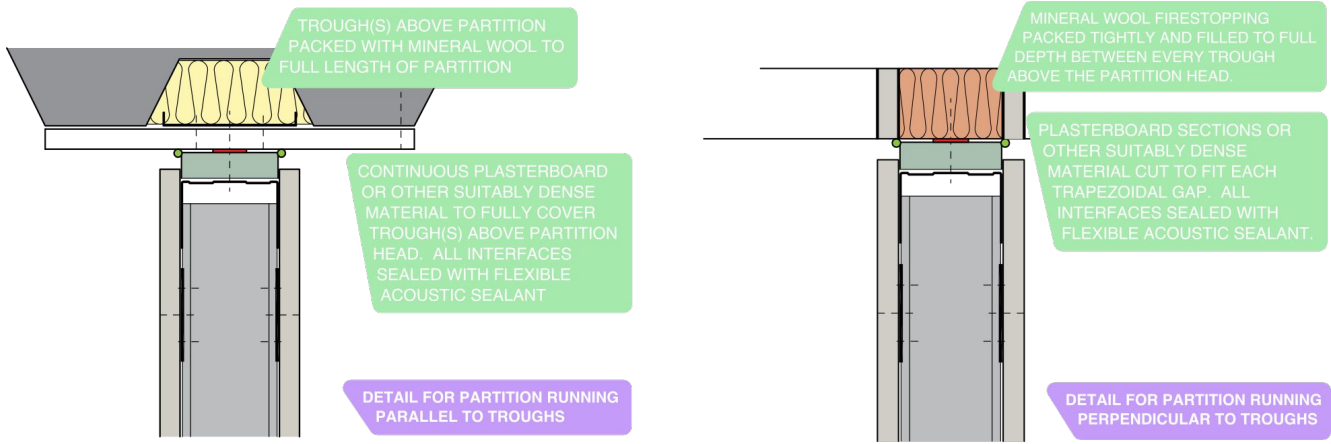


Figure 2: Head details for acoustic partition meeting profile steel deck (acoustic principles only)

Acoustic partition junctions must ensure there are no continuous lightweight elements (e.g. corridor wall linings and façade wall linings) spanning both rooms. Examples are illustrated in Figure 5 below.

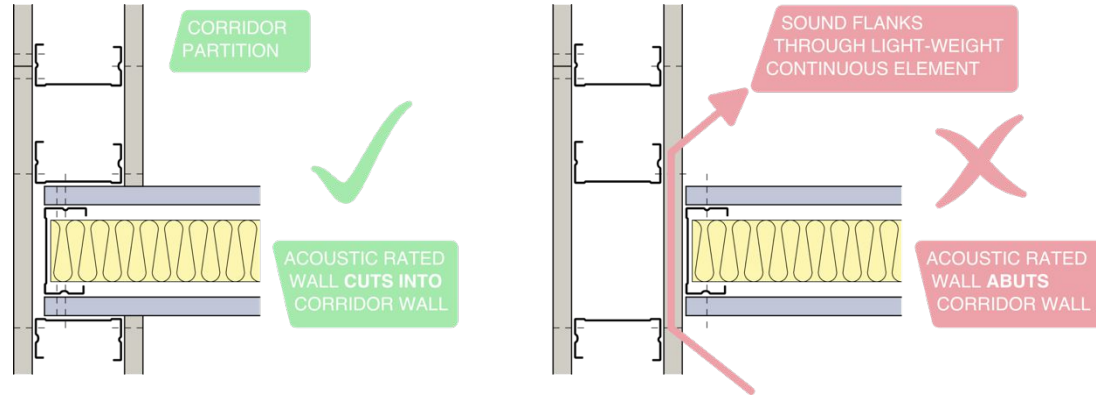


Figure 3: Corridor wall junctions to minimise flanking transmission (acoustic principles only)

See Section 2.3 which discusses flanking sound insulation between the SINTEC rooms which have a perforated roof deck above.



6 ACOUSTIC DESIGN: ROOM ACOUSTICS

Good room acoustics are essential to ensure clear communication in meeting rooms and to control reverberant noise levels in potentially noisy spaces.

