4 Architectural Acoustics

Architectural acoustics deals with the transmission of sound between two rooms or spaces, or from the inside to the outside of a room (and vice-versa).

4.1 Noise ingress

The table in Appendix B sets out the recommended criteria for noise ingress for the completed building (including furniture).

4.2 Controlling background sound

It is important to control the perceived levels of background sound as they have an impact on the levels of privacy and can affect the speech intelligibility. For rooms where it is critical to achieve onerous design criteria, high-quality electronic sound masking systems should be considered. Attention is required to the commissioning works in order to operate effectively.

The application of such systems can lead to a 5 dB reduction in terms of sound insulation criteria. Electronic devices such as a radio or a TV can have a similar effect.

Sound masking could be installed for areas such as open-plan clinical areas, multi-bed rooms, waiting areas, office areas, consulting and examination rooms, areas placed near birthing rooms – and rooms placed at very quiet sites or areas that have low noise levels. The provisions can be adjusted for daytime and night time operation.

4.3 Outdoor noise generating events and factors

The typical outdoor noise sources can be addressed in the following manner:

- Implement a no siren policy on site, unless it is mandatory;
- Helicopter take-offs and landings could cause disturbance. This can be minimised by suitable planning of the hospital and its flight path;
- Rain noise needs to be controlled to avoid annoyance. Heavy rainfall should not exceed the noise criteria in Appendix 2 by more than 20 dB(A) or be more than 65 dB(A);
- Any lightweight roof construction can consist of multiple layers so as to offer adequate sound resistance;
- Laboratory acoustic data are to be used in order assess the resulting interior noise levels

4.4 Airborne sound insulation for rooms

Each space requires adequate sound insulation. Noisy activities should not interfere with the need for quiet in adjacent rooms. Private conversations should not be overheard. The right to privacy for hearing-impaired patients and staff must be taken considered.

This document allows for the impact of raised voices in healthcare facilities.

The following tables present the acoustic requirements for partitions and floors. They are to be followed when designing and specifying the acoustic rating of these elements. Relevant explanation is included on how to use the tables and to undertake the sound insulation calculations. Table 1 below presents the noise parameters for each room.

Room	Privacy requirements for source room	Noise generation of the source room	Noise sensitivity of receiving room
Clinical areas			
Single bed room, Adult	Confidential	Typical	Medium
Multi-bed room, Adult	Moderate	Typical	Medium
On-call room	Confidential	Typical	Medium
Children & older people (single bed)	Private	High	Medium
Children & older people (multi-bed)	Moderate	High	Medium
Consulting room	Confidential	Typical	Medium
Examination room	Confidential	Typical	Medium
Treatment room	Confidential	Typical	Medium
Counselling/ bereavement room	Confidential	High	Medium
Interview room	Confidential	Typical	Medium
Operating theatre suite	Private	Typical	Sensitive
Nurseries	Moderate	Very High	Medium
Birthing room	Private	Very High	Medium
Laboratories	Moderate	Typical	Medium
Dirty utility/sluice	Not Private	High	Not sensitive
Clean utility	Not Private	Low	Not sensitive
Speech and language therapy	Confidential	High	Sensitive
Snoezelen / multi - sensory room	Confidential	High	Sensitive
Public areas			
Multi-faith/ chapel/ prayer room	Private	High	Sensitive
Corridor (no door)	Not Private	Typical	Not sensitive
Atrium	Not Private	High	Not sensitive
Dining	Not Private	High	Not sensitive
Toilets (not cubicles)	Moderate	Typical	Not sensitive
Waiting (large > 20 people)	Not Private	High	Not sensitive
Waiting (small ≤ 20 people)	Not Private	Typical	Not sensitive
Staff areas			
Toilets (not cubicles)	Moderate	Typical	Not sensitive
Main kitchen	Not Private	Very High	Not sensitive
Ward kitchen, pantry	Not Private	Typical	Not sensitive
Storeroom	Not Private	Low	Not sensitive
Rest room	Moderate	High	Medium
Locker / changing room	Moderate	Typical	Not sensitive
Large training / seminar (>35 m2)	Private	High	Medium
Small training / seminar (≤35 m2)	Private	Typical	Medium
Lecture theatre	Private	High	Sensitive
Library / archiving room	Moderate	Low	Sensitive
Single - person office	Private	Typical	Medium
Multi-person office (2 – 4 people)	Moderate	Typical	Medium
Open-plan office (≥5 people)	Not private	Typical	Medium
Boardroom	Confidential	High	Medium
Large meeting room (>35 m2)	Private	High	Medium
Small meeting room (≤35 m2)	Private	Typical	Medium

Table 1 – Sound insulation parameters of rooms

Table 2 below presents the sound insulation ratings in the field.

