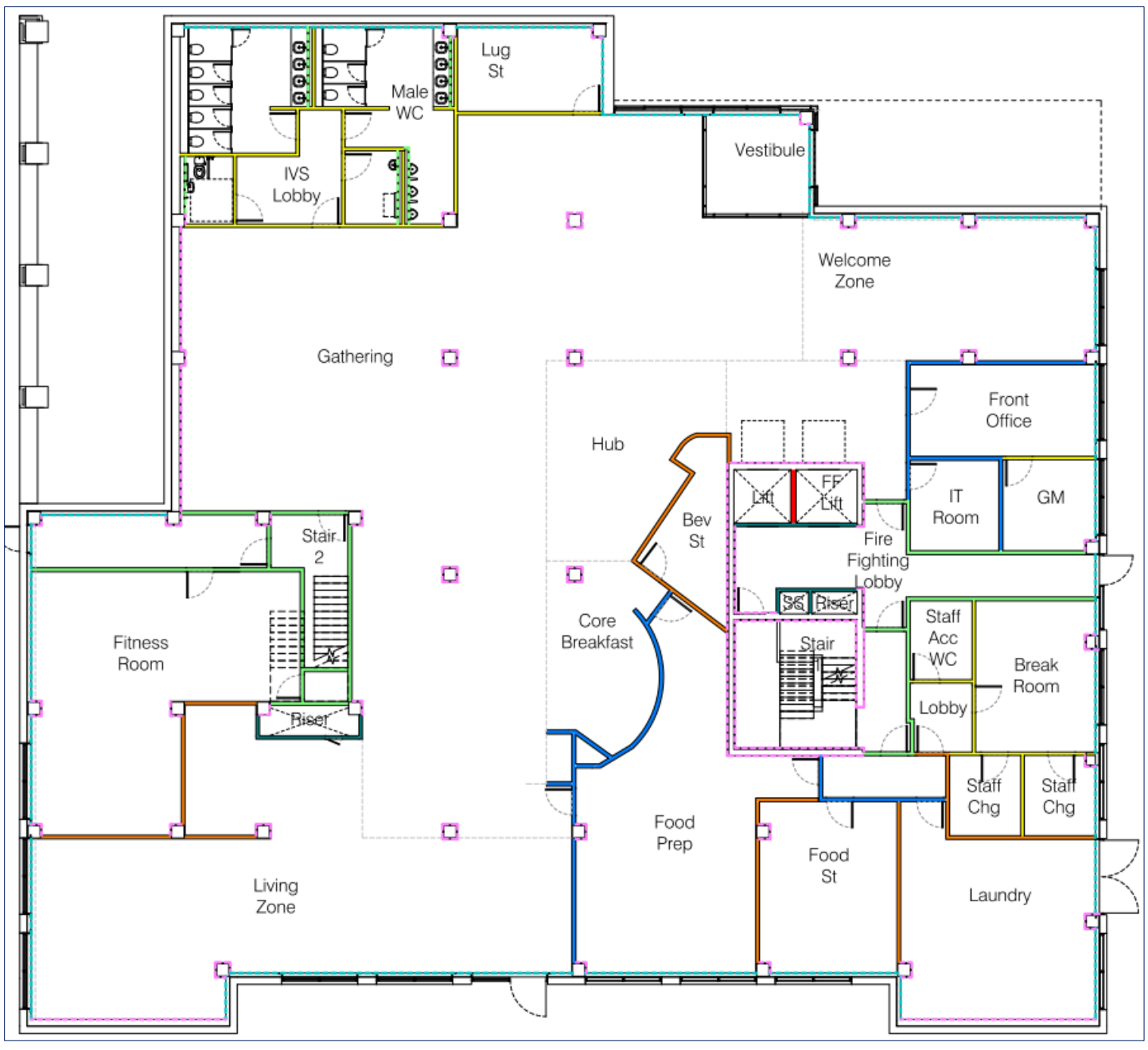
Environoise Consulting Limited, Pioneer House, North Road, Ellesmere Port CH65 1AD
E: info@environoise.co.uk T: 0151 550 4525 W: www.environoise.co.uk

REPORT REF: 21105R03OPpak

CONSTRUCTION REVIEW - ACOUSTICS

PROPOSED 157 BEDROOM HAMPTON BY HILTON – BATH ROAD, HEATHROW



CLIENT: Acre Hotels Limited
7 Churchill Court
58 Station Road
Harrow Middlesex
HA2 7SA

Prepared by:

Oliver Packman AMIOA	Graduate Acoustics Consultant

Checked by:

Paul Kelly MIOA	Principal Acoustics Consultant

Authorised by:

Paul Kelly MIOA	Principal Acoustics Consultant

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Executive Summary

Environoise Consulting Limited has been commissioned by Acre Hotels Limited to review proposed internal and separating constructions for a new build ‘Hampton by Hilton’ hotel at Bath Road, Heathrow and provide recommendations so that requirements can be met.

The building design will comply with the requirements of The Building Regulations 2010: Approved Document E ‘Resistance to the Passage of Sound 2003’ amended 2004 (ADE) and of the Hampton by Hilton Brand Standards – Europe 2500 effective January 2018.

In summary:

Sound Insulation

- A review of the wall and floor sound insulation performances with recommendations is provided in sections 3 and 4 of this report.

Reverberation

- Recommended surface treatments have been recommended to meet the requirements of ADE I corridors and brand standards for ground floor public spaces in section 5 of this report.

Detailing

- General detailing advice has been given in section 6 of this report.

- Detail drawings will be reviewed upon request which will include guidance on penetration details.

Plant

- Plant noise limits have been provided in the Environoise Report ref: 21105R02aOPpak. Recommendations have been given in section 7 of this report to control noise and vibration from plant affecting residential spaces.

Lift Design

- Noise and vibration targets have been given in section 8 of this report to be passed onto the lift manufacturers to make sure that noise and vibration from lifts are suitably controlled.

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1 Introduction

1.1.1 Environoise Consulting Limited has been commissioned by Acre Hotels Limited to provide acoustic consultancy for a proposed new build 'Hampton by Hilton' (HbH) hotel at Bath Road, Heathrow.

1.1.2 Proposals include the development of a 5-storey, 157-bedroom hotel scheme including a basement car park.

1.1.3 The purpose of this assessment is to review proposed internal and separating constructions and provide recommendations if required so that the requirements of the following can be met:

- The Building Regulations 2010: Approved Document E 'Resistance to the Passage of Sound 2003' amended 2004 (ADE)[i]
- Hampton by Hilton Brand Standards – Europe 2500 effective January 2018[ii].
- BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings', 2014.[iii]
- BS 4142:2014 'Methods for rating and assessing commercial sound', 2014[iv]
- Building Bulletin 93 'Acoustic Design of Schools' 2015 (BB93) [v].

2 Criteria

2.1 Hampton by Hilton Brand Standards

Sound Insulation Performance Criteria

2.1.1 Airborne sound insulation requirements for walls and floors are given in Table 2.1. The rationale for recommended targets is given in Appendix B.

Table 2.1: Section 25014.05.N.1 Airborne Sound Insulation Performance

Room Types	Minimum on-site airborne sound insulation target [$D_{nT,w}$ (dB)]
Residential	
Guestroom – Guestroom	55
Guestroom – House Keeping / Corridor (no door)	60
Non-Residential	
Walls containing doors Food Prep - Living Zone / Core Breakfast Food Prep / Laundry - Food Store	40
WC – Gathering (no door) Riser - Stairwell Stairwell – Core Breakfast Laundry – Staff Change Staff Change – Corridor General Manager / IT room - Corridor (no door) IT Room - General Manager / Front Office Break Room / IT Room / General Manager – Lobby Luggage Store – WC Fitness Room – Riser / Corridor / Living Zone Front Office – Welcome Zone	45
Laundry – Corridor (no door)	50

2.1.2 Impact sound insulation requirements for separating floors are given in Table 2.2.

Table 2.2: Section 25014.05.N.2 Impact Sound Insulation Performance.

Room Types	Maximum Impact sound insulation target [$L_{nT,w}$ (dB)]
Guestroom - Guestroom	50
Guestroom – Core Breakfast / Gathering / Living Zone	55
Guestroom – Office / Fitness room	60

Internal walls – Separating Walls between Guestrooms and Corridors (containing doors)

2.1.3 Section 2514.05.G.6 advises that the internal wall separating a Guestroom and associated en-suite bathroom should have a sound insulation performance of ≥45dB R_w

Sound Insulation – Separating Walls between Guestrooms and Corridors (containing doors)

2.1.4 Section 2514.05.G.7 advises that, where rooms require enhanced acoustic privacy (e.g. from entrance lobbies and corridors), doors should have the minimum laboratory airborne sound insulation performance shown in Table 2.3 together for door performance for other hotel spaces.

Table 2.3: Door sound insulation performances

Room Types	Minimum sound reduction performance [R_w (dB)]
Guestroom entrance	38
Guestroom entrance (within 5m of lift lobby)	42
Meeting/function room entrance	35
Offices	30

2.1.5 The requirement under Section 2514.05.G.9 for the sound insulation performance of corridor walls containing Guestroom entrance doors is not clear. However, we have interpreted the text to mean that the sound insulation performance of the wall (R_w) should be rated at 10dB above that required for the door given in Table 2.3. In this case for Guestrooms, the wall performance should be 48 / 52dB R_w depending on their location to lift lobbies.

2.1.6 It should be noted that the Building Regulations target for Guestroom corridor walls containing doors is more onerous compared to that required for the Brand Standards and therefore the Building Regulations requirements would take precedence unless agreed otherwise.

Reverberation

2.1.7 There are no reverberation times requirements for guestrooms but, for some areas of the hotel, the document requires control of mid-frequency reverberant levels (the average reverberation time at 500Hz, 1 kHz and 2 kHz), see Table 2.4.

Table 2.4: Section 25014.05.I.2 Control of Reverberation.