There is also a need to provide acoustic absorption in spaces where there is a risk of process noise levels exceeding the Noise at Work thresholds. Although a full Noise at Work assessment is beyond the scope of this assessment, we have identified the following spaces as falling under this definition:

- Pilot
- Workshop and Welding & Jointing
- Mechanical Testing

In these spaces, acoustic absorption is recommended to reduce reverberant noise levels from process equipment.

6.1 GENERAL ACOUSTIC ABSORPTION STRATEGY

In most occupied rooms and circulation spaces, we envisage the most cost effective solution will be to provide an acoustic tile grid ceiling. In some of the taller spaces a full ceiling may not be practicable therefore acoustic rafts, baffles or direct fix panels may be an option. If a lightweight roof is proposed, a cost effective solution which provides high levels of acoustic absorption would be a perforated metal roof liner. A summary of the recommended strategy is provided below:

Type of space	Reason for absorption
Meeting rooms	Essential: To support clear speech and AV/video-conferencing sound quality
Pilot, Workshop and Welding & Jointing, Mechanical Testing	Recommended: Potential risk of Noise at Work issues
Offices	Recommended: To improve privacy and reduce reverberant noise levels
Other labs or work spaces (inc. Atrium/Breakout)	Advisable: to provide a more comfortable work environment and support speech communication
Other circulation	Advisable: to reduce reverberant noise levels

Table 9: Acoustic guidance documents used to set criteria for each type of space

In the absence of legislative requirements for specific quantities of acoustic absorption, it is important to note that the first sqm of absorption makes the biggest difference, so if the budget does not extend to a full acoustic ceiling in all areas, it is still advisable to provide *some* acoustic absorption in each of the recommended spaces described above.

6.2 ACOUSTIC ABSORBERS

During Stage 4 we have worked closely with the architect to refine the Reflected Ceiling Plans (RCPs) and to ensure they are coordinated with the M&E services distribution. The proposed acoustic absorption options are shown in Table 10 and a marked-up set of RCPs is included in the Appendix summarizing the agreed acoustic strategy.

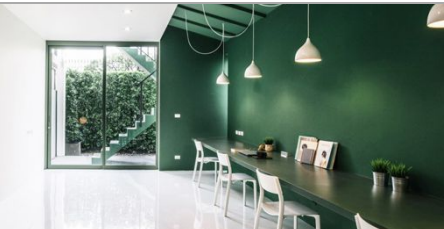
Design option and proposed locations	Acoustic performance	Possible product
Perforated structural roof deck Pilot space, workshops, some SINTEC rooms, etc.	With mineral wool in-fills in the troughs of the trapezoidal deck, this provides good low frequency absorption and average absorption at mid-high frequencies. The proposed roof has PIR insulation instead of mineral wool, and no data is available from Tata Steel for this. If the insulation remains as PIR, it may not provide the same level of sound absorption.	 https://www.tatasteeleurope.com/construction/products/roof/profiles/acoustic-roofdek
Mineral fibre grid ceiling Some circulation spaces, SEM room, some lab spaces	Provides excellent sound absorption and also a degree of sound insulation to reduce noise from M&E plant, flanking and noise break-in/out. Enhanced heavy-weight tiles can offer increased flanking sound insulation in spaces where this is beneficial, e.g. SEM room or the meeting rooms.	 https://www.rockfon.co.uk/products/rockfon-blanka/
Direct fix acoustic panels Pilot space and SINTEC rooms	Excellent performance at mid-high frequencies, which would complement the low frequency absorption provided by the perforated roof deck. Locating the panels close to the noisiest equipment may be more cost effective than distributing the panels throughout the whole room.	 https://www.gbacoustics.co.uk/products/polyester-acoustic-panels-premium
Suspended horizontal rafts Atrium and break-out areas	Excellent performance comparable to a full grid ceiling per sqm, but typically there would be less acoustic absorption because the rafts would not be continuous across the ceiling.	 https://www.ecophon.com/uk/ecophon/free-hanging-units-and-baffles/solo/
Suspended vertical baffles Offices, meeting rooms, some corridors	Acoustic absorption performance is fairly good, but not as good as a ceiling tile or horizontal raft.	 https://www.rockfon.co.uk/products/rockfon-industrial-baffle/#Performance

Table 10: Proposed acoustic finishes.

