Our ref: NIA/9908/21/9947/v1/Wordsworth

1st December 2021

Wordsworth Properties
c/o Mr. Ryan Lewis
Martin Walsh Architectural
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By email only: c/o rl@martinwalsh.co.uk

Dear Sirs,

ACOUSTIC ADVICE
BREEAM 2018 NON-DOMESTIC BUILDINGS: INDUSTRIAL BUILDINGS
WORDSWORTH PROPERTIES, VEHICLE WORKSHOP AND ANCILLARY SPACES

1.00 INTRODUCTION

1.01 Environmental Noise Solutions Limited (ENS) has been commissioned by Wordsworth Properties to provide acoustic advice for a proposed vehicle workshop with ancillary spaces at the existing Wordsworth Properties site on Whaley Road, Barugh Green, Barnsley (hereafter referred to as 'the site').

1.02 It is understood that credits are sought under BREEAM UK New Construction, Non-Domestic Buildings 2018, Health and Well Being 05: Acoustic Performance (Hea 05) and Pollution 05: Reduction of Noise Pollution (Pol 05).

1.03 The aim of Hea 05 is to ensure the building's acoustic performance including sound insulation meet the appropriate standards for its purpose. Hea 05 states that **three credits** can be awarded as follows:

First Credit – Sound Insulation

The sound insulation between rooms and other occupied areas complies with the performance criteria given in Section 7 of BS8233:2014. Alternatively, propose performance standard based on demonstrably best practice.

Second Credit – Indoor Ambient Noise Levels

Achieve ambient noise levels that comply with the design ranges given in Section 7 of BS8233:2014.

Third Credit – Room Acoustics

Achieve the requirements relating to sound absorption and reverberation times, where applicable, set out in Section 7 of BS8233:2014

1.04 With respect to the requirements of Hea 05, where no specific targets are contained in BS 8233:2014, guidance is taken from Building Bulletin 93 'Acoustic Design of Schools: Performance Standards' (BB93), which sets performance standards for indoor ambient noise level, airborne and impact sound insulation, and reverberation time within schools. Since the room uses within the development are all covered within BB93, its use in this case is wholly relevant as alternative acoustic criteria.

1.05 The aim of Pol 05 is to reduce the likelihood of noise arising from fixed installations on the new development affecting nearby noise sensitive buildings. For developments with noise-sensitive receptors (NSRs) within 800 metres, Pol 05 states that **one credit** can be awarded, providing the following criteria are met:

2 Where there are noise-sensitive areas within the assessed building or noise-sensitive areas within 800 m radius of the assessed site, a noise impact assessment compliant with BS4142:2014 is commissioned. Noise levels must be measured or determined for:

2.a Existing background noise levels:

2.a.i at the nearest or most exposed noise-sensitive development to the proposed assessed site

2.a.ii including existing plant on a building, where the assessed development is an extension to the building

2.b Noise rating level from the assessed building.

3 The noise impact assessment must be carried out by a suitably qualified acoustic consultant.

4 The noise level from the assessed building, as measured in the locality of the nearest or most exposed noise-sensitive development, must be at least 5dB lower than the background noise throughout the day and night.

5 If the noise sources from the assessed building are greater than the levels described in criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with the criterion.

1.06 In terms of the 'suitably qualified acoustician' requirement of BREEAM, the author is a Member of the Institute of Acoustics (MIOA) and ENS is a specialist acoustic consultancy and a corporate member of the Association of Noise Consultants (organisation number 144).

1.07 With reference to *'background noise level'* and '*noise rating level'*, useful contextual guidance is provided in British Standard 4142:2014 'Methods for Rating and Assessing Industrial and Commercial Sound' (BS 4142).

1.08 The background noise level is the A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

1.09 The noise rating level is described as the specific sound level (the equivalent continuous A-weighted sound pressure level at the assessment position (NSR) produced by the specific sound source over the given reference time interval) plus any adjustment for the characteristic features of the sound. The character correction relates to whether and to what degree the specific sound is assessed to have an element of tonality, impulsivity and/or characteristics that are readily distinctive against the residual acoustic environment.

1.10 This report details the methodology and results of the assessment and provides information to achieve the four (4) credits sought under BREEAM UK New Construction, Non-Domestic Buildings 2018.

1.11 This report has been prepared for Wordsworth Properties for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties making reference to the report should consult Wordsworth Properties and ENS as to the extent to which the findings may be appropriate for their use.

1.12 A glossary of acoustic terms used in the main body of the text is contained in Appendix 1.

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2.00 SITE SETTING AND PROPOSED DEVELOPMENT

2.01 The site is located within the existing 'Wordsworth Excavations and Crushing' site off Whaley Road, within the Barugh Green area of Barnsley.

2.02 Development proposals are for a single building comprising a main workshop (1248 m^2 floor area and 11 metres height) with offices, canteen, WCs and stores. The stores will be located at ground floor, whilst the offices and canteen will be located at first floor level, which is 8 metres above ground floor level. This arrangement allows flexibility for a future intermediate floor (4 metres above ground floor level), or to facilitate double-height ground floor storage.

2.03 It is understood that the building will be constructed in steel framework with cladding, and that internal walls will be a combination of blockwork and lightweight stud.

