Reducing Transport Noise Impacts

A Guide to Home owners

In South Australia, the responsibility for managing transport noise is shared by homeowners and Local, State and Federal Governments.

- **Local Councils** use traffic calming measures, such as round-a-bouts and speed humps, to discourage traffic from entering residential areas, and use planning and zoning provisions to ensure new residential areas are protected from noisy road and rail corridors.
- **The Department of Planning, Transport and Infrastructure** (DPTI) undertakes noise mitigation when constructing *new* or *substantially upgraded* roads or railways adjacent to areas that are sensitive to noise. DPTI's Road Traffic Noise Guidelines (http://www.dpti.sa.gov.au/standards/environment) outline the circumstances where noise mitigation is considered.
- **The Federal Government** sets national noise standards for new motor vehicles sold in Australia.

Homeowners fund noise mitigation for properties that are exposed to *existing* transport noise or who are not eligible for noise mitigation under the Road Traffic Noise Guidelines. When planning to treat your house for noise, it is important to check where the noise may be entering. Consider the following points:

> Windows and doors
> Ventilation openings in walls
> Roof spaces / ceiling / chimneys
> Cracked masonry
> Holes cut for pipes / conduits etc
> Gaps in fencing / gates.

Treating all the entry points for noise will make a more noticeable difference. Rather than spending a lot on one item, it may be more effective to spend a little less on a range of treatments. If planning a significant investment in noise treatments, consider using an acoustic consultant for advice.

No or Low Cost Options

> Close the windows when the noise is greatest.
> Sleep in a room which does not have a direct frontage to the road or rail corridor.

Install a Fence

Fences are effective at reducing noise levels in outdoor spaces as well as indoor spaces. To establish an effective noise barrier, a fence must be high enough to break line-of-sight between you and the

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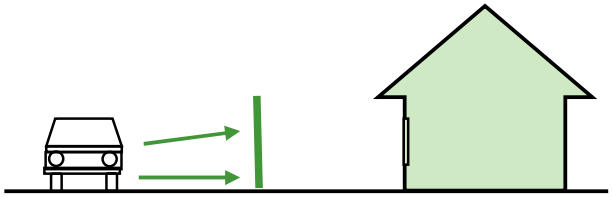
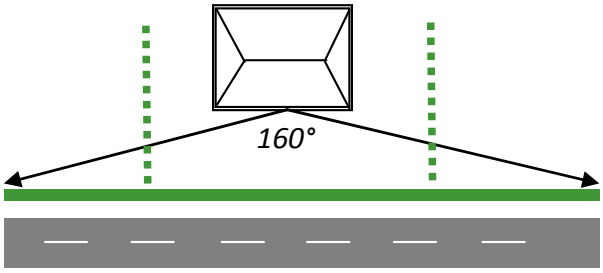
source of the noise, for example car engines or the rail track - wheel interface. Where truck noise is significant, the barrier height may need to be increased to block line-of-sight to the top of the vehicle. Remember to check with your planning authority whether approval is required to construct a new fence.



The barrier must be high enough to block line-of-sight between the noise source and the point where noise may enter your house

To be effective, fences also need to extend down side boundaries, or be long enough to provide at least 160° of protection.



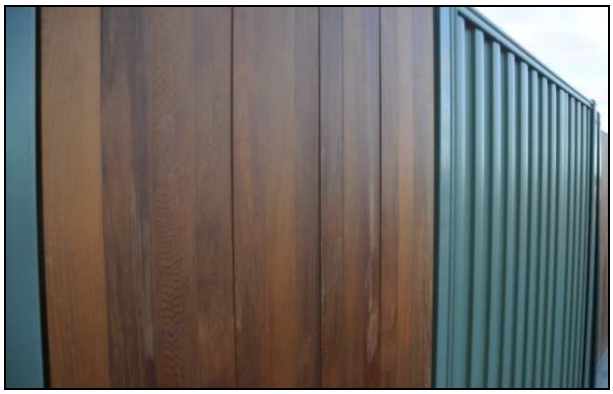
Fence materials

Some materials are better at reducing noise than others.