7 ACOUSTIC DESIGN: M&E NOISE CONTROL

7.1 ENVIRONMENTAL PLANT NOISE EMISSIONS

7.1.1 ASSESSMENT CRITERIA

In order to set appropriate noise emissions limits for noise from the proposed development, it is necessary to determine a representative value for the daytime background noise (L_{A90}). The lowest measured background sound level (L_{A90} 48 dB) has been adopted as the representative daytime background sound level at NSRs.

Although it was not possible to obtain night-time background sound levels during the survey, we have reviewed the data from the Welsh Government's noise mapping which can be found at the *Wales Noise Viewer* website (<http://www.extrium.co.uk/walesnoiseviewer.html>). The data for this site shows that there is a difference of approximately -5 dB between the daytime and night time sound levels at the site. On this basis the representative night-time background sound level at the site would be around L_{A90} 43 dB.

In line with BREEAM PoI 5 and BS 4142, we propose Rating sound limits 5 dB lower than the background noise level at nearby residential receptors. The **rating sound limits are $L_{A,r}$ 43/38 dB (day/night) at the location of the nearby NSRs.**

7.1.2 EXTERNAL PLANT NOISE CONTROL MEASURES

The nearest NSRs are offices/light industrial premises, which are only noise-sensitive during daytime hours. The nearest residential NSR is located some distance away and well screened by intervening buildings. Therefore we expect to find that the plant noise attenuation requirements will be determined by the daytime limits at the adjacent buildings.

During Stage 4 we updated the 3D computer noise model of the proposed site to determine the required noise attenuation measures for external plant. The model results show that without screening, the noise levels are exceeding the noise limits at the NSR 1 (the Keytree (Deloitte) office building to the east of the site). The noise sources which cause the exceedance are SINTEC extract fans, air source heat pumps, VRFs and chillers and the required screening is shown in Figure 4 and 5:

