CI/SfB (35) Xy
09/2016

INTELLIGIBILITY

CONFIDENTIALITY

CONCENTRATION

Passive Acoustical Guide

Role of ceilings in passive acoustics

Inspiring Great Spaces™

Armstrong® CEILING SOLUTIONS

The role of passive ceiling systems and what influences Performance

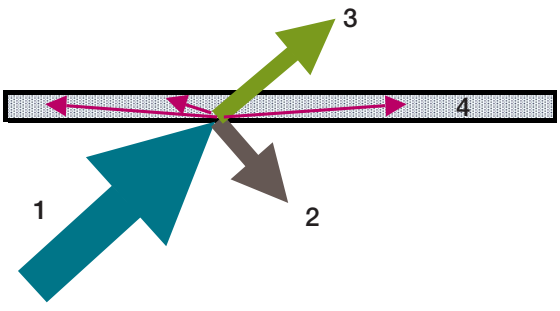
Within buildings, the control of sound involves:
- The Absorption of reflected sound (within a space)
- The Reduction / Insulation of transmitted sound (between spaces).

Passive ceiling systems Absorb and/or Block sound.

The ceiling performance factors are expressed in:
- Sound Absorption = α_w
- Single Pass Sound Reduction = Rw
- Double pass Sound Attenuation = Dnfw.

Absorption α_w is needed to control the reflection of sound which influences:
- Reverberation (significant effect in partitioned spaces)
- Propagation (significant effect in open spaces)
- Noise levels (small effect in all areas).

The sound absorption of a ceiling tile is determined as follows:



1 Incident sound
2 Reflected sound
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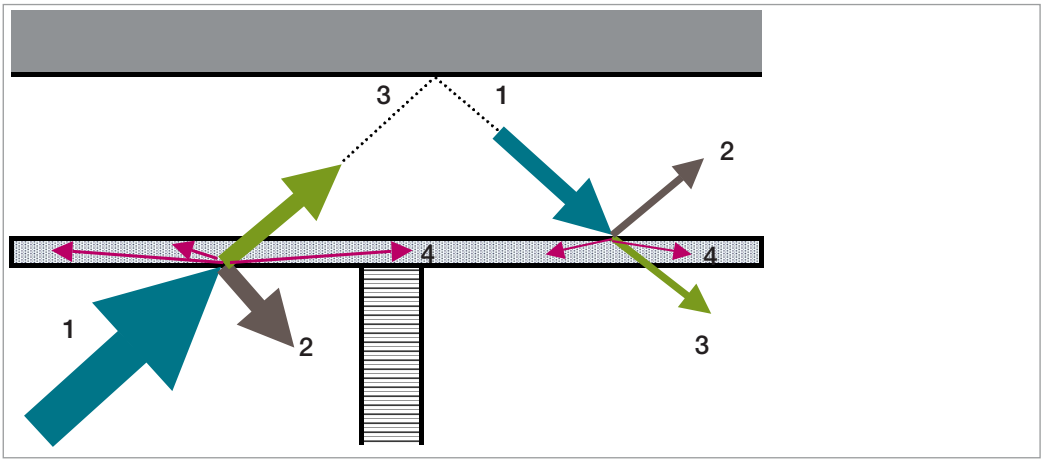
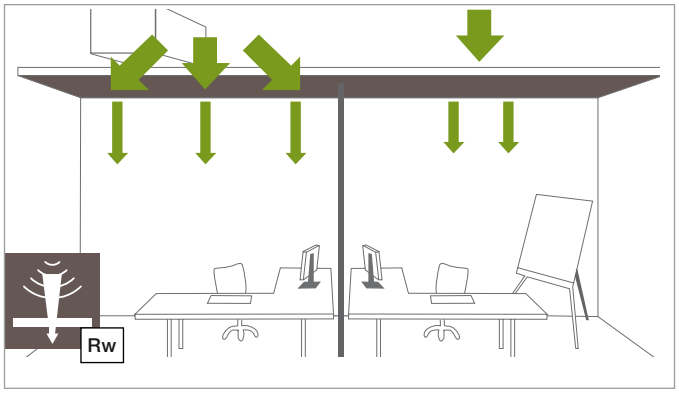
3+4 Sound absorption

Attenuation Dnfw is needed to control:
- Transmission of noise between adjacent spaces with a common void above them.



Reduction Rw is needed to control:

- Vertical transmission through the suspended ceiling where the noise emanates within the ceiling void.
- Vertical transmission of noise between rooms (both above and below) through the structure and suspended ceiling.