Room Types	Maximum Mid-frequency Reverberation time (seconds)
Gathering / Welcome Zone	1.5
Core Breakfast / Living Zone	1.0

2.2 The Building Regulations (Residential Use – Residential Use)

Separating Walls and Floors

2.2.1 Guestrooms will be classified as ‘Purpose Built Rooms for Residential Purposes’ under Table 1b from The Building Regulations 2000: Approved Document E ‘Resistance to the Passage of Sound 2003’ amended 2004 (ADE), see Table 2.5.

Table 2.5: Required On-site Performance of Separating Constructions

	Required sound insulation performance	
	Airborne [$D_{nT,w}$ + C_{tr} (dB)]	Impact [$L'_{nT,w}$ (dB)]
Separating Walls (including Guestroom entrance corridor walls)	≥ 43	NA
Floors and stairs	≥ 45	≤ 62

Internal Walls

2.2.2 Internal walls should have a laboratory sound insulation performance of 40dB R_w or greater, see Appendix B for details.

Guestroom to Corridor Doors

2.2.3 Guestroom to corridor doors should have a laboratory sound insulation performance of 29dB R_w or greater. It should be noted that the Brand Standard targets (see section 2.1.4, Table 2.3) are more onerous than that required for Building Regulations. Therefore, the Brand Manual targets would take precedence unless agreed otherwise.

Pre-completion Testing

2.2.4 Pre-completion testing of separating walls and floors is required under ADE to demonstrate that the on-site sound insulation performances targets are met.

2.2.5 It should be noted that pre-completion testing is not required for partitions that are classified as internal walls; only the separating walls between 'Clusters'.

2.3 Sound Insulation Specification

2.3.1 For specification purposes, it is necessary to relate the on-site performance requirements given in Tables 2.1, 2.2, 2.3 and 2.5 with laboratory rated sound insulation performances (R_w) typically quoted by system providers.

2.3.2 For airborne sound insulation of light-weight wall or floor systems, it is considered good practice to allow for 7dB and 9dB depreciation (due to site constraints and flanking) between laboratory rated (R_w and $R_w + C_{tr}$) and on site measured ($D_{nT,w}$ and $D_{nT,w} + C_{tr}$) sound insulation performances. For masonry constructions, it is good practice to allow for 5dB depreciation.

Table 2.6: Required laboratory rated sound insulation performance of light-weight constructions.

Room Types	Laboratory rated sound insulation performance	
Residential	**HbH [R_w (dB)]**	**ADE [$R_w + C_{tr}$ (dB)]**
Guestroom – Guestroom	≥62 (walls) ≥62 (floors)	≥52 (walls) ≥54 (floors)
Guestroom – House Keeping / Corridor (no door)	≥67 (walls) ≥67 (floors)	≥52 (walls) ≥54 (floors)
Guestroom – Corridor (containing door)	≥52 (walls)	≥52 (walls)
Guestroom En-suite bathroom walls	≥45	≥40

Table 2.6: Required laboratory rated sound insulation performance of light-weight constructions. (Continued)

Non-Residential	**HbH [R_w (dB)]**
Laundry – Corridor (no door)	≥57
WC – Gathering (no door) Riser - Stairwell Stairwell – Core Breakfast Laundry – Staff Change Staff Change – Corridor General Manager / IT room - Corridor (no door) IT Room - General Manager / Front Office Break Room / IT Room / General Manager – Lobby Luggage Store – WC Fitness Room – Riser / Corridor / Living Zone Front Office – Welcome Zone	≥52
Walls containing doors Food Prep - Living Zone / Core Breakfast Food Prep / Laundry - Food Store	≥47

Table 2.7: Required laboratory airborne sound insulation performance of masonry constructions.

Room Types	Laboratory rated sound insulation performance	
Residential	**HbH [R_w (dB)]**	**ADE [$R_w + C_{tr}$ (dB)]**
Guestroom - Guestroom	≥60 (walls) ≥60 (floors)	≥48 (walls) ≥50 (floors)
Guestroom – House Keeping / Corridor (no door)	≥65 (walls) ≥65 (floors)	≥52 (walls) ≥54 (floors)
Guestroom – Corridor (containing door)	≥50 (walls)	≥48 (walls)
Guestroom En-suite bathroom walls	≥45	≥40

Table 2.7: Required laboratory airborne sound insulation performance of masonry constructions Cont.

Room Types	Laboratory rated sound insulation performance
Non-Residential	**HbH [R_w (dB)]**
Laundry – Corridor (no door)	≥55
WC – Gathering (no door) Riser - Stairwell Stairwell – Core Breakfast Laundry – Staff Change Staff Change – Corridor General Manager / IT room - Corridor (no door) IT Room - General Manager / Front Office Break Room / IT Room / General Manager – Lobby Luggage Store – WC Fitness Room – Riser / Corridor / Living Zone Front Office – Welcome Zone	≥50
Walls containing doors Food Prep - Living Zone / Core Breakfast Food Prep / Laundry - Food Store	≥45

Flanking Sound Insulation Performance

2.3.3 The horizontal flanking performance across party walls at the facades should be a minimum of 53 dB $D_{nf,w} + C_{tr}$ to avoid compromise of the overall sound insulation performance.

2.3.4 The vertical flanking performance across party floors at the facades shall be a minimum of 55 dB $D_{nf,w} + C_{tr}$ to avoid compromise of the overall sound insulation performance.

Doors

Guestroom Access Doors

2.3.5 Guestrooms entrance doors should have a laboratory sound insulation performance of ≥38dB R_w (or ≥42dB R_w where within 5m of a lift lobby) to satisfy both Building Regulations and Brand Standards.

Office / Fitness / Function Room Doors

2.3.6 Office doors should have a laboratory sound insulation performance of ≥30dB R_w to satisfy Brand Standards.

2.3.7 Fitness / Function Room doors should have a laboratory sound insulation performance of ≥35dB R_w to satisfy Brand Standards.

Riser Doors

2.3.8 Doors to risers in corridors should have a laboratory sound insulation performance of 35dB R_w or greater.

3 Wall Sound Insulation

3.1 Overview

3.1.1 A review of the proposed wall constructions[1] has been done to determine if these are sufficient to satisfy the target requirements given in Section 2. Recommendations have been made where sound insulation targets have not been met.

3.2 Guestroom - Guestroom Separating Walls

3.2.1 Partition Type 1 is proposed for all separating walls between guestrooms. The construction is as follows:

- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).
- 16mm resilient bars.
- 100mm SFS stud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 16mm resilient bars.
- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).

3.2.2 The laboratory rated[2] sound insulation performance of a separating wall with a similar construction is 62dB R_w / 54dB $R_w + C_{tr}$. This wall system will therefore meet both the ADE requirement of ≥43dB $D_{nTw} + C_{tr}$ and HbH brand standard target of ≥55dB D_{nTw} with good workmanship and detailing.

3.3 Guestroom - Corridor Separating Walls (containing doors)

Proposed

3.3.1 Partition Type 2 is proposed for separating walls containing doors between guestrooms and corridors. The construction is as follows:

- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).

3.3.2 The laboratory rated[3] sound insulation performance of this system is 56dB R_w / 47dB $R_w + C_{tr}$ and therefore will meet HbH brand standard target of ≥48dB R_w or ≥52dB R_w (where guestroom is within 5m of lift lobby). However, this will not meet the ADE target of ≥43dB $D_{nT,w} + C_{tr}$.

[1] 1056 HBH Heathrow - AC(00)001 NBS Document 29th November 2018
[2] Similar construction to Metsec SFS Specification Manual Nov 2010 Wall ref: MFD374
[3] British Gypsum Whitebook Wall Ref: A206231

3.3.3 ADE recognises that the performance of the wall will be compromised by the inclusion of the door, therefore Building Control may agree to the reduced performance for the wall where satisfaction of the HbH brand standard wall and door targets are achieved. This should be agreed with Building Control before becoming integrated into the designs.

Recommended

3.3.4 The following corridor wall construction is recommended should compliance with both HbH and ADE targets be sought:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg /m²).
- Gypframe 70 S 50 "C" Stud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 16mm resilient bars.
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg /m²).

3.3.5 In some locations, Partition Type 1 is proposed for guestroom to corridor walls containing doors (see 3.2.1 for construction). For these locations the wall build-up can be reduced to the construction given above in section 3.3.4. and still meet the HbH and ADE requirements.

3.4 Guestroom - Corridor Separating Walls (not containing doors)

Proposed

3.4.1 For separating walls between guestrooms and corridors (not containing doors), Partition Type 1 is proposed as follows:

- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).
- 16mm resilient bars.
- 100mm SFS stud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 16mm resilient bars.
- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).

3.4.2 The laboratory rated[4] sound insulation performance of the wall is 62dB R_w / 54dB $R_w + C_{tr}$. This wall system will meet the ADE target with good workmanship and detailing. However, will not meet the HbH brand standard target of ≥60dB D_{nTw}.

Recommended

3.4.3 To meet both ADE and the HbH brand standard target, we recommend the following wall construction:

[4] Metsec Specification Manual.

- 3No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).
- 16mm resilient bars.
- 100mm SFS stud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 16mm resilient bars.
- 3No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).

3.4.4 The predicted[5] laboratory rated sound insulation performance of this construction is 67dB R_w / 59dB $R_w + C_{tr.}$ This will meet both the ADE and HbH brand standard targets with good detailing and workmanship.

3.5 Stairwell – Guestroom Separating Walls

Proposed

3.5.1 For stairwell walls adjacent to guestrooms, partition Type 10 is proposed as follows:

- 3 staggered layers of 15mm Gyproc SoundBloc plasterboard.
- 100mm SFS stud.
- 50mm mineral wool insulation (≥10kg/m³).
- 3 staggered layers of 15mm Gyproc SoundBloc plasterboard.

3.5.2 The predicted[5] laboratory rated sound insulation performance of this separating wall is 55dB R_w / 51dB $R_w + C_{tr}$. This wall system will meet the ADE target with good workmanship and detailing, however, will not meet the HbH brand standard target of ≥60dB D_{nTw}.

Recommended

3.5.3 We recommend the separating wall construction described in section 3.4.3. Or alternatively, the following lining system to meet both HbH and ADE target requirements.

