

SOUND INSULATION GUIDELINES

If you are purchasing or renovating a home in the inner city it is important to consider acoustic design. Good acoustic design will reduce noise from services, external areas and other dwellings as well as improve the quality of the living environment.

The acoustic terminology used in this fact sheet is explained in *Fact Sheet 11: Acoustic Terminology*.

Key Issues and Considerations

The wide range of activity in the inner city generates higher levels of external noise than in suburban areas. Noise from activity such as traffic, people on the street, operational commercial sites and waste collection can adversely affect the amenity of those living in the City. As low frequency noise is particularly invasive, reducing the impact of noise from truck engines, buses, music etc. may need to be considered.



To effectively lower the amount of external noise that enters a building and subsequently maintain the amenity of an inner City residence, particular attention to the construction detail of the building is required.

If you are moving into a new apartment or renovating an existing residence, it is recommended you verify any sound insulation specifications with your architect/builder and/or employ the services of an acoustic consultant.

Sound Absorption and Sound Insulation

It is important to choose the correct materials when designing or renovating a residence. When choosing materials for noise reduction, it is important to distinguish between sound absorption and sound insulation as they help to reduce the overall noise level within a space.

The ability of a surface material to reduce sound reflection (i.e. sound absorption) is not the same as its ability to control noise passing into a residence (sound insulation). It is important to make this distinction when choosing materials to reduce noise entering your residence.

Sound insulation refers to the ability of a material to stop or reduce airborne sound. High mass, dense and well sealed materials generally offer improved sound insulation. The following suggestions are an introductory guide on sound insulation and may not be appropriate for all residences or sources of noise. In order to reduce noise effectively, building materials need to have suitable qualities. Higher density and thicker materials are generally more effective at reducing the level of a range of sounds.

After sound has entered a residence (or where it is generated inside a room) it can be reduced by using sound absorbent materials. Sound absorption is the ability of a material to absorb sound within a room and sound absorbent materials such as curtains or carpet are commonly used to reduce sound reflections or echoes which will subsequently improve the sound quality within a room. A room containing smooth or hard surfaces, like concrete or timber will reflect high frequency sound and the sound will reverberate around the room reducing overall sound clarity.

Adelaide (City) Development Plan

The Adelaide (City) Development Plan (www.planning.sa.gov.au/edp/pdf/AD.PDF) provides limits on the allowable noise intrusion into noise sensitive developments (such as residences). Noise attenuation measures are required in a noise sensitive development to achieve the following criteria:

- World Health Organisation (WHO) sleep disturbance criteria:
30 dB(A) L_{eq} and 45 dB(A) L_{max} inside bedrooms
- Australian / New Zealand Standard (AS/NZS) 2107: 2000 - 'Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors' internal design sound level criteria:

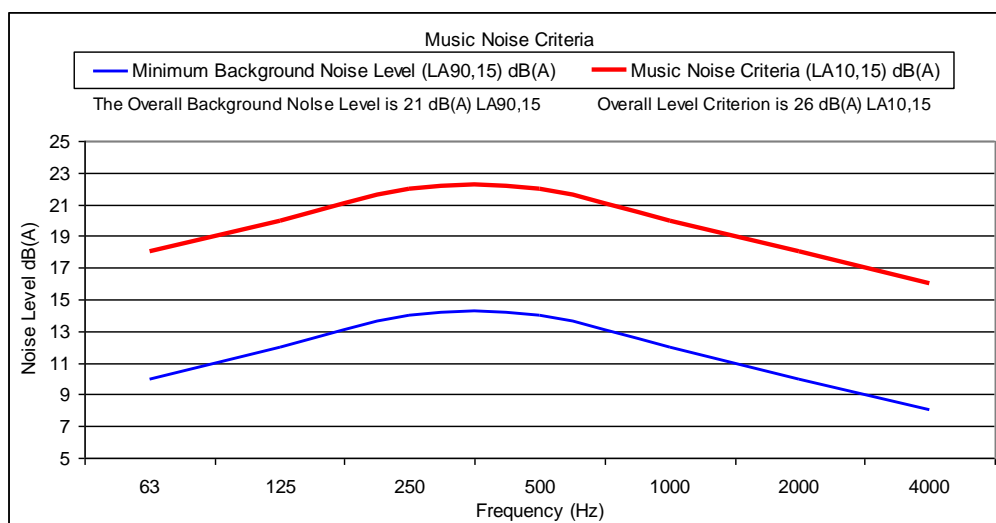
| Type of Occupancy / Activity | Maximum Recommended Design Sound Level, L_{Aeq} dB(A) |
|---|---|
| Houses and Apartments near Major Roads: | |
| Living Areas | 45 |
| Sleeping Areas | 40 |
| Work Areas | 45 |
| Houses and Apartments near Minor Roads: | |
| Living Areas | 40 |
| Sleeping Areas | 35 |
| Work Areas | 40 |