Sheet steel fences are acoustically effective to a height of about 2.4 metres. Thicker, or double layer sheet steel fences may reduce noise effectively with a height over 2.4 metres.

Masonry and stone walls are acoustically effective at any height.

Timber fences are acoustically effective if constructed so that there are no gaps or cracks within or between panels. Thick, dense timber panels, treated to avoid rot, will be more durable and effective than thinner, less dense panels.

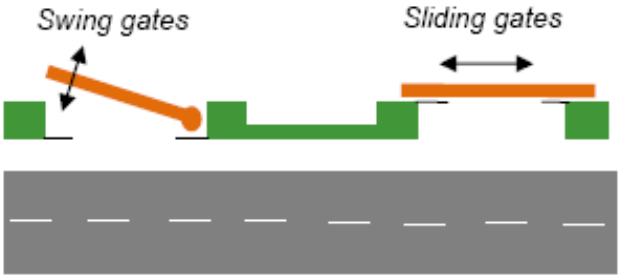


It is important that timber fences do not have any gaps or cracks for the noise to pass through

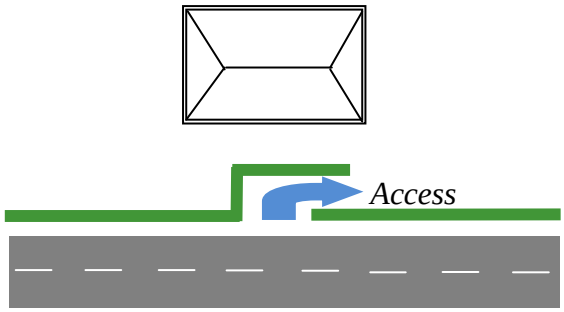
Gates

Gates should be constructed to the same height as the fence and from a material with similar acoustic properties.

It is important that there are no gaps underneath or either side of the gate, as gaps will allow noise to pass through. Overlap barrier sections, overlap the ends of the gate and/or provide seals.



Overlap sliding gates at the ends where possible, and provide plates at the ends of swing gates to cover gaps.



Overlapping barrier sections can be used to provide access without compromising acoustic protection. However it is important to consider the principles of Crime Prevention through Urban Design, ie minimising potential hiding spots for offenders (particularly adjacent footpaths).

Window treatments

Treatments for windows may include one or more of:

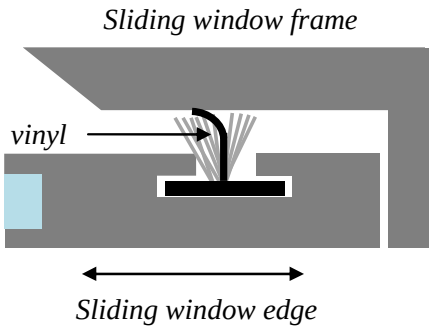
- installing acoustic seals to existing windows
- increasing the thickness of glazing
- installing double glazed windows
- providing a secondary window.

Window seals

Acoustic seals around the perimeter of a window will help to reduce noise by providing a tight seal when the window is shut. Rubber seals are best. It is also possible to fit brush seals with a vinyl fin down the middle which provides better noise protection than traditional brush seals.

Seals should be installed so that the window and frame both contact the seals when closed. The tighter a seal is, the better the noise reduction, provided it is not too thick to prevent the window from being able to be closed properly.

For existing windows that cannot be fitted with acoustic seals (eg some single-hung and double-hung windows), secondary glazing may be installed. Secondary glazing products (either permanently fixed or removable) provide an airtight seal without the need to modify the existing window.



Typical operation of a vinyl fin seal for sliding windows and sliding, glazed doors. It is important that the vinyl fin contacts the window frame.