- ≥10mm cavity.
- Gypframe 48mm "I" stud at 450mm centres.
- ≥25mm mineral wool insulation (≥10kg/m³).
- 1No. layer of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

3.6 Riser Walls

3.6.1 There are risers within some guestrooms on each floor.

3.6.2 The proposed Partition Type 8 construction between risers and adjacent habitable spaces is as follows:

[5] Using Marshall Day Insul v9.0.17 sound insulation prediction software, ±3dB

- 19mm Gyproc CoreBoard plasterboard between studs.
- 90 "I" Studs at 600mm centres with 25mm Mineral wool insulation in cavity
- 2 staggered layers of 15mm Gyproc FireLine plasterboard to non-shaft side.

3.6.3 The laboratory rated[6] sound insulation performance of this wall system is 46dB R_w.

3.6.4 This construction is suitable to control noise breakout from the riser and vertical flanking between guestrooms.

3.7 Guestroom – En-suite (Same Room) Walls

Proposed

3.7.1 For partitions between guestrooms and en-suite bathrooms (within the same room), Lining Type 2 is proposed to be installed to the prefabricated bathroom pod frame. The bathroom pod frame construction is currently unknown, however we have assumed the construction is as follows:

- 1No. layer of 15mm Gyproc Moisture resistant board (≥10.1kg/m^2).
- 64mm deep pod steel frame.
- 1No. layer of 15mm Gyproc Wallboard (≥9.8kg/m^2).

3.7.2 The predicted[7] laboratory rated sound insulation performance of this construction is 39dB $R_{w..}$ This does not meet ethe HbH brand standard target of ≥40dB R_w or the ADE target of ≥45dB R_w.

Recommended

3.7.3 To meet both ADE and the HbH brand standard targets, we recommend that ≥25mm mineral wool insulation (≥10kg/m^3) is installed between the pod steel studs.

3.8 Guestroom – Linen Room (Housekeeping)

Proposed

3.8.1 Partition Type 1 is proposed for separating walls between guestrooms and linen rooms. This is to be lined one side with the following Lining Type 5 construction positioned 30mm away from the face of the separating wall:

- Gypframe "I" stud at 450mm centres.
- ≥50mm mineral wool insulation (≥10kg/m^3).
- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m^2).

[6] British Gypsum Whitebook Wall Ref: A306025
[7] Using Marshall Day Insul v9.0.17 sound insulation prediction software, ±3dB

3.8.2 The predicted laboratory rated[8] sound insulation performance of this system is 77dB R_w / 63dB R_w + C_{tr} and therefore will meet the HbH brand standard and ADE targets with good detailing and workmanship.

Alternative

3.8.3 The proposed lining system can be reduced as follows and still meet the HbH brand standard and ADE targets:

- Gypframe 48mm "I" stud at 450mm centres.
- ≥25mm mineral wool insulation (≥10kg/m³).
- 1No. layer of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
-

3.8.4 The laboratory rated[8] sound insulation performance of this construction is 69dB R_w / 55dB R_w + C_{tr}.

3.9 Non-Residential to Non-Residential

Food Store – Laundry / Food Prep, Food Prep / Bev Store

Proposed

3.9.1 Partition Type 2 is proposed for separating walls between food store and laundry / food prep, Food prep and Bev store. The construction is as follows:

- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).

3.9.2 The laboratory rated[9] sound insulation performance of this system is 56dB R_w and will meet the HbH brand standard target with good workmanship and detailing.

Alternative

3.9.3 The proposed wall system can be reduced as follows and still meet the HbH brand standard target of ≥40dB $D_{nT,w}$:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

[8] Using Marshall Day Insul v9.0.17 sound insulation prediction software, ±3dB
[9] British Gypsum Whitebook Wall Ref: A206231

Fitness Room – Living Zone / Core Breakfast, Laundry – Staff Change, Staff Change – Corridor

Proposed

3.9.4 Partition Type 2 is proposed for separating walls between laundry and staff change, staff change and corridor. The construction is as follows:

- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 15mm Gyproc SoundBloc plasterboard (≥12.6kg/m²).

3.9.5 The laboratory rated[10] sound insulation performance of this system is 56dB R_w and will meet the HbH brand standard target with good workmanship and detailing.

Alternative

3.9.6 The proposed wall system can be reduced as follows and still meet the HbH brand standard target:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- ≥25mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

Front Office – Welcome Zone / Gathering, GM office – IT Room

Proposed

3.9.7 Partition Type 5 is proposed for separating walls between front office and welcome zone / gathering, IT room and GM office / Front office. The construction is as follows:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 92 AS 50 AcouStud at 600mm centres
- Mineral wool insulation to fill cavity (≥10kg/m³).
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

3.9.8 The laboratory rated[11] sound insulation performance of this system is 60dB R_w and will meet the HbH brand standard target with good workmanship and detailing.

Alternative

3.9.9 The proposed wall system can be reduced as follows and still meet the HbH brand standard target.

[10] British Gypsum Whitebook Wall Ref: A206231
[11] British Gypsum Whitebook Wall Ref: A206A292S

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- ≥25mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

Staff Change – Staff Change, Staff WC – Break Room, WC – Gathering, WC – Luggage Store

Proposed

3.9.10 Partition Type 6 is proposed for separating walls between Staff change rooms, Staff WC and Break room, WC and gathering space. The construction is as follows:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 70 AS 50 AcouStud
- ≥125mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

3.9.11 The laboratory rated[12] sound insulation performance of this system is 58dB R_w and will meet the HbH brand standards target with good workmanship and detailing.

Alternative

3.9.12 This proposed wall system can be reduced as follows and still meet the HbH Brand standard target:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- ≥25mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

Break Room / WC / GM Office / IT Room - Corridor, Staff WC – Break Room

Proposed

3.9.13 Partition Type 3 is proposed for separating walls between Break room / WC / GM office / IT room and corridor, Staff WC and break room. The construction is as follows:

.

- 2No. staggered layers of 12.5mm Gyproc Fireline plasterboard (≥9.8kg/m²).
- Gypframe 92 AS 50 AcouStud.
- ≥50mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 12.5mm Gyproc Fireline plasterboard (≥9.8kg kg/m²).

[12] British Gypsum Whitebook Wall Ref: A206A198

3.9.14 The laboratory rated[13] sound insulation performance of this system is 55dB R_w and will meet the HbH brand standard target with good workmanship and detailing.

Alternative

3.9.15 This proposed wall system can be reduced as follows and still meet the HbH Brand standard target:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- ≥25mm mineral wool insulation (≥10kg/m³).
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

Non-Residential Separating Walls Containing Doors (Recommended)

3.9.16 For separating walls containing doors between non-residential spaces, the HbH brand standard target is ≥40dB D_{nTw}. We recommend the following construction:

- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).
- Gypframe 70 S 50 "C" Stud.
- 2No. staggered layers of 12.5mm Gyproc SoundBloc plasterboard (≥10.6kg/m²).

3.9.17 The laboratory rated[14] sound insulation performance of this system is 49dB R_w and will meet the HbH brand standard target with good workmanship and detailing.

3.10 Doors

3.10.1 The recommended laboratory rated sound insulation performances for doors is provided in Table 3.1.

Table 3.1 Recommended door sound insulation performances

Space	Minimum Required Performance [R_w (dB)]
Guestroom Access Doors	38
Guestroom Access Doors (within 5m of lift)	42
Office	30
Fitness / Function Room Doors	35
Riser Doors	

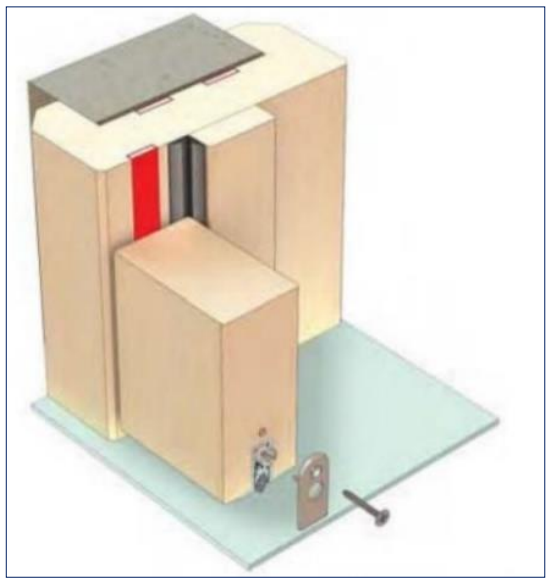
Recommended Door Constructions

3.10.1 The choice of appropriate doors with good door seals is critical to maintaining effective sound reduction and controlling the transfer of sound between spaces.

[13] British Gypsum Whitebook Wall Ref: A206A295
[14] British Gypsum Whitebook Wall Ref: A206166

3.10.2 The above performances can be achieved by a well fitted solid core door sets where door is effectively sealed around its perimeter in a substantial frame with an effective stop. Appropriate seals would either compression (e.g. 'bat wing' or bulb) or wiper seals and installed around the door's perimeter (along with a drop-down threshold seal for guestroom entrance doors). The acoustic integrity of the door will depend largely on workmanship; there should be no gaps between the door and the door frame. See Figure 3.1 for typical example and http://www.lorientuk.com/products/acoustic-seals-smoke-seals-and-fire-seals-for-door-assemblies.

Figure 3.1: Door Seals.



3.10.3 Doorsets are preferred over doors fitted into frames on site as they can be laboratory tested in their frame and are less prone to having their acoustic integrity compromised through poor on-site workmanship. The R_w sound insulation performance of the complete door set, including the framework, should be determined in accordance with BS EN ISO 140-3:1995.

3.11 Interconnecting Doors

3.11.1 Interconnecting door sets are proposed between a number of guestrooms. The door sets between guestrooms must provide an airborne sound insulation performance of 55dB $D_{n,T,w}$ (43dB $D_{nT,w}$ + C_{tr}) or greater, equivalent to that of the separating wall in which it is installed.

