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SOUND INSULATION FOR WINDOWS

The sound insulation of windows refers to the ability of a closed or fixed window to reduce external noise entering your residence.

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

Key Issues and Considerations

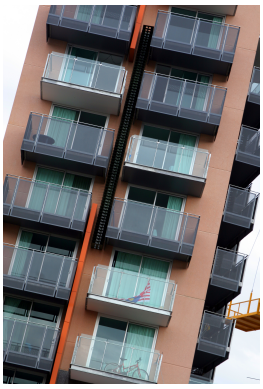
When designing or modifying a window the work must comply with the Building Code of Australia and consideration should be given to the desired reduction of outside noise. Construction that reduces the ingress of external noise must be designed to ensure that it is integral with all other Building Rules requirements such as energy efficiency. If you are concerned about noise, where you live, or are planning to renovate or purchase a house or apartment, you should consider the sound insulation of windows in your residence.

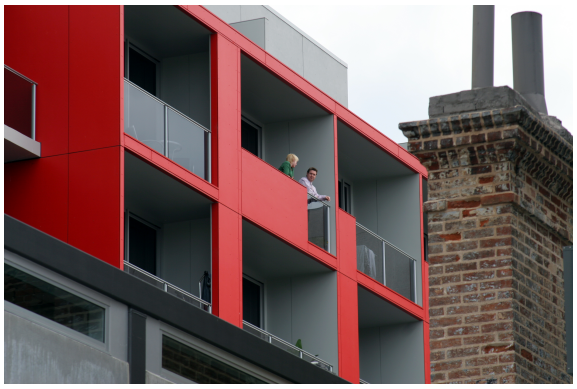
Windows will provide an acoustic weakness to the external facade of a building as noise is generally transferred more easily through glazing than through the external walls. Improving the sound insulation of windows will help to reduce external noise ingress.

The larger the glazed area, the greater the sound transmission through the window, so the level of noise reduction will be dependant on the area of glazing that is treated. The noise transfer through and around windows can be reduced by using thicker and/or laminated glazing, a double glazed system and high quality window perimeter seals.

Noise and Insulation

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 windows is required.





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The ability of a window to reduce noise is dependent on the following elements:

- frame design;
- glazing;
- composition of glass pane type;
- distance between glass panes; and
- seals.

Effect of Area: The larger the glazing area, the greater the amount of noise energy able to pass through it.

Effect of Distance: The more distant the noise source, the lower the noise level. If you situate your bedrooms away from a noise source, you can expect lower levels of noise.

Effect of Height: On higher floors in a building, the street noise level is expected to decrease.

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.

Thermal Considerations

The design of windows to reduce noise should be considered alongside thermal insulation requirements and the local environment. The thickness of glass, type of lamination and size of air gaps directly affects the thermal insulation properties of a window.

General Acoustic Design of Windows

When choosing a window to reduce noise, you should consider:

- materials;
- general construction; and
- best practice design.

Materials

Frame

There are several different materials commonly used for window frames, however, the type of material does not usually have a significant influence on noise reduction properties. The effect of perimeter window seals are the critical issue in window frames.

The window should be well sealed between the frame and the supporting wall as sound can flank around the window when not properly sealed. This also improves thermal efficiency and prevents moisture ingress.

Windows - an example of single and double glazed frames
Source: image (left) courtesy of City of Melbourne's City Sounds2 Noise Fact Sheets and image (right) courtesy of Titane Pty Ltd

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The selection of window type can improve acoustic performance as awning windows with outward opening sashes are preferred to sliding windows as when closed they achieve a positive compression seal against the window frame. There are also proprietary framing systems that provide improved acoustic performance.

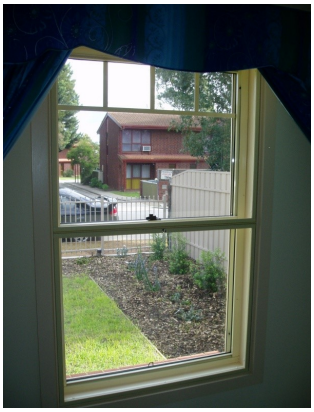
Glazing

There are a number of glazing options available:

- *Single glazing* is the use of a single pane of glass in a window.
- *Double glazing* is the use of two panes of glass in a window separated with a spacer.
- *Triple glazing* is the use of three layers of glass separated with spacers.
- *Secondary glazing or retrofit double glazing* is the use of two separate single glazed windows, where a second single pane is retrofitted to the inside of the existing exterior glazing to effectively double glaze the system.

