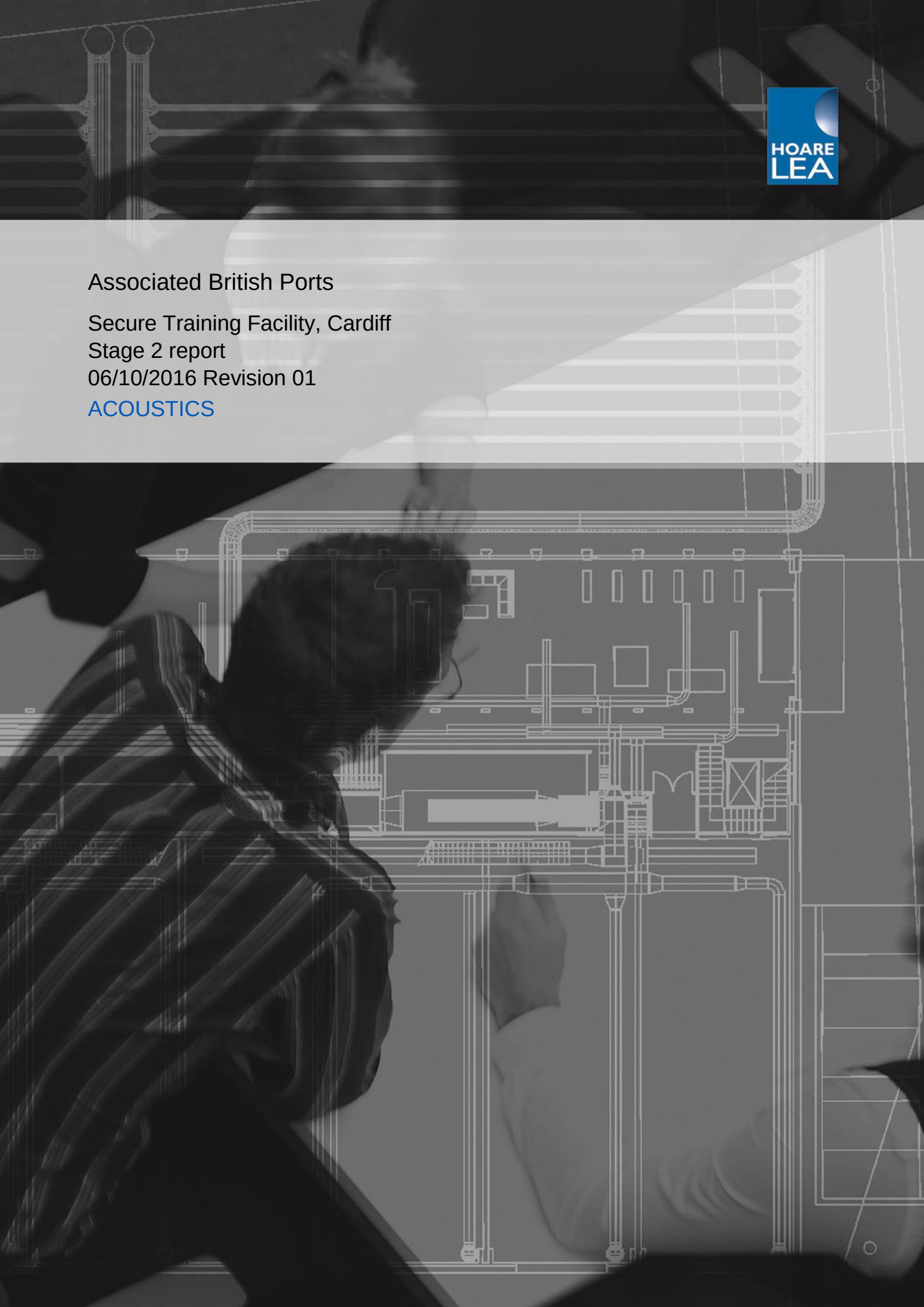

Associated British Ports

Secure Training Facility, Cardiff
Stage 2 report
06/10/2016 Revision 01

ACOUSTICS

Audit sheet

Rev.	Date	Description	Prepared	Verified
01	06/10/2016	Initial Issue	AS	JNB

ACOUSTICS

Secure Training Facility Stage 2 report

Contents

Executive summary

Hoare Lea Acoustics has been appointed to provide a Stage 2 acoustic design report for a secure training facility in Cardiff.

An overview of the criteria and significant considerations relevant to acoustics are given with respect to:

- Internal noise levels.
- Internal separations.
- External noise intrusion.
- Reverberation times.
- MEP plant noise.

This report focuses on the potential noise impacts on the proposed development from existing external noise sources and does not consider the potential noise impacts from the development on nearby noise sensitive receptors, other than from MEP plant.

Introduction

Hoare Lea Acoustics has been appointed to provide a Stage 2 acoustic design report for a secure training facility in Cardiff. During this design stage, noise surveys have been conducted to establish the background noise climate and noise levels acting on the building envelope. The strategy for the means of ventilation for the buildings has been developed. Noise limits for external plant have been prepared and a review of the installation undertaken. The absorptive treatments to achieve an acceptable reverberation time have also been reviewed.

This report only reviews the potential noise impacts on the proposed development from existing external noise sources. Noise impacts from the development on nearby noise sensitive receptors, other than from MEP plant, are not reviewed in this report, as the details of any other potential sources of noise are not known.

Criteria

The Defence Estates Practitioner Guide PG 05/08 provides guidance for the acoustic design of defence buildings. For new builds, an acceptable internal noise limit of 65 dB is suggested in relation to sleep disturbance. This is taken to be a maximum noise level of 65 dB $L_{Amax\ (slow)}$ over a 1 second time period at night.

In the absence of more specific noise criteria, the internal noise level criteria specified in Table 1 have been proposed for the scheme according to BS8233 ‘Guidance on sound insulation and noise reduction for buildings’. The criterion for teaching spaces has been taken from BB93. A 5 dB relaxation applies for naturally ventilated spaces. Therefore internal noise level of 40 dB $L_{Aeq,T}$ should be acceptable

Table 1 - Internal Noise Level Criteria

Use	Overall Criterion
Lobbies / Corridors	45 – 55 dB $L_{Aeq,T}$
Presentation	35 dB $L_{Aeq,T}$
Toilets/Changing	50 - 55 dB $L_{Aeq,T}$
Wardroom / Bar / Breakaway	40 - 45 dB $L_{Aeq,T}$
Kitchen	50 – 55 dB $L_{Aeq,T}$
Drill Hall	45 – 55 dB $L_{Aeq,T}$
Bunks	30 dB $L_{Aeq,T}$
Cellular Offices	35 - 45 dB $L_{Aeq,T}$
Open Plan Offices	35 – 45 dB $L_{Aeq,T}$
Teaching	35 dB $L_{Aeq,T}$

Table 2 below shows a sound insulation matrix derived based on: privacy requirements; source room activity levels; receiver room sensitivities; and criteria in PG05/08.