2.04 The nearest NSRs to the development at the site are considered to be (see Appendix 2 for annotated site location plan):

- Residential dwellings on Medina Way (NSR1), circa 450 metres to the west of the site
- Residential dwellings on Millers View (NSR2), circa 450 metres to the north-west of the site
- Residential dwellings on Springfields (NSR3), circa 460 metres to the south of the site

3.00 BASELINE NOISE SURVEY

3.01 In order to establish the existing daytime and night time ambient and background noise levels at the proposed development and its surrounding environs, baseline noise surveys (in accordance with British Standard 7445-1 Description and Measurement of Environmental Noise - Part 1: Guide to Quantities and Procedures) were undertaken on Monday 19th July through to Tuesday 20th July 2021, and on Thursday 22nd July through to Friday 23rd July 2021.

3.02 For the purpose of the assessment, the following noise monitoring positions were adopted (the approximate location of the noise monitoring positions is contained in Appendix 2):

- MP1 was located at the position of the proposed façade of the offices
- MP2 was located in the vicinity of residential dwellings on Medina Way (NSR1)
- MP3 was located in the vicinity of residential dwellings on Millers View (NSR2)
- MP4 was located in the vicinity of residential dwellings on Springfields (NSR3)

3.03 Noise measurements were undertaken using a Bruel & Kjaer 2250 Type 1 integrating sound level meter. A windshield was fitted for all measurements. Measurements were made in a free field environment at 1.5 metres above local ground level. The measurement system calibration was verified immediately before the commencement of the measurement sessions and again at the end, using a Bruel & Kjaer Type 4231 calibrator. No drift in calibration level was noted. Weather conditions throughout the survey were appropriate for monitoring with a wind speed of < 5 m/s and dry conditions throughout.

3.04 Measurements consisted of A–weighted broadband parameters, together with linear 1/3rd octave band $L_{eq,T}$ levels. Table 3.1 overleaf contains a summary of the measurement data for each measurement session, at each measurement position, rounded to the nearest decibel.

3.05 Ambient noise levels at MP1 were circa **57–62 dB $L_{Aeq,T}$**, and were due to existing yard activity at Wordsworth, and distant road traffic.

3.06 Typical daytime and night time background noise levels at MP2 were circa 55 dB $L_{A90\ (15\ min)}$ and 40 dB $L_{A90\ (15\ min)}$, respectively.

3.07 Typical daytime and night time background noise levels at MP3 were circa 43 dB $L_{A90\ (15\ min)}$ and 41 dB $L_{A90\ (15\ min)}$, respectively.

3.08 Typical daytime and night time background noise levels at MP4 were circa 36 dB $L_{A90\ (15\ min)}$ and 26 dB $L_{A90\ (15\ min)}$, respectively.

Table 3.1 – Summary of Noise Measurement Data

Position	Date	Time	$L_{Aeq,T}$ (dB)	L_{A90} (dB)	L_{A10} (dB)	Comment
MP1	19/07/21	1134-1207	62	43	62	Existing Wordsworth yard activities, distant road traffic
		1513-1543	59	45	61	
	22/07/21	1132-1203	57	53	60	
MP2	19/07/21	1224-1258	64	54	68	Road traffic on the A637 Whaley Road
		1557-1642	65	57	68	
		2245-2316	59	40	62	
	20/07/21	0012-0042	50	40	47	
		0139-0201	48	38	45	
MP3	19/07/21	1426-1457	48	43	48	Distant road traffic, hum from power station
		1701-1746	47	42	48	
		2328-0003	46	41	43	
	20/07/21	0056-0129	42	41	43	
MP4	22/07/21	1215-1315	41	36	42	Local and distant road traffic
		2300-0000	31	27	33	
	23/07/21	0000-0053	29	26	31	

4.00 HEA 05 FIRST CREDIT – SOUND INSULATION

4.01 Hea 05 requires that the airborne sound insulation provided by separating elements should comply with the requirements of Section 7 of BS 8233. Table 3 of BS 8233 provides a matrix of on-site sound insulation taking into account the privacy requirement for the source room, noise generation of the source room and the noise sensitivity of the receiving room, as follows.

Table 3 **Example on-site sound insulation matrix (dB $D_{nT,w}$)**

Privacy requirement	Activity noise of source room	Noise sensitivity of receiving rooms		
		Low sensitivity	Medium sensitivity	Sensitive
Confidential	Very high	47	52	57 A)
	High	47	47	52
	Typical	47	47	47
	Low	42	42	47
Moderate	Very high	47	52	57 A)
	High	37	42	47
	Typical	37	37	42
	Low	No rating	No rating	37
Not private	Very high	47	52	57 A)
	High	37	42	47
	Typical	No rating	37	42
	Low	No rating	No rating	37

*NOTE Background noise can also influence privacy. See also **7.7.6.3**.*

A) $D_{nT,w}$ 55 dB or greater is difficult to obtain on site and room adjacencies requiring these levels should be avoided wherever practical.

4.02 At this development, the requirement applies to the full-height blockwork separating wall between the main workshop and the ancillary spaces, and the separating floor between the first-floor ancillary spaces and underlying uses.

