Irish Building Regulations – Sound

The document specifies the required on-site performance criteria for both airborne and impact sound transmission values for separating elements between residential dwelling units. The current Building Regulations do not require any specific criteria for buildings other than residential dwelling units. It is therefore often the designer’s choice to specify the appropriate level of sound performance of the dividing elements within a domestic dwelling and for other building types. However, guidance to the level of sound performance is often based on specific sector guidance and previous experience.

BS 8233 – Sound insulation and noise reduction for buildings
Code of practice which provides guidance to acoustic ratings appropriate to different building types.

Building acoustics is the science of controlling noise within buildings. This includes minimising noise transmission between compartments and the control of sound characteristics within a space.

The term ‘building acoustics’ embraces both sound insulation and sound absorption.

Sound Insulation
Sound insulation is used to describe the reduction of sound that passes between two spaces separated by a dividing element. The sound energy that passes between these two spaces may occur through the dividing element (direct transmission) or through the surrounding structure (indirect or flanking transmission). It is important to distinguish between both methods of sound transmission as the walls and floors which flank the dividing element, can sometimes contribute significantly to the level of sound transmission. The presence of nearby windows, doors, service ducts, etc. can also affect the level of sound transmission performance.

Common flanking paths
It is therefore the whole acoustic environment of a room or building and its ability to eliminate air paths in the vicinity of sound reducing elements that should be considered when assessing sound transmission performance. For these reasons, it is often unlikely that $R_{w}$ figures quoted from laboratory test conditions will be achieved in practice. Also, when the background noise is low, consideration may have to be given to a superior standard of sound insulation performance in conjunction with the adjoining flanking conditions.

The Irish Building Regulation requirements regarding sound insulation of walls and partitions relates to the transmission of airborne sound only, whereas the regulations regarding a separating floor construction also includes their ability to resist the transmission of impact sounds. Airborne sound relates to sound which is emitted from a source i.e. speech, loudspeakers, instruments etc. Impact sound relates to sound that is generated from contact with the separating element i.e. footsteps and moving furniture etc.

To ensure airborne sound insulation is maximised it is important to seal any openings such as cracks, gaps, or holes. For optimum airborne sound insulation a construction should be airtight. Most gaps can be sealed at the finishing stages using a variety of Gyproc products such as Gyproc Sealant.

**KEY DESIGN CONSIDERATIONS FOR SOUND**

**Suspended ceiling voids**
It is recommended that where sound insulation is important, partitions should, if possible, extend fully to the structural soffit. Sound can travel through a suspended ceiling void over the top of a partition where it abuts the underside of the ceiling.

**Composite constructions**
A common mistake made when designing a dividing element is to specify a high performance construction which incorporates a lower performance element e.g. a doorway. Consideration should be given to the weakest element of the construction and the possible effect it will have on the overall sound resistance.

**Deflection heads**
Where structural movement needs to be accommodated with a deflection head detail at the top of a Gyproc partition system, by definition, movement must be accommodated. It is very difficult to achieve an airtight seal at this location. Loss of sound insulation can be kept to a minimum by including cloaking angles either side of the deflection detail.

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**Deflection head (subject to fire performance)**

1. Gyproc Sealant for optimum sound insulation
2. 50mm timber head plate equivalent to channel width forming fire-stop
3. Gypframe GA4 Steel Angle to minimise loss of sound insulation performance due to air leakage

**Penetrations**
The sound insulation performance of all Gyproc partition systems are quoted as imperforate membranes. Penetrations made through the systems will downgrade the sound insulation performance and should be avoided where sound insulation is critical. Adopting best practice detailing can help to minimise the reduction in sound performance.

**ACOUSTIC PRIVACY**
Two main factors affect the level of acoustic privacy achieved when designing a building:
- The sound insulation performance of the structure separating the two spaces
- The ambient background noise present within the listening room.

The ambient background noise can help to mask speech from an adjacent space and provide enhanced speech confidentiality. Indicative guidance on sound insulation levels for speech privacy are shown in the table below.

**Guide to sound insulation levels for speech privacy**

<table>
<thead>
<tr>
<th>Sound insulation between rooms $R_{w}$</th>
<th>Speech privacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 dB</td>
<td>Normal speech can be overheard</td>
</tr>
<tr>
<td>30 dB</td>
<td>Loud speech can be heard clearly</td>
</tr>
<tr>
<td>35 dB</td>
<td>Loud speech can be distinguished under normal conditions</td>
</tr>
<tr>
<td>40 dB</td>
<td>Loud speech can be heard but not distinguished</td>
</tr>
<tr>
<td>45 dB</td>
<td>Loud speech can be heard faintly but not distinguished</td>
</tr>
<tr>
<td>&gt; 50 dB</td>
<td>Loud speech can only be heard with great difficulty</td>
</tr>
</tbody>
</table>
Along with acoustic privacy, the level of sound energy acceptable within a room should be assessed with regards to intrusive noise levels and the level of potential noise likely to be generated within the room itself. The factors that affect the ambient noise level of a space are:

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

Where control of the ambient noise level is critical, advice should be sought from an acoustic specialist.