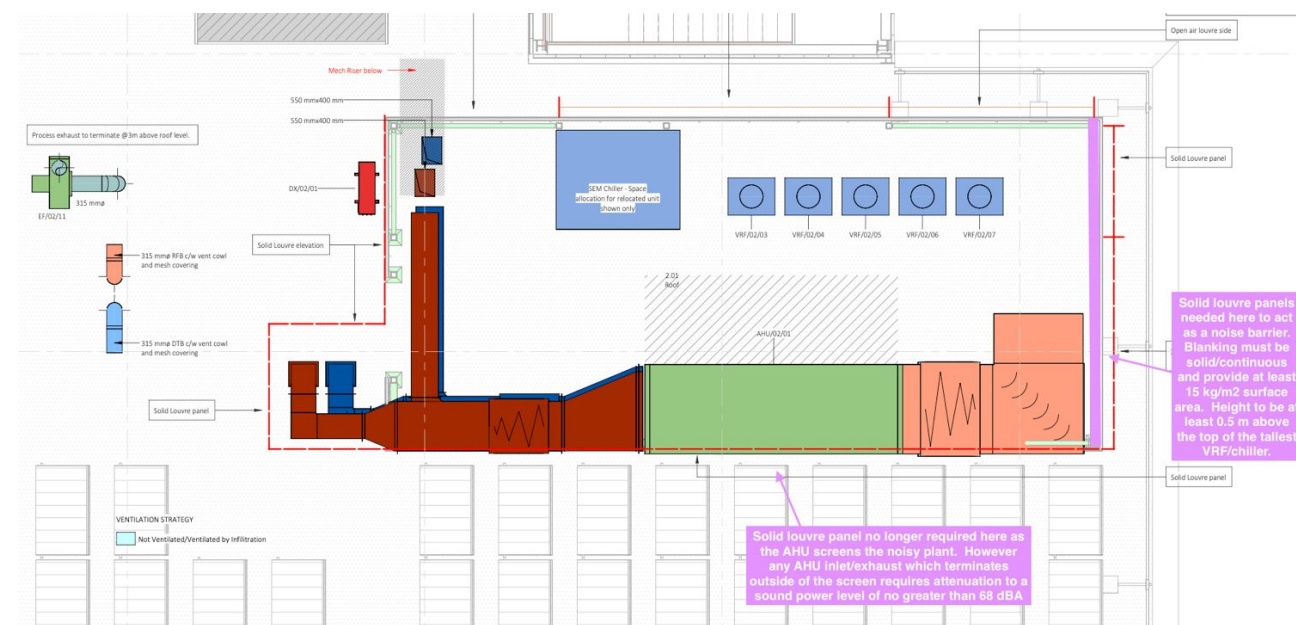


Figure 4: Screening requirements to mitigate rooftop plant noise emissions (northern plant compound).

