

REPORT REF: 21105R01PKmdw

ACOUSTIC CRITERIA REVIEW.

PROPOSED 157 BEDROOM HAMPTON BY HILTON – BATH ROAD,
HEATHROW



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1 Introduction

1.1 Scope of Work

- 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 This report outlines the findings following a review of the acoustic criteria of Hilton by Hilton Brand Standards – Europe 2500 effective January 2018ⁱ.
- 1.1.4 The report also identifies the criteria outlined in The Building Regulations 2010: Approved Document E 'Resistance to the Passage of Sound 2003' (amended 2004)ⁱⁱ.

2 Criteria

2.1 Hampton by Hilton Brand Standards

Internal Noise Levels

- 2.1.1 Internal ambient noise limits (with building services turned off) are presented in Tables 2.1 and 2.2 for residential and non-residential spaces.

Table 2.1: Section 25014.05.F2 External Noise Intrusion Limits (residential).

Room	Internal noise target
Guestroom (07:00 – 23:00 hrs)	40 dB $L_{Aeq,16h}$
(23:00 – 07:00 hrs)	35 dB $L_{Aeq,8h}$ / 45 dB $L_{Amax(fast)}$ *

* For hotels on or close to major international airports, maximum noise levels due to aircraft may be relaxed to 50 dB $L_{Amax,fast}$ subject to permission from Hilton.

Table 2.2: Section 25014.05.F2 External Noise Intrusion Limits (non-residential).

Space	Internal noise target [$L_{Aeq,5min}$ (dB)]
Work Zone	35
Offices	38
Fitness Room	40
Core Breakfast / Hub / Gathering / Living Space	43
WC/staff changing	45
Guest Corridors	47

- 2.1.2 Airborne and structure-borne noise from building services (including equipment rooms) must not exceed the values presented in Table 2.3.

Table 2.3: Section 25014.05.H.1 Building Services Noise Limits.

Room	Noise level target
Guestroom	NR30
Work Zone	NR35
Offices	NR35
BOH/service areas	NR40 - 45
Guestroom bathroom	
Fitness Room	
Core Breakfast / Hub / Gathering / Living Space	NR40
Guest Corridors	
Public WC's	
Staff WC's/changing	NR45

- 2.1.3 Noise within spaces during 'heavy'¹ rainfall on lightweight or glass roofs must be designed not to exceed the levels given in Table 2.4.

¹ Heavy rainfall is considered to be at least a rainfall rate of 40 mm per hour.

Table 2.4: Section 2514.05.M Rainfall Noise.

Room	Rainfall noise level target, [L _{eq,T} (dB)]
Guestroom, including bathroom	NR40

Reverberation

- 2.1.4 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 2.5.

Table 2.5: Section 25014.05.I.2 Control of Reverberation.

Room	Maximum Mid-frequency Reverberation time (seconds)
Work Zone	0.8
Gathering	1.5
Core Breakfast, Gathering, Hub	1.0

Sound Insulation

- 2.1.5 Airborne sound insulation requirements for walls and floors are given in Table 2.6. The rationale for recommended targets is given in Appendix B.

Table 2.6: Section 25014.05.N.1 Airborne Sound Insulation Performance

Partition	Minimum on-site airborne sound insulation target [D _{nT,w} (dB)]
Residential	
Guestroom - Guestroom	55
Guestroom – House Keeping	60
Non-Residential	
Break Room – Staff Change Walls containing doors	40
WC / Change Room – Fitness Room Fitness Room - Riser WC – Corridor (no door) / Stairwell Riser - Stairwell Food Prep - Gathering / Core Breakfast Stairwell – Core Breakfast / Hub Laundry – WC / Staff Change General Manager - Corridor (no door) Work Room - Hub General Manager – Tech / PC	45
Fitness Room – Work Zone Laundry – Corridor (no door)	50

- 2.1.6 Impact sound insulation requirements for separating floors are given in Table 2.7.