- Doors should be ≥54mm thick solid core doors with neoprene 'batwing' or 'bulb/ compression' seals around the head and perimeter with drop down threshold seals which should sit on a hardwood threshold plate.
- The door frame should be 'split' to offer greater isolation to each door leaf.
- There should be no gaps around the doors and reveals should be lined with absorbent material so that there is no build of sound within the cavity. The lining can be bonded carpet if desired.
- A 15mm high timber threshold strip should be installed between back to back doors to reduce flanking noise transmission at the threshold (i.e. an inverse 'T' threshold section). Our recommended threshold details are shown in Figures 3.2 and 3.3. The details should be signed off by Whitbread before being built.

Figure 3.2: Recommended detail.

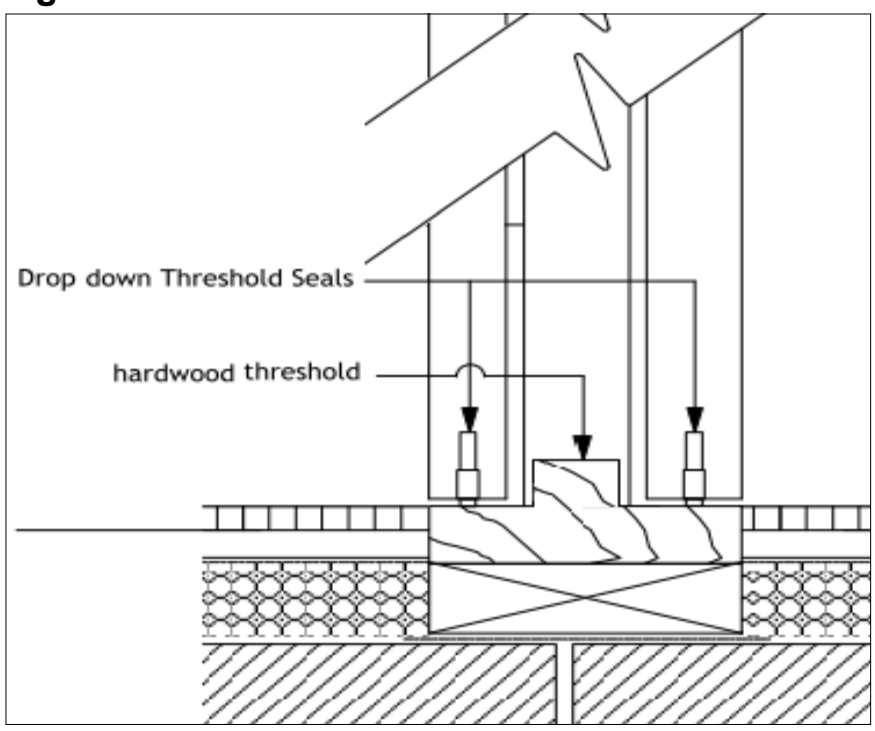
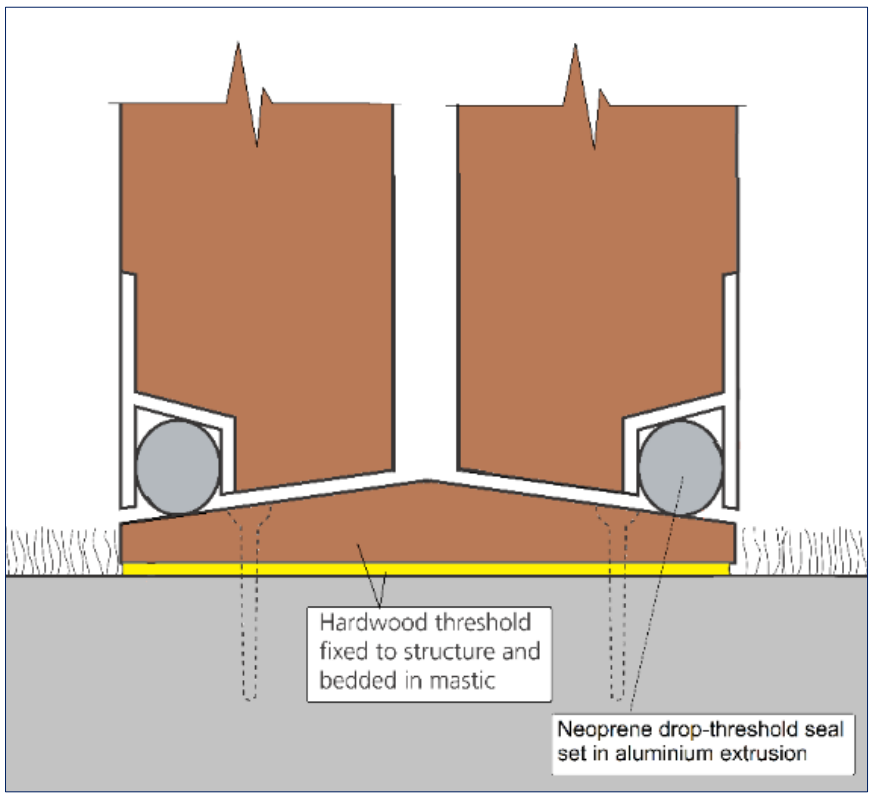


Figure 3.3: Alternative recommended back to back door detail.



4 Floor Sound Insulation

4.1 Overview

4.1.1 A review of floor constructions has been done to determine if these are sufficient to satisfy the target requirements given in Section 2. Recommendations have been made where sound insulation targets have not been met.

4.2 Guestroom to Guestroom Separating Floor

4.2.1 For residential spaces, the ADE requirement for on-site separating floor sound insulation performance targets is ≥45dB $D_{nT,w}$ + C_{tr} and the HbH brand standard target is ≥55dB $D_{nT,w}$.

4.2.2 The separating floor construction is proposed to comprise of the following:

- Floor finish (i.e. Karndean WP411-SR Niveus wood flooring).
- Acoustic underlay.
- 75mm screed.
- 150mm composite concrete floor construction on trapezoidal steel decking (2400kg/m³).
- ≥150mm ceiling void (assumed).
- 1No. layer of 12.5mm Standard plasterboard (≥8kg/m² e.g. Gyproc Wallboard) on MF ceiling frame.

4.2.3 This construction is predicted[15] to have a laboratory rated sound insulation performance of 70 dB R_w / 64 dB R_w + C_{tr}. This build up is sufficient to meet both the ADE and HbH brand standard targets with good workmanship and detailing.

4.3 Residential to Non-residential

4.3.1 The separating floor construction is proposed to comprise of the following:

- Floor finish (i.e. Karndean WP411-SR Niveus wood flooring).
- Acoustic underlay.
- 75mm screed.
- 150mm composite concrete floor construction on trapezoidal steel decking (2400kg/m³).
- ≥150mm ceiling void (assumed).
- 1No. layer of 12.5mm Standard plasterboard (≥8kg/m² e.g. Gyproc Wallboard) on MF ceiling frame.

4.3.2 This construction is predicted[16] to have a laboratory rated sound insulation performance 70 dB R_w / 64 dB R_w + C_{tr}. This build up is sufficient to meet both the ADE and the HbH brand standard

[15] Using Marshall Day Insul v9.0.17 sound insulation prediction software, ±3dB
[16] Using Marshall Day v9.0.17 sound insulation prediction software, ±3dB

targets between guestrooms and Health Club / Kitchen / Servery / Offices with good workmanship and detailing.

4.4 Impact Sound Insulation

Guestroom - Guestroom

4.4.1 To meet the impact sound insulation requirement for Building Regulations of ≤62dB $L_{nT,w}$ and the HbH target of ≤50dB $L_{nT,w}$ for separating floors between guestrooms areas, a resilient layer or acoustic underlay should be bonded to the screed with an improvement in impact performance of ≤23dB ΔL_w or greater such as 'CMS Regupol' or 'Thermal economics Isorubber Base'.

Guestroom – Gathering Zone / Core Breakfast / Living Zone

4.4.2 To meet the impact sound insulation target requirement for HbH of ≤55dB $L_{nT,w}$ for separating floors between guestrooms and the listed ground floor areas, a resilient layer or acoustic underlay should be bonded to the screed with an improvement in impact performance of ≤19dB ΔL_w or greater such as 'CMS Regupol' or 'Thermal economics Isorubber Base.

Guestroom – Fitness Room / BOH Offices

4.4.3 To meet the impact sound insulation target requirement for HbH of ≤60dB $L_{nT,w}$ for separating floors between guestrooms and the listed ground floor areas, a resilient layer should be bonded to the screed with an improvement in impact performance of ≤17dB ΔL_w or greater such as 'CMS Regupol' or 'Thermal economics Isorubber Base.

4.5 Roof Construction

4.5.1 The proposed construction is not known at the time of writing the report. However, we have assumed a minimum concrete composite slab depth of 150mm thickness with insulation of thickness ≥130mm bonded on top and a layer of 15mm British Gypsum Wallboard on an MF ceiling system forming a 150mm (min) void.

4.5.2 The predicted[16] sound insulation performance of this construction is 65dB $R_w + C_{tr}$. This is suitable to reduce external noise ingress into rooms below. Should plant items be installed on the roof, noise from these will need to be reviewed together with the assumed roof construction and mounted (as per section 7 of this report) to minimise the level of noise break-through into the guestrooms.

5 Reverberation

5.1 The Building Regulations

5.1.1 Approved Document E recommends measures to control reverberation in circulation spaces. For entrance halls, corridors or hallways a Class C absorber should be installed to an area (normally the ceiling) equal to or greater than the floor area.

5.1.2 For stairwells or a stair enclosure, absorption is not required where Guestrooms are not directly accessed from these. Otherwise, a Class C absorber would be required to cover an area equal to 50% of the total areas of the stair treads, upper surfaces of landings and the ceiling area of the top floor. Absorptive material is equally distributed between the floors. It is normally most convenient to apply the absorber to the underside of the landing areas and to the ceiling area of the top floor.