Thicker glazing

Most standard windows are 3 mm thick. Thicker glazing (ideally 6 mm or 10 mm) reduces lower frequency road traffic noise due to its density.

Using thicker glass typically requires new window frames, as standard residential frames are not able to bear the additional weight. Ensure new frames are well sealed to the building structure. The frame material does not significantly reduce noise, but it must be strong enough to hold the weight of the glass.

Double glazing

Double glazed windows comprise two panes of glass separated by a gap. The noise reduction through the window is controlled by the thickness of the glass, the width of the air gap, and the gasses, if any, in that gap. The use of thicker glazing and a wider gap, particularly if forming a vacuum, will increase the noise reduction.

The thickness of each pane should be at least 6 mm, but more noise reduction will be attained with two panes of different thickness, eg a 6 mm thick pane and a 10 mm thick pane.

For better noise reduction, the space between the panes of glass should be at least 75 mm. The type of

double-glazing optimised for thermal insulation is not as effective at reducing noise.

As with single glazed windows, it is critical that window seals are provided around the perimeter.

Providing new secondary windows

An alternative to double-glazing is to retrofit a new secondary window with an air gap between the existing window, effectively providing a double glazed window without modifying the existing window.

A minimum 75 mm wide air gap should be achieved with any secondary window designed to reduce transport noise. The secondary window should always be provided with acoustic seals. It is preferable, though not essential, that the existing window is also fitted with acoustic seals.

Secondary windows may be glass or acrylic. Some are sealed magnetically, allowing panels to be removed easily. Others are designed to be sliding, which allows the window to be opened.

The approximate internal noise reduction that can be achieved by different window treatments is shown in Table 1.

An acrylic secondary glazing system installed on the internal side of an existing window.

Door treatments

Treatments for doors may include one or more of the following:

- providing acoustic seals to the door
- replacing hollow core doors with solid core doors
- installing double-glazed doors, if applicable
- upgrading the glazing in doors to thicker glass, if applicable.

Door seals

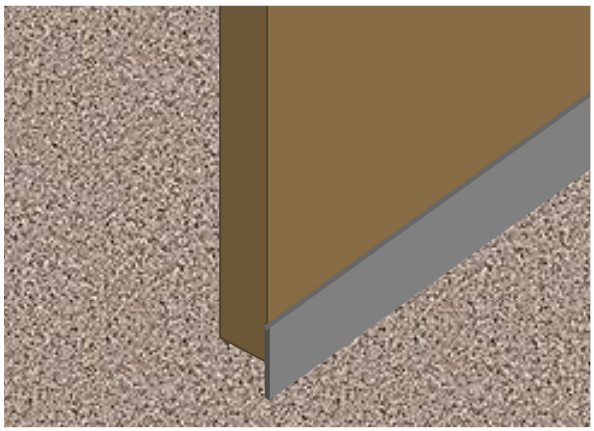
As with windows, gaps around the perimeter of a door will enable noise to enter the building. It is important to provide acoustic seals around the perimeter of any external doors in affected façades.

Installing a solid core door

Solid core doors offer better noise protection than hollow core doors. To effectively reduce noise, the door should be at least 38 mm thick.

Installing double glazed doors

Double glazed doors are effectively double glazed windows. Noise reduction can be improved by using thicker glazing, preferably of two different thicknesses, and by increasing the width of the gap.



Acoustic seal installed on the foot of a door

Table 1 Approximate internal road traffic noise reductions with different window systems