NOISE TECHNICAL FACT SHEET

#1

- Music noise criteria:

The noise level in any bedroom is to be no more than 8 dB above the level of background noise ($L_{90,15min}$) in any octave band of the sound spectrum when exposed to music noise from any existing entertainment premises. Additionally, the music noise ($L_{A10,15min}$) must be less than 5 dB(A) above the background noise ($L_{A90,15min}$) for the overall (sum of all octave bands) A-weighted levels.



*Note: the noise criteria is based on the windows of the noise sensitive development being closed and any existing entertainment premises complying with relevant noise emission legislation.

Although the noise criteria relates to new residential development it also provide guidelines for acceptable noise levels within existing residences.

The City of Adelaide Development Guide on 'Noise Sensitive Development' suggests several common solutions to attenuate noise into City residences. These solutions refer to building layout and upgrading the building facades. Although the common solutions suggested relate to proposed new developments, those which refer to upgrading the façade will also be practical solutions to attenuate noise in existing residences. Refer to City of Adelaide Development Guide from the City of Adelaide website.

Design Strategy

Appropriate design and planning of a dwelling is critical to ensure adequate reduction of noise. It is important to decide on a strategy and plan an approach for achieving the intended level of sound insulation and meet all relevant building requirements during the initial design stage.

Keep the age of the building in mind when refurbishing, as older buildings were subject to lower acoustic standards.

NOISE TECHNICAL FACT SHEET

#1

If the residence is in a conservation area or a heritage place, check Council's planning requirements before undertaking any acoustic insulation building work. Also consult the body corporate if you are intending to modify or renovate apartments.

The design of a residence should properly consider sounds in your neighbourhood and your expectations regarding noise. By employing an acoustic consultant during the design stage you can reduce noise disturbance while enjoying the vibrancy of the inner City.



Heritage, urban design and neighbourhood character are important issues when renovating old buildings. Any works you are considering should respect the unique heritage characteristics of the building.

When detailing a buildings construction it is important to choose materials for wall, floor, ceiling, bulkhead and riser systems that have been acoustically tested and documented. Where specific acoustic properties are required and a supplier is proposing a particular building system or individual building elements it is preferable to receive a valid test certificate on the system or building element as well as a clear statement about the requirements and techniques for constructing the particular system or installing the element. Do not substitute materials without proper testing and documentation as it may adversely affect the acoustic performance of the building and may be in contravention of any Development Approval for the work. For all building elements, the manufacturer's installation instructions should be strictly followed.

The published acoustic performance of a product or system is measured under laboratory conditions and the actual performance of the product after installation is often reduced. To minimise the difference it is important to ensure the correct method of installation is understood at an initial stage, including the construction details at the junctions of different building elements.

Ecologically Sustainable Design

When designing a residence to minimise the impact of noise, it is important to consider principles of ecologically sustainable design (ESD). Significant factors in ESD include:

- layout of the living spaces and positioning of residences to improve the flow of air induced by natural forces for breathing and thermal comfort; and
- orientation of the different living spaces to enhance access to natural light, views and winter sun, while reducing summer heat gains.

These factors can have a significant impact on the quality of the living experience and cost of maintaining a comfortable indoor environment. There is a strong relationship between ecological concerns and acoustic design. Noise impacts will be influenced by ESD factors such as:

- method of ventilation used;
- selection of heating and cooling system, such as hydronic, radiant floor heating or air systems; and
- the design of building elements such as windows and walls for thermal insulation.

A well designed residence will respond to design principles that improve ecological performance and minimise noise impacts. These principles need to be considered from the outset of the project to ensure that the building's design responds optimally to its urban context, especially the bio-climatic and acoustic environment.