5.2 Non-Residential Areas (Brand Targets)

5.2.1 There are no reverberation times requirements for guestrooms within the Brand Standards, but for some areas of the hotel, the document requires control of mid-frequency reverberant levels (the average reverberation time at 500Hz, 1 kHz and 2 kHz), see Table 5.1.

Table 5.1: Section 25014.05.I.2 Control of Reverberation.

Room	Maximum Mid-frequency Reverberation time (seconds)
Gathering / Welcome Zone	1.5
Core Breakfast / Living Zone	1.0

Recommendations

5.2.2 Table 5.2 recommends suitable additional absorptive treatment where required to meet reverberation time criterion. Absorption can be applied to ceilings (i.e. soffit panels or mineral fibre ceiling tiles) or to walls. All walls are to be plasterboard and floors will be floor tiles with areas of carpet.

Table 5.2 Recommended absorption to non-residential areas.

Room type	Minimum recommended absorption class (E to A)	Minimum recommended coverage m²
Gathering / Welcome Zone	A	70
Core Breakfast / Living Zone		70

6 General Detailing

6.1 General

6.1.1 Separation of elements in lightweight separating walls and their mass are important to the acoustic integrity of the whole system. Similarly, the same applies to the degree of separation between the underside of a floor and ceiling or isolated screed and concrete slab.

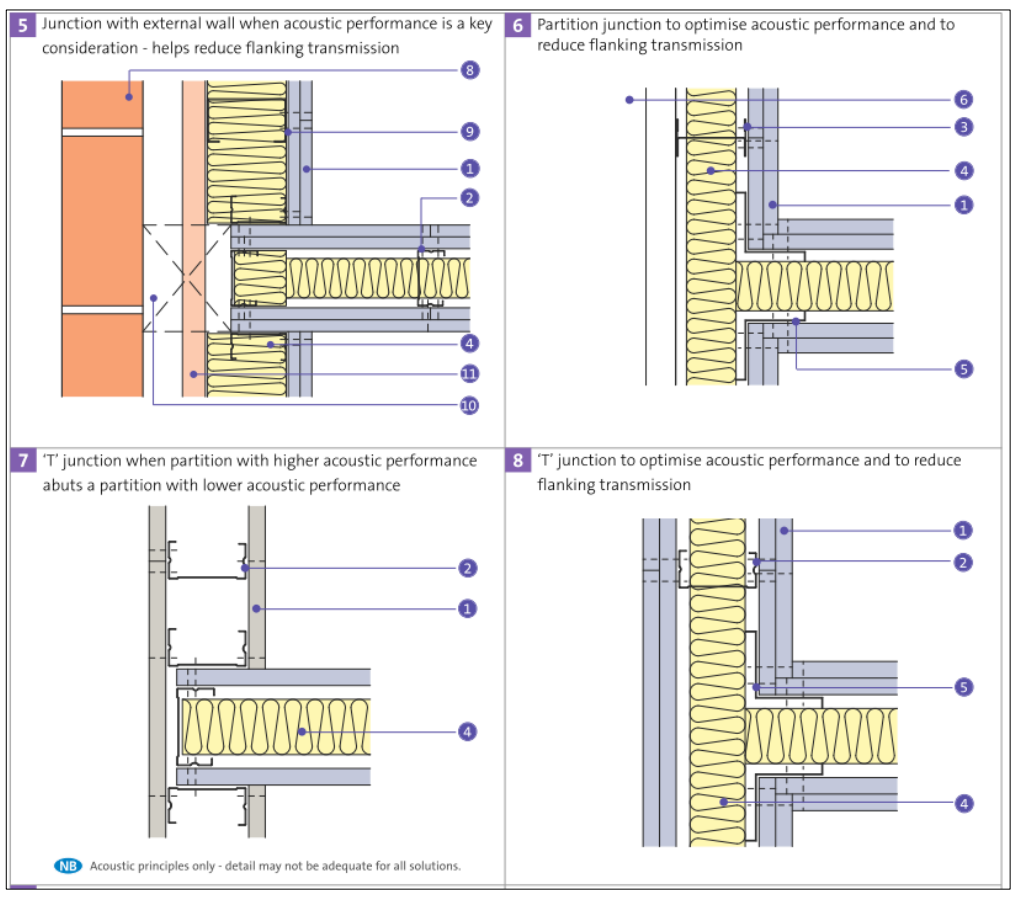
6.1.2 As part of the construction programme, works should be regularly inspected to ensure workmanship is good.

6.1.3 All walls and ceilings to spaces must be as recommended. Where a variation in boards are required, the surface mass of these should not be less than that considered. Where multiple layers of board are to be used, plasterboard layers should be staggered and generously sealed at the perimeters with a dense non-setting resilient sealant (e.g. Gyproc Sealant).

6.1.4 Any changes in angle of boarding e.g. around window apertures please ensure boards are well cut so that they abut each other and are again generously sealed with dense sealant. Penetrations in separating constructions should be suitably detailed to maintain sound insulation performance.

6.1.5 Plasterboard layers at junctions with separating walls and floors should not be continuous across the separating partition. This applies to internal linings of external walls and corridor walls, see Figure 6.1 for typical junction details.

Figure 6.1 Typical junction details

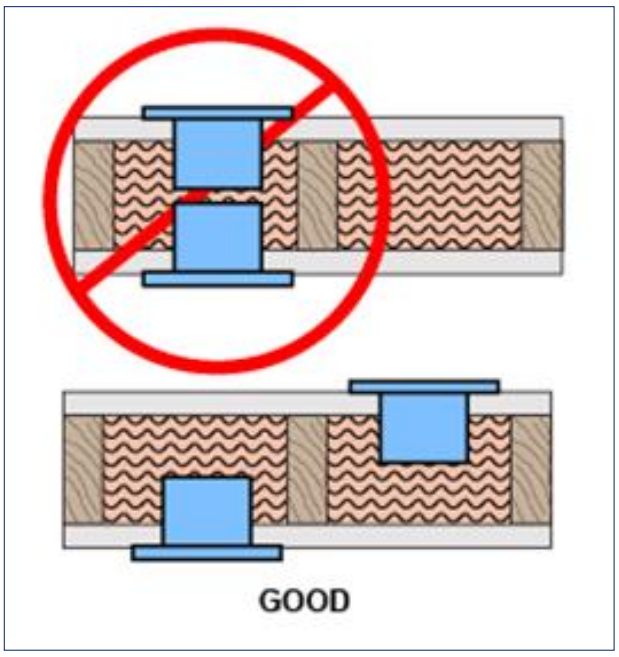


6.2 Wall Penetrations

6.2.1 Deep sockets and chases should not be made in the separating walls.

6.2.2 Back to back sockets in stud walls should be avoided where possible, see Figure 6.2 for good and bad practice.

Figure 6.2: Good/ bad practice for fitting sockets.



6.2.3 The sockets should be staggered and treated with a suitable mouldable fire-rated putty pad (see suitable application in Figure 6.3) e.g. ‘Hilti’ or ‘Rockwool’ putty pads, see:

- https://www.hilti.co.uk/firestop-and-fire-protection-systems/firestop-putties/r4673
- and http://www.rockwool.co.uk/products/intumescent-putty-pads/

Figure 6.3: Application of mouldable fire-rated pad[17].

6.2.4 Good workmanship is key to this detail working i.e. the pad must be well moulded and generously applied around / within the box.

6.3 Pattress Boards within Separating Walls

6.3.1 If timber pattress boards (typically plywood) are proposed within separating walls for fixing of heavier loads such as televisions, desks, wardrobes etc. then the timber pattress should only span between each vertical steel / timber section. It is important the boarding (assumed to be plywood) is not cut and left in exposed in damp conditions as it may then warp meaning that it does not sit flush behind the resilient bar. All timber pattresses should be as thin as possible (less than the

[17] Taken from Hilti website, see: https://www.hilti.co.uk/firestop-and-fire-protection-systems/firestop-putties/r4673

thickness of the resilient bar) small an area as is practicable (for fixings) as larger areas of pattress boarding are more likely to compromise the level of airborne sound insulation offered by the system, particularly at mid-frequency.