Window configuration[1]	Approximate overall internal noise reduction relative to sealed window with 3 mm thick glass, dB(A)	
4 mm sealed glazing	+ 2	Single glazing systems
5 mm sealed glazing	+ 4	
Operable window with 6 mm thick glazing	+ 6	
Operable window with 10 mm thick glazing	+ 9	
3 mm + 6 mm glazing at 50 mm air gap	+ 7	Retrofitted secondary glazing systems
4 mm + 6 mm glazing at 50 mm air gap	+ 8	
5 mm + 6 mm glazing at 50 mm air gap	+ 9	
3 mm + 10 mm glazing at 50 mm air gap	+ 10	
4 mm + 10 mm glazing at 50 mm air gap	+ 11	
5 mm + 10 mm glazing at 50 mm air gap	+ 12	
8 mm + 6 mm glazing at 50 mm air gap	+ 9	Double glazing systems
8 mm + 6 mm glazing at 100 mm air gap	+ 12	
10 mm + 6 mm glazing at 50 mm air gap	+ 14	
10 mm + 6 mm glazing at 75 mm air gap	+ 15	
10 mm + 6 mm glazing at 100 mm air gap	+ 17	
10 mm + 8 mm glazing at 50 mm air gap	+ 14	
10 mm + 8 mm glazing at 100 mm air gap	+ 17	

[1] *All operable window systems assumed to be awning/casement windows with acoustic seals around the perimeter.*

Upgrading glazed doors

External glazed doors can be acoustically treated by upgrading the glazing to at least 6mm in thickness. When upgrading the glazing in a door it is important that the door is also fitted with acoustic seals.

Alternatively, a second glazed door may be installed at an air gap from the existing door, in a separate frame. While this means that you will have to open two doors, it can be a cost effective treatment as the existing door does not need to be modified.

Walls

Treating existing walls

Gaps and cracks in walls, including gaps around any penetrations in a wall (eg pipes or conduits), should be sealed airtight with a suitable filler. Superficial cracks in masonry, brickwork and blockwork walls that do not penetrate completely through the wall may not need to be treated. However, cracks or damage to plasterboard linings of lightweight walls should be repaired.

Lightweight external walls (such as weatherboard) are not as effective at reducing noise as masonry walls. If necessary, lightweight walls can be treated by installing an additional layer of plasterboard or sheet metal on a new set of studs completely separated from the existing wall (by at least 20 mm), and installing glass-fibre, polyester or rockwool insulation, with a minimum density of 14 kg/m^3, in the cavity between the new and existing wall layers.

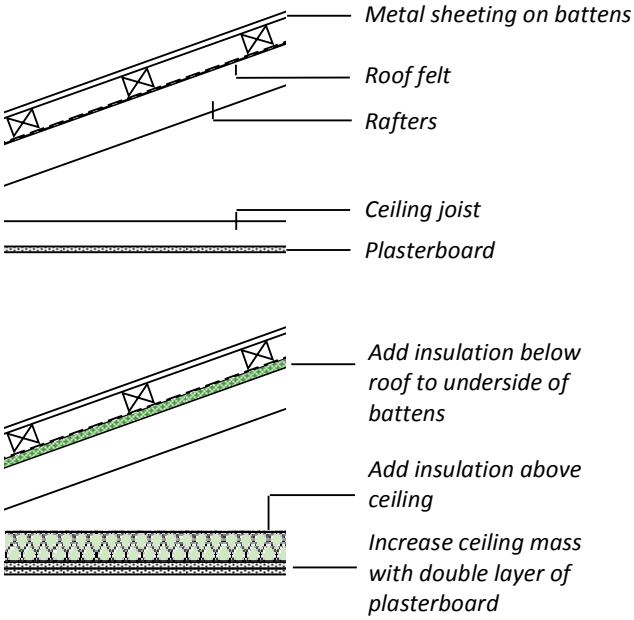
Ceilings and roof spaces

Ceilings of very lightweight construction can allow noise to penetrate. Treatment options include:

- Adding additional ceiling layers, or
- Installing ceiling insulation.

Adding additional ceiling layers

Noise penetrating through a ceiling can be reduced by adding an additional layer of standard 10 mm or 13 mm thick fire-rated plasterboard directly underneath the existing ceiling. Co-incidentally it will improve the roof's energy efficiency as well.



