



**Armstrong House
3 Bassett Avenue
Southampton
SO16 7DP**

T: 02381 555000

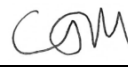
**2 HEXHAM ROAD
READING**

STAGE 4 ACOUSTIC DESIGN REVIEW

Technical Report: R9933-1 Rev 0
(HEX-24A-10-1XX-T-OJ-0001)
Date: 22nd April 2024

For: Morgan Sindall Construction & Infrastructure Ltd
Aquasulis
10-14 Bath Road
Slough, SL1 3SA

24 Acoustics Document Control Sheet**Project Title:** 2 Hexham Road, Reading – Stage 4 Acoustic Design Review**Report Ref:** R9933-1 Rev 0**Date:** 22nd April 2024

	Name	Position	Signature	Date
Prepared by	Neil McLeod BA (Hons) MIOA	Senior Consultant		22/04/2024
Reviewed by	Chris McConnell BSc MSc MIOA	Senior Consultant		22/04/2024
Approved by	Stephen Gosling BEng MIOA	Principal Consultant		22/04/2024
For and on behalf of 24 Acoustics Ltd				

Document Status and Approval Schedule

Revision	Description	Prepared By	Reviewed By	Approved By
0	Approved for issue	Neil McLeod	Chris McConnell	Stephen Gosling

DISCLAIMER

This report was completed by 24 Acoustics Ltd on the basis of a defined programme of work and terms and conditions agreed with the Client. The report has been prepared with all reasonable skill, care and diligence within the terms of the Contract with the Client and taking into account the project objectives, the agreed scope of works, prevailing site conditions and the degree of resources allocated to the project.

24 Acoustics Ltd accepts no responsibility whatsoever, following the issue of the report, for any matters arising outside the agreed scope of the works.

This report is issued in confidence to the Client and 24 Acoustics Ltd has no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

Unless specifically assigned or transferred within the terms of the agreement, 24 Acoustics Ltd retains all copyright and other intellectual property rights, on and over the report and its contents.

© 24 Acoustics Ltd 2024

CONTENTS

1.0	INTRODUCTION	4
2.0	BUILDING REGULATIONS AND COUNCIL REQUIREMENTS	4
3.0	ACOUSTIC PERFORMANCE REQUIREMENTS	8
4.0	DESIGN REVIEW - WALLS	12
5.0	DESIGN REVIEW - FLOORS	16
6.0	DESIGN REVIEW – CONTROL OF REVERBERATION	18
7.0	FURTHER GUIDANCE	19
8.0	GLAZING AND VENTILATION TO RESIDENTIAL AREAS	22
9.0	ACOUSTIC COMMISSIONING TESTS	23
	REFERENCES	24
	APPENDIX A: ACOUSTIC TERMINOLOGY	25
	APPENDIX B: SOUND INSULATION REQUIREMENTS	27

1.0 INTRODUCTION

- 1.1 A new residential development and day care centre is proposed at 2 Hexham Road, Reading. 24 Acoustics Ltd has been instructed by Morgan Sindall, to assist with the acoustic performance of the design from Stage 4 onwards.
- 1.2 The development will comprise a four-storey building, with a day centre on the ground floor providing social care services and specialist housing on all floors.
- 1.3 24 Acoustics produced the development's acoustic performance specification (report reference R8987-3 Rev 0) on behalf of Mace and Hampshire County Council. Ambient noise surveys were undertaken on site by 24 Acoustics in April and May 2021, with the results and findings presented in technical report R8987-2 Rev 2.
- 1.4 All recommendations apply to the acoustic design of the new buildings and compliance with other requirements (e.g. fire/structural) should be checked by other members of the design team.
- 1.5 An explanation of acoustical terms used in this report is provided in Appendix A.

2.0 BUILDING REGULATIONS AND COUNCIL REQUIREMENTS

Requirements of the Building Regulations – Approved Document E

- 2.1 Requirement E1 of Approved Document E "Resistance to the Passage of Sound" 2003 [Reference 1] requires that compliance with the Approved Document be demonstrated by Pre-Completion Testing. The requirements for new build residential properties are reproduced in Table 1 below.

Interface	Airborne Sound Insulation $D_{nT,w} + C_{tr}$ (minimum values)	Impact Sound Transmission $L'_{nT,w}$ (maximum value)
Walls	45 dB	-
Floors and Stairs	45 dB	62 dB

Table 1 - Required Values to Achieve Building Regulations – New Build Properties

- 2.1 Requirement E2 of Approved Document E requires internal walls and floors not forming party interfaces to provide a minimum laboratory sound insulation value of 40 dB R_w. This requirement is applicable to all internal floors and to internal walls between a bedroom or a room containing a WC, and other rooms. Requirement E2 does not apply to internal walls which contain a door.
- 2.2 Requirement E3 of Approved Document E sets out the requirement to control reverberation in common parts of residential buildings, which applies to corridors, hallways, stairwells and entrance halls that provide direct access to apartments.

Reading Borough Council – Employers Requirements

- 2.3 Reading Borough Council's standard Employer's Requirements (Version 3 2019) [Reference 2] state the following in relation to acoustics:

Noise Abatement

B40.080 Where significant external noise sources are likely to cause disturbance a sound survey shall be carried out by a specialist and recommendations incorporated.

