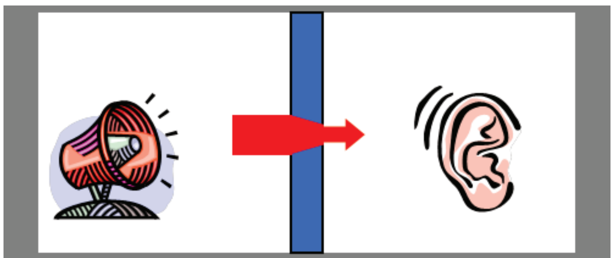
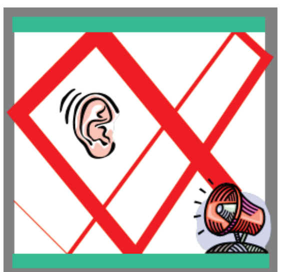
# Sound absorption

Building acoustic is the science of controlling noise in buildings, including the minimization of noise transmission from one space to another and the control of noise levels and characteristics within a space. If both of them are at the correct level, we will experience acoustic comfort. Noise can be defined as sound that is undesirable, but this can be subjective, and depends on the reactions of the individual and the use of space.



Sound insulation (airborne)



Sound absorption

When a noise is troublesome, it can reduce comfort and efficiency. If a person is subjected to noise for extended periods, it can result in physical discomfort or mental distress. In the domestic situation, a noisy neighbour can be one of the main problems experienced in attached housing. The best defense against noise is to ensure that proper precautions are taken at the design stage, and during construction of the building. The correct acoustic climate must be provided in each space and noise transmission levels should be compatible with usage.

## Sound absorption

Sound absorption is the term given to the loss of sound energy on interaction with a surface. Sound absorbent surfaces are used to provide the correct acoustic environment within a room or space. By converting some of the sound energy into heat, sound absorbing material also helps sound insulation because less noise is transmitted to other rooms. However, this reduction in noise is very small when compared with the potential reduction of sound insulation. In other words, sound absorption is never a substitute for adequate sound insulation, since sound absorbent materials allow a large amount of sound energy to pass through them.

## Reverberation time

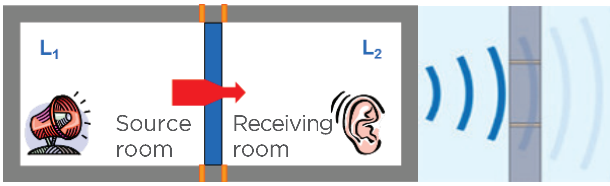
Reverberation is the persistence of sound in particular space after the original sound is removed. A reverberation is created when a sound is produced in an enclosed space causing a large number of echoes to build up, and then slowly decay as the sound is absorbed by the wall, ceiling, floor, air, and every objects in the room. The length of this sound decay is knows as reverberation time, and can be controlled using sound absorbing materials. The time it requires for reflections of a direct sound to decay 60dB is the reverberation time (RT60). The appropriate reverberation time for a space will be dependent on the size and function of the space. Some recommended reverberation times are given in Table 4.

Table 4 - Reverberation time recommendation

| ROOM | Reverberation Time |
|---|---|
| Office | 0.4 - 0.7s |
| Meeting room | 0.6 - 0.9s |
| Cinema | 0.6 - 0.9s |
| Classroom | 0.5 - 0.8s |
| Theatre | 0.9 - 1.3s |

# Sound insulation

Sound insulation is the term describing the reduction of sound that passes between two spaces separated by a dividing element. In transmission between two spaces, the sound energy may pass through the dividing element (direct transmission) and through the surrounding structures (indirect or flanking transmission).



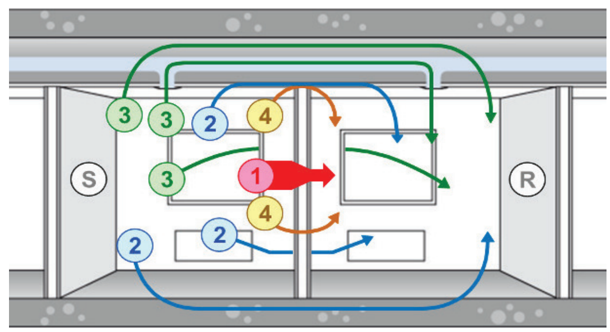

In designing for sound insulation, it is important to consider both ways of transmission. The walls or floors, which flank the dividing element, constitute the main paths for flanking transmission, but this can also occur at windows, ventilation ducts, doorways service penetration through the wall, i.e socket boxes, etc.
The sound insulation of walls is normally only related to the transmission of airborne sounds. These include speech, musical instruments and other sounds which originate in the air.