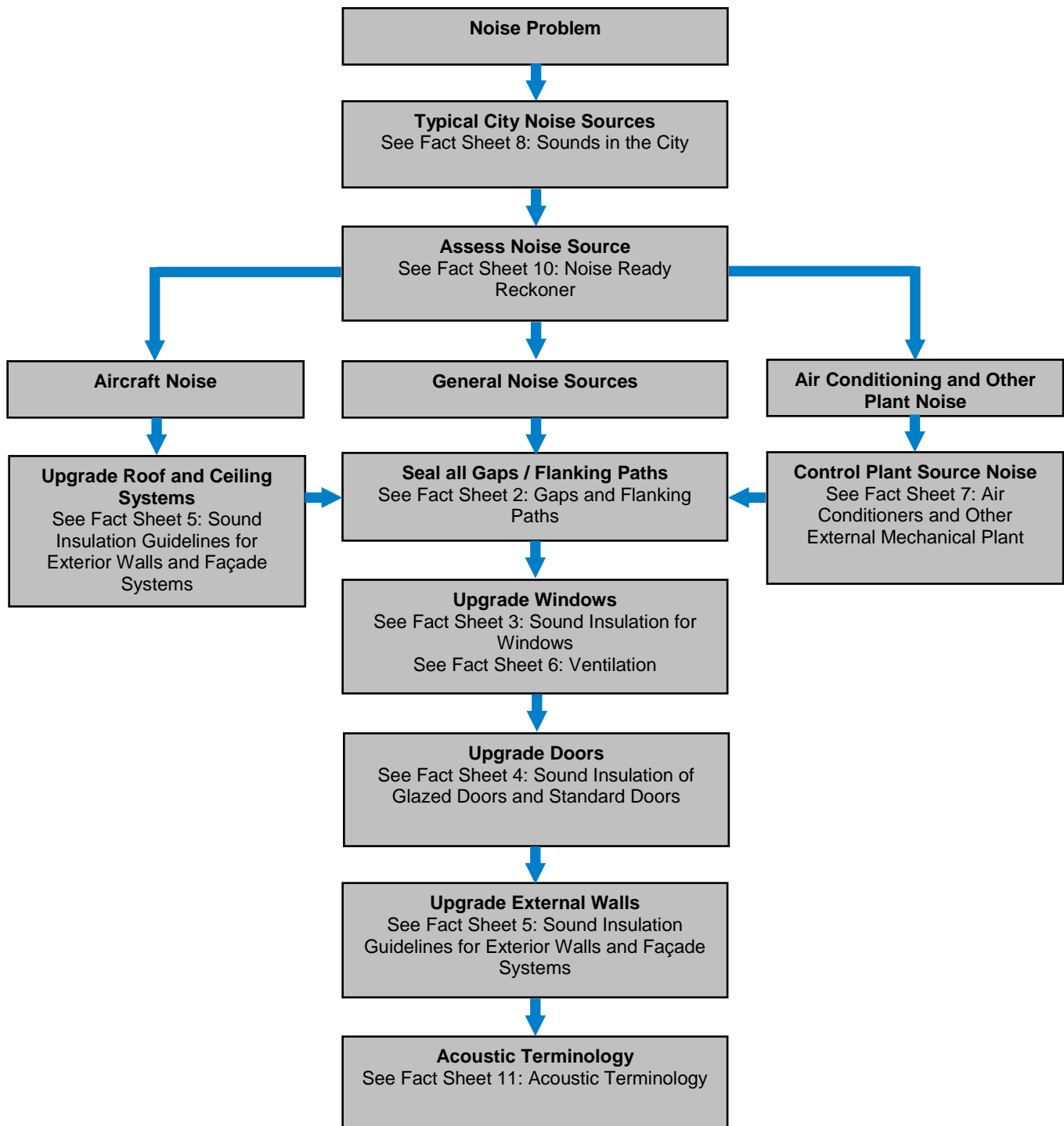
Once the building's form, facade, orientation and layout of functional spaces are formulated to best respond to ecological and acoustic design principles, the performance and design of specific building elements can be addressed, including their thermal and acoustic performance. In many cases, well considered acoustic design can be achieved while making significant ecological performance gains and vice-versa.