Table 2.7: Section 25014.05.N.2 Impact Sound Insulation Performance.

Partition	Maximum Impact sound insulation target [$L_{nT,w}$ (dB)]
Guestroom - Guestroom	50
Guestroom – Work Zone, Hub, Core Breakfast	55
Guestroom - Office	60

2.2 Planning Condition 07

2.2.1 Decision Notice for the planning application (ref: 43794/APP/2017/3704) issued by the London Borough of Hillingdon Council states the following:

‘Prior to the commencement of development, a sound insulation and ventilation scheme for protecting the proposed development from road and air traffic noise has been submitted to and approved in writing by the Local Planning Authority. The scheme shall meet acceptable internal noise design criteria. Thereafter, the scheme shall be implemented and maintained in full compliance with approved measures.

2.2.2 The Local Authority does not prescribe noise and vibration standards for hotel bedrooms according to paragraph 5.5 of its Supplementary Planning Document Noise Generating and Noise Sensitive Development document. We therefore consider the Brand Standard internal noise targets in Table 2.1 to be suitable to discharge the planning condition.

2.3 The Building Regulations

2.3.1 Bedrooms 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 2.8.

Table 2.8: 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	≥ 43	NA
Floors and stairs	≥ 45	≤ 62

Internal Walls

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

Guestroom to Corridor Doors

2.3.3 Guestroom to corridor doors should have a laboratory sound insulation performance of 29dB R_w or greater.

Reverberation in Common Parts

2.3.1 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.

- 2.3.2 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.



3 Airborne Sound Insulation Specification

3.1 Walls and Floors

3.1.1 To meet the on-site sound insulation targets in Tables 2.6 and 2.6, the following laboratory rated sound insulation performances are required as explained in Appendix B. Table 3.1 provides targets for light-weight constructions and Table 3.2 provides targets for masonry constructions.

Table 3.1: Required laboratory rated sound insulation performance of light-weight constructions.

Room Areas	Laboratory rated sound insulation performance [R_w / $R_w + C_{tr}$ (dB)]	
Residential	Brand (dB R_w)	ADE (dB $R_w + C_{tr}$)
Guestroom - Guestroom	≥62 (walls) ≥62 (floors)	≥52 (walls) ≥54 (floors)
Guestroom – House Keeping	≥67 (walls) ≥67 (floors)	≥52 (walls) ≥54 (floors)
Guestroom En-suite bathroom walls	≥45	≥40
Non-Residential	Brand (dB R_w)	
Fitness Room – Work Zone Laundry – Corridor (no door)	≥57	
WC / Change Room – Fitness Room Fitness Room - Riser WC – Corridor (no door) / Stairwell Riser - Stairwell Food Prep - Gathering / Core Breakfast Stairwell – Core Breakfast / Hub Laundry – WC / Staff Change General Manager - Corridor (no door) Work Room - Hub General Manager – Tech / PC	≥52	
Break Room – Staff Change Walls containing doors	≥47	



Table 3.2: Required laboratory airborne sound insulation performance of masonry constructions.

Room Areas	Laboratory rated sound insulation performance [R_w / $R_w + C_{tr}$ (dB)]	
Residential	Brand (dB R_w)	ADE (dB $R_w + C_{tr}$)
Guestroom - Guestroom	≥ 60 (walls) ≥ 60 (floors)	≥ 48 (walls) ≥ 50 (floors)
Guestroom – House Keeping	≥ 65 (walls) ≥ 65 (floors)	≥ 52 (walls) ≥ 54 (floors)
Guestroom En-suite bathroom walls	≥ 45	≥ 40
Non-Residential	Brand (dB R_w)	
Fitness Room – Work Zone Laundry – Corridor (no door)	≥ 55	
WC / Change Room – Fitness Room Fitness Room - Riser WC – Corridor (no door) / Stairwell Riser - Stairwell Food Prep - Gathering / Core Breakfast Stairwell – Core Breakfast / Hub Laundry – WC / Staff Change General Manager - Corridor (no door) Work Room - Hub General Manager – Tech / PC	≥ 50	
Break Room – Staff Change Walls containing doors	≥ 45	

3.2 Flanking Sound Insulation Performance

- 3.2.1 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.
- 3.2.2 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.