## Indirect paths (Flanking transmission)

Flanking sound is defined as sound from a source room that is not transmitted via the separating building element. It is transmitted indirectly via paths such as windows, external walls, and internal corridors.

It is imperative that flanking transmission is considered at the design stage and construction detailing is specified so as to eliminate or at least to minimize any downgrading of the acoustic performance.

The sound insulation values quoted in system performance tables are laboratory values. The practicalities of construction will mean that acoustic performance measured in the laboratory will be difficult to achieve on site. One of the main reasons for this difference is the loss of acoustic performance via flanking transmission paths.
Small openings such as gaps, cracks, or holes will conduct airborne sound and can significantly reduce the sound insulation of a construction.
Reduction in flanking transmission will help in achieving good room acoustics. For optimum sound insulation, a construction must be airtight.




1. Direct transmission
2. Flanking transmission via adjacent constructions (floor, wall and ceiling)
3. Transmission via ceiling void, windows and ventilation ducts etc
4. Leakage

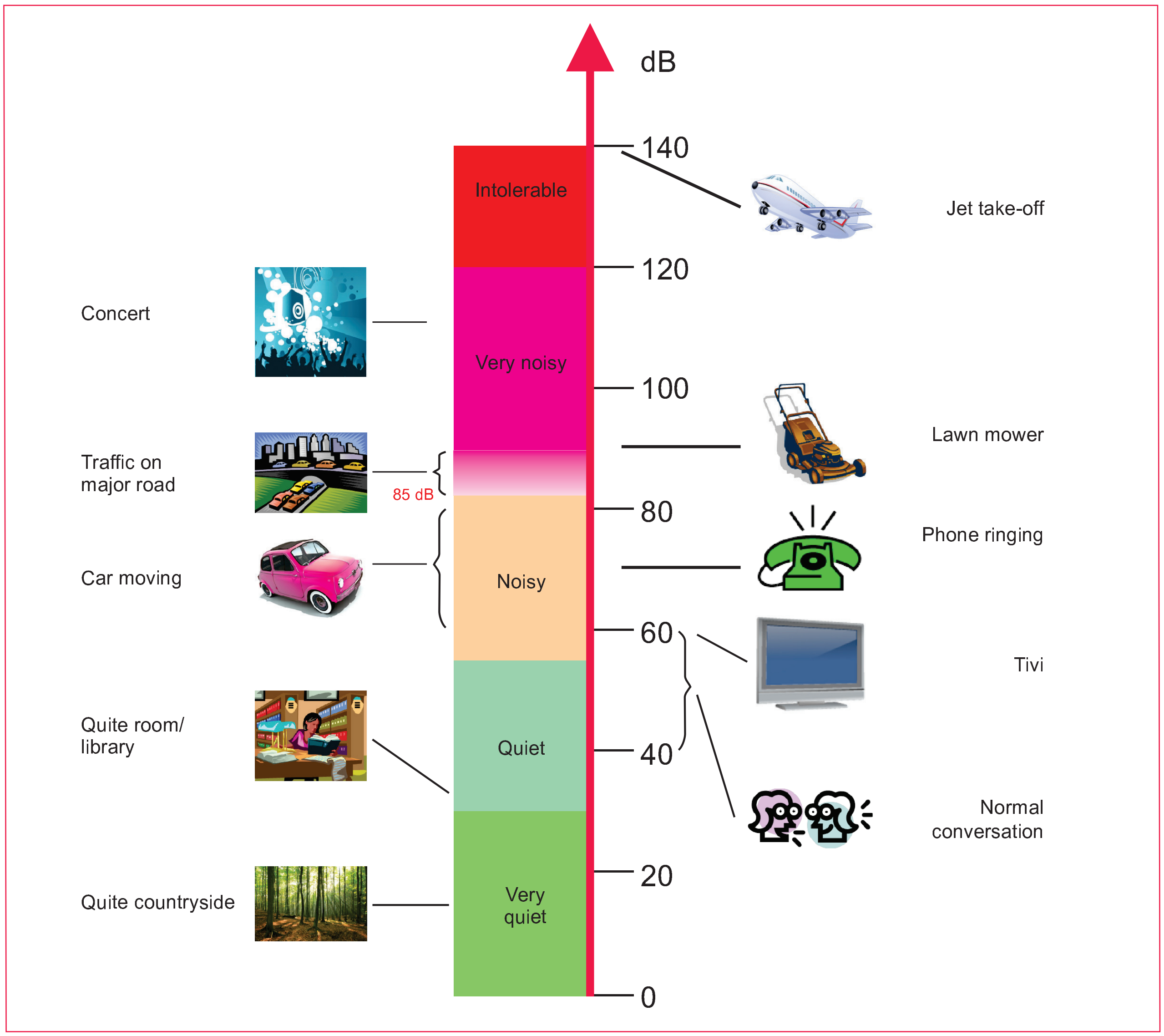
S = Source room
R = Receiving room

## Ambiance noise level

Along with acoustic privacy, the level of sound energy acceptable within a room should be assessed as regards intrusive noise levels, and the level of potential noise likely to be generated within the room itself. The factors that affect the ambiance noise level of a space are:

- The level of external noise
- The level of sound insulation designed into the surrounding structures
- The amount and type of sound absorbing surfaces within the room
- The noise generated by building services

## Guide to noise levels and sound insulation levels for privacy



# Rating methods

## Sound insulation

The sound insulation rating methods are defined in:

- BS EN ISO 10140-2 : 2010
- ASTM E90-04
- ASTM E413-16a
- TCVN 7192-1 : 2002 (ISO 717-1:1996)

### $R_w$

#### Weighted Sound Reduction Index

Single number quantity that characterizes the airborne sound insulating properties of a material or building element over a range of frequencies from 100 Hz to 3150 Hz, measured in accordance with BS EN ISO 10140-2:2010 or TCVN 7192-1:2002/SDD1:2008 (ISO 717-1:1996/AMD 1:2006). The figure indicates the amount of sound energy being stopped by the element when tested in laborary. The higher the figure, the better the sound insulation.