Generally, secondary glazing is the most cost efficient way of significantly reducing the noise ingress in existing buildings. Where a building is Heritage listed, this may be an option as the second glass pane is retrofitted to the inside of the window and the external façade of the building remains unaffected. It is important to obtain advice from a Heritage Officer when any alterations are proposed to Heritage listed buildings as all work will require Development Approval.

As each residence is different both in its location and construction there is no single best method of acoustic reduction and employing an acoustic consultant can guide you in selecting the best option.



Windows - an example of secondary glazing
Source: Magnetite

Glass Pane Type

For single glazed windows, after appropriate sealing the thickness of glass is the major factor influencing the passage of sound. Typically, thicker glass offers better sound insulation than thinner glass, particularly when the major problem is low frequency noise such as truck engine or music noise. Toughened, coated, wired and patterned glass types behave acoustically similar to standard float glass.

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Laminated glass performs slightly better than other types of glass when the major problem is high frequency noise such as tram wheel squeals or traffic noise. The improvement is due to a PVB (polyvinyl butyral) interlayer that helps to reduce the passage of sound at high frequencies. This layer is sandwiched between two panes of glass. However, laminated glass offers little improvement over other glass of the same thickness when the main problem is low frequency noise.

Laminated glass can also offer a thermal protection layer that can significantly improve energy efficiency. Thick PVB laminated glass in conjunction with tight seals and a well manufactured and installed frame system ensures a good level of sound insulation.

Air or Gas Filled

Insulating double glazed systems with a gas other than air (usually an inert gas such as argon or krypton) in the airspace between panes is another recent innovation in window technology. Gas filling increases thermal insulation but does not significantly contribute to noise reduction.

General Construction

Distance between Glass Panes in Secondary Glazing Systems

In most cases, the larger the air cavity between glass panes in double glazed systems, the more noise the window system can reduce. All air gaps must be sealed to ensure the window achieves maximum noise reduction.

Small air gaps between panes of glass can provide good thermal insulation properties but only offer minimal acoustic insulation. To achieve good thermal insulation double glazed systems should have an air gap of about 12mm between each pane of glass, whereas to achieve good acoustic insulation the air gap should be between 50mm and 150mm. It is important to distinguish between thermal and acoustic insulation as some glazing suppliers may not specialise in both areas.

A moisture absorbing desiccant may be required in the cavity to minimise fogging or condensation in the cavity.

Seals

As with all building structures, cracks enable sound to enter a building. These noise *flanking paths* can defeat noise reduction techniques. This is of particular concern for openable windows. Even windows with good weather stripping can have compromised noise reduction due to air leakage.

Windows should have perimeter acoustic seals to reduce flanking. With fixed glazing, the noise transfer via flanking paths around the pane should be minimised with high quality perimeter seals, for openable windows perimeter seals do not work as well. For openable windows, awning windows are preferable over sliding or pivoting windows as they are able to achieve a positive compression seal.

*Note: acoustic seals only provide suitable performance if they are properly fitted. Seals should be selected on their performance and simplicity of use, and they should be low

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maintenance and have a long life. Solid seals are more effective acoustically than brush type seals in sealing any gaps around the window perimeter airtight.

Test Your Existing Window Seals

- Before you purchase new glazing, consider fixing or installing seals on your existing windows. This could achieve the noise reduction you want.
- Seal any gaps around windows with plasticine, or an equivalent malleable, but weighty substance.
- Consider the improvements for several days and nights.

- If improvements are sufficient, sealing devices can be fitted which will allow windows to open, whilst maximising noise reduction when closed.
- The tighter a window closes the better the noise reduction.

Installation

Correct installation is an important aspect of window treatment. Consult a reputable tradesperson when arranging installation.