Privacy requirement for source room	Noise generation of the source room	Noise sensitivity of receiving room		
		Not sensitive	Medium sensitivity	Sensitive
Confidential	Very high	47	52	★
	High	47	47	52
	Typical	47	47	47
	Low	42	42	47
Private	Very high	47	52	★
	High	42	47	52
	Typical	42	42	47
	Low	37	42	42
Moderate	Very high	47	52	★
	High	37	42	47
	Typical	37	37	42
	Low	No rating	No rating	37
Not private	Very high	47	52	★
	High	No rating	42	47
	Typical	No rating	No rating	42
	Low	No rating	No rating	37

Table 2 – Sound insulation rating to be met on site - DnTw in dB

★ Avoid these adjacencies by careful planning. If this is unavoidable, aim for a minimum of $D_{nT,w}$ 57 dB. In practice this is extremely difficult since it would translate to very wide partitions and onerous demands on the building structure to appropriately minimise flanking noise.

Definition of terms in tables 1 and 2

The below definitions apply to the terms used in the above tables 1 and 2.

Abbreviation	Meaning
Confidential	Raised speech would be audible but not intelligible, and normal speech would be inaudible.
Private	Normal speech would be audible but not intelligible.
Moderate	Normal speech would be audible and intelligible but not intrusive.
Not private	Normal speech would be clearly audible and intelligible.
Sensitive	Room cannot accommodate any noticeable noise from rooms next door
Medium sensitivity	Room generally needs to be free from noise of other rooms.
Not sensitive	Noise from other rooms does not affect the use of the receiving room.

Understanding Tables 1 and 2

Table 2 makes reference to the privacy of a source room, anticipated levels of noise generation and the room sensitivity. It references the necessary rating of sound insulation considering Table 1 requirements. The parameter is the weighted standardised level difference - DnTw as measured in the field.

The sound-insulation requirement is assessed between a pair of rooms in each direction (room A to room B and room B to room A) using the privacy requirement for the source room, the noise generation of the source room and the noise sensitivity of the receiving room indicated in Table 1.

Example of how to calculate this is given at the Appendix of the document i.e. Example of sound insulation calculation.

The above Table 2 and calculation method in the Appendix references Rw. If during design stage there is a requirement for a STC rating then the approximate difference from Rw to STC is ± 1 unit.

4.5 Long term accommodation

When dealing with the design of spaces that are used for long term patients e.g. nursing homes, mental health wards, long term care and slow stream rehabilitation, the sound insulation criteria should meet the criteria for rooms for residential purposes.

When installing a wall/ partition, build it slab to slab, apply appropriate filling at junctions and joints and back fill with mortar any chasing in the walls. Acoustic sealant used should meet both acoustical and fire life safety requirements.

4.6 Impact sound insulation considerations

It is imperative that the impact noise is controlled at source wherever possible. Care is needed during the planning of the healthcare facilities so that heavily trafficked corridors are separated from sensitive spaces such as inpatient areas.

Try to avoid placing inpatient units under heavily trafficked corridors. If this is unavoidable, allow for impact sound insulation treatments.

Maintain a maximum field value rating of L'_{nTw} 65 for floors over noise-sensitive areas. There may be scenarios where extra sound insulation is required e.g. floors located above multi-sensory rooms.

4.7 Doors

When a door is included in a partition, the partition's acoustical performance will be significantly downgraded. A typical door performance will range from R_w 30 to R_w 35 dB. For scenarios where great sound insulation is required, suitable high-performance door sets or lobbied doors would be required.

In order to achieve an appropriate acoustic performance for the doors/ door sets, installation of doors seals will be necessary. Door seals around the whole door perimeter, including threshold and meeting stiles will be required. Avoid air gaps between the door leaf and the door frame.

In some situations, acoustic requirements may present conflicts with other requirements. For example, opening force of the doors during emergency conditions, infection control issues, ventilation requirements through door undercut etc. In such cases, it is up to the designers to balance these requirements and make the best overall decision.

Recommended door acoustic performance requirements are outlined below.

Area	Door performance – Rw (dB)
Corridors	30 – 35
Patient rooms – single or multi bed	35
Examination room	30
Consulting room	30
Bereavement room	35 - 40
Interview room, dining, laboratories	30
Operating theatre	30
Birth room	35 - 40
Waiting rooms	30
Speech and language therapy	35
Kitchen	30
Offices	30
Meeting room	35
Boardroom	35
Toilets	30
Plantroom	45

Table 3 – Airborne sound insulation rating for doors

4.8 Examples of door configurations

Here are some typical examples of door construction and acoustic rating they achieve.

A 45 mm thick solid core door with a mass per unit area of 27 kg/m^2 fitted with appropriate door seals at the perimeter, undercut and head jamb will achieve a rating of R_w 30 dB. Seals can be compression or wipe seal type and must be well fitted.

A 54mm thick solid core door with a mass per unit area 29 kg/m^2, fire rated with appropriate door seals at the perimeter, undercut and head jamb will achieve a rating of R_w 35 dB. Seals can be compression or wipe seal type and must be well fitted.

A 59mm thick solid core door with a mass per unit area 31 kg/m^2, fire rated with appropriate door seals at the perimeter, undercut and head jamb will achieve a rating of R_w 40 dB. Seals can be compression or wipe seal type and must be well fitted.