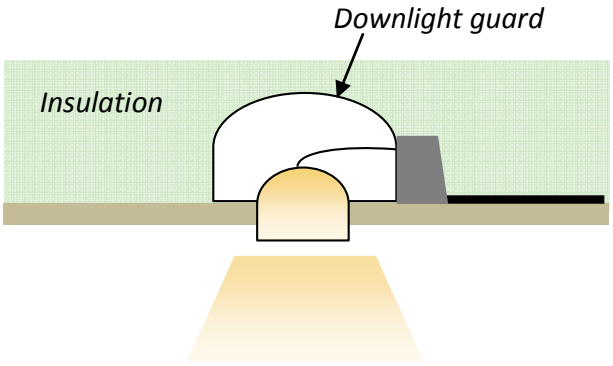
The additional layer of plasterboard can normally be direct fixed to the existing ceiling, increasing the mass and thickness of the system and improving the noise reduction.

When adding an additional layer of plasterboard to the ceiling, it is important to consider whether the ceiling support system will be able to bear the additional weight. If not, then the ceiling support system may also need to be upgraded.

Installing ceiling insulation

If not already present, ceiling insulation can be laid across the entire ceiling area to reduce noise. The thicker the insulation, the greater the noise reduction achieved. Use insulation at least 100 mm thick and with a minimum density of 14 kg/m^3.

Ensure suitable clearance is provided between the insulation and any downlights to avoid creating a fire hazard, or install noise and fire resistant downlight guards.



Downlights can pose a fire hazard when covered with insulation. Suitable clearance should be provided or downlight guards installed.

Treating chimneys

As most chimneys are directly open to the outdoors, they need to be treated to reduce noise impacts.

If the chimney is functional, a metal damper can be installed on the top of the chimney to reduce noise when it is not in use. The damper can be opened when the chimney is to be used. If a chimney is not functional, it may be sealed off completely.

Check any existing chimney dampers to ensure they are operating effectively. Reseal them if necessary.

Air vents and wall-mounted air conditioners

Air vents in a façade exposed to road traffic noise can let noise in, and should be either:

- replaced with a vent that reduces traffic noise; or
- acoustically treated; or
- removed and the resulting gap in the wall repaired with appropriate material.

To reduce noise transmission, through wall-mounted air conditioners, remove the unit and replace (if necessary) with a split-system air conditioning unit.

Alternative ventilation

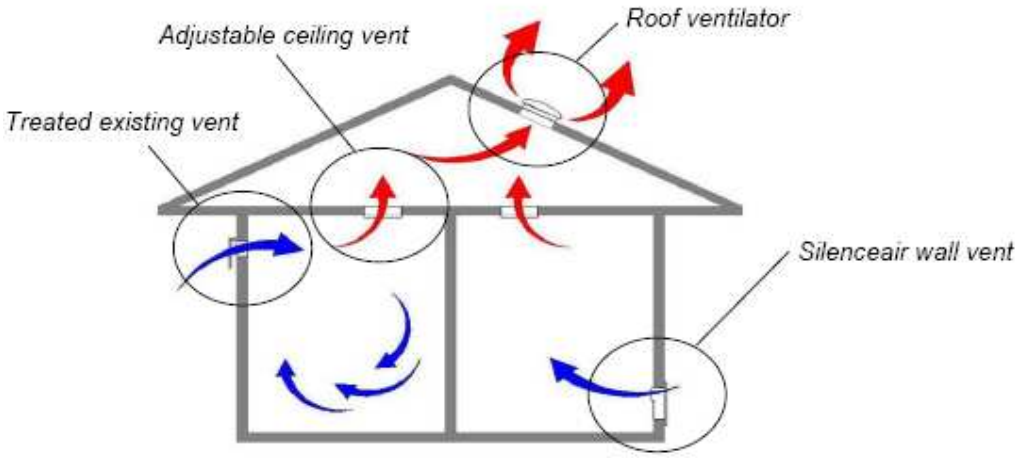
Rooms that have all doors and windows exposed to traffic noise may need to be provided with alternative ventilation to enable windows and doors to be closed while still having access to fresh air.

