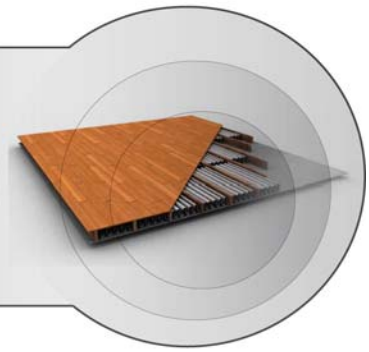
FACT SHEET 9

Sound Insulation for Floors



The sound insulation of floors refers to the ability of a floor system to reduce noise entering your residence from below and noise caused by movement such as walking.

Key Issues and Considerations

When designing or modifying a floor, consideration should be given to noise and impact insulation from other apartments and integration with other building elements.

Noise and Impact Insulation

A particular concern in the acoustic design of floors is impact sound insulation to apartments located below. Impact noise is generated by activities such as walking. The floor surface finish and overall method of construction has an effect on impact noise. A well designed floor/ceiling system should insulate against both impact and airborne noise.

New residential apartment buildings are usually constructed with a minimum 150mm concrete slab floor, and either carpet, acoustically installed tiles or timber flooring. This type of construction usually results in an acceptable level of noise control and impact isolation.

Old buildings and converted warehouses often have lightweight timber floors and exposed beams, resulting in poor noise control. Noise problems associated with these situations include:

- poor airborne sound isolation, resulting in noise from talking, radios, televisions, telephones, doors closing, washing machines etc being audible through the ceiling and/or floor;
- poor floor impact insulation, resulting in noise from residents walking on timber or tiled floors being audible below; and
- poor low frequency isolation from residents walking or children running on carpeted floors, producing a thumping or booming noise in the unit below. In the worst cases, light fittings and ceilings rattle.

To reduce noise in timber floors there are a number of things to consider:

- floor surface;
- insulation between floor/ceiling;
- ceiling material and thickness; and
- resilient isolation of components.

The City of Melbourne recommends an acoustic consultant be employed to conduct an assessment of the property prior to undertaking any sound insulation, to ensure the proposed changes provide significant noise reduction.

Integration with other building elements and thermal considerations

Treatment of floor/ceiling systems to reduce noise should be considered alongside thermal insulation requirements. Keep the age of the building in mind when refurbishing as older buildings were subject to lower acoustic standards. It is also important to consider the acoustic construction of other building elements that connect to the floor/ceiling system.

General Acoustic Design of Floors

When choosing a floor to reduce noise, you should consider: materials, general construction and best practice design.

Materials

Floor surface

When considering the floor finish there are two main concerns:

- noise to below, and
- reflected sound from inside the room.

For timber constructed floor/ceiling systems, the most significant material in impact sound insulation is the surface finish. Hard surfaces like concrete, timber or tiles are more problematic than soft finishes such as carpet because they can increase structure borne sound transference.

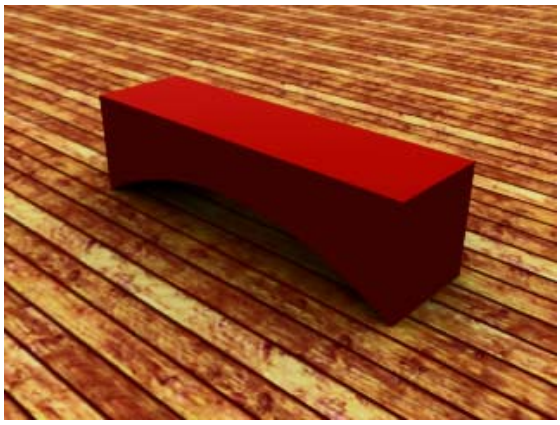
Carpet is one option to consider for improving the impact noise insulation of floors. Alternative hard-floor systems can also be considered. The choice of floor covering is important as part of the initial fit-out and as part of a future upgrade.