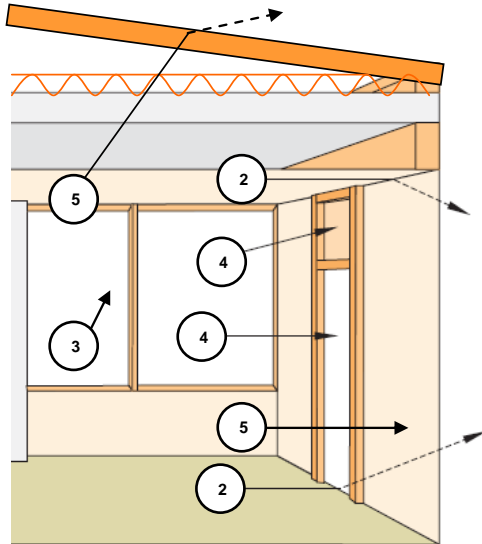
NOISE TECHNICAL FACT SHEET

#1

Noise Control Process

The following flow-chart illustrates a good approach to minimising external noise ingress into residences. Each process is discussed further below and elaborated on in the other Noise Technical Fact Sheets.





Source: Boral Selector - Plasterboard Systems

Diagram Legend

2. Air leaks through gaps, cracks or holes
3. Windows
4. Doors and Lightweight Panels above Doors
5. External Walls and Roof-Ceiling Systems

**Note: diagram numbers refer to relevant Noise Technical Fact Sheet.*

Gaps / Flanking Paths

Sound can enter your residence in unexpected ways, such as through gaps and cracks around the edges of building elements. These noise paths are commonly referred to as flanking paths and are often a cause of poor sound reduction in residences.

Flanking is the transfer of noise through paths around a building element, rather than through the building element directly. Flanking paths occur through:

- gaps and cracks in a building element;
- incorrectly sealed junctions between two materials;
- noise passing through gaps and weaknesses around building elements; and
- penetrations in building elements from building services.

Incorrectly installed acoustic control measures can provide flanking paths that will reduce the success of noise reduction techniques. Older buildings can develop acoustic problems as they age due to the likelihood of gaps and cracks in building elements increasing in size and sealed elements failing thus increasing the size and number of flanking paths and subsequently increasing the likelihood of significant noise problems.

To reduce noise transfer via flanking paths it is necessary to ensure that all penetrations, joints and junctions are sealed airtight with a flexible caulking compound. This is often difficult to retrofit. To save time and money, these issues should be addressed in the initial design or during the construction process.

For more information see *Fact Sheet 2: Gaps and Flanking Paths*.

*Note: when windows are fixed closed and sealed air tight, ventilation is required to provide the required out door air flow into a residence. See *Fact Sheet 6: Ventilation*.

Windows and Glazed Doors

Windows and glazed doors will provide an acoustic weakness to the facade of a building as noise is transferred more easily through glazing than through the external walls. Improving the acoustic performance of windows and doors will reduce external noise entering your residence.

The larger the glazed area, the greater the sound transmission through the element, so the level of noise reduction will be dependant on the area of glazing that is treated. The following is recommended to acoustically treat any windows or glazed doors:

- use perimeter seals around windows so that flanking paths are minimised. Note that rubber seals are more effective than brush seals;
- replace existing glass with a thicker pane or replace standard glass with laminated glass;
- replace existing glazing with a double glazed system, or retrofit existing glazing with another pane to double glaze the system. Note that the larger the air gap in the double glazed system the better the noise reduction; and
- use high quality perimeter door seals around glazed door.



For more information see *Fact Sheet 3: Sound Insulation for Windows* and *Fact Sheet 4: Sound Insulation for Glazed Doors and Standard Doors*

Standard Doors

Standard doors will also provide an acoustic weakness in the external façade of a building. Generally, the sound insulation properties of a door are dependant on the door composition and the use of quality door seals.

Hollow core doors are lightweight and are primarily for interior use as they have little inherent acoustic or thermal insulation properties.

Solid core doors should be used for the exterior and wherever increased sound, fire or thermal insulation is required. High quality perimeter door seals should be used around the door and proper installation of the door seals are required to ensure that there is a good seal between the door and the door frame.

For more information see *Fact Sheet 4: Sound Insulation for Glazed Doors and Standard Doors*.