Separating Walls

4.03 The criteria for the sound insulation ratings to be achieved on site (dB $D_{nT,w}$), take account of all sound–transfer paths. To achieve these standards, partitions need a laboratory derived weighted sound reduction index (R_w) significantly higher than the site performance stipulated. Construction details and quality of workmanship are vitally important to achieve an on–site sound insulation performance. Sound flanking up, over and around partitions and floors (including penetrations) should not prevent the requirements being achieved.

4.04 Although the separating wall is to be built in blockwork, the offices will contain internal vision panels, and therefore the calculation for *lightweight* partitions is robustly adopted. For lightweight partitions, to calculate the R_w required to meet a given $D_{nT,w}$, the following relationship should be used:

$R_w = D_{nT,w} + 10 \log (S/V) + 14$ where

S = common area of separating element being considered (m^2)
V = volume of receiving room (m^3)

4.05 The airborne sound insulation requirements of separating walls (without doorsets) have been assessed with regard to the proposed layout, room dimensions, and guideline values within Section 7 of BS 8233. See Table 4.1 for a summary of the requirements and Appendix 3 for an annotated markup.

Table 4.1 – Sound Insulation Requirements of Separating Walls

Source Room			Receiving Room		BS 8233 Standard	Wall Specification
Name	Privacy Requirement	Activity Noise	Name	Sensitivity		
Workshop	Not Private	High	Office / Meeting	Medium	42 dB $D_{nT,w}$	48 dB R_w
Workshop	Not Private	High	Office	Medium	42 dB $D_{nT,w}$	48 dB R_w
Workshop	Not Private	High	Canteen	Low	37 dB $D_{nT,w}$	45 dB R_w

4.06 Based on the ratio of the vision panels to the blockwork office walls, a composite performance of 48 dB R_w can be achieved with glazing rated at **42 dB R_w** set within a wall rated at **58 dB R_w**.

4.07 A wall performance of 58 dB R_w can be met with the following configuration:

- 140 mm MIDI block (min. density 1900 kg/m^3)
- 35 mm GypLyner channel with 25 mm Isover APR 1200 between the studs
- 2 layers of 12.5 mm SoundBloc (staggered joints)

Note: MIDI blocks (circa 290mm length x 215mm height x 140mm thick) are two thirds of the length of a standard block (keeping the weight of the blocks below 20 kg/m^3) with a close textured finish (for paint grade and fair faced applications).

4.08 The 42 dB R_w vision panel requirement may be met with one of the following indicative glazing configurations:

- 6 mm glass / 6-20 mm gap / 10.8 Pilkington Optiphon
- 6 mm float glass / 16 mm Argon / 8.4 mm SGG Stadip Silence
- 6 mm glass / 100 mm gap / 4 mm glass

4.09 There are no vision panels in the separating wall between the workshop and the canteen. The required performance of 45 dB R_w can be met with 140 mm MIDI blocks (min. density 1900 kg/m^3) with **no additional lining**.

4.10 Although the consideration of walls containing doorsets is not mandatory under BS 8233, it is recommended that the interconnecting door between the two offices is rated at **35 dB R_w** and set within a wall rated at least **45 dB R_w**, in accordance with the recommendations in BB93.

4.11 A lightweight wall performance of 45 dB R_w can be met with the following configuration:

- 1 x 15 mm Duraline board
- 70 mm standard 'C' studs at 600 mm centres with 25 mm Isover APR 1200 between studs
- 1 x 15 mm Duraline board

4.12 It is recommended that doorset between the office and the stairwell is rated at **30 dB R_w**. The corridor wall between the office and the stairwell is to be built in blockwork and should therefore provide sufficient sound insulation without any further measures.

4.13 In order that the required in-situ sound insulation performance is achieved in practice, flanking transmission paths will need to be controlled through careful junction detailing. The following points should be considered to control flanking sound transmission:

- The heads of the walls should be taken up to, and be well-sealed against, the roof liner tray or overlying steel beams, and not to any suspended ceilings (an indicative junction detail for separating walls taken up to liner trays is shown in Schematic 4.1 overleaf)

- Where the walls run perpendicular to the profiled liner tray, acoustic profile fillers (e.g. PFC Corofil Acoustic Profile Fillers – https://www.pfc-corofil.com/products/view/1734/pfc-corofil-acoustic-profile-fillers) should be used at the head of the walls

- To control flanking at the head of the separating walls, a plasterboard ceiling (1 x 12.5 mm standard plasterboard) on metal frame should be installed throughout the first floor (a further lay-in-grid mineral tile ceiling may be required beneath this to control reverberation)

- In order to prevent flanking around the separating walls, the inner leaf of the external wall of the Office / Meeting room and Canteen should be double-boarded with dense board, and must not be continuous across the blockwork separating wall (**note: this junction detail should be reviewed by ENS once finalised**)

- At the junction of separating walls with masonry, the separating wall should be built up to the masonry and not any wall linings

- Service penetrations through separating walls should be avoided where possible, but if required, all voids around the pipework should be sealed with flexible sealant. The service opening should be kept to the minimum required for the services to pass through

- Where services (eg SVPs) run internally to noise sensitive rooms, they should be lagged with a minimum 25 mm mineral wool quilt and boxed in with two layers of gypsum-based board, each layer a nominal 8 kg/m^2 (joints staggered)

- Preferably, there should be no sockets in separating walls, but if required they should not be back-to-back and the rear of the socket should be lined with 2 no. layers of dense plasterboard (or use Hilti CP 630 Putty Pads)