**SOUND INSULATION - RATING METHODS**

The sound insulation rating methods that follow are defined in:

*BS EN ISO 717: Part 1: 1997 (airborne)*

and

*BS EN ISO 717: Part 2: 1997 (impact)*

**Rw**

This single figure rating method is the rating used for laboratory airborne sound insulation tests. The figure indicates the amount of sound energy being stopped by a separating building element when tested in isolation in the absence of any flanking sound paths. With airborne sound insulation, the higher the figure the better the performance.

**DnTw**

This single figure rating method that gives the airborne sound insulation performance between two adjacent rooms within a building as measured on site. The result achieved is affected not only by the separating element but also by the surrounding structure and junction details. The result achieved therefore become site specific.

**Ctr**

The Ctr adaption term is a correction that can be added to either the Rw (laboratory) or DnTw (site) airborne rating. The Ctr adjustment focuses on the lower band frequencies, in particular the performance achieved in the 100-315 Hz frequency range. Ctr is not a statutory requirement within the Building Regulations, but is sometimes required to meet project specific requirements.

**Lnw**

This single figure rating method is the rating used for laboratory impact sound insulation tests on separating floors. The figure indicates the amount of sound energy being transmitted through the floor test in isolation, in the absence of any flanking paths. With impact sound insulation, the lower the figure the better the performance.

**Lntw**

The single figure rating method that is used for impact sound insulation tests for floors. The figure indicates the sound insulation performance between two adjacent rooms within a building as measured on site. The result achieved is affected not only by the separating floor but also by the surrounding structure. The result achieved therefore become site specific.

**Dncw**

The single figure laboratory rating method that is used for evaluating the airborne sound insulation performance of suspended ceilings. Laboratory tests simulate the room to room performance of the suspended ceiling when a partition is built up to the underside of the ceiling with sound transmitted via the plenum.

**Lightweight constructions**

Typically the average sound insulation of a material forming a solid partition is governed by its mass. The heavier the material, the greater the resistance to sound transmission. The empirical mass law states that to increase the sound insulation of a solid partition by about 4dB, the solid mass must be doubled.

Increasing mass alone is a very inefficient way of achieving sound insulation. One of the advantages of using lightweight cavity partitions and walls is that they exceed the typically predicted sound reduction values that can be achieved, when compared to solid constructions of the same dimensions.

**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. Sound absorbing materials can also convert some of the sound energy to heat, assisting in sound insulation. However, this reduction in noise is very small and should not be considered as an adequate substitute for sound insulation.

**Reverberant energy**

Reverberation is the persistence of sound in a particular space after the original sound is removed. The length of this sound decay is known as the reverberation time and can be controlled using sound absorbing materials. The appropriate reverberation time will be determined by the size and function of any given space.
Speech Clarity
Reverberation time alone cannot be relied upon to deliver a suitable environment for good speech intelligibility. In any situation where sound communication is critical e.g. conference room, lecture theatre or classroom, the design of the space must consider an appropriate mixture of sound reflective and sound absorbing surfaces.

SOUND ABORPTION RATING METHODS

The following ratings are calculated in accordance with BS EN ISO 11654:1997.

Sound Absorption Coefficient, $\alpha_s$
Individual sound absorption figures quoted in third octave frequency bands are used within advanced modelling techniques to accurately predict the acoustic characteristics of space. The coefficient ranges from 0 (total reflection) through to 1 (total absorption).

Practical Sound Absorption Coefficient, $\alpha_p$
A convenient octave-based expression of the sound absorption coefficient, commonly used by acoustic specialists when performing calculations of reverberation times within a building space.

Sound Absorption Rating, $\alpha_w$
A single figure rating used to describe the performance of a material. Sometimes a bias may be applied to a particular frequency band range i.e. low, mid or high.

Noise Reduction Coefficient, NRC
The NRC value is the arithmetic mean of the absorption coefficients across a limited frequency range which does not include the upper and lower most frequencies. This can sometimes lead to a misleading perception of a material if they perform particularly well (or bad) at these extremes.