Sealing the Gaps

As mentioned, any gaps around the perimeter of doors and windows should be sealed air tight.

A sound rated door should not have any gaps or air vents as these will defeat its sound insulation properties. If a doorway has a gap at the bottom, use an 'all weather seal,' such as a metal strip with a rubber flap mounted to it, or thermal sealing foam strips.

Generally:

- Full perimeter acoustic seals should be used on all access doors and sensitive windows.
- Brush type seals have poor acoustic insulation; a tight rubber seal will offer better results.
- Allow for the adjustment and maintenance of acoustic seals on access doors and windows.

Test Your Existing Window and Door Seals

- Before purchasing new glazing or doors, consider fixing or installing seals on your existing windows and doors. This could achieve the noise reduction you want.
- Temporarily seal any gaps around windows and doors with plasticine, or an equivalent malleable, but weighty substance.
- Monitor the improvements for several days and nights. If improvements are sufficient, sealing devices can be fitted that allow windows to open, while maximising noise reduction when closed.

*Note: when windows are fixed closed and sealed air tight, ventilation is required to provide the required out door air flow into a residence. See *Fact Sheet 6: Ventilation*.

Insulation

Wall and ceiling insulation, such as noise control batts, can be used to assist in noise reduction. Noise batts offer acoustic insulation and are ideal for installation in metal and timber stud wall systems, and above ceilings. They are also effective in improving energy performance and reducing heating and cooling costs. Generally, thicker insulation within a cavity contributes to improved sound reduction.



Image courtesy of CertainTeed Acoustic

Quick Tips on Batt Installation

- Always remember to wear gloves, a mask and goggles if you are installing batts yourself.
- Some batts are made from recycled glass. Using recycled products reduces the amount of waste going into landfill, helping our environment!

External Walls and Roof-Ceiling Systems

Good design of the external walls, roof and ceilings will significantly reduce noise ingress into a residence, and as such, the construction of these elements are important to the overall acoustic design of a building.

Walls

External walls are usually constructed from one of the following:

- steel / timber studs;
- masonry;
- blockwork; or
- brickwork.

There are two primary construction techniques for walls:

Cavity Wall Construction

This type of construction consists of two leaves of walling separated by a cavity. The most popular forms of cavity wall construction are brick veneer and cavity masonry construction. Brick veneer is constructed with an external leaf of masonry and an internal leaf of lightweight walling such as plasterboard clad timber or steel frame. All wall construction must comply with the requirements of the Building Code of Australia.

Single Skin Walling

Walling of this type may be a single leaf of masonry construction or lightweight construction. The lightweight construction will usually be a steel or timber frame with plasterboard internal wall linings and proprietary external linings that can have paint or render finish.

Airborne noise transmission through the external walls can be minimised by:

- employing either thicker/heavier wall systems, or systems with larger cavities and moderate cladding thickness;
- ensuring all junctions are sealed air tight; and
- using acoustic insulation in the wall cavity.

Roof - Ceiling Systems

Residential ceilings are typically a single layer of plasterboard direct fixed to the ceiling support structure with insulation in the cavity between the ceiling and the roof. The roofs are generally clad with tiles or sheet metal (such as colorbond roofing).

Increasing the thickness of the plasterboard lining for walls and ceilings (by using multiple layers or increasing the thickness of the sheet from the nominal 10mm thickness) may also increase the sound insulation of the system. Where multiple layers are used the joints between layers must be staggered to ensure flanking paths are not created at sheet joins.

Additionally, fire-rated or sound-rated plasterboard may increase the sound insulation of a system.

For more information see *Fact Sheet 5: Sound Insulation for Exterior Walls and Facade Systems*.

Air Conditioning and Other Machines

Noise from externally located air conditioners, pumps and other machines may require noise control measures to minimise noise intrusion into nearby residences. Noise control measures include properly designed screens and enclosures to shield the equipment and the replacement of existing noisy equipment with a quieter alternative.



The noise emission from residential air conditioning and other machines is regulated by the Environment Protection (Machine Noise) Regulations 1994. The maximum permissible noise level during night time periods is 45 dB(A), the specified times varies depending on the class of machines.