Typical alternative ventilation methods include:

- roof space ventilators.
- acoustic wall vents
- ducted reverse cycle air conditioning
- evaporative cooling.

Roof space ventilators

Roof space ventilators provide ventilation to habitable rooms directly below the roof space. A variety of ventilators are available, ranging from conventional turbine ventilators which provide natural ventilation, to motorized fan units that can be manually or thermostatically controlled to operate when required.



Roof space ventilators combined with ceiling vents remove air from the rooms, drawing fresh air in through wall vents

Ceiling mounted air vents are required to allow the transfer of air from the occupied areas to the roof space above. Closable ceiling registers allow air flow to be regulated through the rooms. The register may be closed when ventilation is not required or heat loss needs to be limited.

Roof space ventilator *Image: CSR Edmonds*

Wall vents

Acoustic wall vents are passive ventilators that can be installed in existing walls to provide fresh air while providing some noise control. In typical residences, two vents would serve a two-person bedroom and three vents a living room. Acoustic wall vents cannot easily be fitted into all types of walls, for example masonry walls.

To reduce noise through existing wall vents, an external hood constructed of galvanised sheet steel and lined internally with minimum 25 mm thick, 14 kg/m^3 acoustic insulation can be fitted. This type of treatment does not require internal work.

Powered ventilators are mechanical ventilators installed on the interior of a wall and connected to the outside via a wall duct. They provide both air filtration and noise reduction, and typically work in any standard wall construction. The air flow provided by the ventilator should be checked against the air flow requirements for the room to determine the number of units required.

Acoustic wall vent installed in a double brick wall
Image: Silenceair

Reverse cycle and evaporative air conditioning systems

Both reverse cycle, split ducted air conditioning systems and evaporative cooling systems can be installed to supply conditioned outdoor air to rooms without allowing external noise in.

Evaporative cooling systems typically have lower installation and maintenance costs than reverse cycle air conditioning systems, and require less energy to operate. However, they require a breeze path through a room to work effectively. While this can normally be provided via an open window, this will not be possible where noise is a problem. Alternative breeze paths will need to be provided (e.g. through the ceiling) to allow effective operation of the system.

Building or renovating

When building a new house or renovating an existing house that is exposed to noise from a transport corridor, there are several opportunities to reduce noise impacts.

The most important considerations are:

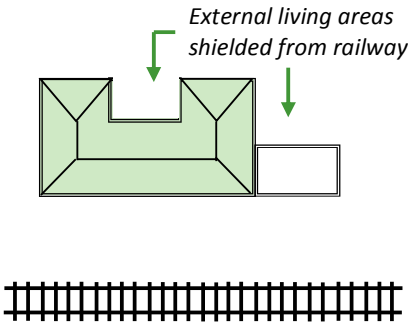
- the location of the house on the block (site layout)
- the arrangement of internal living spaces (floor plan)
- the building materials used.

The following suggestions may not be suitable for all circumstances. Design features aimed at reducing noise will need to be balanced with other considerations, such as streetscape character, setback requirements, solar access etc. Contact your local council to discuss planning requirements.