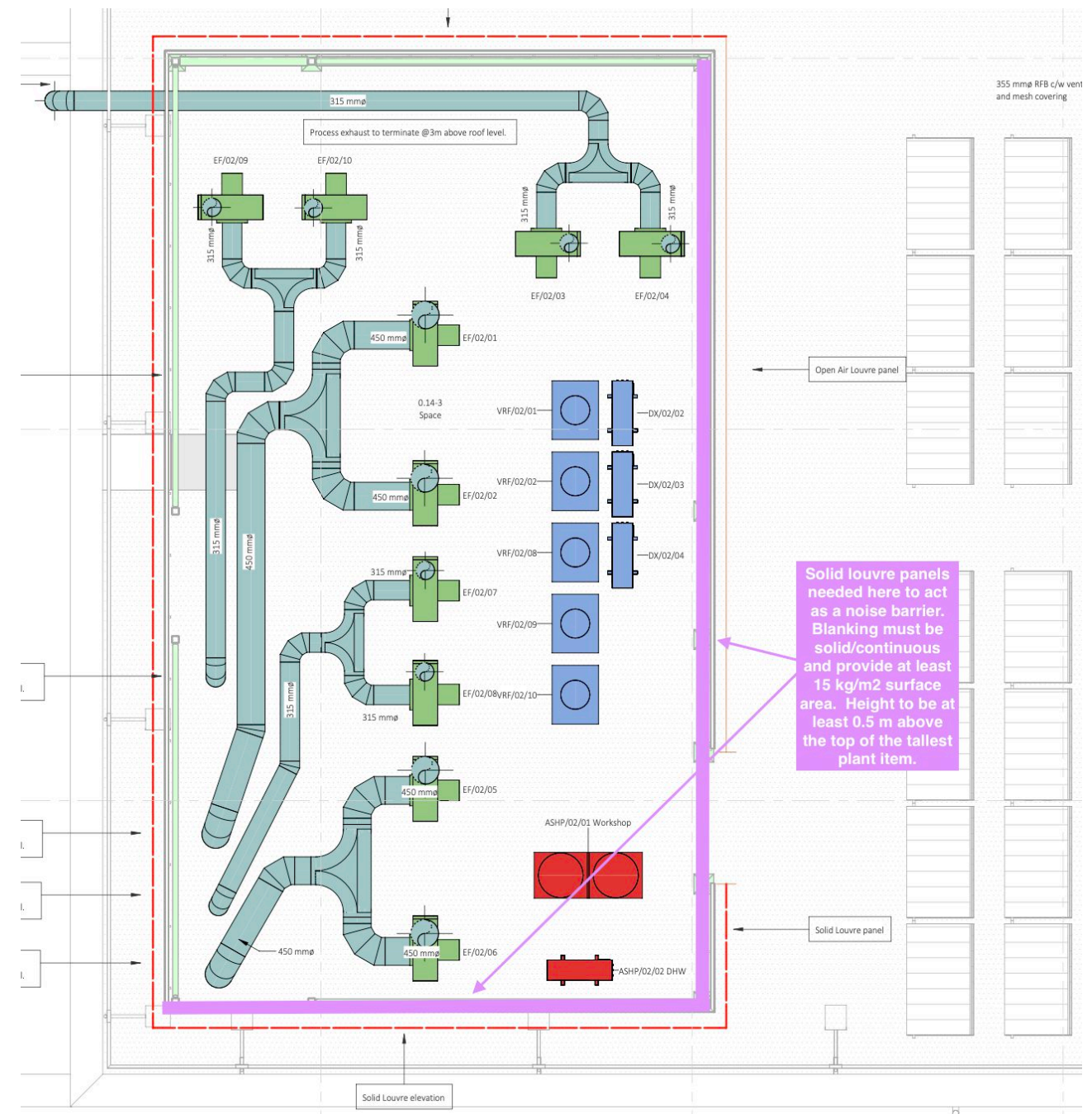


Figure 5: Screening requirements to mitigate rooftop plant noise emissions.

We understand that the proposed weather louvres can come with an optional steel blanking panel. Assuming the blanking panel is continuous and provides at least 10 kg/m² surface mass, the noise model results in Figure 6 and 7 show that this is a suitable noise mitigation solution.

Please note: the assessment assumes that the plant will not exhibit any audible tonal, intermittent or other distinctive characteristics at the location of the NSRs. **The plant manufacturers must confirm compliance with this assumption**, otherwise penalties will apply in line with BS 4142 and additional noise mitigation may be required.



Figure 6: Daytime noise contour plot (plant noise sources, 4 m above ground level).



Figure 7: Night time noise contour plot (plant noise sources, 4 m above ground level)

The results of the model have been assessed in comparison to the background sound levels, in line with the method set out in BS 4142:2014 and the results are as follows:

Receptor (See Fig.1)	Time period	Rating sound level, $L_{A,r}$ (dB)	Background sound level, L_{A90} (dB)	Comparison between rating and background (dB)	Compliant with BREEAM Pol5?
NSR1	Day	42.9	48	-5.1	Yes
	Night	n/a	n/a	n/a	n/a
NSR2	Day	39.7	48	-8.3	Yes
	Night	n/a	n/a	n/a	n/a
NSR3	Day	41.8	48	-6.2	Yes
	Night	n/a	n/a	n/a	n/a
NSR4	Day	35.1	48	-12.9	Yes
	Night	34.0	43	-9.0	Yes

Table 11: BS 4142 noise assessment results

The results confirm that the proposed plant is capable of compliance with the BREEAM Pol5 requirements.

7.2 INTERNAL PLANT NOISE

7.2.1 VENTILATION STRATEGY AND NR LIMITS

Full details of the acoustic issues relating to the ventilation strategy are provided in Section 4.2, which confirms that the proposed mechanical ventilation strategy is suitable acoustically subject to the design and installation of suitably quiet ventilation plant.

All mechanical ventilation systems will need to ensure the IANL criteria are not exceeded and we have provided guideline NR levels for each type of space in Table 4.

The proposed rooftop ASHPs will generate significant noise levels at roof level. We recommend that opening rooflights or high level windows be avoided in proximity to this area. **If open roof or clerestory windows are required for ventilation of any internal spaces, please advise and we can calculate the predicted internal noise levels in the applicable rooms to check compliance.**

For the SEM room, we recommend that the ventilation system be designed to achieve the lowest possible services noise level, in order to maximise the operational resolution of the microscope. The IANL and NR criteria in Table 1 should be treated as maximum levels and ideally a ventilation system noise level closer to NR20 should be targeted, if practicable.

7.2.2 DUCTWORK DESIGN AND INSTALLATION GENERALLY

Ductwork should be installed to ensure a minimum of regenerated noise and laminar airflow within the system by incorporating:

- 1. Gradual bends,
- 2. Gradual changes in cross-sectional area/long transition pieces, and
- 3. Rectangular ductwork with a near unity aspect ratio.