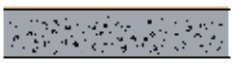
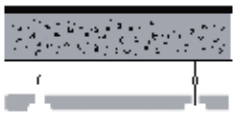
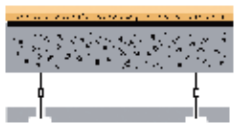
The contribution that suspended ceilings can make towards the achievement of adequate airborne sound insulation through floors.

Massive concrete based floor constructions are normally required in order to achieve adequate levels of airborne (Rw) sound reduction to comply with advisory or legislative requirements.

However, sometimes the sound reduction of a concrete ceiling soffit is insufficient and nearly always offer very little useful sound absorption to the rooms below them which could, in the absence of any other significant sound absorption, result in excessive reverberations times and noise levels. Suspending a 'hard' or 'soft' mineral fibre ceiling below the soffit may not only dramatically improve the sound absorption to the room but can also improve the overall sound reduction of the floor construction.

While 'soft' fibre ceilings can undoubtedly provide higher sound absorption than 'hard' fibre equivalents, their contribution to sound reduction is obviously lower as the table below shows.

The advantage of approximately 3 dB that 'hard' ceilings have over 'soft' fibre products is noticeable.

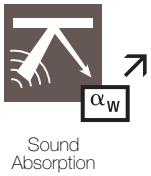
			Rw (dB)
Typical solid in-situ concrete floor. Minimum thickness 150 mm.			**45 - 50**
Typical solid in-situ concrete floor with a suspended ceiling system.		With typical tiles in 'hard' fibre from Armstrong	**50 - 55**
		With 'soft' tiles	**47 - 52**
Typical solid in-situ concrete floor with proprietary lightweight floating floor using a continuous layer.		With typical tiles in 'hard' fibre from Armstrong	**55 - 60**
		With 'soft' tiles	**52 - 57**

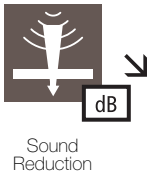
Construction – Concrete with a PVC/Vinyl or carpet surface

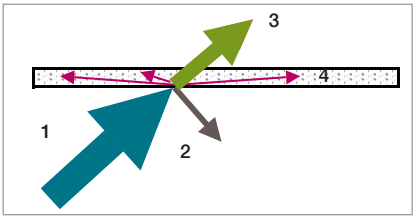
Physical characteristics of ceiling tiles

The physical characteristics of the material of ceiling tiles determine its acoustical properties. Three factors play a role: • **porosity** • **thickness** • **density**

• **When porosity increases,** the absorption performance increases as well, but the ability to block sound decreases.

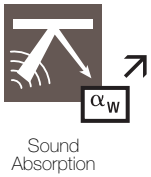


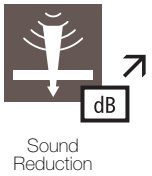


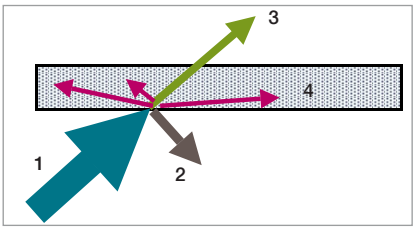


The sound within the room diminishes but noise from outside penetrates more easily.

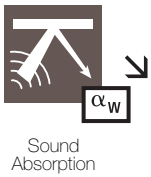
• **When thickness increases,** the absorption and insulation performances increase as well.

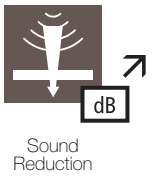


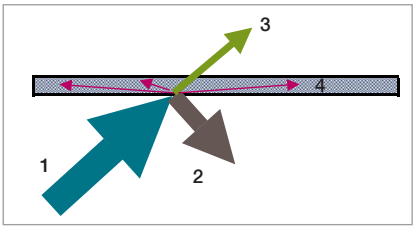




• **When density increases,** the insulation performance increases as well, but the sound absorption decreases.







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The main differences between Sound Absorption & Sound Reduction

	SOUND ABSORPTION	SOUND REDUCTION
CONTROLS	Reflections within rooms	Transmission between rooms
EFFECT UPON	Performing & listening conditions	Privacy & Disturbance
BENEFITS	Room occupants	Room neighbours

Read more on the Active Acoustic Brochure

Read more on the General Acoustic Brochure

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