- Cable chases within blockwork partitions should be avoided. Where this is not possible, the depth of any cable chases should be minimal and fully bonded and skimmed

- Depending on the ventilation strategy for the development and the layout of ductwork, consideration may need to be given to the provision of cross-talk attenuators in the duct system to control noise transmission between noise sensitive spaces

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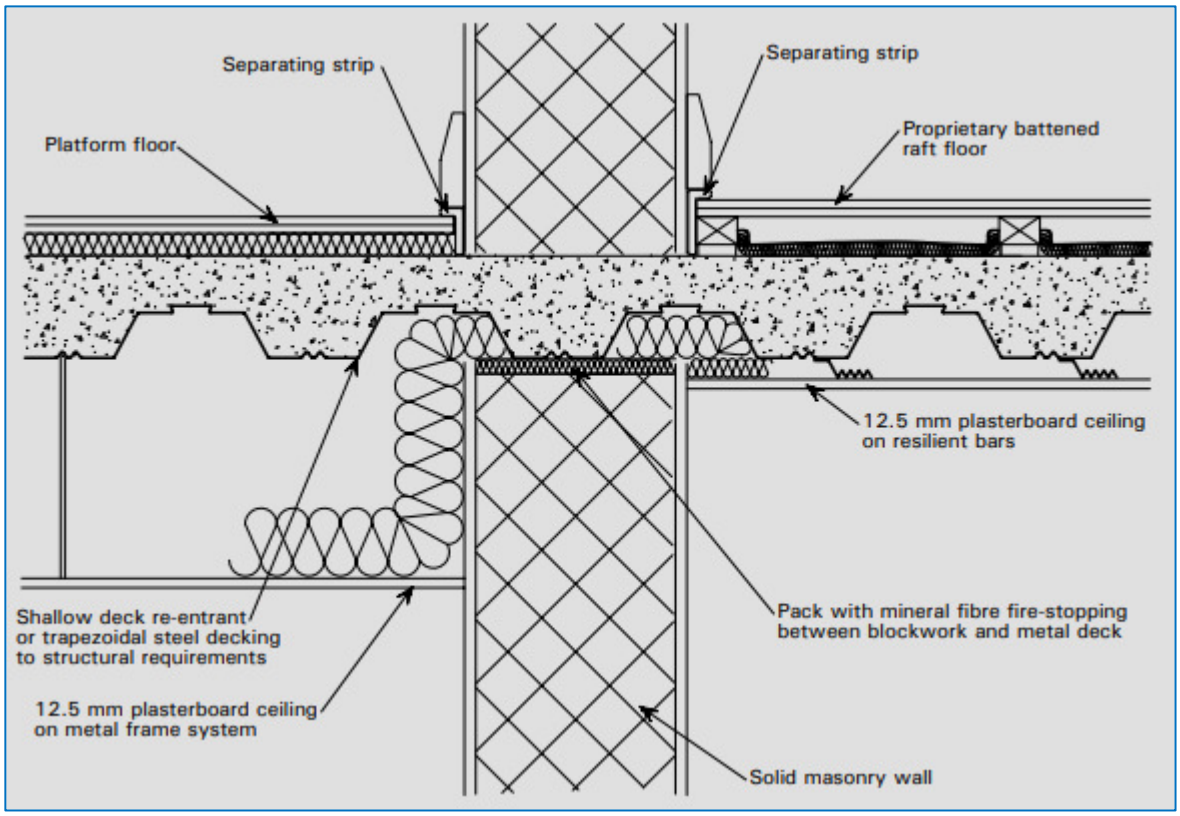
Schematic 4.1 – Blockwork Wall Head Detail



Separating Floors

4.14 In the scenario where an intermediate floor level is not installed, the airborne sound insulation requirement of the separating floor is taken as **42 dB $D_{nT,w}$**, based on double-height ground floor stores (high activity noise, no privacy requirement) impacting on first floor offices (medium sensitivity).

4.15 This performance would readily be met with circa 140–160 mm concrete on a profiled metal deck (or any other concrete construction) underdrawn with a standard plasterboard ceiling on metal frame, providing that flanking transmission is adequately controlled.

4.16 Where the perimeter walls to a separating floor are continuous between rooms and of < 215 mm brick/blockwork a major flanking transmission path exists. This is because the coincidence dip of a 100 - 150 mm brick/blockwork wall is around 200 Hz. This is the frequency at which sound generated in one room will preferentially travel along the wall and reradiate in the room below (a form of resonance), flanking around the separating floor.

4.17 It has been recommended that the full-height blockwork separating wall is lined on the office side with the British Gypsum GypLyner wall lining. To minimise vertical flanking, this lining should continue along the blockwork stairwell corridor wall of the office (see Appendix 3 for location of lining).