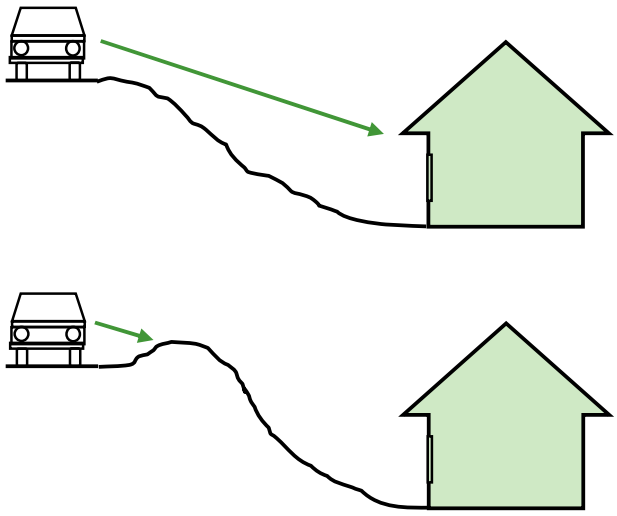
Locating the house on the block

Locate the house as far away from the road or rail corridor as possible. Doubling the distance from the road will reduce the average noise level by 3-4 decibels (dB[A]), and peak levels by 6 dB[A].

- Locate sheds or garages so that they shield the house from noise.
- Use the house and other buildings (eg sheds) to shield outdoor living areas such as courtyards or barbecue area.



- Make use of existing natural features such as slopes to block the line of sight between the transport corridor and the house. If appropriate, excavate to provide better noise protection.



- Supplement careful site planning by building noise barriers in the form of earth mounding, fencing and walls or a combination of these (provided other requirements for safety, urban design and access can be met).

Designing the floor plan

- Locate noise-sensitive rooms such as bedrooms at the rear of the house or as far as possible from the source of the noise. Locate noise-tolerant rooms (such as the garage, laundry and bathroom) closer to the noise source, using them to shield the more noise-sensitive areas.
- Minimise the number of doors and windows on the side(s) of the house exposed to noise.
- If designing a two-storey house, remember that the ground floor is easier to protect from noise than the upper floor. Noise-sensitive rooms like bedrooms will generally be quieter if located downstairs.

Selecting the right building materials

- Heavy, non-porous materials such as brick and concrete provide better noise insulation than lightweight materials. The effectiveness of these materials will be boosted when combined with materials which absorb noise, such as rockwool and fibreglass batts. Walls consisting of two outer panels filled with noise absorbing material are most effective at reducing noise. Consider building a double-brick wall on the side(s) of the house exposed to noise to provide extra protection.
- Concrete slab floors are better at reducing noise than wooden floors.
- Flat roofs allow less noise to enter than pitched roofs, and parapets are more effective at noise reduction than traditional eaves.
- Use solid core doors with noise seals on the side(s) of the house exposed to noise.
- Use thick glass, double glazing or secondary glazing for windows or glass doors exposed to noise (see information above for the effectiveness of different glazing systems)
- Install insulation in the roof space.

Related planning information

The South Australian Planning Policy Library contains policies relating to protection of new houses from noise sources (https://www.sa.gov.au/__data/assets/pdf_file/0014/13055/SA_Planning_Policy_Library_version_6.pdf). If you plan to build a new house or substantially add to an existing house near a major transport corridor, your development application may be assessed against these policies, refer to the Design Guidelines for more detail. http://www.sa.gov.au/__data/assets/pdf_file/0016/21391/Design_Guidelines_Reducing_noise_and_air_impacts_from_road_rail_and_mixed_land_use.pdf

Check your local council Development Plan to see if your site is located in an area identified on the *Noise and Air Emissions Overlay.*

Table 2 Performance of different types of wall in terms of traffic noise reduction

Type of wall construction		**Traffic noise reduction**[1]
External fibre cement sheeting with cavity insulation (5 mm fibre cement sheets, 75 mm insulation)	**Internal lining:** 1 sheet of 10 mm plasterboard	31
	Internal lining: 2 sheets of 10 mm plasterboard bonded together	35
	Internal lining: 2 sheets of 13 mm sound-rated plasterboard	45
Autoclaved concrete panel (external 75 mm autoclaved concrete block, internal 10 mm plasterboard)		41
Brick veneer with cavity insulation (110 mm thick bricks, 75 mm insulation, internal 10 mm plasterboard)		49
Double brick (110 mm thick bricks, steel-point connections)		48

[1] $R_w + C_{tr}$ (sound attenuation performance of the wall, weighted to place greater emphasis on low frequencies)