B40.081 Care must be given to the siting of rooms to minimise interference from noise:

1 Like rooms within flats should be stacked.

2 Hanging of dwelling plane should be considered to minimise shared walls and floors.

Sound Testing

B40.085 Pre-completion sound testing based on 'Normal programme of testing', described in Building Regulations Approved Document 'E' (2010 edition with 2015 Amendments), shall be carried out by a UKAS (or a European equivalent) accredited acoustic consultant paid for by the Constructor to achieve the following related to the Approved Document E:

1. Minimum airborne sound insulation values that are at least 3dB higher for houses and 5dB higher for flats and impact sound insulation that are at least 3dB lower for houses and 5dB lower for flats than the Performance Standard in the Approved Document.

B40.086 In the event that testing to the required standard is carried out and the tests fail then the Constructor shall, at his own cost, take remedial action and obtain re-tests until the required level is met.

Draft Planning Conditions (Planning Reference 230279)

2.4 Draft planning condition 14 states:

"No mechanical plant shall be installed until a noise assessment of the proposed mechanical plant has been submitted and approved by the Local Planning Authority. The assessment shall be carried out for in accordance with BS4142:2014+A1:2019 methodology. The predicted specific sound level ($L_{Aeq,TR}$) (with reference to BS:4142) as measured at a point 1 metre external to the nearest noise-sensitive facade shall be at least 10dB below the pre-existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation. The predicted rating level, $L_{Ar,Tf}$ (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to the nearest noise-sensitive façade (habitable window of a dwelling) shall not exceed the pre-existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation. The plant shall thereafter only be installed in accordance with the assessment and shall thereafter be maintained so that it operates to the same standard.

REASON: To safeguard the amenities of the adjoining premises and the area generally, in accordance with Policy CC8 and EN17 of the Reading Borough Local Plan 2019."

2.5 A request for the council to amend this condition was prepared by 24 Acoustics in July 2023. The measured background sound levels at night are low and a specific sound level of 25 dB $L_{Aeq, 15 \text{ min}}$ (5 dB below the background sound level) was recommended for plant operating during the night time (between 23:00 and 07:00 hours). This request is not reflected in the draft condition.

2.6 Draft condition 12 refers to glazing and ventilation, stating:

"The glazing, ventilation and any other mitigation specified shall be installed in accordance with the specifications recommended within the Noise Assessment submitted with the application [24 Acoustics, 9 Feb 23, R8987-2 Rev 2].

REASON: In order to protect the amenity of future occupants of the proposed development in accordance with Policy CC8 of the Reading Borough Local Plan 2019."

- 2.2 Draft condition 13 requires enhanced sound insulation between residential and non-residential spaces:

"No development shall commence on site until a detailed scheme for protecting the dwellings from noise emissions from the commercial use hereby approved and informed by an assessment of the likely noise emissions from the approved commercial use, has been submitted to and approved in writing by the Local Planning Authority. The scheme itself shall be designed, specified and constructed so that the sound insulation performance of the separating floor/ceiling between the uses achieves a minimum airborne sound insulation performance of greater than or equal to 55 dB (Dntw +Ctr) and ensures that the noise levels within the property do not exceed the values specified in BS8233:2014 with appropriate penalties and adjustments for the character of the noise. The scheme shall make suitable provision for insulation from structure borne noise.

Thereafter, the development shall not be carried out other than fully in accordance with the approved scheme which shall be completed before any part of the accommodation hereby approved is first occupied and shall be retained and maintained as such at all times thereafter.

REASON: In order to safeguard the amenity of occupiers of the residential accommodation in accordance with Policies CC8 and EN16 of the Reading Borough Local Plan 2019."

3.0 ACOUSTIC PERFORMANCE REQUIREMENTS

- 3.1 The acoustic criteria set out in the following sections were established at Stage 3 design and are replicated here for clarity.

Sound Insulation Performance Requirements – Walls and Floors

- 3.2 The airborne and impact sound insulation requirements for party walls and party floors are summarised in Table 2 and in Appendix B.

Interface	Airborne Sound Insulation $D_{nT,w} + C_{tr}$ (minimum values)	Impact Sound Transmission $L'_{nT,w}$ (maximum value)
Walls Between Flats Between Flats and Lifts / Stairs	50 dB	N/A
Walls Between Flats and Common Corridors	45 dB	N/A
Floors Between Flats	50 dB	57 dB
Floors / Walls Between Day Care Centre / Plant Rooms and Flats	55 dB	57 dB

Table 2 - Airborne and Impact Sound Insulation Requirements – Party Interfaces

- 3.3 Sound insulation requirements for the ground floor partitions within the day care centre have been derived based on relevant guidance (e.g. BB 93 and BS 8233: 2014). Appendix B shows the sound insulation requirements for the day care centre walls.
- 3.4 Achieving the required sound insulation performances will depend on careful workmanship and attention to detail. Any service penetrations must be well sealed and flanking transmission must be carefully considered during design and construction.

Sound Insulation Performance Requirements – Doors and Screens

- 3.5 Access doors to all apartments should comply with the Building Regulations requirements by achieving a good perimeter seal (including the threshold where practical) and a minimum mass per unit area of 25 kg/m²; or by achieving a minimum sound reduction index of 29 dB R_w.
- 3.6 Within the day care centre and assisted living support areas, the internal entrance door to the Quiet Room shall either be a 29 dB R_w rated door or a 44mm solid fire door (to appropriate fire rating) with batwing acoustic seals to the head and jambs. There are no acoustic requirements for other doors within the day care centre.
- 3.7 Internal glazed screens or vision panels separating a corridor from an occupied room shall be specified to achieve a minimum lab rating of 33 dB R_w.