3.3 Doors

Guestroom Access Doors

- 3.3.1 Office doors should have a laboratory sound insulation performance of 29dB R_w or greater. For specification consistency it may be more practicable to specify 30dB R_w doors.

Office / Fitness Room Doors

- 3.3.2 Office doors should have a laboratory sound insulation performance of 30dB R_w or greater.

-
- 3.3.3 The Fitness Room door should have a laboratory sound insulation performance of 35dB R_w or greater.

Riser Doors

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

4 Services Plant Noise

4.1 Plant Noise Impact - Planning

- 4.1.1 Services plant noise should be suitably controlled to minimise the potential for complaint. The acoustic report done by others² to inform the planning application has provided limiting plant noise levels based on a review of the existing background noise levels at the site, see Table 4.1.

Table 4.1: Plant noise limits at NSRs.

Period	Lowest background noise level [LA90,15min (dB)]	Limiting plant noise level [LAeq,T (dB)] at 1m from NSR (free-field)
Daytime (07.00 – 23.00)	52	42
Night-time (23.00 – 07.00)	45	35

- 4.1.2 The nearest noise sensitive receptor is taken to be Axis House apartments approximately 14 metres to the east of the site.
- 4.1.3 A detailed plant noise impact assessment will need to be done when plant details, plant noise data and layouts are available.

4.2 Roof-top Plant Vibration Isolation

- 4.2.1 Roof-top plant shall have suitable isolation to achieve 95% isolation at frequencies of concern.

4.3 Vibration to Bedrooms

- 4.3.1 Vibration from the operation of plant shall be at a level that will not disturb those within Guestrooms. The Brand Standards state the following:

To satisfy the above requirements, vibration in Guestrooms from all sources shall be below 0.05m/s² (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)'ⁱⁱⁱ.

- 4.3.2 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.

² Report ref: 103350.ph.Issue3 by Acoustics Plus dated 10.07.2018.

5 Lift Noise

5.1 Overview

- 5.1.1 Noise from the operation of lifts shall be at a level that will not disturb those within bedrooms. To achieve this, the following lift specification is recommended. Please refer to section 4.3 and our recommendations below:

5.2 Lift Noise in Corridors.

- 5.2.1 Noise from lifts should not exceed 35dB $L_{Aeq,T}$ or 55dB $L_{Amax,fast}$ (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.

5.3 Acceleration/ deceleration

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

5.4 Vibration and Jerk

- 5.4.1 Vibration levels on the 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)^{iv}. The rate of change of Acceleration and deceleration rates should not exceed $2m/s^3$. Jerk for low speed geared lifts should not exceed $3.5m/s^3$.

5.5 In-carriage noise

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

	Lift speed	Maximum ambient noise level
•	2.5-2.0m/s	55dB $L_{Aeq,T}$

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

5.6 Good Installation Practice

- 5.6.1 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.
- 5.6.2 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.

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/m²).

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.

References

- ⁱ Section 25014.05 of the 'Hampton by Hilton - Brand Standards – Europe 2500' (Effective January 1, 2018)
- ⁱⁱ The Building Regulations 2010: Approved Document E 'Resistance to the Passage of Sound 2003' (amended 2004).
- ⁱⁱⁱ *ISO 2631-2:2003 'Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 2: Vibration in Buildings (1Hz to 80Hz*
- ^{iv} BS6472-1 'Guide to evaluation of human exposure to vibration in buildings'. Part 1: Vibration sources other than blasting, 1992.