Spigot arrangements should not contribute to regenerated noise within ducts or cause turbulent airflow to terminal components. Ductwork should be installed in a manner to ensure that no self-noise such as rattling or ringing is audible.

Grilles and diffusers should be selected such that they do not result in any significant levels of airflow regenerated noise at normal operational air velocities.

As a general guide, ductwork should be sized in order to meet the guideline maximum airspeeds shown below:

IANL criterion L_{Aeq} , (dB)	Ducts leading to the room (m/s)	Terminal airspeeds (m/s)
30	3	2
35	4	2.5
40	5	3
45	6	3.5

Table 12: Guideline air velocity limits for ductwork

7.2.3 CROSSTALK ATTENUATORS

During Stage 4 we will review the proposed ventilation layout plans and marked up where crosstalk attenuators will be required to ensure the partitions aren't undermined.

All ventilation ductwork serving rooms in the music department are likely to require attenuators, or acoustically lined (not lagged) ductwork between branch and terminal. This applies to both supply and extract ducts. Silencers should be located as close as possible to the point where the ductwork penetrates the corridor wall (if applicable).

7.3 BUILDING SERVICES ROUTING

One of the most common causes of acoustic test failures is unnecessary and/or poorly sealed building services penetrations. Wherever possible, all building services distribution should be via corridors, not through acoustic partitions. This concept is illustrated in Figure 8 and applies to ventilation, pipework and electrical services.

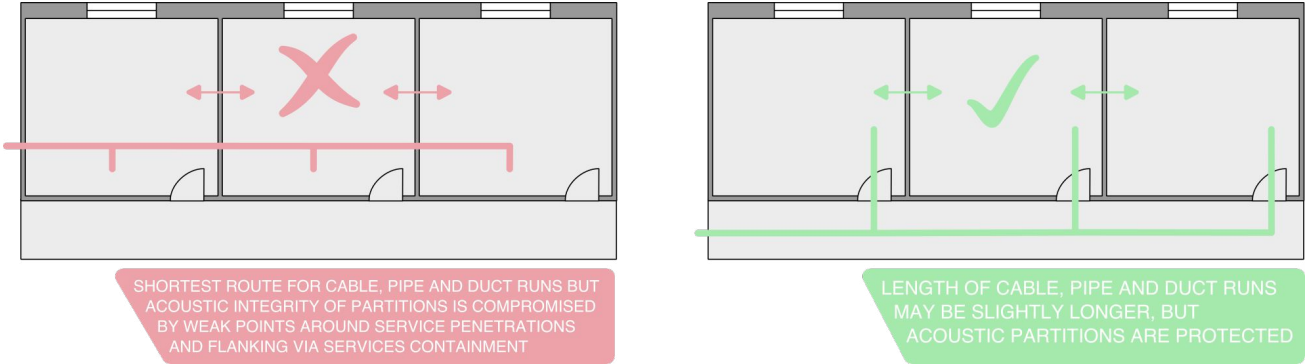


Figure 8: Services distribution should be via corridors, not passing through/over acoustic partitions.

If it is not possible to route services away from acoustic partitions, then acoustic service penetrations will be required and the following general guidance applies:

1. All penetrations should be formed with the minimum practicable clearance.
2. The remaining gap should be packed tightly with mineral wool and sealed using a collar of material with surface weight 9 kg/m² extending at least 50 mm past the edge of the penetration.
3. All interfaces should be sealed using a non-hardening flexible acoustic sealant.
4. If present, any lagging (acoustic or thermal) shall be removed from the section of duct penetrating the partition.
5. Soil and rainwater pipework routed through ceiling voids shall be avoided wherever possible. Where this is not possible, the pipework shall be routed via an acoustic enclosure with acoustic access panels for any rodding eyes.
6. If present, duct/pipe lagging (acoustic or thermal) should only be removed from the section of duct penetrating the element.
7. Pugging bags (e.g. clay/mortar/sand) should be used to fill larger gaps after the installation of electrical services such as cable trays, conduits etc. These should be rammed tightly to completely fill any excess gap.