Table 2 – Site Specific 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	48	55	60
	High	48	48	55
	Typical	48	48	48
	Low	43	43	48
Moderate	Very High	48	55	60
	High	38	43	48
	Typical	38	38	43
	Low	No rating	No rating	38
Not Private	Very High	48	50	60
	High	38	43	48
	Typical	No rating	38	43
	Low	No rating	No rating	38

Based on the values in Table 2, the $D_{nT,w}$ criteria in Table 3 have been derived for the most sensitive internal separations. These $D_{nT,w}$ requirements are in-situ dB values (weighted standardised level difference referenced to a reverberation time of T_{mf} for the receiving space).

Table 3 – Significant Performance Criteria for Airborne Sound Insulation between Spaces

Source Room	Receiver Room	Required $D_{nT,w}$
Induction Area	Presentation	48 dB
Fitness Suite	Bunks	60 dB
Kitchen	Presentation	55 dB
Bunks	Bunks	48 dB
Showers/WCs	Bunks	48 dB

Internal Separations

The acoustic parameter $D_{nT,w}$ dB includes the effects of all flanking sound paths between the adjacent spaces. Therefore, R_w values of internal partitions separating these spaces need to be above the respective $D_{nT,w}$ values to allow for noise intrusion through other paths.

Bunks, which have a low tolerance to noise, are located directly above the Fitness Suite, which will generate relatively high levels of noise. The minimum required $D_{nT,w}$ value given in Table 2 for this scenario is therefore particularly high. A separated floor with a mass barrier ceiling over the fitness suite is recommended. However, this will give R_w 65 at best. Therefore, flanking paths will require due consideration in order to achieve 60 dB $D_{nT,w}$, such as implementing independent wall linings. Gym equipment should be mounted so as to reduce vibration levels. Although 60 dB $D_{nT,w}$ is a high acoustic performance, there could still be adverse impacts associated with noise, should the Fitness Suite and Bunks be used simultaneously.

It is noted in PG05/08 that the design of walls, floor and structure separating sleeping quarters should generally meet the performance standards given in the Approved Document part E of the Building Regulations.

The presentation room on the ground floor is separated from the induction area by double doors that will weaken the acoustic performance of the partition. High performance acoustic doors are therefore recommended. However, the 48 dB criteria will still not be achieved with the spaces separated by double doors.

A common window on the second floor between the Officer Bunk and Open Plan Office should be blanked off to reduce noise transmission between these spaces.

The building envelope is proposed to be constructed from one of the three following options:

1. 250mm Precast planks with screed.
2. 150mm steel and concrete composite with dovetail profile.
3. 150mm steel and concrete composite with trapezoidal profile.

All of three of these options are expected to have similar acoustic performances and achieve the criteria provided in Table 1. However, option 3 is the provided option from an acoustic point of view.

The above comments are shown marked up on drawings in Appendices A-D.

External Noise Intrusion

Noise surveys have been conducted around the proposed development site. Road traffic noise is the dominant source of noise in the area and dictates the general noise climate. During the day, all elevations are typically subject to noise levels of 60 dB $L_{Aeq,T}$. During night-time periods, noise levels are typically in the order of 56 dB $L_{Aeq,T}$. These noise levels are exceeded at times, but considered suitable for the purposes of design.

Where natural ventilation is proposed, façade performances are limited to a maximum of 15 dB. The internal noise level criteria in Table 1 should still be achieved, where rooms are naturally ventilated, but would generally result in noise levels at the upper end of the criteria. Teaching spaces on the third floor are an exception to this however. Therefore, acoustic ventilators on the roof may be an option to reduce noise levels. Detailed analysis will be required at the next design stage. It is likely that the attenuation of the windows will vary, depending on prevailing climate. On this basis, it may be reasonable to assume a longer term (annual) average sound insulation value of 15 dB. However, at peak summer temperatures this value may not be realised.

From the measurements conducted on site, L_{Amax} noise levels at the bunk facades are not generally expected to exceed 80 dB. Therefore, Internal L_{Amax} noise levels of 65 dB are not expected to be exceeded, based on the current proposed use of mechanical ventilation for sleeping accommodation.

Windows serving bunks will need to achieve R_w 35 dB.

Reverberation Time

In line with guidance from PG05/08, reverberation time within the majority of spaces, particularly teaching areas should be controlled to 0.8 seconds. Therefore, in general, suspended class C ceilings will be required throughout all occupied spaces.

MEP Proposals

Neither the planning condition with respect to noise, or fixed plant selections, are known at this stage. Background noise levels in the area, which will contribute in dictating the noise limits, are elevated by road traffic noise. Nevertheless, land to the north east of site, as shown below in Figure 1, has the potential to be consented for residential development, which would lower the plant noise limits as the separation distance between the proposed development façade and nearest residential receptor could be lowered from 160m to possibly 60m.

The noise limits given in Table 3, are limits for the total noise from all plant associated with the development, for day and night-time periods are therefore proposed.

Period	Background Noise Level at 60m [1]	Local Authority Requirement [2]	Noise Limit at 60m	Noise Limit at 5m [3]
Daytime	45 dB $L_{A90, 1hour}$	-10 dB	35 dB $L_{Ar,Tr}$	57 dB $L_{Ar,Tr}$
Night-time	41 dB $L_{A90, 15min}$	-10 dB	31 dB $L_{Ar,Tr}$	53 dB $L_{Ar,Tr}$

Notes

[1] - Based on typical low noise levels measured on site
[2] - Cardiff Council advise a rating level of Background -10dB
[3] - Distance corrected - should include for any tonal or other acoustic feature corrections

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ABP

Secure Training Facility, Cardiff
Stage 3 report
11/01/2018 Revision 7
ACOUSTICS

Audit sheet

Rev.	Date	Description	Prepared	Verified
1	11/04/2017	Initial Issue	AS	JB
2	12/04/2017	Updated Mark Ups	AS	
3	29/06/2017	Final Issue	AS	JB
4	06/07/2017	Tender Issue	AS	JB
5	21/12/2017	Revised design	AS	JB
6	22/12/2017	Update following internal review	AS	JB
7	11/01/2018	Mark-ups amended based on revised layouts	AS	JB

This report has been prepared for ABP only and expressly for the purposes set out in an appointment dated 14/12/2017 and we owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

ACOUSTICS

Secure Training Facility Stage 3 report

Contents

Executive summary

This report provides acoustic design advice for the revised layout proposed for the secure training facility in Cardiff in relation to:

- internal separations;
- external noise intrusion;
- building regulations compliance;
- control of reverberation time; and
- Building services noise control.