The design for both hard floor covering and carpet options should allow for:

- sufficient ceiling height to be maintained in all rooms; and
- an excessively high step not being formed between carpet and other floor surfaces within the unit.

Smooth surfaces in a room tend to reflect high frequency sound. Surfaces such as carpet offer better absorption of sound than hard surfaces like concrete and timber, which can increase sound reflection or reverberation. In rooms with hard floor surfaces, soft furnishings such as rugs and drapes are helpful in overcoming reverberation issues.

The ability of a surface material to reduce sound reflection (sound absorption) is not the same as its ability to control noise passing through from the unit below (sound insulation). It is important to make this distinction when choosing a floor system. High mass, dense and well sealed materials generally offer improved sound insulation.



Floor Surface – timber and concrete floors are more problematic acoustically

Insulation

The sound insulation of a lightweight floor system can be improved by introducing sound absorption into cavities. When there is a gap between the floor and ceiling below it can be filled with insulation batts. Generally, the greater the density of the insulation, the more sound reduction is achieved.

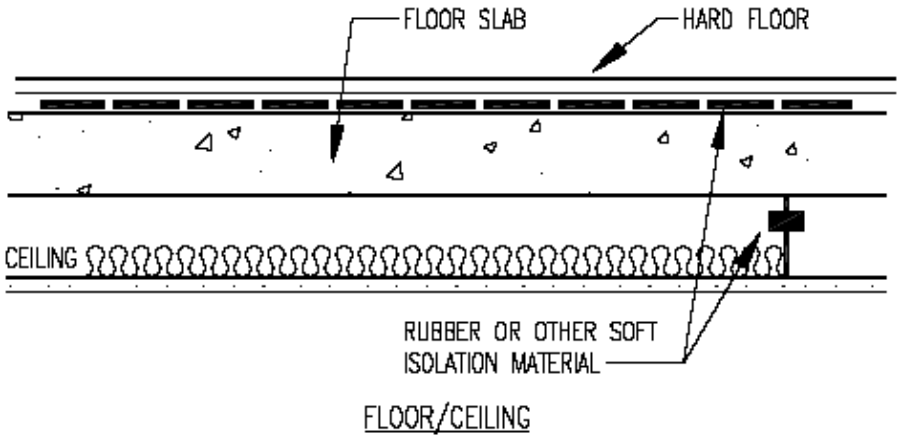
General Construction

Increasing the thickness of building materials and ensuring all gaps are sealed can help considerably with sound insulation.

Resilient Isolation
To improve sound insulation and decrease structure-borne noise in timber construction, it is best to isolate the building components from one another using resilient compounds (such as rubber or silicone), or detach/decouple the construction altogether in a suspended ceiling or floating floor construction.

A floating floor is a method of construction where the floor sits on isolating components, resulting in a reduction of structure-borne noise transference.

A suspended ceiling can also provide better reduction of structure-borne noise due to the decoupling of the construction. In these designs, the ceiling hangs from resilient hangers attached to the floor joists or concrete slab, allowing more space for services and sound insulation in the ceiling cavity.



Vibration Isolation Treatment – Floor/Ceiling construction
(Image from ABCB Document: Guideline on Sound Insulation)

Best Practice

Isolate the components from one another using resilient compounds (such as rubber or silicone) or by detaching the construction altogether as in a suspended ceiling or floating floor. Proprietary systems are also available that provide increased acoustic performance.

If you have a noise problem, achieving a useful improvement in sound insulation requires a decrease of at least five decibels (dB), preferably 10 to 15dB. An improvement of less than 5dB is normally not worth the additional expense.

If you are comparing quotations for sound insulation, look at the noise reduction performance of different options. Remember that most products will perform better in laboratory conditions than in final installation. Ensure the specified noise reduction of the treatment is presented in decibels or a suitable acoustic measurement. Noise reduction figures presented as percentages can be misleading.

Examples of Design

This section provides further information on design, with examples of different acoustic treatments.