7.4 PLANT ROOM NOISE LEVELS

The noise levels within the plant room will need to be controlled to minimise noise transmission within the building and noise break-out to the external environment. **Noise levels inside plant rooms should not exceed NR65 and noise levels outside external louvres should not exceed sound power limits of 55 dBA.**

7.5 PLANT FIXINGS AND VIBRATION

Fixings connecting significant building services items (e.g. fans/boilers/pumps) to the building structure should be resiliently mounted if there is any risk of the IANL criteria being exceeded.

7.6 LIFT NOISE

Stair cores and lift shaft walls should comprise at least 200 mm thick in-situ concrete or dense concrete block. Lift fixings, rails, motors and any other components which could cause or transmit lift noise/vibration should be designed to ensure lift noise does not exceed the IANL criteria in Table 1 in any occupied spaces.

7.7 PIPEWORK, DRAINAGE AND SYPHONIC DRAINAGE

Waste water and rainwater pipes which pass through classrooms should be boxed in with mineral wool and one layer of 12.5 mm plasterboard. Siphonic drain pipes should ideally not run through noise sensitive spaces and they should be fixed via acoustically resilient pipe fixings and boxed in with 2 layers of dense plasterboard (min 12.5 kg/m²) and min. 50 mm mineral wool.

7.8 HAND DRYERS

The proposed layouts feature toilets which are located fairly close to the SEM room. Some modern low-energy hand dryers can generate very significant levels of noise and we recommend that these be avoided, with quiet-specification hand dryers selected instead.



8 BREEAM CREDITS

We understand that the project is being assessed under BREEAM Bespoke 2018. The specific requirements for Hea 5 and Pol5 have not been defined at this stage but typically **all available credits should be achievable** based on the current design proposals. Specific details for each credit are set out below.

8.1 HEA5

Three credits are typically available under Hea5 provided that the building meets the acoustic performance standards and testing requirements relating to sound insulation, indoor ambient noise level and room acoustics. The proposed criteria are set out in Section 2 and these would typically form the basis of the Hea5 assessment.

8.2 POL5

One credit is available where a noise impact assessment compliant with BS 4142:2014 is commissioned and the noise level from the assessed building, as measured in the locality of the nearest or most exposed noise-sensitive development, is at least 5 dB lower than the background noise throughout the day and night. A BS4142 Noise Impact Assessment has been undertaken and the results shown in Section 7.1 confirm that the Pol5 credit is achievable. Following installation of the plant, the M&E sub-contractor will need to confirm that the plant has been installed in line with the assumptions in this report, then the credit can be awarded.

8.3 SUITABLY QUALIFIED ACOUSTICIAN

The assessment and design work detailed in this report have been undertaken by Paul Driscoll, MIOA. Paul can be considered to be 'suitably qualified' for the purposes of a BREEAM assessment because:

- 1) He has over 18 years relevant experience working as an acoustic consultant in the UK, working on projects in all sectors of the built environment; including, acting in an advisory capacity to provide recommendations for suitable acoustic performance levels and mitigation measures; and
- 2) Paul is a Member of the Institute of Acoustics.

8.4 DEMONSTRATING COMPLIANCE

A programme of acoustic measurements will be carried out by a compliant test body.

SOUND INSULATION TESTS

Measurements of sound insulation (airborne and impact) will be made between a sample of acoustically sensitive spaces, in accordance with the relevant part of BS EN ISO 16283 series. Where possible, measurements will be conducted between one in four pairs of adjacent acoustically sensitive rooms.

REVERBERATION TIME AND INDOOR AMBIENT NOISE MEASUREMENTS

Measurements of reverberation time will be made in accordance with the engineering grade (or better) requirements of BS EN ISO 3382-2:2008 and in each receiver room. Noise level measurements will be made in at least one in ten noise sensitive rooms.

ENVIRONMENTAL NOISE EMISSIONS MEASUREMENTS

There is no requirement to measure environmental noise emissions to demonstrate compliance with Pol5.



APPENDIX: ACOUSTIC MARK-UP DRAWINGS

Acoustic comments
Date: 08 Jul 2024
By: PD

