

Room Acoustic Considerations - 87

Reverberation

Reverberation time is the time taken for the sound pressure level to drop by 60dB after the generated noise has been stopped. Areas with a long reverberation time are referred to as being 'live', e.g. cathedrals and churches. Those with a short reverberation time are referred to as being 'dead', e.g. offices with thick carpets and absorbent ceilings.

A reduction of 60dB in the sound pressure level is equivalent to the reduction of acoustic energy by a factor of one million. As a rough guide the reverberation time of a room is approximately equal to the time it takes for loud clapping to become inaudible.

Sound absorption is the reduction of sound energy. The sound absorption coefficient provides the relationship between absorption and reflection of a sound. A value of 0 represents total reflection and a value of 1 represents total absorption.

Multiplying the sound absorption coefficient by 100 provides the percentage of sound energy being absorbed, e.g. a sound absorption coefficient of 0.75 stands for a sound absorption of 75% and a sound reflection of 25%.

In 1920 W.C. Sabine published an article describing the relationship between reverberation time, the volume of a room and sound absorption. Today, there are complex computer programs to calculate the acoustic behaviour of rooms. Nevertheless, in practice most people still use Sabine's equation.

It is important to remember that the equation is based on a diffused sound field, i.e. an evenly distributed sound field in a room of equal proportions and not exceeding 2000m³ in volume.

Sound Absorption

The average noise level in a room is dependent on the sound source and the sound absorption. Increasing the absorption within the room will generally reduce the noise level, in practice by approximately 3 to 10dB.

Double or Nothing

To achieve an audible improvement the absorption within a room has to be increased by a factor of 2. Therefore, an increase of the absorption of the ceiling from 20% to 40% or from 40% to 80% is advisable, an increase from 70% to 80% will show very little, if any, noticeable improvement.

When the intended use of a specific area is known (music room, conference area, cinema, school etc) it is then possible to calculate the optimum reverberation time to make that area suitable for the intended use. As the ceiling generally represents a large proportion of the room's surface area it can be a major influence on the acoustic performance.

High Absorption is Not Always Good

It is important to take into consideration all of the surfaces within a room to ensure that the correct balance between absorption and reflection is achieved. Too much absorption in a room can be as bad as not enough.

Speech can only be heard clearly if background noise is controlled or kept to a minimum. The best way to achieve this is to ensure the correct balance between sound and reverberation.

If used in conjunction with a hard, acoustically reflective ceiling, acoustic screens may be ineffective and have little effect in providing any privacy. However, an absorbent ceiling will complement the screen and assist in maintaining a much higher degree of acoustic separation when installed in an office where screens are used.

Sound Insulation

Suspended ceilings improve the insulation value of a soffit. With an OWAacoustic ceiling this can be up to 10dB, i.e. a reduction of half of the audible sound.

Noise from Flanking Paths

A great deal of attention is given to ensuring that the ceiling provides the maximum level of sound insulation but it should be remembered that sound will also find its way through the walls (flanking paths). Attention should therefore be given to the room as a whole when addressing the issue of sound insulation.

Various services such as HVAC, plumbing, electrical and telecommunication systems can be concealed in a ceiling void. However some may create sufficiently high levels of noise to be disconcerting, as well as annoying, to the occupants below. Dependent on the type selected, an OWAacoustic panel can provide noise reductions of 18 to 36dB.

Light Fittings, etc.

Where service elements such as light fittings, loudspeakers and grilles break into the ceiling plane, care should be taken to ensure that any gaps or holes left are stopped or at least kept to a minimum.

The room to room insulation between two adjacent rooms that have a common ceiling void is described in EN 20 140-9.

Pattern	Thickness	Dn, c, w
Harmony	15mm	31 dB*
	20mm	34 dB*
Plain	15mm	42 dB*
	20mm	45 dB*
Constellation	15mm	35 dB*

The addition of a mineral wool overlay can improve the room to room insulation value of an OWAacoustic ceiling by approximately 2dB per 10mm.

Janus is a special ceiling tile designed to provide sound insulation of up to 49dB in any of the available surface patterns. Using a pattern such as Harmony or Futura the optimum levels of both absorption and insulation can be achieved (more details see leaflets no. 570 and 557).

Janus	Thickness	Dn, c, w
Harmony	30 - 33 mm	49 dB*
*Values for concealed grid systems (exposed grid systems approx. 2 dB less)		