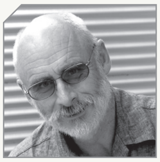
DESIGN RIGHT

Designing for quiet

Good acoustic quality is an invisible building feature. When done well, you don't notice it, but if not, there can be significant negative effects.



BY TREVOR PRINGLE,
ANZIA, BRANZ PRINCIPAL WRITER

AS DWELLING density increases, building occupants often become more aware of noise, that is, any unwanted sound the occupant cannot control.

For building designers, key areas that need consideration in the design of dwellings are:

- inter-tenancy noise – from adjacent dwellings and neighbours
- environmental noise – street or building-generated noise, such as traffic, exuberant people, night clubs and bars, night street works or construction
- building services noise – air conditioning, heat pumps, drainage, plumbing, lifts.

Noise can impact health

Excessive noise levels can significantly affect the amenity of a dwelling and the health and wellbeing of its occupants. Some suffer from misophonia, also known as selective sound sensitivity syndrome, where a common noise causes anxiety or anger.

Other factors that influence how we perceive noise are:

- frequency – low-frequency noise (10–200 Hz) is more intrusive and harder to mitigate
- volume
- time – how long the noise persists
- inability to influence generation of the noise
- distance – how far away the noise source is
- tolerance – tolerance of noise may decrease as housing density increases
- age – we become more aware and possibly less tolerant of noise as we get older, particularly low-frequency noise
- desire for reasonable acoustic privacy, particularly with the closer proximity of neighbours.

Main types of sound transmission

There are generally two types of sound transmission to consider:

- Airborne transmission – noise originating in air, such as voices, music and vehicle traffic.
- Impact transmission – noise originating directly on the structure by blows or vibration.

A third type, known as flanking transmission, is any sound transmitted to the receiver but not directly through the separating element. These indirect or flanking paths between source and receiver are harder to predict and can often significantly affect acoustic performance.

For example, consider the sound carried via a duct or common ceiling space between two adjacent rooms, adjacent windows in adjoining tenancies or transmitted via a common floor slab. Even if the wall directly between the rooms transmits no sound, some noise will still be heard in the receiving room via these flanking paths.

Airborne and impact transmission is usually made up of sound travelling via direct and flanking paths.

Barriers to acoustic comfort

The aim for individual dwellings is to obtain good acoustic comfort, that is, occupants are satisfied with the level of noise and experience sufficient privacy. Dwellings with good acoustic quality provide acoustic comfort to most occupants, with better quality achieving higher satisfaction rates.

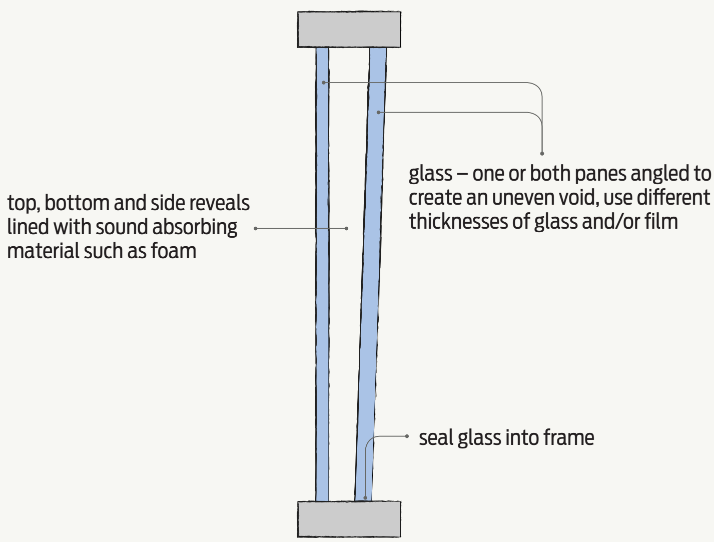


Figure 1 **Acoustic glazing.**

Acoustic comfort is difficult to achieve where:

- designers do not understand the principles of good noise control – design and detailing
- developers or designers don't place a priority on acoustic performance, don't budget for acoustic design or include it early in the design process or don't understand the value of good acoustic design (integrating it into the whole building design is critical for good acoustic outcomes)
- acoustic considerations are not included early enough in the building design process
- designers lack a source of readily accessible, independent and New Zealand-specific information on acoustics (presently, the industry relies on manufacturers' proprietary systems to meet Building Code requirements)
- installers and contractors are unaware of basic acoustic concepts (simple workmanship errors can significantly reduce acoustic performance)
- proposed solutions are not achievable on site
- subsequent tradespeople do not understand the sensitivity of acoustic design details to minor errors in construction or modification, such as installing a duct through a completed acoustic separation.