Internal Ambient Noise Levels

- 3.8 The indoor ambient noise level criteria for the residential scheme are summarised in Table 3 below, along with criteria for internal noise levels from mechanical services.

Room	Internal Noise Level from external sources	Noise Level from Mechanical Services (dB L _{eq})
Living Room	≤ 35 dB L _{Aeq,16 hour} day (07:00-23:00)	≤ NR 30
Bedroom	≤ 35 dB L _{Aeq,16 hour} day (07:00-23:00) ≤ 30 dB L _{Aeq,16 hour} night (23:00-07:00) And ≤ 45 dB L _{Amax, f} night (23:00-07:00) for regular events *	≤ NR 25

Table 3 - Criteria for Internal Ambient Noise Levels – Residential Flats

*No more than 10 exceedances of 45 dB L_{Amax, f} per night

- 3.9 Upper limits for internal ambient noise levels within the ground floor day care centre are given in Table 4 below, alongside criteria for internal noise levels from mechanical services.

Room	Internal Noise Level (dB L _{Aeq} , 30 mins)	Noise Level from Mechanical Services (dB L _{eq})
Admin	≤ 40	NR 30 to 35
Medical		
Art / Multi-Function		
Life Skills		
Reception		
Office		
Meeting		
Sensory Room	≤ 35	NR 25 to 30
Quiet Room		
Circulation / Lobby	≤ 45	NR 35 to 40
WCs	≤ 50	NR 40 to 45
Changing Place		

Table 4 - Criteria for Internal Ambient Noise Levels – Day Care Centre

- 3.10 The façade of the care centre does not require specific acoustic specifications to achieve the internal noise criteria.
- 3.11 Noise from mechanical systems serving the residential apartments and day care centre shall be specified, design and installed to achieve the relevant criteria set out in Tables 3 and 4, which are cumulative and apply when all systems are operating at design duty. The limits apply to noise from plant that is not tonal, intermittent or otherwise distinctive in character and the mechanical services must be designed to avoid such characteristics. Noise levels from mechanical ventilation systems should be determined at 1.5m from the grille in completed rooms.
- 3.12 Noise levels from mechanical services systems not serving the room shall not exceed a level 10 dB lower than those in Tables 3 and 4.
- 3.13 Noise arising from lifts and associated equipment should not exceed a maximum noise level of 35 dB L_{Amax, fast} within any residential dwelling, during any part of the lift cycle. Noise from lift operation should not exceed 55 dB L_{Amax, fast} within the lift lobby, during any part of the cycle including announcements.
- 3.14 Vibration arising from building services, including from lifts and associated equipment, shall not exceed Wb 0.01 m/s² peak acceleration, within any residential dwelling or within the day care centre and assisted living support areas.

Reverberation Time

- 3.15 Reverberation time criteria are expressed in terms of the mid-frequency T_{mf} which is the average of the reverberation times at 500 Hz, 1 kHz and 2 kHz single octave bands. The values provided are representative of the reverberation times expected when the room is finished, furnished for normal use and unoccupied.
- 3.16 The required mid-frequency reverberation times for each of the new spaces within the ground floor day care centre are given in Table 5.

Room	Reverberation Time (T_{mf} , seconds)
Sensory Room	≤ 0.6
Quiet Room	
Reception	≤ 0.8
Office	
Meeting Room	
Medical Room	
Life Skills	
Art / Multi-Functional (up to 61 m ²)	
Large Multi-Functional (95 m ²)	≤ 1.0

Table 5 - Reverberation Time Criteria - Day Care Centre

- 3.17 Reverberation in circulation spaces shall also comply with the requirements of Approved Document E. Absorption shall be provided in line with either calculation method A or method B in Section 7 of Approved Document E. This requirement is applicable to the following areas:
- All corridors / lobbies that provide direct access to apartments.
 - All circulation spaces within the day care centre.
- 3.18 For corridors / lobbies that provide direct access to apartments, the most straightforward means of compliance is to specify a Class C (or better) absorptive ceiling throughout, in accordance with Method A from Section 7 of Approved Document E.

External Plant Noise

- 3.19 External Noise levels from all new plant associated with the development should be assessed in accordance with British Standard BS 4142: 2014 [Reference 4].

- 3.20 Reading Borough Council's typical requirements are for noise from plant to be 10 dB below the background noise level at the nearest noise sensitive receptor, and this has been included as a planning condition (draft condition 14).
- 3.21 In addition, noise from the new plant shall not exceed a level of 3 dB below the existing background noise levels outside residential windows of the new development, subject to agreement with the local planning authority.
- 3.22 The design and select of the plant shall include noise attenuation measures, to be fully developed during detailed design, in order to achieve the required external noise levels. All building services plant shall be designed to avoid tonal, impulsive or other distinctive characteristics. If any such characteristics are present then a suitable correction is applicable, in accordance with BS 4142:2014.
- 3.23 All plant must be appropriately isolated from the structure (i.e. using appropriately specified anti-vibration mounts) to prevent the transmission of structure borne noise into other areas of the building.

4.0 DESIGN REVIEW - WALLS

Apartment Party Walls

- 4.1 The majority of party walls will be generally formed of the following minimum construction:

Wall type PT01

- Two layers 15mm British Gypsum Soundbloc
 - Gypframe 60 c-stud framework cross-braced at 3600mm centres
 - 100mm Isover APR 1200 mineral wool to cavity
 - Gypframe 60 c-stud framework cross-braced at 3600mm centres
 - Two layers 15mm British Gypsum Soundbloc
- Studwork spaced to form a minimum overall partition width of 300mm

- 4.2 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement ($\geq 50 \text{ dB } D_{nT,w} + C_{tr}$) and is acceptable.