The noise emission from commercial air conditioning plant is regulated by the Environment Protection (Industrial Noise) Regulations 1994 and the Adelaide (City) Development Plan (www.planning.sa.gov.au/edp/pdf/AD.PDF)

The maximum permissible noise level is 55 dB(A) from 7:00am to 10:00pm and 45 dB(A) from 10:00pm to 7:00am. In or adjacent to a Residential Zone, the North Adelaide Historic (Conservation) Zone or the Park Lands Zone maximum permissible noise level is 50 dB(A) from 7:00am to 10:00pm and 40 dB(A) from 10:00pm to 7:00am.

If you are experiencing excessive noise from any air conditioning plant or other machines, raise the problem with your neighbour or contact management of the premises to advise them of the problem. If there is no response, contact Council's Environmental Health Services to investigate on (ph) 8203 7118.

For more information see *Fact Sheet 7: Sound Insulation for Air Conditioners and Other External Mechanical Plant*.

Best Practice

- 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 15 dB. An improvement of less than 5 dB is normally not worth the additional expense as the change will only be just perceptible.
- If you are comparing quotations for sound insulation, look at the noise reduction performance of different options, remembering that most products 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.

Acoustic Consultant

If you are considering any sound insulation, it is recommended that you verify any sound insulation specifications with your architect/builder and/or employ the services of an acoustic consultant to ensure the proposed changes provide significant noise reduction.

To contact an acoustic consultant visit the Yellow Pages Directory (under Acoustical Consultants) or for an acoustic consultant who is part of the Association of Australian Acoustical Consultants (AAAC) visit www.aaac.org.au

Other Fact Sheets

A number of other Noise Technical Fact Sheets complement the information in this document. These can be downloaded from the City of Adelaide website: www.cityofadelaide.com.au/noise

Fact Sheet 1: Sound Insulation Guidelines

Fact Sheet 2: Gaps and Flanking Paths

Fact Sheet 3: Sound Insulation for Windows

Fact Sheet 4: Sound Insulation for Glazed Doors and Standard Doors

Fact Sheet 5: Sound Insulation for Exterior Walls and Facade Systems

Fact Sheet 6: Ventilation

Fact Sheet 7: Sound Insulation for Air Conditioners and Other External Mechanical Plant

Fact Sheet 8: Sounds in the City

Fact Sheet 9: Adelaide City Road Traffic Noise Map

Fact Sheet 10: Noise Ready Reckoner

Fact Sheet 11: Acoustic Terminology

Fact Sheet 12: Frequently Asked Questions

Fact Sheet 13: Sound Insulation for Internal/Common Walls

Fact Sheet 14: Sound Insulation of Floors

Fact Sheet 15: Mechanical Plant for Commercial Buildings

Fact Sheet 16: AAAC Star Rating

The Building Code of Australia Compliance

The Building Code of Australia (BCA) should be consulted to ensure that any sound insulation upgrades comply with the requirements of the BCA. It should be noted that although the upgrade of a building element may be acoustically beneficial, it may not comply with the requirements of the BCA.

Australian Building Codes Board

The Noise Technical Fact Sheets contain content sourced from the Building Code of Australia and Guidelines on Sound Insulation, published by the Australian Building Codes Board (ABCB). These documents can be purchased from the ABCB website: www.abcb.gov.au

Standards

The standards which apply in the Development Plan are:

- Australian/New Zealand Standard 2107:2000 “Acoustics - Recommended design sound levels and reverberation times for building interiors”
- World Health Organisation, Guidelines For Community Noise, Edited by B Berglund et al, 1999) (<http://www.who.int/docstore/peh/noise/guidelines2.html>)
- Recognised liquor licensing noise limits (www.olgc.sa.gov.au). These are modified to apply within bedroom and living areas.

Contacts / Additional Information

Additional information can be obtained from:

- Australian Association of Acoustic Consultants (www.aaac.org.au)
- Australian Acoustical Society (www.acoustics.asn.au)
- Office of the Liquor and Gambling Commissioner (www.olgc.sa.gov.au)
- South Australian EPA (www.epa.sa.gov.au/noise.html)
- South Australian Police (www.sapolice.sa.gov.au)
- Yellow Pages (www.yellowpages.com.au search “acoustic”)
- Australian Window Association (www.awa.org.au)

NOISE TECHNICAL FACT SHEET

#1

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Contact Us

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