Are there any rules?

The Building Code requires sound control for inter-tenancy walls and floors (clause G6 *Airborne and impact sound*), but it does not require acoustic privacy for external walls and windows or for partitions and walls within a dwelling.

However, designers can always take a Building Code plus approach to the design of inter-tenancy walls and floors and consider acoustic privacy for the external envelope and internal wall and dwelling layout.

As a guide, levels of acoustic privacy are:

- STC 30 – provides poor sound control with little acoustic privacy between spaces
- STC 30–40 – normal conversations can be heard in adjacent spaces
- STC 40–50 – raised voices can be heard in adjacent spaces
- STC 50 – provides reasonable acoustic privacy
- STC 60+ – good acoustic privacy.

Reducing external noise impact

There are several options to minimise the impact of external noise. However, there are also draw-backs associated with most of them.

Windows can be designed to minimise noise transmission, but all benefit is lost when the windows are opened. Using thicker glass or insulating glass units designed to reduce heat loss also reduces sound transmission.

To maximise noise mitigation through the external envelope, the designer can:

- use walls that incorporate mass, such as concrete or concrete masonry construction (doubling the mass of a wall increases the STC rating by 5–6 dB)
- specify smaller windows in walls that face noise sources
- add noise control insulation, separate or stagger stud construction or use a proprietary acoustic-rated wall construction system in lightweight framing (adding insulation within a wall or floor/ceiling cavity will improve the STC rating by 4–6 dB).

Reducing noise transmission by 10 dB is roughly equivalent to halving the perceived loudness of the sound coming through the wall, over a range of low frequencies.

For stand-alone dwellings and low-level buildings, consider:

- constructing heavy fences between the building and sources of noise
- earth bunding if there is sufficient space
- locating spaces that require quiet away from the street.

Reducing internal noise impact

To reduce noise transmission within the dwelling, the designer can:

- place buffer rooms between noise sources and quiet spaces
- add acoustic insulation and greater mass to internal walls (for example, specify them as acoustic-rated walls)
- separate or shield windows in adjacent tenancies
- specify sound-absorbing surface finishes to reduce reverberation within spaces
- physically separate solid components to minimise the conduction of vibrations
- use a heavy fabric for window drapes
- install seals on all doors and any unsealed windows
- use solid-core doors
- avoid the need for air conditioning at quiet times
- locate plumbing and wastepipes away from quiet rooms or ensure that they are adequately soundproofed, and insulate any ducting
- use built-in wardrobes as sound buffers between bedrooms
- use soft and absorbent furnishings.

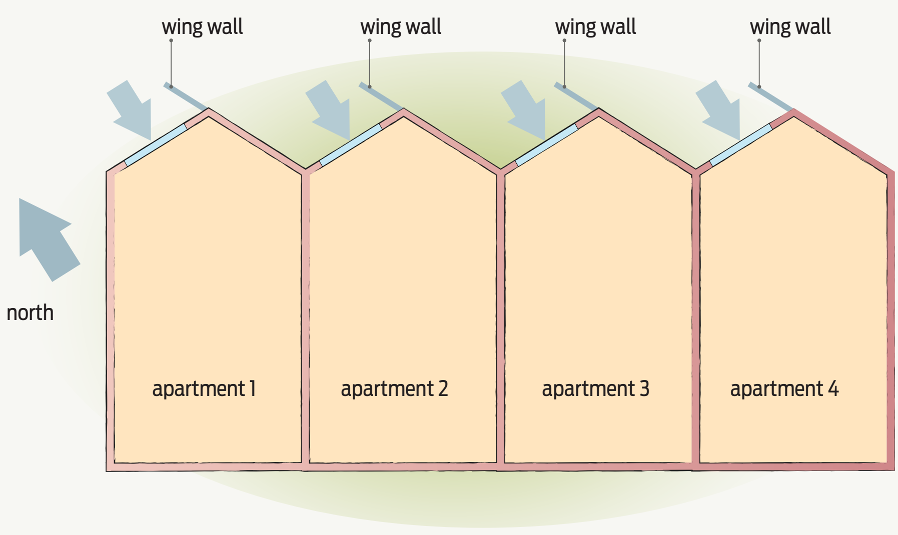


Figure 2 **Plan view – locate windows in walls (arrowed) to reduce potential flanking noise between apartments. Adding wing walls as shown will further reduce the potential for flanking noise.**