Apartment Corridor Walls

- 4.3 Party walls to corridors will be formed of the following minimum construction:

Wall type PT02

- Two layers 15mm British Gypsum Soundbloc
- Gypframe 48 C-stud framework cross-braced at 3600mm centres
- 25mm Isover APR 1200 mineral wool to cavity
- Gypframe 48 C-stud framework cross-braced at 3600mm centres
- Two layers 15mm British Gypsum Soundbloc

Studwork spaced to form a minimum overall partition width of 300mm

- 4.4 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement ($\geq 45 \text{ dB } D_{nT,w} + C_{tr}$) and is acceptable.

Plant Room, Electrical Switch Room and Care Centre Party Walls

- 4.5 The party walls separating apartments from the ground floor plant room and electrical switch room; and separating the day care centre from all residential areas, will be formed of the following minimum construction:

Wall type PT03

- Two layers 15mm British Gypsum Soundbloc
- Gypframe 60 C-stud framework cross-braced at 3600mm centres
- 200mm Isover APR 1200 mineral wool to cavity
- Gypframe 60 C-stud framework cross-braced at 3600mm centres
- Two layers 15mm British Gypsum Soundbloc

Studwork spaced to form a minimum overall partition width of 550mm

- 4.6 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement ($\geq 55 \text{ dB } D_{nT,w} + C_{tr}$) and is acceptable.

Day care Corridor Walls and Residential Internal Walls

- 4.7 Corridor walls within the day care centre and walls within apartments will be formed of the following minimum construction:

Wall type PT04

- Single layer 12.5mm British Gypsum Soundbloc
- Gypframe 70 C-stud framework
- 50mm Isover APR 1200 mineral wool to cavity
- Single layer 12.5mm British Gypsum Soundbloc

- 4.8 The above construction achieves the required sound insulation performance (≥ 40 dB R_w) and is acceptable.

Day Care Separating Walls

- 4.9 The walls separating rooms within the day care centre will be formed of the following minimum construction:

Wall type PT05

- Single layer 12.5mm British Gypsum Soundbloc
- Gypframe 70 c-stud framework
- 50mm Isover APR 1200 mineral wool to cavity
- Single layer 12.5mm British Gypsum Soundbloc

- 4.10 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement (≥ 40 dB $D_{nT,w}$) and is acceptable.

Riser Party Walls (first floor and higher)

- 4.11 The party walls separating apartments from risers will be formed of the following minimum construction:

Wall type pt09

- Two layers 15mm British Gypsum Soundbloc
 - Gypframe 60 I-stud framework with no bracing
 - 100mm Isover APR 1200 mineral wool to cavity
 - Gypframe 60 I-stud framework with no bracing
 - Two layers 15mm British Gypsum Soundbloc
- Studwork spaced to form a minimum overall width of 250mm

- 4.12 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement ($\geq 50 \text{ dB } D_{nT,w} + C_{tr}$) and is acceptable.

Lift Shaft to Apartments

- 4.13 The lift shaft will comprise minimum 200mm concrete core ($\geq 2200 \text{ kg/m}^3$) and shall be lined with the following minimum construction:

- Minimum 200mm concrete core
- Minimum 10mm gap to ensure no contact
- Minimum 48mm metal stud
- Minimum 50mm mineral wool between studs
- Two layers 12.5mm standard density plasterboard

- 4.14 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement ($\geq 50 \text{ dB } D_{nT,w} + C_{tr}$) and acceptable in limiting disturbance from noise transfer via stair core and lift shaft areas.

Store Rooms

- 4.15 Walls to the following rooms do not adjoin sensitive spaces and will comprise either 140mm or 190mm single-skin medium density blockwork, which is acceptable:

- ASHP
- Bin store
- Substation
- Refuse store
- Scooter store

5.0 DESIGN REVIEW - FLOORS

Apartment Party Floors

5.1 The party floor construction between residential apartments will comprise a screed on a reinforced concrete slab:

- Floor finish (varies)
- 70mm concrete screed
- 70mm rigid thermal insulation
- Minimum 5mm resilient layer (minimum 18 dB ΔL_w)
- Minimum 225mm reinforced concrete slab (minimum 2200 kg/m³)
- Minimum 150mm cavity with minimum 50mm mineral wool (density of 10 kg/m³ or greater)
- Single layer 15mm British Gypsum Wallboard on standard metal frame

5.2 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirements (≥ 50 dB $D_{nT,w} + C_{tr}$ and ≤ 57 dB $L'_{nT,w}$) and is acceptable.

Party Floor to Day Care Centre

5.3 The party floor construction between residential apartments and the day care centre will also comprise a screed on a reinforced concrete slab:

- Floor finish (varies)
- 70mm concrete screed
- 70mm rigid thermal insulation
- Minimum 5mm resilient layer (minimum 18 dB ΔL_w)
- Minimum 225mm reinforced concrete slab (minimum 2200 kg/m³)
- Minimum 150mm cavity with minimum 50mm mineral wool (density of 10 kg/m³ or greater)
- Ceiling varies (see Section 6):
 - Mineral fibre ceiling tile
 - Metal Plank Accessible Ceiling
 - Single layer 15mm British Gypsum Wallboard on standard metal frame

5.4 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement (≥ 55 dB $D_{nT,w} + C_{tr}$) and is acceptable.