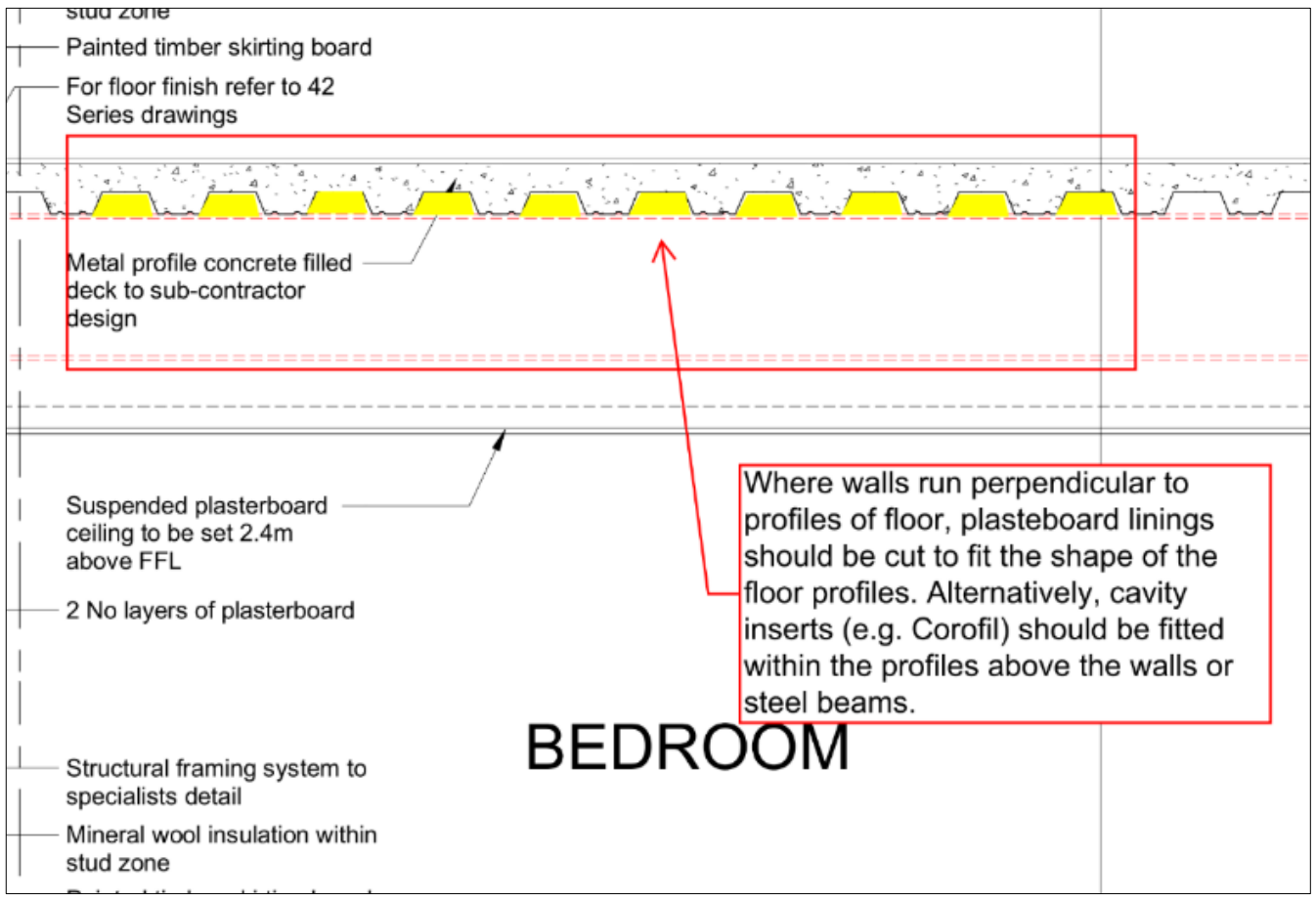
6.4 Wall Base & Head Detail

6.4.1 All separating walls must be built full height from slab to the structural soffit with suitable base and head detail to allow for deflection but to reduce the possibility of flanking noise transfer.

6.4.2 Where separating walls abut the profiles of the profiled floor deck, the cavities formed should be suitably sealed to minimise sound flanking via the formed voids.

6.4.3 Rockwool type cavity inserts (e.g. Corofil C144) should be installed across the partition within the formed cavities (see Figure 6.4). This is also applicable above any steel beams at separating wall lines.

Figure 6.4: External wall and floor example detail.



6.4.4 Where partitions run parallel to the profiles, we recommend that the plasterboard linings are taken up to the decking and sealed with a dense flexible sealant (e.g. Gyproc Sealant) for their full length.

6.5 Ceiling Penetrations

6.5.1 Any proposed down-lighters should not compromise the sound insulation of the ceiling. Downlighters should only be fitted where there is a ceiling void of sufficient depth to accommodate the downlighters and excess space. This is required in order to avoid potential contact between downlighters and the underside of the floor construction. Where this is not possible, light fixtures should be surface mounted.

6.5.2 Downlighters should be installed in accordance with the manufacturer's instructions, at no more than one light per $2m^2$ of ceiling area in each room at centres not less than 0.75m, into openings not exceeding 100mm diameter or 100 x 100mm.

6.5.3 Either acoustic rated hoods should be placed over the back of down-lighters in the ceiling void or acoustically rated/ tested down-lighters should be installed tight into their created aperture.

6.6 Floor Services Penetrations

6.6.1 ADE provides guidance where pipes and ducts penetrate a floor separating habitable spaces.

6.6.2 It states that, pipes and ducts should be isolated from the separating floor construction and enclosed for their full height (length) in each guestroom on either side of the separating partition using:

- Board of at least 15kg/m². This can be two layers of staggered 12.5mm thick standard plasterboard (e.g. 8kg/m² - 'British Gypsum Gyproc Wallboard) or one layer of 19mm thick standard plasterboard (e.g. 15kg/m² - British Gypsum Gyproc Plank').
- The enclosure should be lined or pipes should be lagged with 25mm mineral wool insulation (≥10kg/m³).
- The enclosure, joints or gaps should be sealed with dense non-setting resilient sealant (e.g. Gyproc Sealant).

6.7 Wall Services Penetrations

6.7.1 The following service penetration schedule is recommended in order to limit the level of flanking noise between dividing / separating partitions. This should be forwarded to the plasterboard system installers.

Single Metal / Plastic Pipe – 15mm to 108mm

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

Ventilation Ducting Serving Adjacent Rooms

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

Ventilation Ducting Passing Through Room

- Penetration should be packed with mineral wool and well-sealed with non-hardening mastic.
- Duct should be lagged with 15 mm Muftilag P.

Conduit / Single Cable

- Penetration should be packed with mineral wool and well-sealed with non-hardening mastic. Ends of conduit should also be sealed.

Tray / Trunking with Lid / Ducting with Lid / Data Basket / Dado Trunking – with Cables

- Tray/trunking/basket should be cut either side of partition with no hard contact through penetration.
- Services should be passed via a sleeve through penetration.
- Sleeve/partition junction should be well sealed with non-hardening mastic.
- Any internal void within the sleeve should be filled with mineral wool.
- 'Jigsaw' pieces of sound-resistant plasterboard should be fixed around the service, covering the penetration.

6.7.2 Where penetrations are significantly larger than the services passing through it, in order that this does not compromise the performance of the dividing partition, any gap between the service pipe or duct should be packed with dense mineral fibre and a pattress comprising 2No. layers of dense plasterboard (e.g.12.5mm thick Gyproc SoundBloc board) should be installed around the penetration, set on a continuous bead of acoustic mastic.

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

6.7.4 Where pipework / SVP pass through habitable rooms, these should be wrapped / lagged with 25mm thick mineral wool insulation and boxed in to their full height in each room with two layers of 12.5mm thick plasterboard (≥8kg/m²).

6.7.5 Service penetrations should be routed through the corridor walls where practical. If it is necessary to breach dividing / separating walls then the aperture should be suitably sealed as follows.

- Pipe work and cable tray penetrations through dividing walls should be filled with a mastic faced firebatt (1mm mastic / 50mm thick, 140kg/m^3 mineral wool) and sealed with mastic. If the penetrations are not within a bulkhead they should be further sealed with an MDF cover plate.

- Ductwork penetrations should include suitable crosstalk attenuation and scribe-cut plasterboard should be fixed around the duct penetration and sealed on a bed of dense non-setting resilient sealant (e.g. 'Siniat Intumescent Acoustic Sealant'). Exposed ductwork in rooms may require lagging to control the break-in of noise.

- Flush finished electrical fittings can reduce the acoustic performance of the partitions. Where flush finishes are preferred to surface mounting of trunking and fittings, the back boxes of the fittings should be shallow to the acoustic performance of the partition.

- For the general filling of small apertures, the gaps should be tightly packed with mineral wool and sealed on both side with dense flexible non-setting dense sealant e.g. Intumescent Acoustic Sealant. Expanding foam is not suitable as an acoustic sealant and must not be used.

6.8 Detail Review

6.8.1 Detail drawings for wall and floor constructions will be reviewed on request, when available. The review will also include guidance on penetration details to maintain the sound insulation performance of separating constructions.

7 Plant

7.1 Plant Noise Targets

7.1.1 Plant noise limits have been provided in the Environoise Report ref: 21105R02aOPpak. Recommendations have been given in section 7 of this report to control noise and vibration from plant affecting Guestrooms.

7.2 Plant Isolation Target

7.2.1 Vibration from the operation of plant shall be at a level that will not disturb those within Guestrooms. Section 2514.05 of the Brand Standards states the following:

To satisfy the above requirements, vibration in Guestrooms from all sources shall be below 0.05m/s^2 (in any direction vertical or horizontal) when measured and evaluated in accordance with ISO 2631-2:2003 'Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 2: Vibration in Buildings (1Hz to 80Hz)[vi].

7.2.2 Vibration Dose Values shall not exceed 0.2m/s$^{1.75}$ over a 16-hour day or 0.1m/s$^{1.75}$ over an 8-hour night-time period in accordance with BS6472:1992.

7.2.3 Plant should have suitable isolation to achieve 95% isolation of frequencies of concern.

7.2.4 N.B. We do not give advice on specific vibration isolators (e.g. spring isolators) as typically manufactures / suppliers advise on this. However, in an effort to assist generic plant isolation advice is given in section 7.3.

7.3 Plant Mounting

7.3.1 Plant vibration isolation measures should be considered where plant it proposed internally or externally (e.g. on the roof), even with a thick concrete construction. The level of isolation between plant item and fixing is dependent on the following factors:

- Mass of the plant (kg).
- Forcing frequency of plant item (Hz).
- Number of connections plant item has with roof.
- Plant is suitably distributed across all supporting points.

7.3.2 It is likely that rubber/spring anti-vibration mount should be employed between the plant and supporting structure. Manufacturers of such mounts should have a technical service to advise on the correct mounts to use. They will need to know the weights and weight distribution of the plant over the slab, and the lowest forcing frequency likely to be encountered. Such companies are:

- http://www.christiegrey.com/ipf.html
- http://www.totalvibrationsolutions.com/

7.3.3 Plant vibration isolators should be chosen such that the natural frequency of the item when mounted on the isolators is substantially below the forcing frequency of the item of plant and the natural frequency of the supported plant.

7.3.4 Connections from plant must be flexible to reduce vibration transfer.

7.3.5 Care must be taken in the orientation of any exhaust duct terminations and the noise level produced by the termination so that proposed guestrooms are not adversely affected.

Supporting Structures

7.3.6 Plant supported on a separating construction shall have a ≥10mm neoprene washer either side of the supportive metal fixing so that the Unistrut has no contact with the plant, unless the units have built in anti-vibration systems. This is so that any movement or excitation from the units is not transferred into the construction above.

7.3.7 No supporting ceiling hangers shall have contact with any plant or ductwork or their associated plant fixings within the ceiling void.

7.3.8 No ductwork shall sit directly on its metal supporting structure, a neoprene sleeve must be placed between the duct and supporting brace or strap.