Some rooms in the proposed secure training facility are naturally ventilated and others are mechanically ventilated. Detailed advice is provided in relation to managing adverse noise impacts associated with the mixed ventilation strategy.

1. Introduction

Hoare Lea has been appointed by ABP to provide a Stage 3 acoustic design report for the revised layout of the secure training facility in Cardiff.

Noise surveys have been carried out as part of the Stage 2 design to establish the background noise climate and noise levels acting on the building envelope. This report provides acoustic design requirements to be met by the construction in relation to:

- internal separations;
- external noise intrusion;
- building regulations compliance;
- control of reverberation time; and
- Building services noise control.

2. Client Brief

The client has advised the following three points that are influential on the acoustic design:

- Provision should be made for the dining room which may be used as a drill hall while presentations are carried out below or teaching is taking place above.
- Gymnasium sound transference is considered a potential noise issue within the building.
- The offices are not expected to be in use at the same time as the bars.

3. Planning Conditions

The following planning conditions have been applied to the scheme:

Prior to the beneficial use of any dormitory accommodation, a scheme shall be submitted to and approved in writing by the Local Planning Authority which will describe how it is intended that the dormitory accommodation adjacent to the Gym within the development will be sound proofed.
Reason: To ensure that the design of the development will be likely to achieve a sleeping environment for occupants of the accommodation approved.

Prior to the beneficial use of any dormitory accommodation adjacent to the proposed Gym, a report shall be submitted to and approved by the local planning authority in writing to evidence that the sleeping areas within the development adjacent to the Gym are insulated to the receipt of sound up to 60dB.
Reason: To ensure that an acceptable sleeping environment for occupants has been achieved.

The two conditions appear to be applied to the same issue. The wording is imprecise but the interpretation of the requirement is that a $D_{nT,w}$ 60 dB separation is required vertically between the Fitness Suite and the Bunks above. The dormitory accommodation has been relocated in the amended design. On this basis it is assumed these Conditions no longer apply.

4. Internal Separations

The sound insulation matrix shown in Table 1 has been derived based on: privacy requirements; source room activity levels; receiver room sensitivities; and criteria in PG05/08[1].

Privacy Requirement	Activity Noise of Source Room	Noise Sensitivity of Receiving Rooms		
		Low Sensitivity	Medium Sensitivity	Sensitive
Confidential	Very High	48	55	60
	High	48	48	55
	Typical	48	48	48
	Low	43	43	48
Medium	Very High	48	55	60
	High	38	43	48
	Typical	38	38	43
	Low	No rating	No rating	38
Not Private	Very High	48	50	60
	High	38	43	48
	Typical	No rating	38	43
	Low	No rating	No rating	38

Table 1 – Site Specific Sound Insulation Matrix (dB $D_{nT,w}$)

The $D_{nT,w}$ criteria in Table 2 have been derived for the most sensitive internal separations from the matrix in Table 1. These $D_{nT,w}$ requirements are in-situ dB values (weighted standardised level difference referenced to a reverberation time of T_{mf} for the receiving space).

Source Room	Receiver Room	Required $D_{nT,w}$
Induction Area	Kitchen	60 dB
Fitness Suite	Dining	60 dB
Dining	Offices	60 dB

Source Room	Receiver Room	Required $D_{nT,w}$
Dining	Classroom	60 dB
Classroom	Classroom	48 dB
Training Room	Classroom	48 dB
Conference Room	Classroom	48 dB
Breakaway and Bev Bay	Classroom	48 dB
Showers/WCs	Bunks	48 dB

Table 2 – Significant Performance Criteria for Airborne Sound Insulation between Spaces

The mark-ups in Appendix A provide the R_w values necessary for partitions and doors to achieve the D_{nTw} criteria in Table 2.

Example constructions that are rated at the R_w values in Appendix A are provided below.

R_w 56 dB (Ctr 8dB) rated example (approximately 144 mm overall depth):

- Two layers of 15mm Gyproc SoundBloc (or equal and accepted) board linings, each side of
- 92mm acoustic Studs at 600mm centres, with
- 50mm of Isover acoustic partition roll (or equal and accepted) in the cavity.

R_w 56 dB rated example (approximately 130 mm overall depth):

- Two layers of 15mm Gyproc SoundBloc (or equal and accepted) board linings, each side of
- 70mm ‘C’ Studs at 600mm centres, with
- 50mm of Isover acoustic partition roll (or equal and accepted) in the cavity.

R_w 52 dB rated example (approximately 120 mm overall depth):

- Two layers of 12.5mm Gyproc SoundBloc (or equal and accepted) board linings, each side of
- 70mm ‘C’ Studs at 600mm centres, with
- 50mm of Isover acoustic partition roll (or equal and accepted) in the cavity.

R_w 47 dB rated example (approximately 100 mm overall depth):

- One layer of 15mm Gyproc SoundBloc (or equal and accepted) board linings, each side of
- 70mm ‘C’ Studs at 600mm centres, with
- 25mm of Isover acoustic partition roll (or equal and accepted) in the cavity.

R_w 45 dB rated example (approximately 100 mm overall depth):

One layer of 12.5mm Gyproc SoundBloc (or equal and accepted) board linings, each side of
70mm 'C' Studs at 600mm centres, with
25mm of Isover acoustic partition roll (or equal and accepted) in the cavity.

4.1 Bunks

It is noted in PG05/08 that the design of walls, floor and structure separating sleeping quarters should generally meet the performance standards given in the Approved Document part E of the Building Regulations.

On this basis the separating walls and floors should achieve the following:

Source Room	Receiver Room	Separation	Required $D_{nT,w} + C_{tr}$
Residential Lounge	Bunks	Party Wall	43 dB
Stair Void	Bunks	Party Wall	43 dB
WC/Showers	Bunks	Party Wall	43 dB
Accommodation Office	Bunks	Party Wall	43 dB
Bunks	Bunks	Party Wall	43 dB
WC/Showers	Bunks	Party Floor	45 dB
Guard Lodge/Magazine Store	Bunks	Party Floor	45 dB

The separating walls should achieve at least a laboratory value of $R_w + C_{tr}$ 48 dB, this can be achieved with a wall of footprint 144mm. A wall with a rating of R_w 56 dB with a no greater than 8 dB C_{tr} correction would suffice.

The separating floors should include a suspended ceiling used in conjunction with an acoustic tile backer minimum mass 16kg/m2, R_w 27 dB. The suspended ceiling must have at least a 300mm void. Service penetrations must be made through the tile backer system to maintain the acoustic integrity.