Party Floor to Plant room and Laundry

5.5 Please ensure that the plant room and laundry are fitted with plasterboard ceilings to form the following minimum construction:

- Floor finish (varies)
- 70mm concrete screed
- 70mm rigid thermal insulation
- Minimum 5mm resilient layer (minimum 18 dB ΔL_w)
- Minimum 225mm reinforced concrete slab (minimum 2200 kg/m³)
- Minimum 150mm cavity with minimum 50mm mineral wool (density of 10 kg/m³ or greater)
- Single layer 15mm British Gypsum Wallboard on standard metal frame

5.6 With a high degree of workmanship and detailing, the above construction would be expected to achieve the project sound insulation requirement (≥ 55 dB $D_{nT,w} + C_{tr}$).

Terraces and External Walkways

5.7 The building is set back at upper levels, forming terraces and external walkways above the day care centre and apartments. It is recommended that a resilient layer (e.g. 12.5mm Sylomer SR11 or similar) be installed between the pedestal and thermal insulation on the terrace.

5.8 This provision is to control impact sound transmission, in line with the requirements of Approved Document E.

6.0 DESIGN REVIEW – CONTROL OF REVERBERATION

- 6.1 With reference to the preliminary Stage 4 ceiling plans, the required areas of acoustic absorption in the day care centre are described in Table 6.

Room	Minimum Requirements for Absorption (per room)
Sensory Room (1.15)	Carpet as shown and <u>additional 18m² Class A absorption</u>
Sensory Dark Room (1.25)	<u>additional 23m² Class A absorption</u>
Quiet Room (1.8)	Carpet as shown and <u>additional 5m² Class A absorption</u>
Reception	Carpet as shown and <u>additional 6m² Class A absorption</u>
Office (1.7)	Carpet as shown and <u>additional 3m² Class A absorption</u>
Meeting Room (1.24)	Carpet as shown and <u>additional 6m² Class A absorption</u>
Medical Room	<u>additional 3m² Class A absorption</u>
Life Skills (1.19)	28.8 m ² Class A ceiling tile as shown
Multi-Functional (1.31)	28.2 m ² Class A ceiling tile as shown
Multi-Functional (1.10)	20.2 m ² Class A ceiling tile as shown
Multi-Functional (1.22)	51.8 m ² Class A ceiling tile as shown
Art and Multi Functional (1.23)	30.2 m ² Class A ceiling tile as shown

Table 6 - Acoustic Absorption Requirements

- 6.2 Class A ceiling tiles include the majority of mineral fibre tiles available from Ecophon, SAS, Armstrong and Rockfon. Alternative solutions (eg, wall panels, rafts) are available and 24 Acoustics would be pleased to review any such solutions.
- 6.3 Circulation spaces within the day care centre and common corridors leading to apartments are shown to have a metal plank accessible ceiling to approximately 70% of the ceiling area. Please ensure that the metal plank ceiling is specified to achieve absorption Class A, to comply with the project acoustic requirements.

7.0 FURTHER GUIDANCE

Workmanship

- 7.1 The on-site sound insulation performance of a wall or floor construction can be significantly (ie, in excess of 5 dB) lower than that measured within a purpose-built testing facility. This is often due to the presence of flanking sound transmission – ie, sound travelling between spaces via structures other than the party wall or floor. Flanking sound transmission represents an important design consideration for developments where high levels of sound insulation are required. Flanking sound transmission is commonly reduced via the use of elements such as independent wall linings, floating floors and suspended ceilings.
- 7.2 Quality of workmanship is a critical factor that can significantly influence the level of sound insulation performance achieved in a completed development. Even minor deviations from the specification, such as failing to completely isolate the perimeter of a floating floor from surrounding walls, can severely reduce performance. Under normal site conditions, the acoustic performance of a sample of identically constructed walls or floors will also follow a distribution, albeit skewed to the low side of the mean value. In real terms these factors make it imperative to design party walls and floors with an inherent safety margin; typically 3 to 5 dB above the stated performance specification.
- 7.3 The success of the constructions is heavily reliant on workmanship and detailing, hence it is recommended to instruct the site foreman to undertake daily inspections to ensure that the details are being built as planned.

Public Health Systems

- 7.4 Any soil vent pipes or other services passing through dwellings should be enclosed with the following minimum construction, or similar:
- Minimum 2 layers 12.5mm standard density plasterboard
 - Minimum 48mm metal stud
 - Minimum 25mm mineral wool (10 kg/m³) in the cavity
- 7.5 The above construction is also required where soil vent pipes or rainwater pipes pass through apartments to the day care centre.
- 7.6 Horizontal offsets and services passing directly through the party wall and floor constructions should be avoided as far as practicable.

- 7.7 It is assumed that, in most instances, soil vent pipes and other services will be able to transfer within the screed depth to dedicated risers. Where this is unavoidable, details should be issued to 24 Acoustics for review.
- 7.8 The detailing around any steelwork or concrete columns will require careful consideration, so as to not compromise the overall sound insulation performance. Please forward typical details to 24 Acoustics for review.

Building Services

- 7.9 No items of plant should be fixed to party walls and all plant and associated duct/pipework must be installed correctly on suitable anti-vibration mounts, as specified by the supplier/manufacturer. Resilient pipe/duct connections (bellows) shall be installed to all systems.
- 7.10 Through-wall fans can be difficult to isolate from the structure and attenuate so care should be taken when selecting and installing any units that are in close proximity to habitable rooms. Where there is a risk of disturbance, consideration should be given to passive louvred openings or relocating the fans.
- 7.11 Where possible, fans should not be installed in risers/shafts that share a party wall with a dwelling and should always be fitted with both atmospheric and roomside attenuation, as required.
- 7.12 Please issue details of the general services plant and plant room equipment (including electrical and water tank) in order that consideration may be given to the required sound insulation performance and external noise levels.