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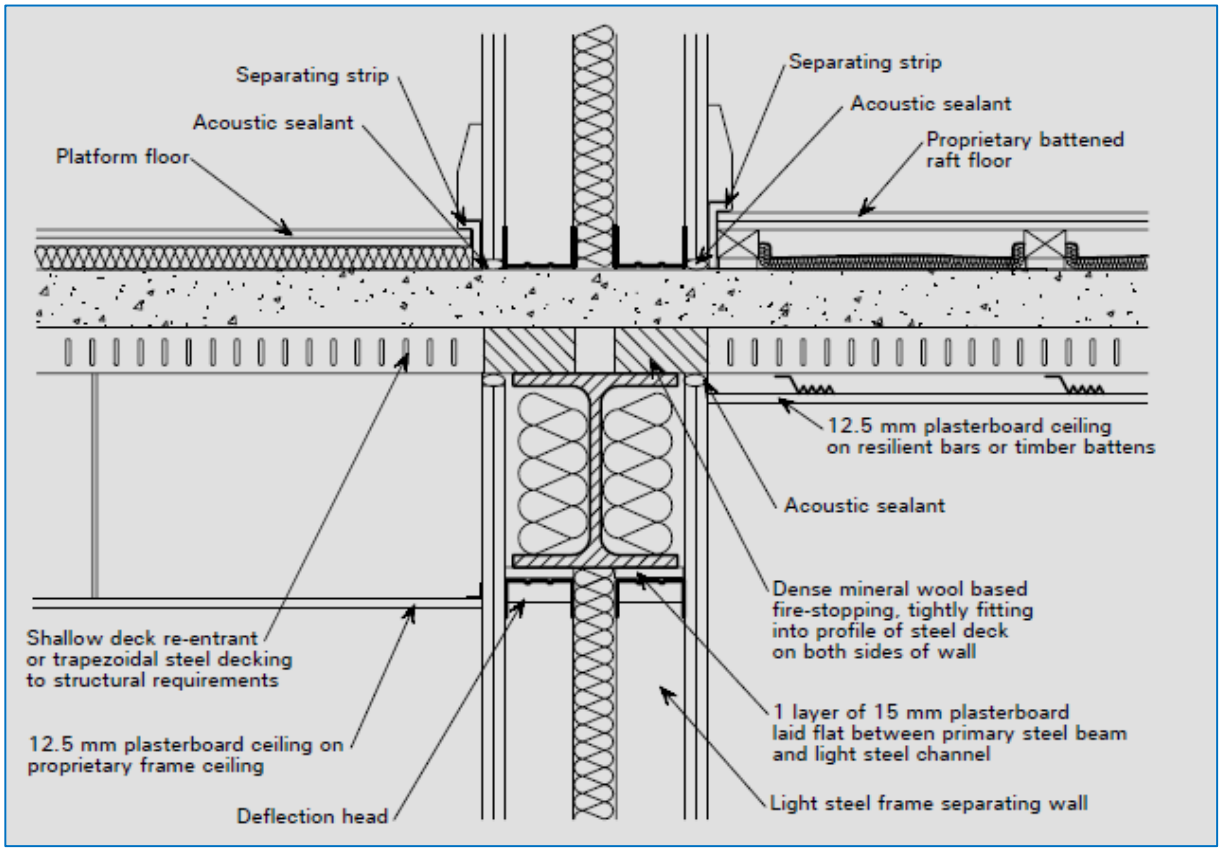
Control of Flanking Noise in Steelwork

4.18 The primary steel framework has the potential to be one of the main sources of flanking sound transmission, either directly via the members or indirectly by bridging of other structural elements. The schematics below indicate typical flanking control treatments. The general principle is that the steelwork should, as far as practical, be isolated and also clad/encased to dampen any resonant frequencies.

4.19 Exposed steelwork should be encased in 2 layers of 12.5 mm dense plasterboard with mineral wool in the web of the steel. Where a steel beam runs perpendicular through a separating wall, the web of the steel should be fully sealed with a timber packer over the head of the wall and the lining to the steelwork should not be continuous across the junction.

4.20 Where new separating walls coincide with steel beams, the wall should be taken up to the encased beams, with ceilings dropped in on either side. Alternatively, the lining plasterboard of the separating walls should fly past the steel beam and be taken up to the metal deck as shown in Schematic 4.2 below. The plasterboard should not be in contact with the beam.

Schematic 4.2 – Separating Wall to Overlying Steel Beam



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4.21 Any columns that are on the line of the separating wall must be integrated so they do not act as a bridge through the wall for sound transmission. It is important to ensure that the gypsum lining is not fixed back to the columns, and to provide some resilience between the column and separating wall structure.

4.22 Schematics 4.3 and 4.4 provide appropriate indicative details for situations where separating walls terminate at columns.