Floors above accommodation should either have a carpet or resilient backed vinyl (minimum ΔL_w17 dB) to meet the requirements for control of impact transmission.

Entrance doors to bunks should be rated at R_w 29 dB. The walls adjacent to the doors have been rated at R_w 47 dB to avoid over-specification as the door is the weak path. Minimum privacy requirements should be met from the corridor to the bunk areas.

4.2 Separating Floors Higher Acoustic Requirements

The separating floor comprises a composite steel concrete deck with a minimum thickness of 150mm and 80mm minimum cover over the deck. This can be anticipated to achieve around $D_{nT,w}$ 48 dB in conjunction with a $D_{nc,w}$ 32 dB ceiling, without further enhancement. This will satisfy the majority of separations within the scheme.

Enhanced separations are required to the areas marked on the appended plans.

D_{nTw} 60 dB is the highest practical sound insulation that can be achieved with the proposed separating floor with a mass barrier ceiling as below, maintaining the same level. In order to achieve this the following construction is recommended:

Mass Barrier Ceiling Construction (230mm zone)

- 100mm mineral fibre quilt 20kg/m^3
- Two layers 12.5mm acoustic rated plasterboard
- Services zone and ceiling beneath

The Dining Room is a double height space, so the mass barrier ceiling has been continued at second floor level. The Dining Room shares party walls with multi occupancy offices at second floor. The walls have been specified as the bedroom party walls, $R_w + C_{tr}$ 48 dB, the predicted noise intrusion when the Dining Room is in use as a Drill Hall with an operational noise level of 80 dB $L_{Aeq,T}$ is around 40 dB $L_{Aeq,T,}$ the activity will be audible in these offices when this occurs.

Any common structure will require independent linings. A mineral fibre quilt of 50mm thick is required in these zones.

The Fitness Suite should incorporate a mass barrier ceiling above as previously described.

Measures should be incorporated to control structureborne noise from the equipment in the Fitness Suite, it is assumed this would be part of the fit out.

Appendix B provides visual depictions of these constructions. Appendix C shows where these mass barrier ceilings should be located.

Doors separating office areas should achieve R_w 35 dB. The double doors between the Induction Area and Presentation room will prevent the required D_{nTw} criteria being achieved. This is likely to result in speech in the Induction Area being audible within the Presentation room. A higher performing double doorset that is usable on a daily basis is likely to be rated at R_w 38 dB, which in conjunction with the specified wall type is likely to achieve an overall reduction of $D_{nT,w}$ 40 dB, approaching privacy, but not rendering activity in the Induction Area inaudible.

4.3 Public Health Services

All public health pipework must be mounted on acoustic brackets achieving a 10 dB reduction in structureborne noise. In addition all pipework is to be provided with a wrap of mineral wool and enclosed in at least 15kg/m^2 of boards.

4.4 Lift Core

The lift is sited within the Male Bunks, the lift shaft should comprise at least an R_w 65 dB enclosure and have mitigation to the lift guide rails. The detailed design should achieve noise intrusion no greater than $L_{Amax\ (fast)}$ 25 dB in the Dormitory. This should be fully developed at the next design stage.

Within the Accommodation office the noise level should not exceed $L_{Amax\ (fast)}$ 35 dB.

4.5 Servery Hatch

The Dining Area and Kitchen are connected by a Servery Hatch, it should be noted that there will be significant noise transfer between the two spaces. Acoustic rated roller shutters at R_w 27 dB as a maximum, this would improve the situation but not render the noise intrusion inaudible.

4.6 Plant Roof Level

Plant is proposed to be located above the Third Floor accommodation, the lightweight roof system, has a low sound insulation value, on this basis the nosier plant should be located over stair void area and corridor. The ceiling should achieve at least $D_{nc,w}$ 35 dB throughout this level. A final review will be required of all plant at this level at the next design stage to ensure the stated criteria are not exceeded. All plant will require significant vibration isolation measures.

5. External Noise Levels

Noise surveys were conducted around the proposed development site as part of the Stage 2 acoustic design. These results were mostly corroborated by supplementary validation measurements.

During the day, all elevations were typically subject to noise levels of 60 dB $L_{Aeq,T.}$ During night-time periods, noise levels were typically in the order of 56 dB $L_{Aeq,T.}$ These noise levels were exceeded at times, but considered suitable for the purposes of design.

During night-time periods the L_{Amax} noise level is typically around 60 dB and reaches up to 80 dB. Noise levels measurements were occasionally above 80 dB $L_{Amax(fast)}$. However, these instances were so rare, that 80 dB $L_{Amax(fast)}$ is considered suitable for design purposes.
The dominant sources of noise on site during the survey period were: passing vehicles; local works; distance road traffic; and seagulls. Passing helicopters were dominant, when present. These sources of noise were spread diametrically around the proposed secure training facility. Therefore, the area is considered to represent a complex noise climate.

6. External Noise Intrusion

Guidance for the acoustic design of defence buildings is provided in the Defence Estates Practitioner Guide PG 05/08. Within PG 05/08 an acceptable internal noise limit of 65 dB is suggested for new builds in relation to sleep disturbance. The relevant noise metric of this level is not specified. Therefore, it has been conservatively assumed that this represents a maximum noise level of 65 dB $L_{Amax(slow)}$ over a 1 second time period at night.

No specific guidance is available for noise levels at training facilities. Therefore, internal noise level criteria has been derived based on the advice given in: BS8233 'Guidance on sound insulation and noise reduction for buildings' (BS8233)[2]; and Building Bulletin 93 'acoustic design of schools' (BB93)[3].

Table 3 lists the internal noise level criteria.

Use	Overall Criterion	Suitable for Natural Ventilation
Lobbies/Corridors	45 - 55 dB $L_{Aeq,T}$	Yes
Presentation	35 dB $L_{Aeq,T}$	No
Toilets/Changing	50 – 55 dB $L_{Aeq,T}$	Yes
Wardrobe/Bar/Breakaway	40 – 45 dB $L_{Aeq,T}$	Yes – borderline
Kitchen	50 – 55 dB $L_{Aeq,T}$	Yes
Dining Room	30 dB $L_{Aeq,T}$	Yes
Bunks	35 - 45 dB $L_{Aeq,T}$	No
Cellular Offices	35 – 45 dB $L_{Aeq,T}$	Yes – borderline
Open Plan Offices	35 – 45 dB $L_{Aeq,T}$	Yes – borderline
Teaching	*35 dB $L_{Aeq,T}$	No

Table 3 - Internal Noise Level Criteria

Notes
**5 dB relaxation applies for naturally ventilated spaces according to BB93. Therefore internal noise levels of 40 dB $L_{Aeq,T}$ should be acceptable where rooms are naturally ventilated.*

An average annual sound insulation value of 15 dB is assumed were natural ventilation is proposed. On this basis, column 3 of Table 3 indicates which rooms are deemed to be suitable for natural ventilation, from a noise point of view.