Flanking Constructions

7.13 The strip sections describe the typical external wall construction as brickwork with SFS. Subject to a review of all party wall and floor junction details, please ensure the following enhanced external wall construction is provided.

- 102.5mm facing brickwork
- 50mm clear cavity
- Breather membrane
- 225mm Mineral Fibre
- 100mm SFS (built slab to slab)
- Minimum 50mm mineral wool in the cavity
- Two layers 12.5mm British Gypsum Wallboard

7.14 This enhanced external wall construction is required in order to achieve the party wall and floor sound insulation requirements of 50 dB $D_{nT,w} + C_{tr}$ and 55 dB $D_{nT,w} + C_{tr}$.

Detailing of Junctions

7.15 Achieving the target site sound insulation performance will depend on careful workmanship and attention to detail. All partitions must be built full-height to the underside of the soffit/roof structure and flanking transmission must be carefully considered with typical junction details issued to 24 Acoustics for review.

7.16 Please also note the following comments during detailed design and construction:

- Details of any curtain walling or other glazing/structural systems that extend past the party walls or party floors should be issued to 24 Acoustics for review
- It is critical to ensure that floating screed layers do not make physical contact with the adjacent walls or skirting. The manufacturer's specific details should be followed, including the use of flanking strips around the full perimeter of the room
- Wherever mineral wool has been specified above, this is not interchangeable with extruded thermal insulation (eg, Celotex) or expanded foam
- Party walls should run from slab to slab with all joints sealed with flexible, non-hardening sealant
- All plasterboard joints in party walls and flanking details should be sealed with flexible, non-hardening sealant
- The manufacturers of each element should be contacted to confirm the proposed use of the product is acceptable and the manufacturers' installation guidelines should be followed

- Piped services, sockets and switches etc. located in plasterboard party walls should be staggered so they are not in opposite bays and boxed in (putty pads may be employed for sockets and switches) in order to control sound transmission

8.0 GLAZING AND VENTILATION TO RESIDENTIAL AREAS

- 8.1 In line with 24 Acoustics' noise assessment (report reference R8987-2 Rev 2) the non-glazed elements of the external wall described in Section 7 will achieve a minimum sound insulation performance of 52 dB R_w .
- 8.2 Background ventilation is to be provided to all habitable rooms within each plot by a local combined mechanical ventilation and heat pump system which will provide supply and extract ventilation plus heating and cooling. Inlet and exhaust louvres will be installed on the façades of each plot. As validated by others, this ventilation and cooling system will enable the overheating requirements of Approved Document O to be achieved without opening windows.
- 8.3 The minimum glazing specifications for all living rooms and bedrooms in the development are described in Table 7.

Minimum Octave (Hz) Band Sound Reduction Index, dB					
125	250	500	1k	2k	4k
24	20	25	35	38	35

Table 7 - Glazing Sound Insulation Specification (all living rooms and bedrooms)

- 8.4 In making a comparison with the values in Table 7, it is important that the glazing figures used are the result of tests in accordance with ISO 10140, Part 2: 2010. The quoted minimum sound reduction specifications must be achieved by the entire glazing system as a whole, including frames, seals, any insulated panels and not just the glass. The requirements also apply to any external doors to habitable rooms.
- 8.5 For guidance, a standard double-glazing configuration (Minimum 31 dB R_w) would be capable of achieving the required sound reduction performance if installed properly (i.e. with appropriate frames and seals, etc.), e.g. 4 mm glass / 12 mm cavity (minimum) / 4 mm glass.
- 8.6 With the proposed mitigation measures as detailed above, the project requirements for internal noise levels can be achieved in apartments.

- 8.7 The mechanical ventilation and heat pump systems shall be specified, designed and installed to not exceed internal noise levels of NR 30 in living rooms and NR 25 in bedrooms.

9.0 ACOUSTIC COMMISSIONING TESTS

- 9.1 In accordance with the acoustic performance specification report, acoustic commissioning testing shall be undertaken prior to practical completion, to ensure that the relevant spaces (as built) achieve the acoustic performance criteria specified in Section 3 of this document.
- 9.2 A programme of sound insulation testing shall be undertaken within the flats, in accordance with Approved Document E, to comprise the following:
- Airborne sound insulation tests across party walls;
 - Airborne sound insulation tests across party floors;
 - Impact sound insulation tests across party floors;
- 9.3 At least one set of tests (comprising 2 airborne subtests of party walls, 2 airborne subtests of party floors and 2 impact subtests of party floors) shall be undertaken for 1 in every 10 dwellings. A sample of party walls and floors between the ground floor day care centre and adjacent dwellings shall also be tested for airborne sound insulation.
- 9.4 Measurements of internal noise levels from building services shall also be undertaken within at least 1 in every 10 dwellings.
- 9.5 The following aspects shall be tested in at least one in four rooms of a given use within the day care centre, to demonstrate compliance with the acoustic specification:
- Internal noise levels from external sources;
 - Internal building services noise levels;
 - Airborne sound insulation of partitions;
 - Reverberation times.
- 9.6 Where testing identifies any spaces that do not meet the acoustic performance criteria, remedial works and re-tests will be necessary to demonstrate compliance prior to occupation.
- 9.7 An assessment of external noise from plant shall also be provided to the client, in accordance with BS 4142: 2014, to demonstrate that the new plant achieves the required external noise levels.