### $D_{nT,W}$

#### Weighted standardized level difference

The on-site airborne sound reduction performance between two rooms, measured in accordance with BS EN ISO 10140-2:2010. The performance is not just dependent on the dividing element itself. It is also dependent on other available transmission paths, e.g surrounding structures, junction details, penetrations etc., through which sound can travel.

### $R'_w$

#### Weighted apparent sound reduction index

On-site airborne sound insulation performance established by calculation, combining the $D_{nT,W}$ and room volumes (and sometimes even fixtures and fittings).

### $C_{tr}$

#### A spectrum adaption term

An adaption of the sound insulation performance curve of an element of structure, used as a correction factor that targets low frequency noise (in particular 100-315 Hz), and was originally introduced to control traffic noise.

### dBA or dB(A)

#### A-weighted sound pressure level

A unit of measure for decibels with an A-weighted scale. The measure of sound intensity or pressure, adjusted in consideration of the human ear's sensitivity to various frequencies.

### STC

#### Sound Transmission Class

This figure is obtained by classifying the measured values of sound transmission loss in accordance with ASTM Standard E413-16a, "Classification for Sound Rating Insulations". The STC rating considers sound transmission loss values at frequencies from 125 Hz to 4000 Hz.

### FSTC

#### Field sound transmission class

Sound transmission class calculated in accordance with Classification ASTM E413-16a using values of field transmission loss.

### $\alpha_w$

#### Sound Absorption Rating (Alpha w)

The sound absorption performance of a material. It is ability to reduce reverberation/ echoing within a room, hallway etc over a range of frequencies, calculated in accordance with BS EN ISO 11654:1997. A modifier L, M or H can be added to indicate if the spectral shape is dominated by a particular frequency:

- L means the absorption is predominantly in the low frequency region
- M means the absorption is predominantly in the mid frequency region
- H means absorption is predominantly in the high frequency region.

### $\alpha_s$

#### Sound Absorption Coefficient (Alpha s)

1/3rd octave-based expression of the sound insulation absorption.

### NRC

#### Noise Reduction Coefficient (NRC)

The sound absorption performance of a material based on a simple average of the full octave frequencies 250 Hz, 500 Hz, 1000 Hz and 2000 Hz.