Design Considerations

In general, the sound insulation performance of floor and ceiling elements can be improved by:

- increasing the surface mass of the material;
- the use of additional skins of material, preferably with a cavity;
- increasing the depth of cavities and internal insulation;
- the use of materials with low stiffness; and
- the addition of damping, especially to thin stiff elements.

Sound Absorption
The sound insulation of a lightweight construction can be improved by introducing sound absorption batts into cavities. These batts can also increase thermal performance.

It should be noted that thermal insulation requirements become less important in situations where the floor/ceiling system is separating two living spaces that are expected to be maintained at the same temperature. Where there is no significant difference in temperature between adjoining residences, insulation does not usually offer a significant thermal benefit.

Where absorption is already present, marginal improvements can be produced by upgrading the sound absorption material. The sound absorption performance of a material can be quantified by its noise reduction coefficient (NRC). Different materials such as glass wool, rock wool, polyester fibre, natural wool or cellulose fibre are sound absorptive. There are several proprietary ceiling systems incorporating insulating materials and offering increased noise reduction.

Sound reduction performance can be slightly improved by:

- using an insulating material with thinner fibres;
- increasing the density of, and hence the number of fibres within a given material; and
- increasing the thickness of the absorbing material itself.

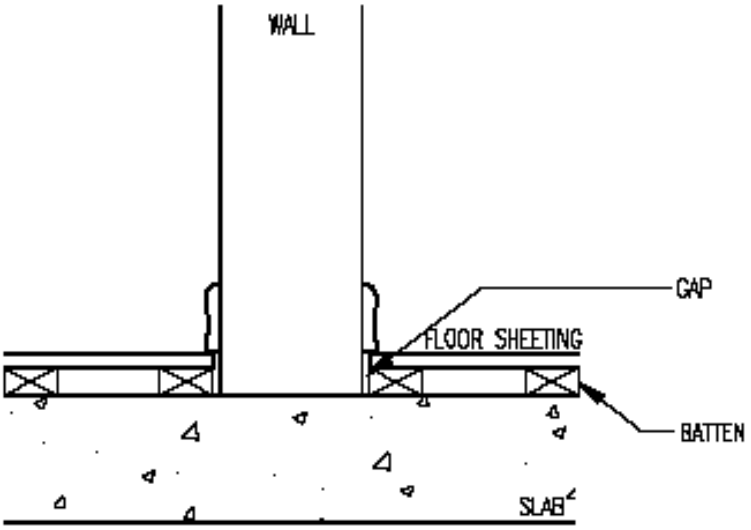
In most cases the ceiling must be resiliently mounted for insulation to have acoustic benefit.

Floor/Ceiling Construction – installing batts
(Image courtesy of CertainTeed pty ltd)

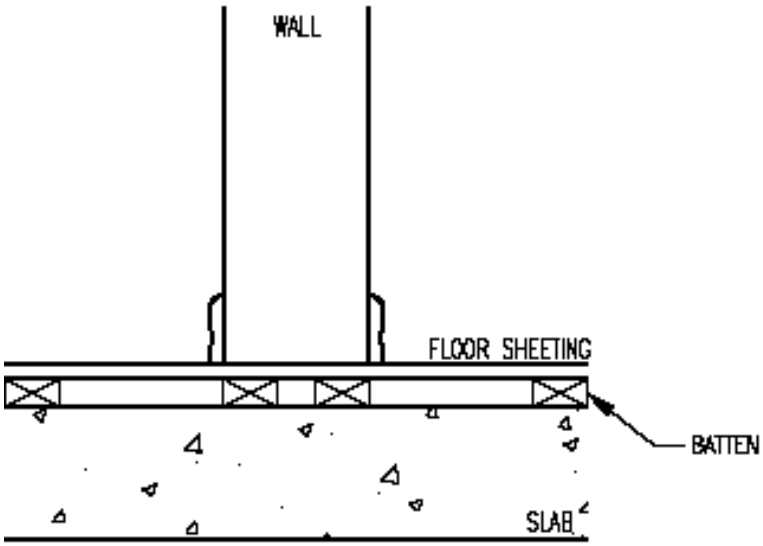
Resilient Isolation

The transference of structure-borne noise can be reduced by increasing the vibration isolation in a system. This can be done by:

- using a suitably soft connecting material such as rubber, neoprene or isolation springs between the building elements;
- increasing the size of the air gap or cavity between the panels; and
- introducing vibration isolated floors to adjacent rooms located on a common slab.