REFERENCES

1. The Building Regulations, Approved Document E: Resistance to the Passage of Sound, 2003 (with amendments 2004).
2. Reading Borough Council, Employer's Requirements, Version 3, 2019
3. Reading Borough Council. Reading Borough Local Plan, 2019.
4. British Standards Institution. British Standard 4142. Methods for Rating Industrial and Commercial Sound, 2014.

APPENDIX A: ACOUSTIC TERMINOLOGY

Noise Levels

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dBA weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dBA is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dBA. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/ decrease of 10 dBA corresponds to a doubling/ halving in perceived loudness.

External noise levels are rarely steady, but rise and fall according to activities within an area. In attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

- i) The L_{Amax} noise level

This is the maximum noise level recorded over the measurement period.

- ii) The L_{Aeq} noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 as the "value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T , has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.

Airborne Sound Insulation

Voices, hi-fi systems, television and radio sound and musical instruments are all sources of airborne sound. They excite the air around them and the vibration in the air is transmitted to surrounding surfaces, such as walls, ceilings and floors. This sets these constructions into vibration and this vibration is re-radiated in neighbouring rooms as sound. Energy is lost in the transmission path and this is referred to as transmission loss or more generally, airborne sound insulation. The most simple measure of sound insulation between two rooms is the sound level difference, D , which is the arithmetic difference between the sound level, in dB, in the source room and the sound level in the receiving room.

Other measures of sound insulation include the sound reduction index (R , obtained by laboratory test), the apparent sound reduction index (R' , obtained in field tests) and the standardised level difference (D_{nT} , used mainly in the sound insulation of rooms in dwellings and other cellular rooms). The relevant test procedures are laid down in BS EN ISO 140. The results are obtained over a range of frequencies. A single-figure "weighted" result can be obtained from one-third octave band results measured over the frequency range 100 - 3150Hz by using a curve-fitting procedure laid down in BS EN ISO 717. The subscript "w" is added to the descriptors above, for example; $D_{nT,w}$.

Impact Sound Isolation

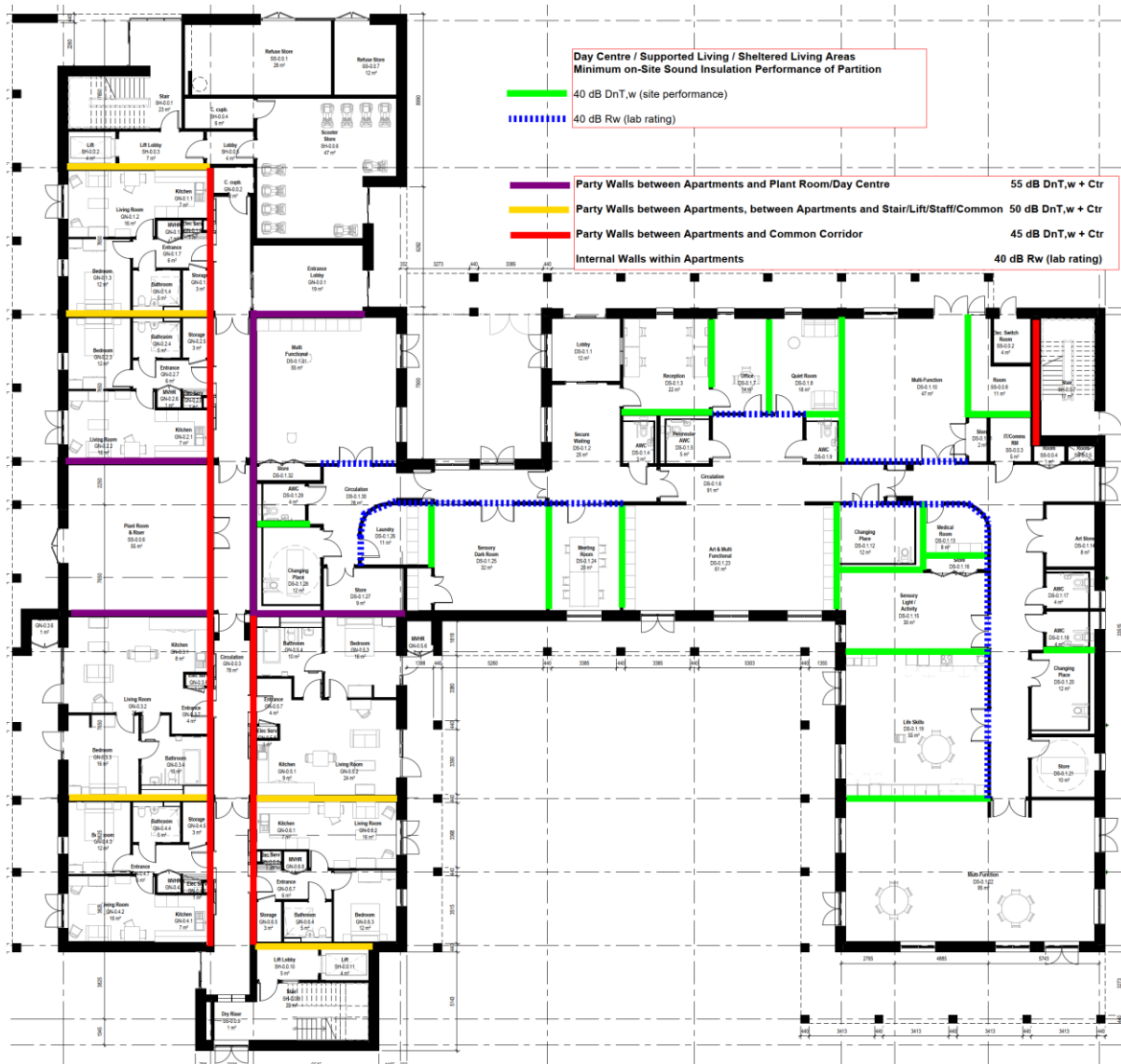
In the case of impact sound, the building construction is caused to vibrate as a result of a physical impact. Footsteps on floors are the most obvious example. The vibration is radiated as sound in neighbouring rooms. Impact insulation is measured using a standard tapping machine, which drops weights cyclically onto a floor. The sound pressure level is measured in the receiving room below and the result is known as the impact level, L_i . This test is used in the evaluation of domestic separating floors. As with airborne sound, the test procedures are set out in BS EN ISO 140 and the single-figure weighting of the results is described in BS EN ISO 717. The descriptor for the final result of a field test is $L'_{nT,w}$.