A 69 mm thick steel acoustic door composed of a frame and leaf manufactured with a 1.5 mm thick polished metal sheet with inner filling of sound proofing and absorbing material and equipped with double perimeter seals will achieve a rating of R_w 45 dB.

Doors with vision panels should achieve the overall door acoustic rating.

4.9 Planning Considerations

Here are some planning recommendations to improve acoustic performance:

- Careful space planning is necessary in order to avoid inappropriate space adjacencies e.g. waiting areas close to doors of consulting rooms or inpatient rooms.
- Avoid placing rooms that generate high or very high noise next to sensitive or medium sensitivity rooms.
- Avoid interconnecting doors between consulting rooms (except in Mental Health consulting rooms).
- Avoid doors of “private” or “confidential” rooms being opposite each other across a corridor.
- Fit soft action closers for doors giving access to “noise sensitive” areas.
- Use intercom for highly sound performing doors.
- Minimise sliding doors should due to difficulties with acoustic performance (as well as cleaning and maintenance difficulties).

4.10 Openable windows

In healthcare facilities openable external windows are generally discouraged due to the impact on the HVAC systems and the ingress of uncontrolled, unfiltered air.

If a facility includes some openable external windows, that face outdoor areas which may be accessed by people, this can lead to seriously compromised acoustic comfort. Suitable controls need to be put place to avoid external noise from people and activities outside the windows.

Furthermore, consideration of possible sound transfer between adjacent spaces by direct reflection of open windows is required.

4.11 Movable / folding partitions

The acoustic performance of the operable partitions is limited and often unreliable.

It is not recommended to use them when the speech privacy is a prerequisite or where high insulation ratings are needed.

4.12 Structure – borne sound and lightweight construction

Some rooms within the healthcare buildings that can generate structure-borne noise to the walls. For example, toilets, kitchens, workshops etc. When lightweight construction is used and there are sensitive adjacencies present, the propagation of the structure-borne noise should be controlled. This may include the use of twin stud frames, resilient board mountings, or spacing the source of impact away from the wall.

In addition, resilient fixings should be used for pipework fixed to lightweight partitions. Examples of these situations include WC waste pipes and rainwater pipes that should not be rigidly fixed to light structure.

Where there are internal glass partitions or viewing panels they also need to meet the requirements of the sound insulation Tables above. If this is not achievable, use a glazing build up that has an Rw rating no less than 10 dB below than required for the partition alone.

Where windows or vision panels are within doors or next to doors the glazing only needs to match the acoustic performance of the doors, not walls.

4.13 Weak construction configurations – flanking control

Sound that propagates indirectly between two spaces such as over or around separating elements (rather than directly through those elements) causes annoyance and results in poor acoustic performance. This is referred to flanking noise. In order to achieve the design criteria and offer a suitable acoustic climate, this effect needs to be controlled.

Both horizontal and vertical flanking routes need to be considered. Junction details are key to the overall sound insulation between spaces. Typically, junctions of acoustic partitions with other walls are the source of potential weaknesses due to flanking sound transfer along the inner skin.

This issue can occur even at external walls, especially when partitions i.e. walls and/ or floors are abutting façade glazing/ building envelope. The internal lining to a lightweight external wall should not be continuous across an acoustic wall or floor. Ribbon windows, shared windows or full-height glazing are low acoustic performing constructions and are not recommended for “private” or “confidential” privacy rooms and/ or “high” or “very high” noise generating rooms.

Ideally walls should be installed slab to slab, slab to the roof or slab to soffit above so as to achieve optimum performance. For raised access floor scenarios, the wall should extent through the floor to the slab below.

Attention is necessary at the head of the walls, which should be carefully sealed against the floor, soffit or the roof above. Extra attention is required where the slab is profiled and therefore sealing is relatively difficult.

When a wall has a junction with a lightweight roof, it should extent to the underlining of that roof.

For scenarios where the wall extends beyond the ceiling but not to the slab/ soffit/ roof above careful detailing is necessary. In this situation, the ceiling would need to offer sufficient sound insulation e.g. suitable density of plasterboard ceiling and insulation.

4.14 Bathroom pods

Bathroom and Ensuite acoustic design is highly important in order to avoid low acoustic performance. They need to meet the relevant sound criteria referenced in the sound insulation tables above.

It is recommended that all the walls of Bathrooms and Ensuites in health facilities should be extended to the slab, soffit or roof above and sealed. This is for both Acoustic performance and control of the air flows.

Where Ensuite Bathrooms are installed back to back, they require an imperforate, acoustically rated partition between them. Attention is necessary for their service penetrations, typically through their ceiling.

For scenarios where an Ensuite Bathroom forms part of a bedroom, it is considered part of it, hence should meet the requirements of the sound insulation tables.

4.15 Audiology facilities

Extra care should be given to the acoustic design of hearing test rooms within audiology facilities.

High acoustic performance is critical to their clinical performance. Individual test rooms are in the very quiet design category. However, there may be hearing test rooms where the noise levels would be very high. Therefore, room acoustics are critical.

It is often more practical to install a commercially available sound insulated audio booth within an audiology room to ensure the best performance during the patient testing.