Floor Lateral Vibration Isolation - Good Design practice – Floors in adjacent rooms Isolated
(Image from ABCB Document: Guideline on Sound Insulation)



Floor Lateral Vibration Isolation - Bad Design practice – common floor between adjacent rooms
(Image from ABCB Document: Guideline on Sound Insulation)

Different Acoustic Treatments

The following acoustic treatments represent three different levels of acoustic design. They are provided as an example only and are by no means exhaustive. The City of Melbourne recommends consultation with an acoustician to ensure correct design for your project.

Minimal Treatment

Minimal timber construction:

- 19mm tongued and grooved boards over 175mm x 50mm timber joists; and
- 75mm mineral insulation with a density of 11kg/m³ laid between joists on 10mm plasterboard fixed to underside of joists.

This example is indicative of timber construction with minimal thought given to sound insulation or absorption and is similar to that found in converted warehouses and terrace type dwellings. The construction does not meet Building Code of Australia 1996 or 2004 requirements.

Footfall noise is both transferred and reverberated due to the hard surface finish and continuous construction. It is possible to increase the impact insulation in a number of ways including carpeting the floor surface or using other soft finishes such as cork. In conjunction with carpet, soft furnishings such as drapes can help absorb sound generated within a space.

Standard Treatment

Standard reinforced concrete construction:

- 150mm reinforced concrete slab;
- 28mm furring channels and isolation mounts fixed to underside of slab @ 600 centres;
- 65mm polyester insulation fixed between furring channels; and
- 13mm plasterboard to underside of furring.

This method of concrete construction is an example of the minimum required to comply with the regulations of the Building Code of Australia regarding sound insulation for floors between dwellings.

It can provide impact sound insulation of Lnw+Ctr = 62 and airborne sound insulation of Rw+Ctr = 50. This design takes into account bass frequencies generated by stereos and home theatre systems. It is possible to increase the impact insulation in a number of ways including carpeting the floor surface or using other soft finishes such as cork.

Noise can also be reverberated inside a space due to the hard surface finish of concrete. In conjunction with carpet, soft furnishings such as drapes can help to absorb sound. Using these elements can dramatically decrease noise reverberation in your home.

Improved Treatment

Standard reinforced concrete construction with carpet:

- 200mm reinforced concrete slab with carpet on underlay.

This method of concrete construction is also an example of the minimum required to comply with the regulations of the Building Code of Australia regarding sound insulation for floors between dwellings. By carpeting the floor surface or using other soft finishes such as cork, it is possible to increase the impact insulation and absorption of a floor.

For noise generated within a space, soft furnishings such as drapes and carpet are helpful. In conjunction with carpet, soft furnishings can help absorb sound generated within a space. Using these elements can dramatically decrease noise reverberation in your home.

Challenges

Challenges to good acoustic design of floor/ceiling systems can arise from renovation works and flanking paths.

Renovation

Refurbishments have the potential to severely compromise the acoustic performance of a building. Old buildings and converted warehouses often have lightweight timber floors and exposed beams, resulting in poor noise control.

In designing a floor system that uses carpet for noise reduction, consider the possibility of future renovation works. Where carpet is replaced by hard floor finishes during renovation works, the impact isolation performance of the floor will invariably be reduced. The reduction could be as high as 25 to 30 dB.

This level of reduction is difficult to recover and the use of resiliently suspended ceilings becomes an important part of any design solution. However, a ceiling of this type would need to be installed at the time of construction as there is no guarantee of access to the unit underneath for retrofit later.