## Design standards

### Table 5 - Sound insulation standards of building elements between rooms

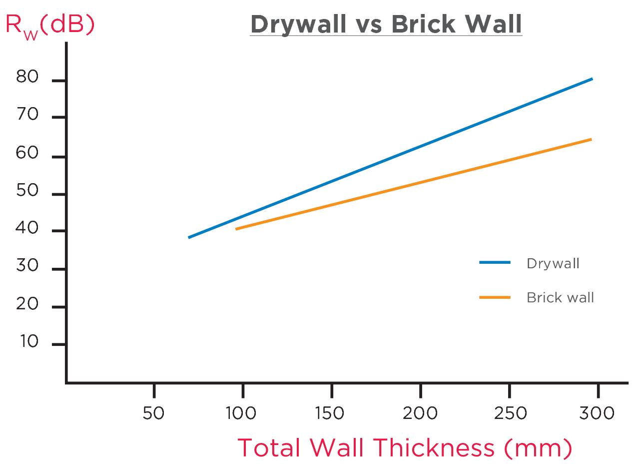
| Building type & Component type | CK*, dB |
|---|---|
| High sound insulation level:<br>• Musical school: wall & floor<br>• Administration buildings, office, hospital: wall & floor for areas need high quiet level<br>• 4 Star Hotel: wall & floor between guest room<br>• Administration buildings, office, hospital: wall & floor for areas adjacent to high noise level | 55 |
| Medium sound insulation level:<br>• Residential<br>• Motel, hostel, non-ranking hotel<br>• Administration buildings, office: wall & floor between working rooms<br>• Hospital: wall & floor between: patient room, operation room, doctor room, watching TV room, reading room.<br>• School, college, university: wall between: laboratory, reading room, lecture room. | 50 |
| Low sound insulation level:<br>• Residential: internal wall- Hotel: internal wall.<br>• Administration buildings, office, store: internal wall, reception areas<br>• Hospital: wall & floor between: patient room, operation room, doctor room, watching TV room, reading room.<br>• School, college, university: floor between: laboratory, reading room, lecture room. | 45 |

** CK: Airborne sound insulation (dB)*
*Source: TCXDVN 277:2002*

## How Gypwall lightweight solution is better than traditional wall

Typically the average sound insulation of a material forming a solid wall is governed by its mass. The heavier the material, the greater resistance it is to sound transmission. To increase the sound insulation of a solid wall by about 5 dB, the mass must be doubled. This is known as the empirical mass law.

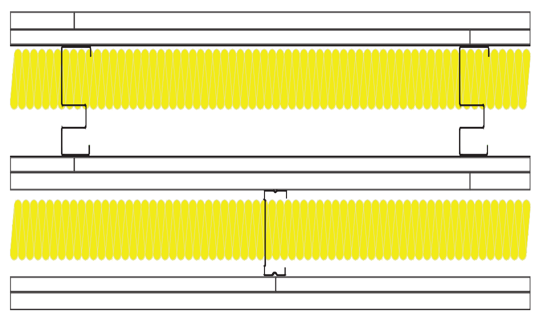
Drywall systems versus the mass law shows how cavity systems consistently exceed mass law predictions. This demonstrates that adding mass is not always the best method when satisfying acoustic design requirements, and that lightweight systems, if correctly designed, can provide very effective acoustic solutions.




The use of two completely separated stud frames can produce even better results. In this case, the maximum transmission of energy is through the cavity between the plasterboard linings. The air in the cavity can be considered as a spring connecting the linings, which allows the passage of energy. The spring will have some inherent damping, which can be significantly increased by the introduction of a sound absorbing material, such as glass wool, positioned in the cavity.

Air-spring coupling becomes less significant as the cavity width increases. In practice, cavities should be as wide as possible to insulate against low frequency sounds.

Two important effects are resonance and coincidence, occuring in drywalls. These are governed by such physical properties as density, thickness and bending stiffness, whereby a reduction in sound insulation occurs at certain frequencies. In lightweight cavity constructions, these effects can be decreased by the use of two or more board layers. A simple way of increasing the sound insulation performance of a single layer metal stud is, therefore, to add an additional layer of plasterboard to one or both sides.



Drywall Twin Frame_Sound Insulation
Rw = 69 dB