As discussed in Section 4 of this report, L_{Amax} noise levels at the facades are not generally expected to exceed 80 dB. Therefore, Internal L_{Amax} noise levels of 65 dB are not expected to be exceeded, based on the current proposed use of mechanical ventilation for sleeping accommodation. However, for this to work, it should be ensured that windows serving bunks achieve R_w 35 dB.

7. Control of Reverberation Time

In line with guidance from PG05/08, reverberation time within the majority of spaces, particularly teaching areas should be controlled to 0.8 seconds. Therefore, in general, suspended class C ceilings will be required throughout all occupied spaces. Bunk Rooms include suspended ceilings but this is not specially an acoustic requirement.

8. Building Service Noise Control

At the next design stage the final plant selections will be reviewed to ensure that the noise limits discussed in this section are met. The advice given here is for general guidance only and does not necessarily present a design solution.

The noise limits given in Table 4, are limits for the total noise from all plant associated with the development, for day and night-time periods are therefore proposed.

Period	Background Noise Level at 60m [1]	Proposed Noise Limit [2]	Noise Limit at 60m	Approximate Noise Limit at 5m [3]
Daytime	45 dB $L_{A90,\ 1hour}$	Equal to background	45 dB $L_{Ar,Tr}$	67 dB $L_{Ar,Tr}$
Night-time	41 dB $L_{A90,\ 15min}$	Equal to background	41 dB $L_{Ar,Tr}$	63 dB $L_{Ar,Tr}$

Table 4 – Preliminary plant noise limits at 60 metres secure training facility façade.

Notes
[1] - Based on typical low noise levels measured on site
[2] – This should be confirmed with Cardiff Council but represents a low noise impact.
[3] - Distance corrected - should include for any tonal or other acoustic feature corrections

Table 5 below shows the noise limits for the total noise of all the operational fixed plant at the Facility. Therefore, the sum of the noise levels from all fixed plant should not exceed these levels. The nearest existing noise sensitive residential receptors are over 150m away. However there is the potential for residential receptors to be located at 60 metres from the development in the future. Whichever the more onerous criterion of table 4 or 5 should apply. The criteria in table 5 are equivalent to 10 dB below the typical external noise levels, so that plant noise levels are can be considered as generally negligible and not contribute to the general noise climate unless ambient noise levels are lower than typical. The other critical selection parameter is achieving the required internal noise level below the plant deck, it is likely that plant noise will have to be restricted to below 55 dB(A) at one metre to achieve the requirements without enhancing the roof or ceiling. Significant vibration isolation will be required to all plant installations.

Period	Noise Limit
Daytime (07:00 to 23:00)	50 dB $L_{Ar,1\ hour}$
Night-time (23:00 to 07:00)	46 dB $L_{Ar,15\ minute}$

Table 5 – Plant noise limits at 1m from the secure training facility façade.

For internal noise where the spaces are served by means of mechanical ventilation or where service pass through serving other spaces the following requirements of Table 6 apply:

Use	Overall Criterion
Lobbies/Corridors	NR40
Presentation	NR30
Toilets/Changing	NR45
Wardroom/Bar/Breakaway	NR40
Kitchen	NR45
Dining Room	NR40
Bunks	NR25
Cellular Offices	NR35
Open Plan Offices	NR40
Teaching	NR30

Table 6 – Internal Noise Limits Services Installations

Where services are remote from the rooms a criterion of 10 NR below the stated values applies. The stated limits apply to both airborne and structureborne noise.

9. References

1. Defence Estates, PG05/08 Acoustic Design for Defence Buildings, June 2011
2. British Standards Institute, BS8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’, 2014
3. Department for Education, BB93: acoustic design of schools - performance standards, December 2014

Appendix A – marked up drawings showing required acoustic performances of internal separations