Even with the addition of a resiliently suspended ceiling, the floor/ceiling system may still be 15 to 20 dB lower than the original carpet design. In this case, noise may still be experienced in the apartment below.

When renovation is a future possibility, it is advisable to ensure sufficient detail is readily available to future occupants via the body corporate for floor, ceiling and wall modifications.

When renovating an existing structure, the following areas may require extra detailing and attention.

Flanking Paths - Sealing Gaps

In order to minimise flanking paths, the design of a floor system will need to consider detail for all connecting walls.

Sealing gaps at the perimeter of floor/ceiling systems is essential, as gaps at the junction of these building elements are a common flanking path (especially in renovated buildings). Gaps can also open up over time from building movement, limiting sound insulation.

- Gaps at the perimeter of wall and floor/ceiling systems should be sealed and airtight, using an appropriate mastic compound.
- Robust acoustic design should be used to allow for site conditions where surfaces may not be straight, true or square. This is especially important around joints, walls, floors, ceiling junctions and penetrations
- The treatment applied to seal gaps should be sufficiently flexible to allow for building movement
- The floor/ceiling system will need to control noise and vibration travelling through timber floorboards, joists, beams, external walls or ceilings

You may also need to consider other building requirements in design and construction.

- Avoid potential fire hazards from acoustic treatment by covering electrical wiring or lighting with acoustic insulation.
- When upgrading acoustic ratings, the additional mass of building elements should not exceed maximum acceptable structural loading.
- Consider variations in the building fit-out driven by unexpected site conditions that may require revised designs.

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Image on page 5 courtesy of CertainTeed pty ltd

Acoustic Consultant

The City of Melbourne recommends an acoustic consultant be employed to conduct an assessment of the property prior to undertaking any sound insulation to ensure the proposed changes provide significant noise reduction and value for money.

You should engage reputable, appropriately qualified, experienced/competent acoustic engineers or consultants to do this work. There is a listing for Acoustical Consultants in the Yellow Pages. The Association of Australian Acoustical Consultants (www.aaac.org.au) and the Australian Acoustical Society (www.acoustics.asn.au) are also available to assist you in deciding the appropriate person or company to engage.

Other Fact Sheets

A number of other fact sheets complement the information in this document. These can be downloaded from:

The City of Melbourne website: www.melbourne.vic.gov.au/noise or
City Sounds 2 – Acoustic Design Resource website: http://sound.sial.rmit.edu.au/ADR

Fact Sheet 1: Acoustic Terminology
Fact Sheet 2: Sound Insulation Guidelines
Fact Sheet 3: Room Overviews and Planning
Fact Sheet 4: Sound Insulation for Windows
Fact Sheet 5: Sound Insulation for Glazed Doors
Fact Sheet 6: Sound Insulation for Standard Doors
Fact Sheet 7: Sound Insulation for Exterior Walls and Façade Systems
Fact Sheet 8: Sound Insulation for Interior / Party Walls
Fact Sheet 9: Sound Insulation for Floors
Fact Sheet 10: Sound Insulation for Ceilings
Fact Sheet 11: Sound Insulation for Building Elements and Services
Fact Sheet 12: Air Conditioners
Fact Sheet 13: Audio Equipment
Fact Sheet 14: Sound in the City

Australian Building Codes Board

The Acoustic Design Resource fact sheets contain content sourced from the Building Code of Australia and Guideline on Sound Insulation, published by the Australian Building Codes Board (ABCB). These documents can be purchased from the ABCB website: www.abcb.gov.au

References

This project has been developed by the City of Melbourne in partnership with the Spatial Information Architecture Laboratory (SIAL) of RMIT University.

For more information visit
www.sial.rmit.edu.au

Spatial Information Architecture Laboratory

Contact Us

This fact sheet is part of CitySounds2 - Acoustic Design Resource. To experience CitySounds2 go to:
www.melbourne.vic.gov.au/noise or http://sound.sial.rmit.edu.au/ADR

For further information call the City of Melbourne Hotline on (03) 9658-9658
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