7.3.9 Any large plant proposed shall need hanging on resilient hangers in addition all plant and ductwork must not sit directly on the metal supporting structure.

8 Lift Design

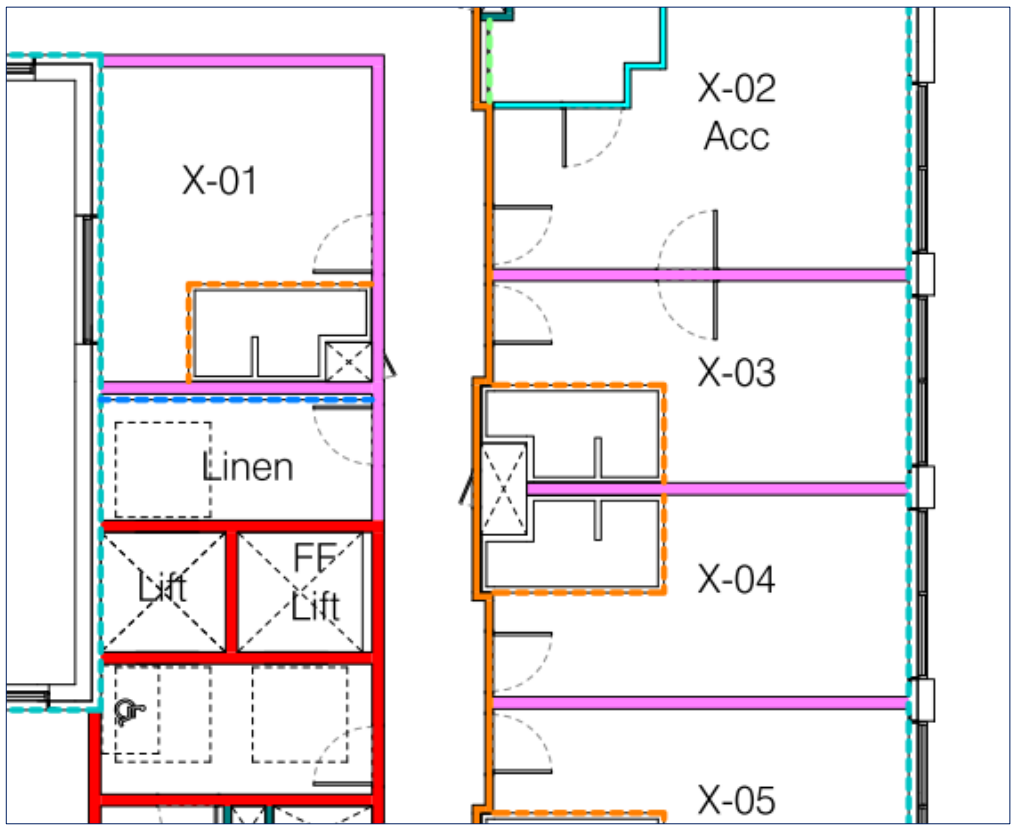
8.1 Overview

8.1.1 The design of mechanical systems such as lifts is seen to be the responsibility of others and not of Environoise Consulting Limited. However, we have given guidance on the control of noise and vibration from lift movements to minimise disturbance from lift movements to those in residential spaces.

8.2 Lift Shaft

8.2.1 No lift shafts are proposed adjacent to guestrooms. The closest lift shafts are separated from guestrooms by either corridors or linen rooms, See Figure 8.1.

Figure 8.1: Lift Location.



8.2.2 The lift shaft shall be detached from the rest of the surrounding structure. Recommendations given in the following sections are applicable to the entire lift shaft ‘run’.

8.2.3 To reduce structure borne sound further via the separating floor and wall constructions from the lifts to the guestrooms / living spaces, our recommended lift specification to control the level of noise and vibration transfer is as follows:

Acceleration/ deceleration

8.2.4 Acceleration and deceleration rates should not exceed 1.5m/s^2 at any time during a complete cycle and should preferabley be lower than 1.2m/s^2.

Vibration and Jerk

8.2.5 Vibration levels on any floor slab shall not exceed curve 1.4 as defined by BS6472: 1992 ‘Evaluation of Human Exposure to Vibration in Buildings’ (1Hz to 80Hz) [vii]. The rate of change of

Acceleration and deceleration rates should not exceed 2m/s^3. Jerk for low speed geared lifts should not exceed 3.5m/s^3.

In-carriage noise

8.2.6 When travelling at maximum velocity noise noise measured within the carriage should not exceed the following limits:

Lift speed	maximum level
• 2.5-2.0m/s	55dBA

8.2.7 Noise from the lift motor should be less than 75dBA at one metre.

Good Installation Practice

8.2.8 The lift motor must be mounted on elastomeric bearings with a natural frequency of less than 15Hz. The natural frequency on the isolators should not be to low so the lift carriage positioning is not affected.

8.2.9 Guide rails and the counter balance weights shall not be attached to the shaft walls which adjoin guestrooms. Guide rail brackets should not come into direct contact with the lift shaft walls but should be suitably fixed to the structural beams of the shaft. They should be fastened to the building at the edge of the floor slab. The floor slab edges are inherently stiffer than the shaft walls and will limit the transmission of the rail/guide interactions from generating structure borne noise in adjacent spaces. It is fundamental to ensure that the cars run smoothly up and down the rails.

8.2.10 Steel beams and supporting diverter sheaves and pulleys should be as stiff as possible and suitably isolated from the main structural building elements. Long span beams should be avoided and beams terminated as closely as possible to columns rather than other horizontal beams. The stiffness of the beam support should be at least 3 times greater than the stiffness of the beam.

8.3 Lift Lobby Noise

Lift Announcments

8.3.1 Noise from lifts should not exceed 35dB $L_{Aeq,T}$ or 50dB $L_{Amax,fast}$ (maximum noise events are usually ‘ping’ or voice announcement) when measured 1 metre from the door face and between 1.2m and 1.5m above floor level at any time during the lift cycle.

References

[i] The Building Regulations 2010: Approved Document E ‘Resistance to the Passage of Sound 2003’ amended 2004.

[ii] Section 25014.05 of the ’Hampton by Hilton - Brand Standards – Europe 2500’ (Effective January 1, 2018)

[iii] BS 8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’, 2014.

[iv] BS 4142:2014 ‘Methods for rating and assessing commercial sound’, 2014.

[v] Building Bulletin 93 ‘Acoustic Design of Schools’ 2015 (BB93).

[vi] *ISO 2631-2:2003 ‘Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 2: Vibration in Buildings (1Hz to 80Hz*

Appendix A: Building Acoustic Terms

Absorption

Conversion of sound energy to heat, often by the use of a porous material.

Absorption coefficient

A quantity characterizing the effectiveness of a sound absorbing surface. The proportion of sound energy absorbed is given as a number between zero (for a fully reflective surface) and one (for a fully absorptive surface). Note that sound absorption coefficients determined from laboratory measurements may have values slightly larger than one. See BS EN 20354:1993.

Absorptive material

Material that absorbs sound energy.

Airborne sound

Sound propagating through the air.

Airborne sound insulation

Airborne sound insulation is insulation that reduces the transmission of airborne sound (sound that propagates through air) between buildings or parts of buildings. Airborne sound insulation between two rooms is calculated from the difference between sound pressure levels in the source and receiving rooms, plus a factor taking into account the absorption in the receiving room. The most commonly used rating factor is the Standardized level difference, $D_{nT,w}$ – see below.

Decibel (dB)

The unit used for many acoustic quantities to indicate the level with respect to a reference level.

D_{nT}

The difference in sound level between a pair of rooms, in a stated frequency band, corrected for the reverberation time. See BS EN ISO 140-4:1998.

$D_{nT,w}$

A single-number quantity which characterizes the airborne sound insulation between rooms. See BS EN ISO 717-1:1997.

$D_{nT,w} + C_{tr}$

A single-number quantity which characterizes the airborne sound insulation between rooms using noise spectrum no. 2 as defined in BS EN ISO 717-1:1997. See BS EN ISO 717-1:1997.

C_{tr}

The correction to a sound insulation quantity (such as $D_{nT,w}$) to take account of a specific sound spectra. See BS EN ISO 717-1:1997.

Direct transmission

The process in which sound that is incident on one side of a building element is radiated by the other side.

Dynamic stiffness

A parameter used to describe the ability of a resilient material or wall tie to transmit vibration. Specimens with high dynamic stiffness (dynamically 'stiff') transmit more vibration than specimens with low dynamic stiffness (dynamically 'soft'). See BS EN 29052-1:1992 for resilient materials. See BRE Information Paper IP 3/01 for wall ties.

Flanking element

Any building element that contributes to sound transmission between rooms in a building that is not a separating floor or separating wall.

Flanking transmission

Sound transmitted between rooms via flanking elements instead of directly through separating elements or along any path other than the direct path.

Floating floor

A floating floor consists of a floating layer and resilient layer (see also resilient layer and floating layer).

Floating layer

A surface floor layer that rests on a resilient layer and is therefore isolated from the base floor and the surrounding walls (see also resilient layer).

Framed wall

A partition consisting of board or boards connected to both sides of a wood or metal frame.

Frequency

The number of pressure variations (or cycles) per second that gives a sound its distinctive tone. The unit of frequency is the Hertz (Hz).

Frequency band

A continuous range of frequencies between stated upper and lower limits, (see also octave band and one-third-octave band).

Hertz (Hz)

The unit of the frequency of a sound (formerly called cycles per second).

Impact sound

Sound resulting from direct impact on a building element.

Impact sound insulation

Sound insulation which reduces impact sound transmission from direct impacts such as footsteps on a building element.

Independent ceiling

A ceiling which is fixed independently of a separating floor or an internal floor (see separating floor and internal floor).

Internal floor

Any floor that is not a separating floor (see separating floor).

Intermediate landing

A landing between two floors (see also landing).

Internal wall

Any wall that does not have a separating function.

Isolation

The absence of rigid connections between two or more parts of a structure.

Landing

A platform or part of floor structure at the end of a flight of stairs or ramp.