Reverberation time

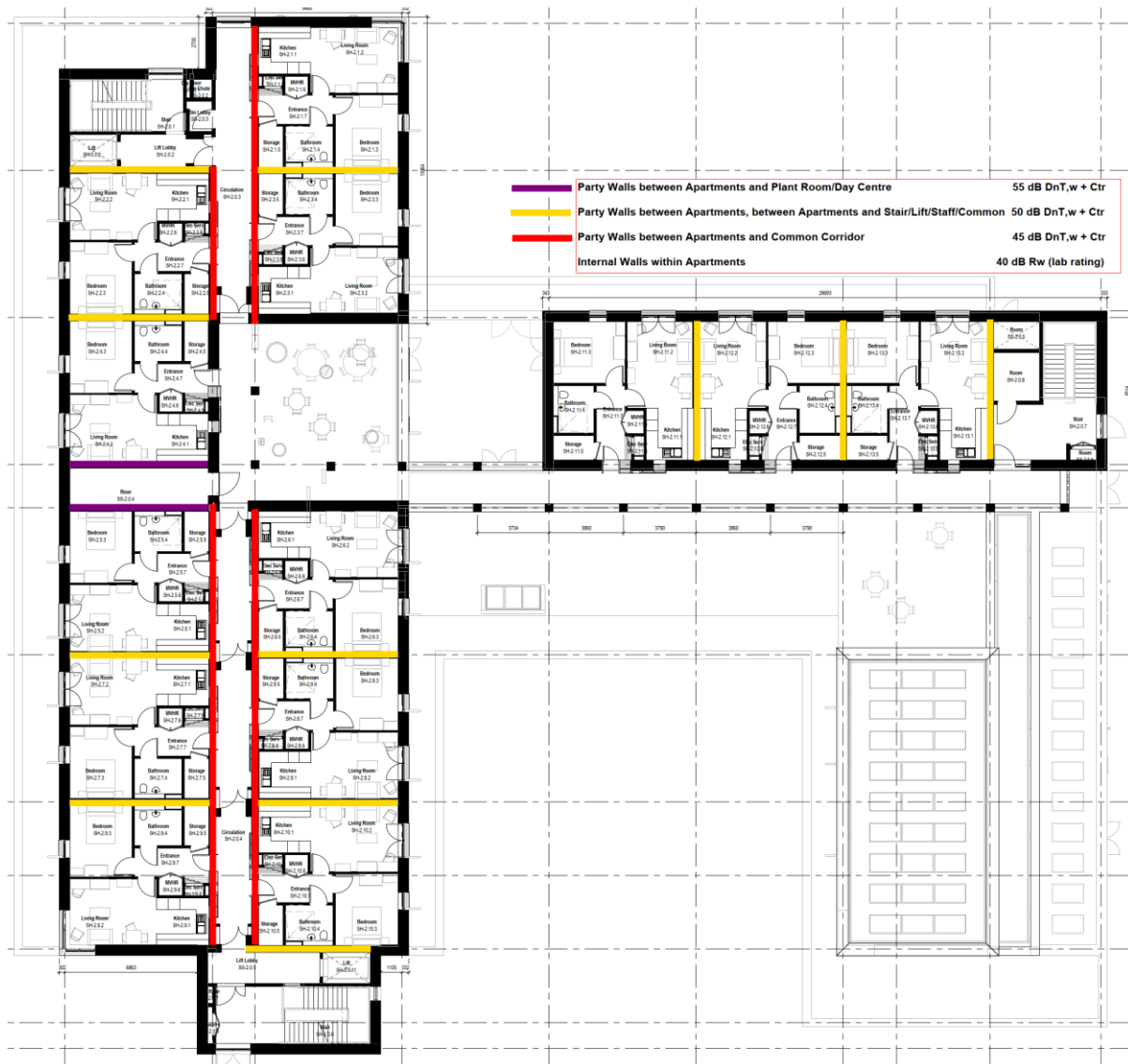
The reverberation time is a measure of the rate of decay of sound in a room and this influences the sound pressure level of noise in that room. It is defined as the time taken, in seconds, for the level of sound in a room to decrease by 60 dB (a millionth of its original energy value) after the discontinuation of a sound. Reverberation time is measured in accordance with the requirements of BS EN ISO 140.

APPENDIX B: SOUND INSULATION REQUIREMENTS

Ground Floor– Sound Insulation Requirements



First Floor– Sound Insulation Requirements



Second Floor– Sound Insulation Requirements



Third Floor– Sound Insulation Requirements