Best Practice

- Frames should be well sealed internally and externally to provide acoustic, thermal and moisture protection. Awning windows are preferred to sliding windows as they are able to achieve a positive compression seal. Consider the kind of noise you are trying to reduce when choosing a glazing system. There are several proprietary framing systems that provide improved 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 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. Remember 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.

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Examples of Design

This section provides examples of different acoustic treatments for windows. They are provided as examples only and are by no means exhaustive. Consultation with an acoustic consultant to ensure correct design for your project is recommended.

Single Glazing

Single glazing in non-sealed frame:

- 6mm float glass set in a non-sealed timber frame.

This is the construction of standard external windows. It is usually sufficient for residences where there is minimal external noise. This type of glazing generally does not have good airborne sound insulation (R_w 15 – 20) as thin standard glass is used and the window perimeter is not sealed.

The acoustic performance of single glazing can be improved by replacing the pane with thicker and/or PVB laminated glass and installing high quality perimeter seals.

Source: City of Melbourne's City Sounds2 Noise Fact Sheets

Single glazing with acoustic seals:

- 6mm or 10mm glass set in sealed metal or timber frame.

The use of high quality seals around the window frame reduces flanking around the edges of the glazing. This increases the sound insulation of the window system (R_w 30 – 33).

Single laminated glazing with acoustic seals:

- 6.38mm or 10.38mm PVB laminated glass set in sealed metal or timber frame.

Laminated glass performs slightly better than ordinary glass due to a PVB interlayer that helps reduce the passage of sound, but only at high frequencies. In most cases, thick laminated glass in conjunction with tight seals and a well manufactured and installed frame system ensures a good level of sound insulation (R_w 33 – 36).

Source: City of Melbourne's City Sounds2 Noise Fact Sheets

If the window needs to open, awning styles are preferable over sliding windows as they are able to achieve a positive compression seal.

*Note: standard window frames are generally only suited to 6 – 6.38mm thick glazing; if 10 – 10.38mm glazing is to be used a special proprietary frame may have to be installed.

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Double Glazing

Double glazing:

- 6mm glazing – 50 to 100mm air gap – 6 mm glazing set in a sealed metal or timber frame.

Double glazing will significantly improve the sound insulation of a window system (R_w 40 – 45).

The air gap between the two panes should be at least 50mm with air gaps greater than 100mm being acoustically preferable.

- 50mm air gap is good for reducing noise from speech and cars.
- 100mm air gap is good for reducing truck and other low frequency noise.

Secondary glazing (retrofit double glazing):

- 6.38mm - 12.38mm PVB laminated glass set in a sealed metal or timber frame with 50 - 100mm air gap to original glazing; or
- 4.50mm - 10mm optical grade acrylic set in a sealed metal or timber frame with 50 - 100mm air gap to original glazing.

The installation of an additional glazed pane retrofitted to the existing glazing can significantly improve sound insulation. The improvement on noise reduction depends on the:

- thickness of the original glazing;
- thickness and type of the additional pane;
- distance between the panes; and
- effectiveness of the perimeter window seals.

Source: City of Melbourne's City Sounds2 Noise Fact Sheets.

With high quality acoustic seals, the airborne sound insulation of this type of window is very good (R_w 40 – 47).

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Challenges

Low Frequency Noise

Low frequency noise is usually generated by music or heavy vehicles and is more difficult to control and reduce than high frequency noise. Where low frequency noise is of concern, the overall design of a window may need to be evaluated by an acoustic consultant as standard glazing may not achieve the quality of noise insulation expected.

Standard double glazing (e.g. 6mm glazing - 50mm air gap - 6 mm glazing) is often ineffective at significantly reducing low frequency noise. The reduction of low frequency noise depends on the glazing thickness and the air gap between panes. A single, thick (10 - 12mm) pane of glass may be more effective in reducing low frequency noise than standard double glazing systems. For low frequency noise, laminated glass is no better than float or toughened glass.

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

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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

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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)

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Acknowledgements

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The Fact Sheet contains content sourced directly from the City of Melbourne's City Sounds 2 Noise Fact Sheets, which can be viewed at www.melbourne.vic.gov.au/noise and copyright in this material remains the property of the City of Melbourne. City of Adelaide gratefully acknowledges the assistance of the City of Melbourne in the use of this material in the preparation of the Fact Sheets.

Contact Us

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