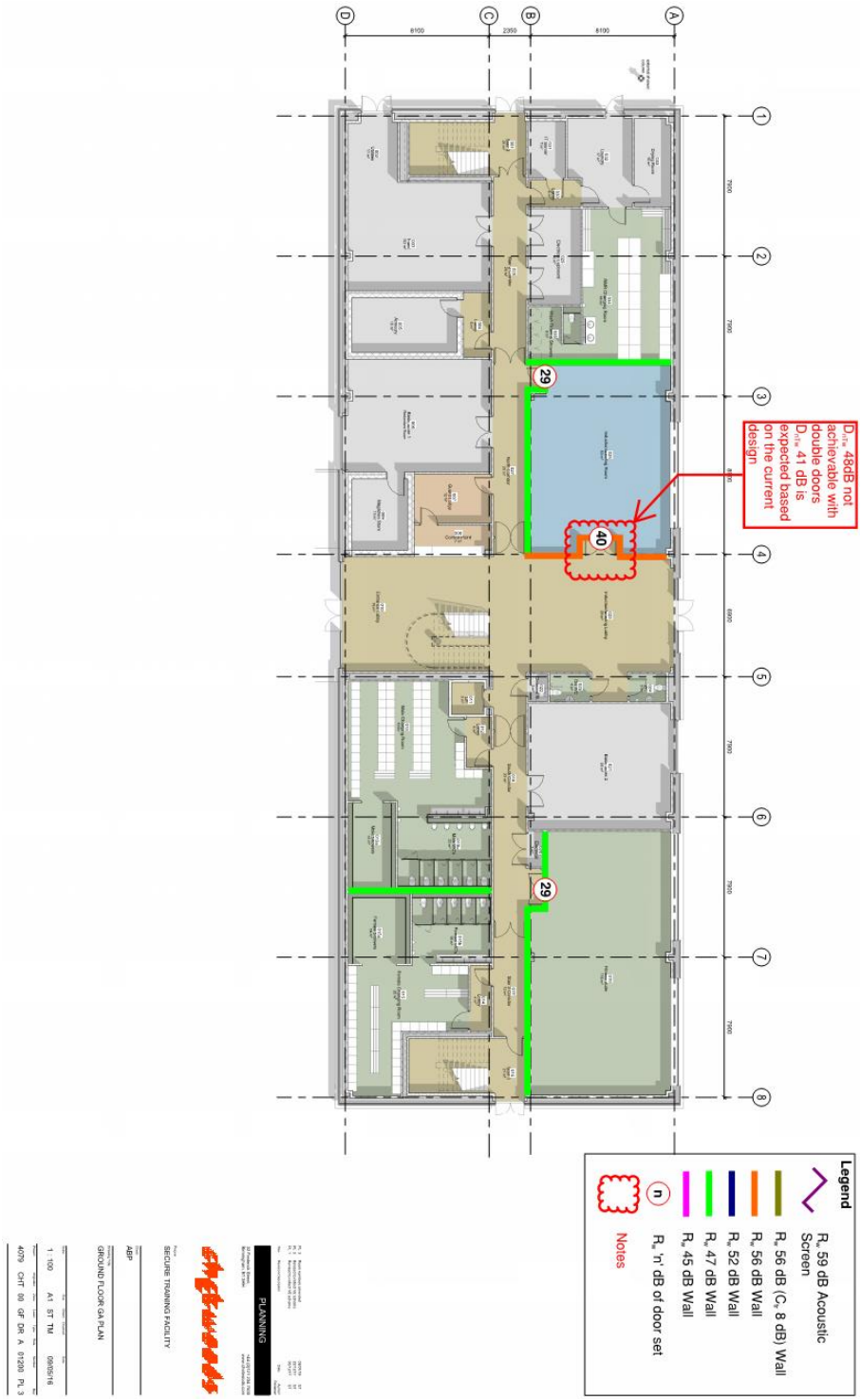

Figure A1 – Ground Floor Acoustic Mark Up

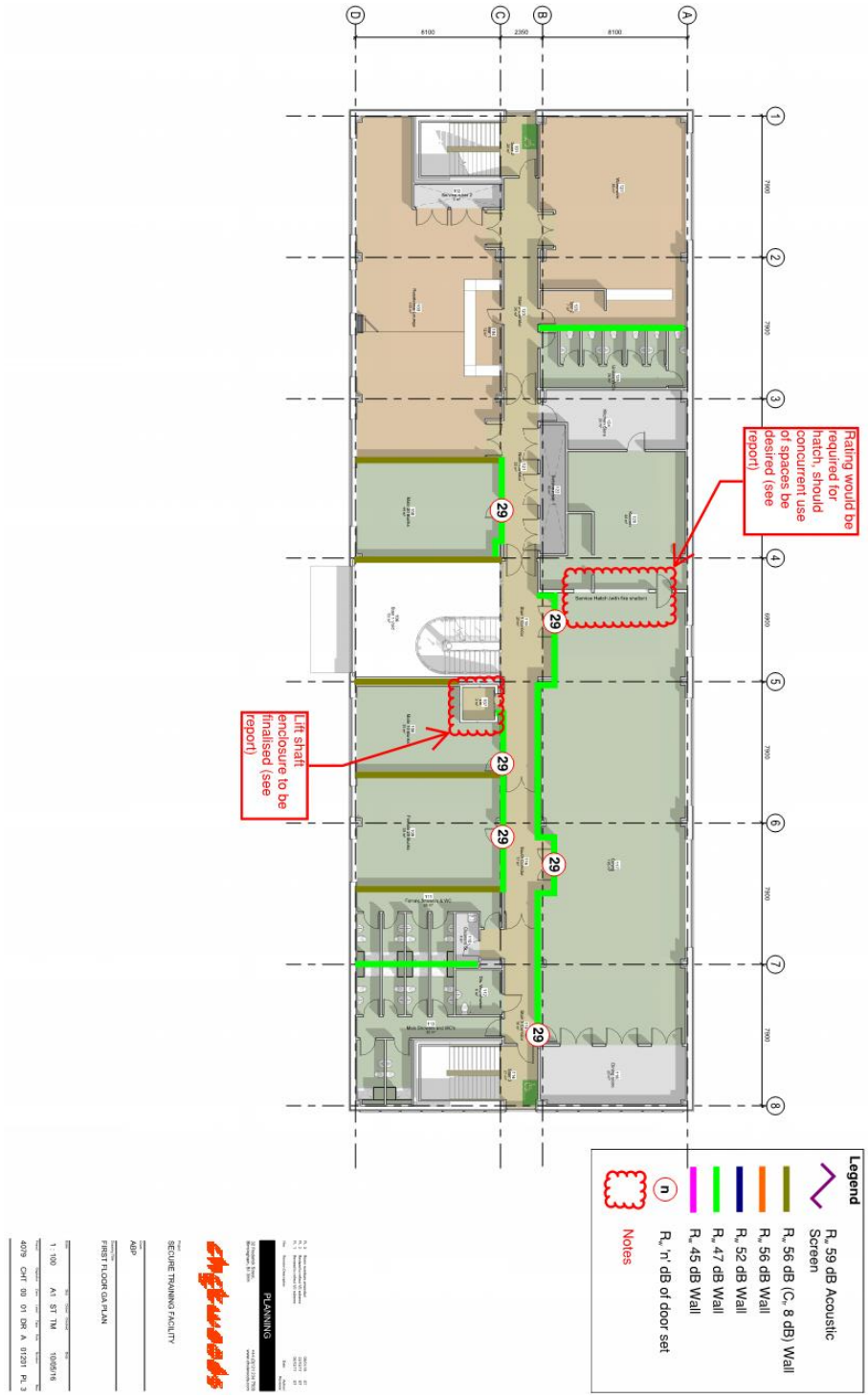

Figure A2 – First Floor Acoustic Mark Up

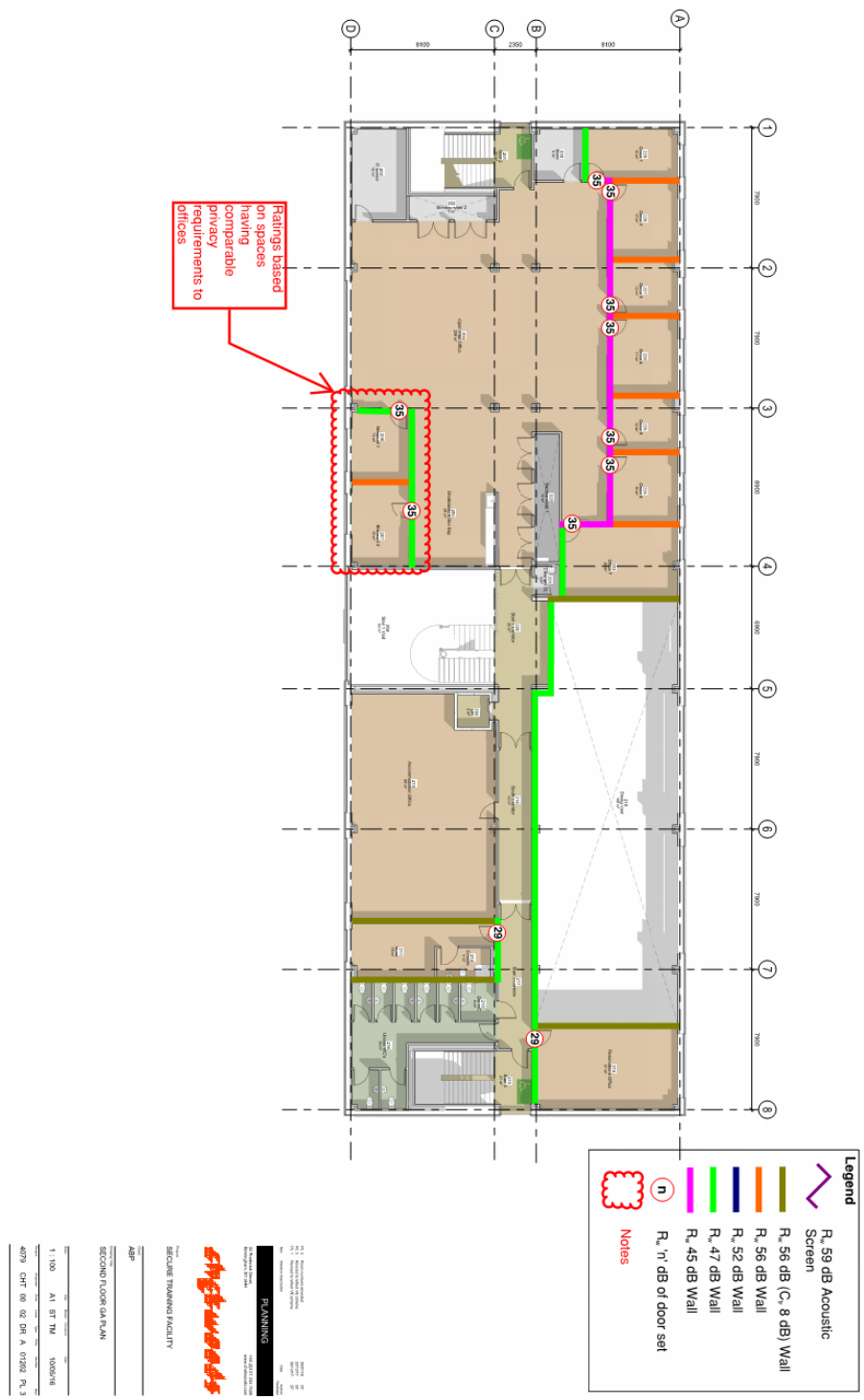