Schematic 4.3 – Integration of Steel Column into a Masonry Separating Wall

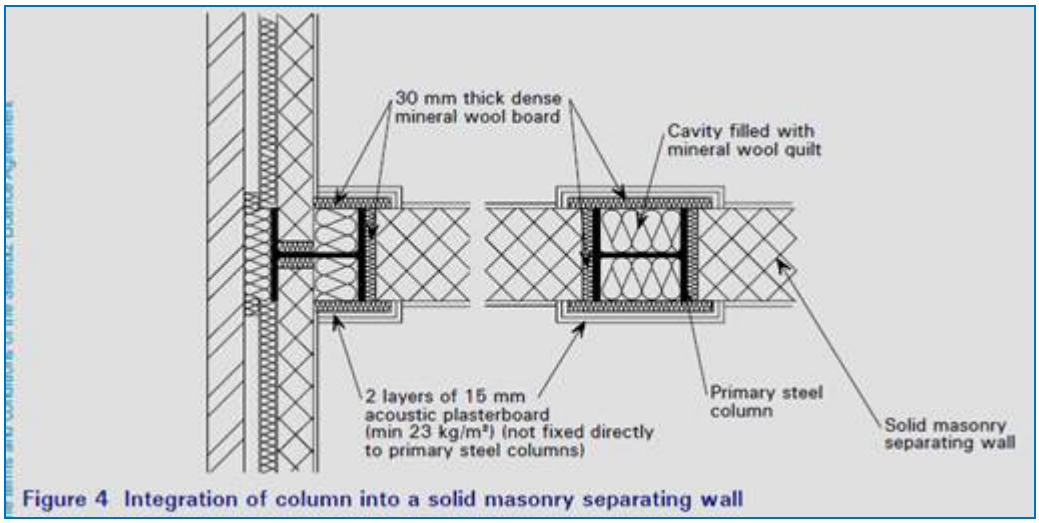
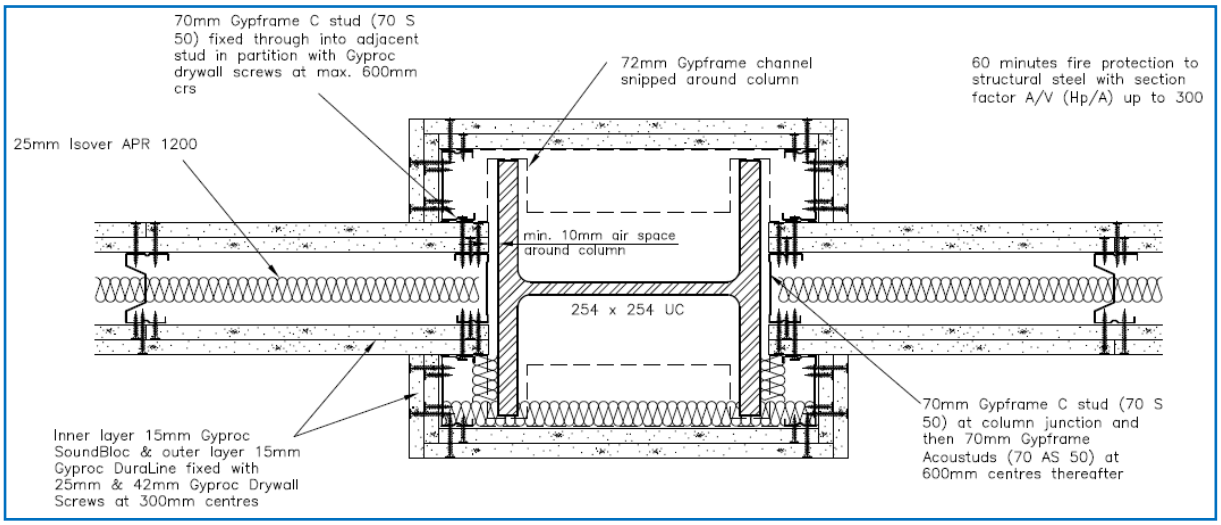


Figure 4 Integration of column into a solid masonry separating wall

Schematic 4.4 – British Gypsum Column Junction Detail (08/7877/01)



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5.00 HEA 05 SECOND CREDIT – INDOOR AMBIENT NOISE LEVELS

5.01 Hea 05 requires that the indoor ambient noise requirements for noise intrusion from external sources complies with the requirements of Section 7 of BS 8233. These requirements are summarised in Table 5.1 below:

Table 5.1 – Indoor Ambient Noise Level Requirements

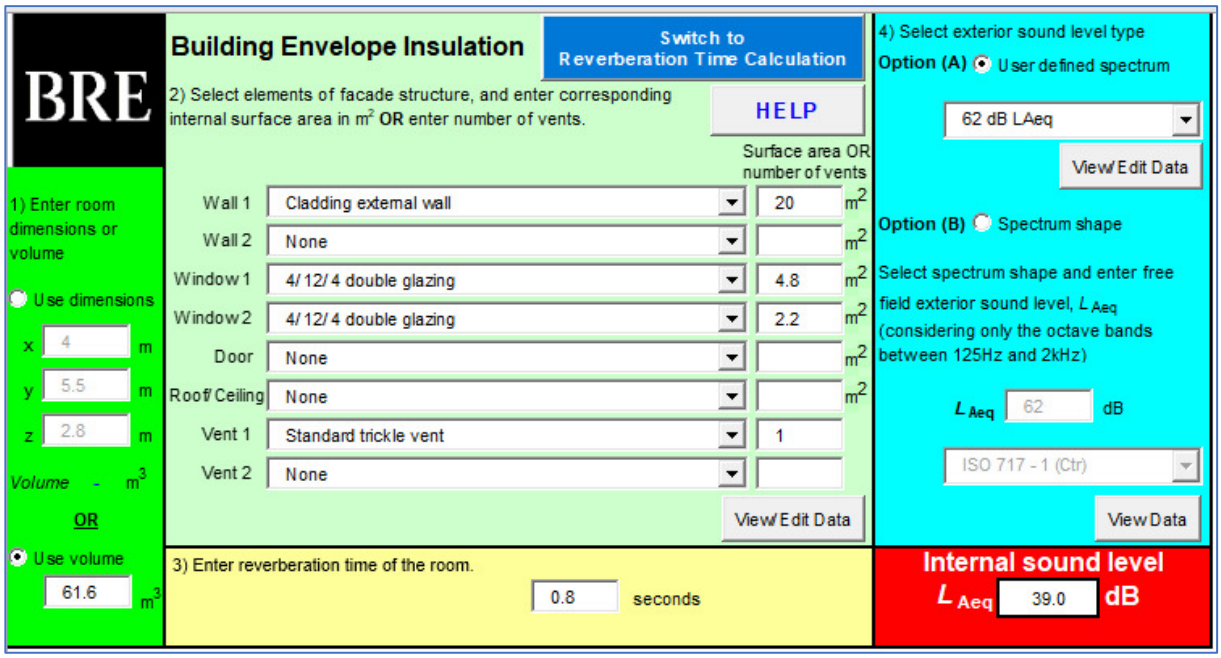
Room	BS 8233 Room Type	Internal Ambient Noise Level Target
Office / Meeting	Executive office	35–40 dB $L_{Aeq, T}$
Office	Staff/meeting room, training room	35–45 dB $L_{Aeq, T}$
Canteen / Break Room	Canteen	50–55 dB $L_{Aeq, T}$