L'_{nT}

The impact sound pressure level in a stated frequency band, corrected for the reverberation time. See BS EN ISO 140-7:1998.

$L'_{nT,w}$

A single-number quantity used to characterize the impact sound insulation of floors. See BS EN ISO 717-2:1997.

Noise

Noise is unwanted sound.

Octave band

A frequency band in which the upper limit of the band is twice the frequency of the lower limit.

One-third-octave band

A frequency band in which the upper limit of the band is $2^{1/3}$ times the frequency of the lower limit.

R_w

A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1:1997.

Resilient layer

A layer that isolates one element from another, reducing the vibration transmission between them. A resilient layer is used to provide a ‘floating’ floor so that there is some isolation between the floating floor and the base floor and surrounding walls.

Reverberation

The persistence of sound in a space after a sound source has been stopped.

Reverberation time

The time, in seconds, taken for the sound to decay by 60 dB after a sound source has been stopped. It is proportional to the room volume, and inversely proportional to the total absorption, and so can be estimated if the absorption coefficients of the main surfaces and features in the room are known.

Separating floor

A floor that separates flats or rooms for residential purposes.

Separating wall

A wall that separates adjoining dwelling-houses, flats or rooms for residential purposes.

Sound pressure level

A quantity related to the physical intensity of a sound.

Sound reduction index (*R*)

A quantity, measured in a laboratory, which characterizes the sound insulating properties of a material or building element in a stated frequency band. See BS EN ISO 140-3:1995.

Spectrum

The composition of a particular sound in terms of separate frequency bands.

Structure-borne sound

Sound which is carried via the structure of a building.

Surface mass

Mass per unit area, expressed in kilograms per metre squared (kg/m^2).

ΔL_w

The measured improvement of impact sound insulation resulting from the installation of a floor covering or floating floor on a test floor in a laboratory. See BS EN ISO 717-2:1997.

Appendix B: Sound Insulation Parameters

Brand Manual Targets

The brand manual states the following with respect to commissioning sound insulation tests:

1. *Sound insulation between vertically and horizontally adjacent spaces, including crosstalk via ductwork and service risers, must achieve the minimum levels of performance set out in Section 2514.05.N.*

2. *Performance targets are set as in-situ values for airborne and impact sound insulation. Sound insulation performance must be demonstrated to Hilton Worldwide by means of an agreed program of pre-completion testing.*

The brand manual accepts that the English R'_w sound insulation performance parameter can be considered the same as the American ASTC parameter in the extract below.

3. *Numerically, the sound insulation performance descriptors of weighted sound reduction (R_w R'_w) [1] and sound transmission class (STC, ASTC) [2] are generally equivalent. Within this document, therefore, the parameters are considered directly interchangeable.*

The R'_w performance target is not a typically used on-site test parameter. We have proposed on-site target criteria based on commonly used descriptors in the UK (i.e. $D_{nT,w}$, $D_{nT,w} + C_{tr}$) which can be considered equivalent to or better than that included in the HbH standards which will also enable Building Regulation requirements to be met. The R'_w performances have been considered interchangeable with $D_{nT,w}$ values

Internal Walls

Requirement E2 of ADE states that:

'Dwelling-houses, flats and rooms for residential purposes shall be designed in such a way that:

a) Internal walls between a guestroom or a room containing a water closet, and other rooms; and
b) Internal floors

provide reasonable resistance to sound.'

Requirement E2 does not apply to:

a) An internal wall that contains a door;
b) An internal wall which separates an en-suite toilet from the associated guestroom;
c) Existing walls and floors in a building which is subject to a material change of use.

Table 0.2 of ADE requires that internal walls should have a laboratory sound insulation performance of 40dB R_w or greater.

Specification of R_w Performance for Walls and Floors

For specification purposes, it is necessary to relate the on-site R'_w / $D_{nT,w}$ performances and requirements given in Tables 2.1 to 2.5 with laboratory rated sound insulation performances (R_w) typically quoted by UK system providers.

R'_w / $D_{nT,w}$ to R_w

For airborne sound insulation of light-weight wall or floor systems, it is considered good practice to allow for 7dB and 9dB depreciation (due to site constraints and flanking) between laboratory rated (R_w and $R_w + C_{tr}$) and on site measured (R'_w / $D_{nT,w}$ and $R'_w + C_{tr}$ / $D_{nT,w} + C_{tr}$) sound insulation performances. For masonry constructions, it is good practice to allow for 5dB depreciation.

Appendix C: Risk Management Schedule

Table C1: Assessment of risks with control measures.

Severity Classifications (S)	Probability Classifications (P)	Degree of Risk (R)
1. Minor – Minor accident, resulting in no serious injuries or lost time; little or no damage to property or the environment.	1. Improbable – no known instances of such an event occurring.	0 – 5 = Low Risk; ensure controls are adhered to and activity need not alter.
2. Moderate – Potential injury necessitating less than 3 days off work; damage to property or the environment requiring remedial work.	2. Remote – past experience suggests that event rarely occur.	6 – 10 = Moderate Risk; tolerable, but efforts should be made to reduce the risk where cost effective and reasonably practicable.
3. Serious – Accident reportable under RIDDOR 95; serious damage to property or the environment.	3. Possible – experience shows that events occur on occasions.	11 – 15 = Substantial Risk; all practicable measures must be taken to reduce the level of risk; tolerable only where further risk reduction is impracticable or disproportionate to the risk involved.
4. Major – Accident resulting in serious or permanent injury; major or permanent damage to property or the environment.	4. Probable – experience shows that events occur frequently.	16 – 25 = Extreme Risk; Unacceptable except in extraordinary circumstances; all control measures must be taken regardless of cost.
5. Catastrophic – Accident resulting in death or severe disablement; destruction of property; irreversible damage to the environment.	5. Likely – very likely to happen unless actively prevented.	>26. Works must be aborted and project need to be reviewed.

Table C1 (continued): Assessment of risks with control measures.

Activity	Hazard	Consequence	Degree of Risk			Risk Control Measures	Residual Risk			Risk Owner
			S	P	R		S	P	R	
Access to/ from site	Tripping or slipping hazards and falling objects.	Low risk	2	2	4	Take due care and attention to avoid tripping hazards. Do not work externally at height. Always sign in and out of site if required.	2	1	2	Contractor and consultant
Lifting or moving blockwork	injury through heavy load or improper lifting technique	Low risk	2	3	6	Blocks should be less than 20kg. Workers should wear gloves, steel toe cap boots and protective glasses. Workers must lift by bending their knees not their back. Make sure path is not obstructed by items being carried.	2	2	4	Contractor
Handling sheets of plasterboard	Injury through heavy load or improper lifting technique	Low risk	2	3	6	Plasterboard handled should be less than 20kg per sheet. Regardless of the mass several contractors may be needed to carry boards. Workers should wear gloves, steel toe cap boots and protective glasses. Workers must lift by bending their knees not their back. Make sure path is not obstructed by items being carried.	2	2	4	Contractor
Handling sheets of glass	Injury through heavy load/ improper lifting technique or laceration	Moderate	3	3	9	Detailed review of handling and positioning of glass to be done before installation by contractor. Glazing may need to be craned into position due to high mass. All glazed units must be clearly marked with tape/ marker to avoid people walking into the glass. Glazing must be handled with appropriate gloves only. Regardless of the weight, several contractors may be needed to carry units. Workers should wear gloves, steel toe cap boots and protective glasses. Workers must lift by bending their knees not their back. Make sure path is not obstructed by items being carried.	3	2	6	Contractor
Dust inhalation	Injury through being temporarily blinded of damage to lungs	Low risk	2	3	6	Only work in well ventilated space and wear appropriate PPE including dust mask. If cutting material make sure gloves are worn. Signage may be required to prevent other workers entering the space.	2	2	4	Contractor

Table C1 (continued): Assessment of Risks with Control Measures.

Activity	Hazard	Consequence	Degree of Risk			Risk Control Measures	Degree of Risk			Risk Owner
			S	P	R		S	P	R	
Hearing damage	Injury to hearing or consequence of verbal communication not being heard	Moderate	3	3	9	Review of construction or demolition methods and all workers exposed to high levels of noise to be provided with suitable hearing protection. In the case of sound insulation testing, suitable signage should be used to warn contractors of high noise risk to certain rooms.	3	2	6	Contractor. Contractor and acoustic consultant for sound insulation tests.

Table C1 (continued): Assessment of Risks with Control Measures.

Activity	Hazard	Consequence	Degree of Risk			Risk Control Measures	Degree of Risk			Risk Owner
			S	P	R		S	P	R	
Working at height	Injury or death through falling.	Substantial	4	3	12	Avoid working at height and only work at height where there is no other possible place of work at ground level. If it is impracticable to avoid working at height, do as much work as is practicable from the ground. In addition, you must seek to ensure that the distance from the ground is minimised as far as is practicable. Make sure that there is clear access to and from the area proposed to work and also that this area shall not become blocked. The area of work is well lit. Be fully aware of emergency evacuation and rescue procedures – which also relates to the point above. Wear suitable Personal Proactive Equipment (PPE) clothing e.g. high-visibility jacket, steel toe-cap boots and hard hat (important for protection from falling objects). Make sure you don't overload or overreach when working at height. Do not work with any loads in excess of 25kg; it may be safer for someone to pass you a load rather than you carry it up a ladder for example so that both arms can be used. Request the use of others (trained to work at height i.e. through uses of harnesses and installed fall protection systems etc.) through the site's main contractor, sub-contractor or his agent to assist if for example it is simply to install or remove noise or vibration monitoring kit. If no assistance can be given, as outlined in the bullet point above then only work at height if it safe to do so with checklist outlined below: There is a fall protection system in place (with guard rails at least 1.5 metres high) which has been recently inspected by the main contractor or sub-contractor. The working surface has been confirmed as a robust one (not fragile) by the main contractor or sub-contractor. If working on a ladder the ladder should be lashed/ secured to the high level area. The fixing should be confirmed as secure by the main contractor or sub-contractor.	4	2	8	Contractor