Figure A3 – Second Floor Acoustic Mark Up

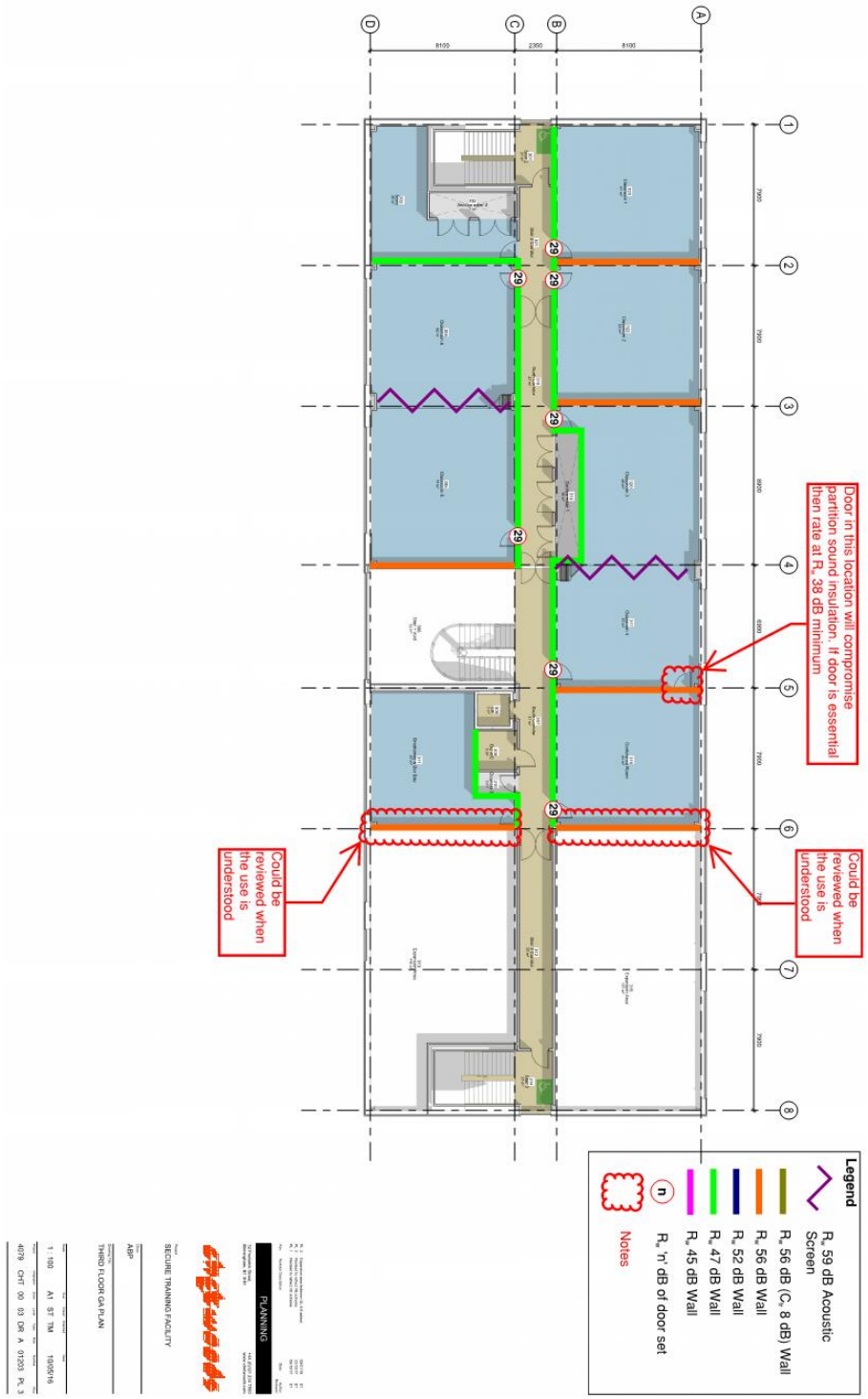

Figure A4 – Third Floor Acoustic Mark Up

Appendix B – Construction details for floors separating most noise sensitive areas