5.02 Ambient noise levels at the development footprint were measured at up to 62 dB $L_{Aeq, T}$.

5.03 In order to calculate the sound insulation requirements of the building envelope, the Building Research Establishment (BRE) building envelope insulation calculation spreadsheet was used. This spreadsheet is based on the calculation methodology advocated in BS 8233. The spreadsheet allows input of external noise levels, room dimensions and reverberation time together with parameters for the various elements of the building envelope and calculates the internal noise level in terms of the external noise level metric (L_{Aeq} in this case).

5.04 As evidenced in the example calculation spreadsheet overleaf, the target criteria will be readily met with the provision of standard thermal glazing (i.e. 4 mm glass / 6-20 cavity / 4 mm glass) and standard (non-acoustic) trickle vents.

<u>BRE Calculation Spreadsheet for Office / Meeting</u>



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6.00 HEA 05 THIRD CREDIT – ROOM ACOUSTICS

6.01 No specific reverberation time criteria are contained in BS 8233:2014. Reference is therefore made to the reverberation times set out in BB93 for various room uses, as summarised in the following table:

Table 6.1 – Reverberation Time Requirements

Room	BB93 Room Type	Reverberation Time (500 to 2000 hertz)
Office / Meeting	Meeting room	≤ 0.8 seconds
Office	Office	≤ 1.0 seconds
Canteen / Break Room	Dining room	≤ 1.0 seconds

6.02 It has been recommended that an imperforate plasterboard ceiling is installed throughout first floor in order to address flanking transmission at the head of the separating wall. Therefore, a further lay-in-grid ceiling containing **Class C** ceiling tiles is required in order to meet the reverberation time requirements in the rooms detailed above.

6.03 Alternatively, consideration should be given to 'thinner' proprietary solutions, such as:

- Echosorba tiles (30 mm thickness)
  http://www.soundsorba.com/acoustic-products/sound-absorption/echosorba/

- Acospray DC2 Spray-on treatment (20 mm depth required to achieve Class C absorption)
  https://www.stil-acoustics.co.uk/Seamless-Acoustic/Acospray.html

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7.00 POLLUTION (POL 05) NOISE ATTENUATION

7.01 The noise rating level from fixed installations at the proposed extension, as measured in the locality of the nearest or most exposed noise sensitive receptors, should be at least 5 dB below the background noise levels during both daytime and night time when assessed in accordance with BS 4142:2014.

7.02 Based on the noise data detailed in Section 3.00, Table 7.1 provides the highest permissible free-field cumulative noise rating levels of fixed installations associated with the proposed development at the nearest noise sensitive receptors.

Table 7.1 – Limiting Cumulative Plant Rating Levels

Period	Limiting Plant Rating Noise Level at Receptor		
	NSR1 – Medina Way	NSR2 – Millers View	NSR3 – Springfields
Day (07:00 – 23:00)	50 dB $L_{Ar,T}$	38 dB $L_{Ar,T}$	31 dB $L_{Ar,T}$
Night (23:00 – 07:00)	35 dB $L_{Ar,T}$	36 dB $L_{Ar,T}$	21 dB $L_{Ar,T}$

7.03 Given the significant separation distances involves, it is considered that compliance with such limits would be readily achievable with judicious selection of plant, equipment, building envelope and/or standard noise mitigation techniques.

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8.00 CONCLUSIONS

8.01 BREEAM acoustic advice has been provided for the proposed vehicle workshop with ancillary spaces at the existing Wordsworth Properties site on Whaley Road, Barugh Green, Barnsley.

8.02 Providing the recommendations detailed in this report are adopted, it is considered that 3 credits can be awarded under Health and Wellbeing (Hea 05) Acoustic Performance.

8.03 Based on the assessment detailed in this report, it is considered that 1 credit can be awarded under Pollution (Pol 05) Reduction of Noise Pollution (subject to validation of the proposed plant).

I trust the foregoing is sufficient for your needs. Should you have any queries regarding the above, please do not hesitate to contact me.