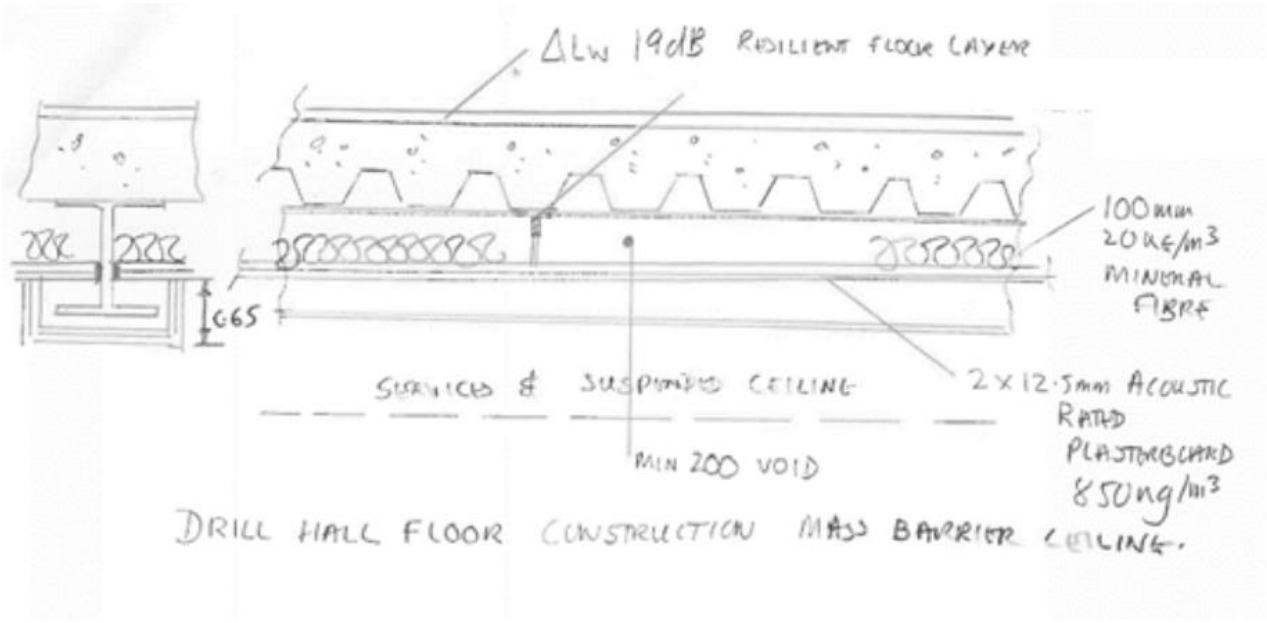

Figure B1 – Higher Performance Ceiling Constructions

Appendix C – Construction details for floors separating most noise sensitive areas

Figure C1 – Ceiling Requirements above Ground Floor

Figure C2 – Ceiling Requirements above First Floor

Figure C3 – Ceiling Requirements above Second Floor

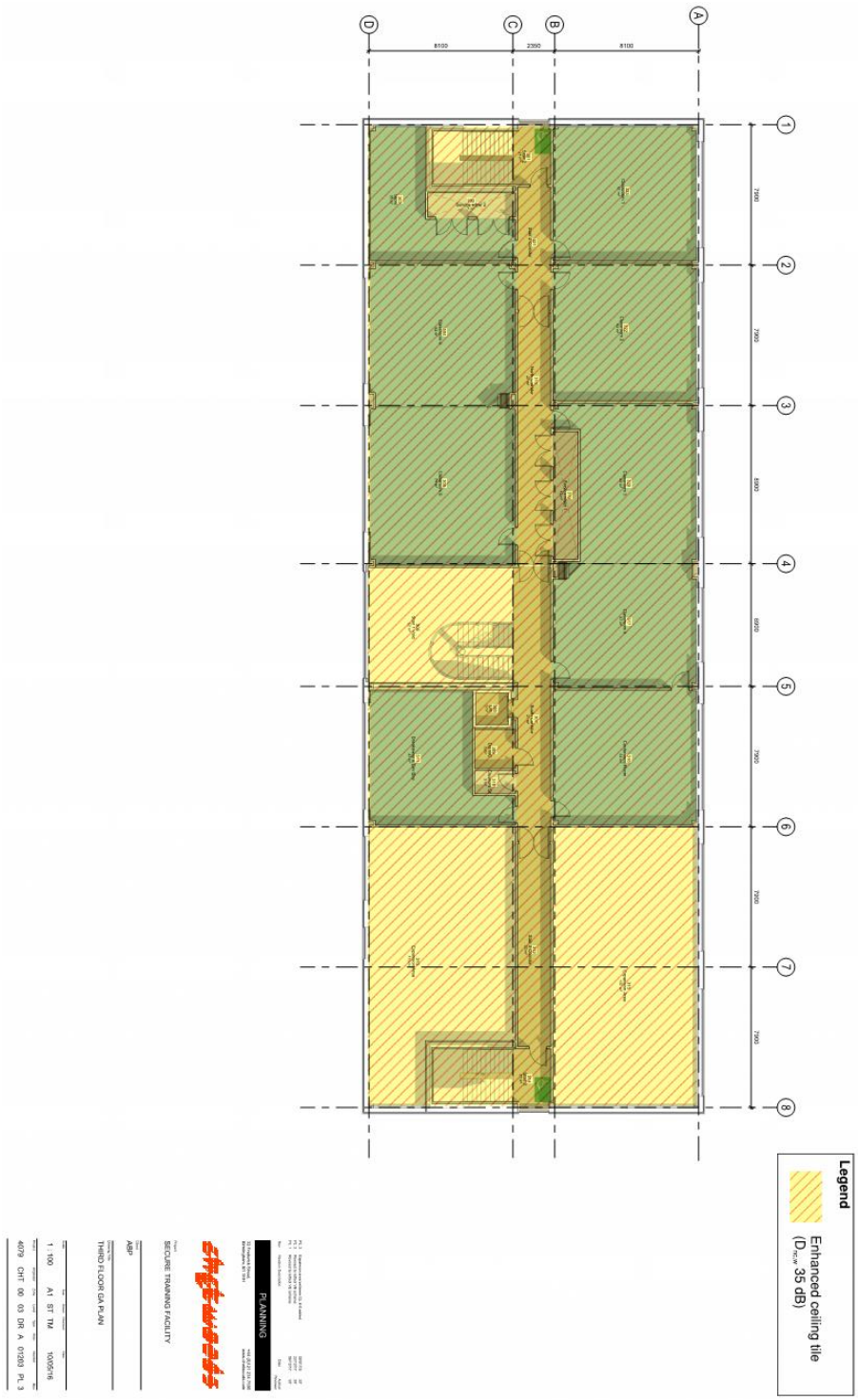

Figure C4 – Ceiling Requirements above Third Floor