Yours sincerely

Richard Whitaker BSc (Hons)
MIOA, Diploma in Acoustics and Noise Control
Environmental Noise Solutions Limited

cc File

Appendix 1
Glossary of Acoustic Terms

Sound Pressure Level (L_p)

The basic unit of sound measurement is the sound pressure level. As the pressures to which the human ear responds can range from 20 µPa to 200 Pa, a linear measurement of sound levels would involve many orders of magnitude. Consequently, the pressures are converted to a logarithmic scale and expressed in decibels (dB) as follows:

$$L_p = 20 \log_{10}(p/p_0)$$

Where L_p = sound pressure level in dB; p = rms sound pressure in Pa; and p_0 = reference sound pressure (20 µPa).

A-weighting Network

A frequency filtering system in a sound level meter, which approximates under defined conditions the frequency response of the human ear. The A-weighted sound pressure level, expressed in dB(A), has been shown to correlate well with subjective response to noise.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq, T}$

The value of the A-weighted sound pressure level in decibels of continuous steady sound that within a specified time interval, T, has the same mean-square sound pressure as a sound that varies with time. $L_{Aeq, 16h}$ (07:00 to 23:00 hours) and $L_{Aeq, 8h}$ (23:00 to 07:00 hours) are used to qualify daytime and night time noise levels.

$L_{A10, T}$

The A-weighted sound pressure level in decibels exceeded for 10% of the measurement period, T. $L_{A10, 18h}$ is the arithmetic mean of the 18 hourly values from 06:00 to 24:00 hours.

$L_{A90, T}$

The A-weighted sound pressure level of the residual noise in decibels exceeded 90% of a given time interval, T. L_{A90} is typically taken as representative of background noise.

$L_{AF\ max}$

The maximum A-weighted noise level recorded during the measurement period. The subscript 'F' denotes fast time weighting, slow time weighting 'S' is also used.

Sound Exposure Level (SEL or L_{AE})

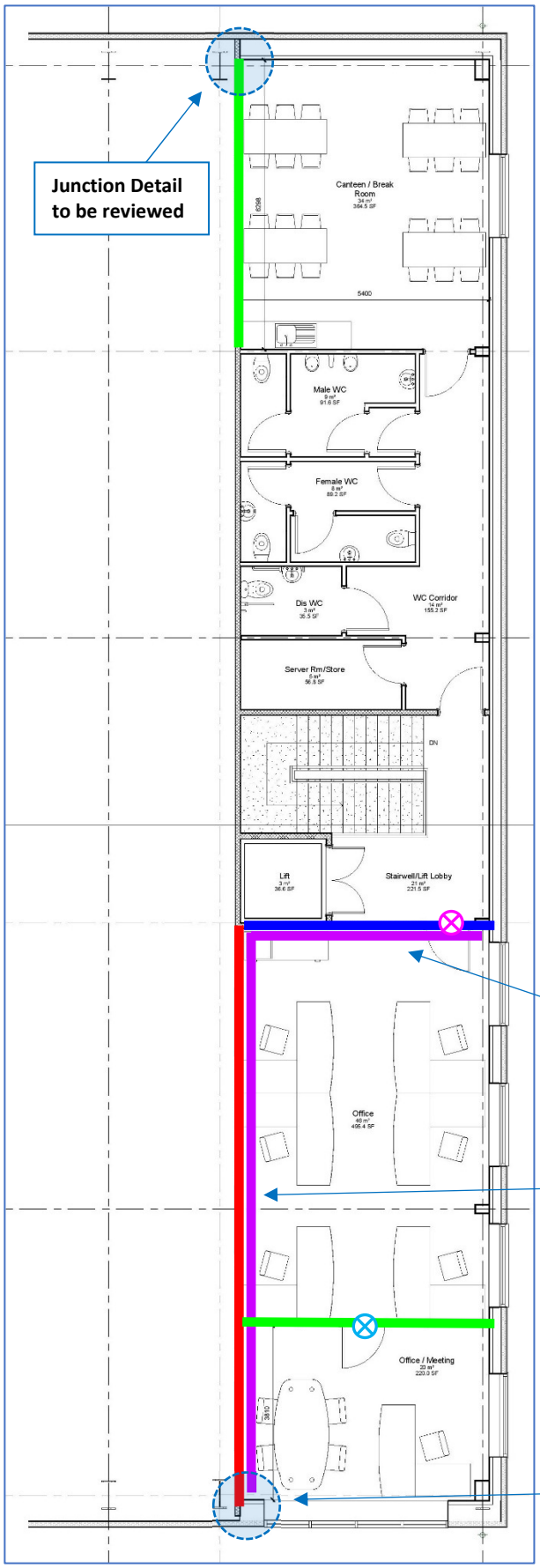
The energy produced by a discrete noise event averaged over one second, no matter how long the event actually took. This allows for comparison between different noise events which occur over different lengths of time.

Weighted Sound Reduction Index (R_W)

Single number quantity which characterises the airborne sound insulation properties of a material or building element over a defined range of frequencies (R_W is used to characterise the insulation of a material or product that has been measured in a laboratory).

Appendix 2 – Site Location Plan and Approximate Monitoring Positions

Appendix 3 – Annotated Site Layout Plan



Airborne Sound Insulation Requirement
40 dB R_w Separating Wall
45 dB R_w Separating Wall
58 dB R_w Separating Wall

Doorset Sound Insulation Requirement	
30 dB R_w	⊗
35 dB R_w	⊗