TechDirect™ White Paper

Reducing Sound Transmission

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1. INTRODUCTION

Sound surrounds us every day of our lives and our hearing is the only sense other than our eyes which can provide information on events which occur a long distance away. Our hearing allows us not only to become aware of an event but to pinpoint its location without seeing it. Sound is present in many forms and intensities and can be pleasing or annoying, soothing or disruptive. Therefore, it is important that we control it to make our lives enjoyable.

2. BACKGROUND

The aim of this document is to explain how external noise enters our homes and affects our indoor environment. It outlines the key factors that influence how we experience sound, such as vibrations, frequency, and sound pressure. The document also provides practical solutions to reduce noise, including improving window performance, sealing gaps to prevent air leakage, and selecting appropriate building materials. By understanding these elements, homeowners can create quieter, more comfortable living spaces.

Sound is created when a vibrating surface transfers its movement to the surrounding air. As the surface moves forward, it pushes the air, creating higher pressure. When it moves back, it creates lower pressure. This back-and-forth motion forms alternating high and low-pressure waves. These waves make our eardrum vibrate, sending signals to our brain, which we perceive as sound. In simple terms, sound is a pressure wave caused by vibrations.

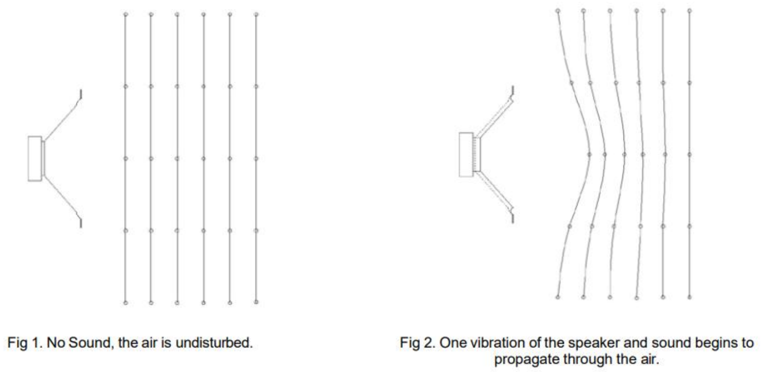

Figure 1. Sound Waves

Characteristics of sound

The speed of vibration is called frequency, measured in hertz (Hz), indicating how many vibrations happen per second. High frequency means a high-pitched sound, and low frequency means a low-pitched sound. Humans can hear frequencies between 20 Hz and 20,000 Hz, though sounds exist outside this range.

Loudness depends on sound pressure - higher pressure means louder sound. Extremely high pressure can cause pain and damage to the ear. Because our ears don't perceive loudness in a linear way, decibels (dB) are used to measure sound intensity. This measurement is called the Sound Pressure Level.

Reduce the transmission of noise

When sound waves hit a window, three things can happen:

- They can be reflected away, causing minimal disturbance inside.
- They can be absorbed and dissipated, also causing little concern.
- What isn't reflected or absorbed passes through the window by vibration or air leakage.

Reduce vibration

Ordinary glass can vibrate at the same frequency as the noise source, allowing sound to penetrate through the window. VLam Hush™ and ComfortHush™ include a special 3-layer co-extruded interlayer that has been specifically engineered to reduce vibration, making it effective in reducing urban noise.

Addressing a noise problem

To reduce noise in a home, windows are often the weakest point. Installing soundproof windows helps, but it's also important to choose well-insulated walls, floors, and roofs. Sealing all gaps in the building's exterior is essential for better overall noise reduction.

Designing to solve a noise problem

Solving a noise problem involves understanding three key factors:

1. What is the external noise level
2. What is the desired noise level inside the occupied space.
3. The material/barrier (in this case the outer building materials) between the noise source and the occupied space. The acoustic performance of this material/barrier needs to at least make up the difference.

In simple terms, if external noise measures 70 dB and the desired internal level is no more than 30 dB, then the material/barrier of the building envelope will need to provide a reduction of 40 dB.

Different noise sources produce different frequencies - traffic noise is predominantly low-frequency, while aircraft noise contains more high-frequency components. An effective solution requires identifying both the type and intensity of the noise and selecting glazing that performs across the relevant frequency range. It's important to remember, though, that glass is only one component of the building envelope; walls, ceilings, and other elements must also be assessed to ensure the overall system meets the acoustic target.

Reduce air leakage

Reducing noise starts with preventing air leakage. Wherever air escapes, sound can travel with it. Even small gaps or cracks allow noise to pass through, reducing overall window performance.

VLam Hush™ performs best when paired with well-sealed window frames that minimise air leakage. Operable sashes, compared with fixed windows, are generally more challenging to seal effectively, so high-quality sealing systems are essential to achieve optimal acoustic performance.

Many window fabricators offer dedicated acoustic window and door systems designed to improve both sound reduction and energy efficiency. Professional installation is equally important to ensure a tight fit between the window and the wall, with all gaps properly sealed.

Sound reduction index (Rw) and Decibels (dB)

The Weighted Sound Reduction Index (Rw) is a single-number rating that represents the overall sound reduction provided by a building element across a range of frequencies. It is expressed in decibels (dB).

Decibels use a logarithmic - not linear - scale. On a linear scale, doubling the measured value means doubling the quantity. However, sound does not behave this way. Because the dB scale is logarithmic, changes in sound levels do not correspond intuitively to our perception.

A 10 dB increase in sound pressure level is generally perceived as roughly twice as loud. For example, a rise from 60 dB to 70 dB feels like a doubling of loudness. Conversely, reducing a noise level by 10 dB - from 60 dB down to 50 dB - feels like the loudness has been cut in half, this is demonstrated in Figure 2.

dB Increase	Relative Loudness% Increase		dB Decrease	Relative Loudness% Decrease
0	0		0	0
1	7		1	7
2	15		2	13
3	23		3	19
4	32		4	24
5	41		5	29
6	52		6	34
7	63		7	38
8	74		8	43
9	86		9	46
10	100		10	50
20	400		20	75
30	800		30	88
40	1600		40	94
50	3200		50	97

Figure 2. Relationship between dB and relative loudness as sensed by our ears

A 1 or 2 dB variance is barely perceptible. The higher the Rw number, the better a sound insulator will need to be.

Coincidence Dip

The coincidence dip refers to the frequency at which a glass panel vibrates in sync with the incoming sound waves. At this frequency, the glass transmits sound more readily, causing a noticeable drop in its sound-insulating performance. Each glass thickness has its own characteristic coincidence frequency, meaning the dip occurs at different points across the spectrum.

This effect can be reduced by using laminated glass, where the interlayers help smooth and lessen the dip. Specialised acoustic interlayers - such as VLam Hush™ - can significantly minimise or almost eliminate the coincidence dip altogether, resulting in more consistent sound insulation across all frequencies.

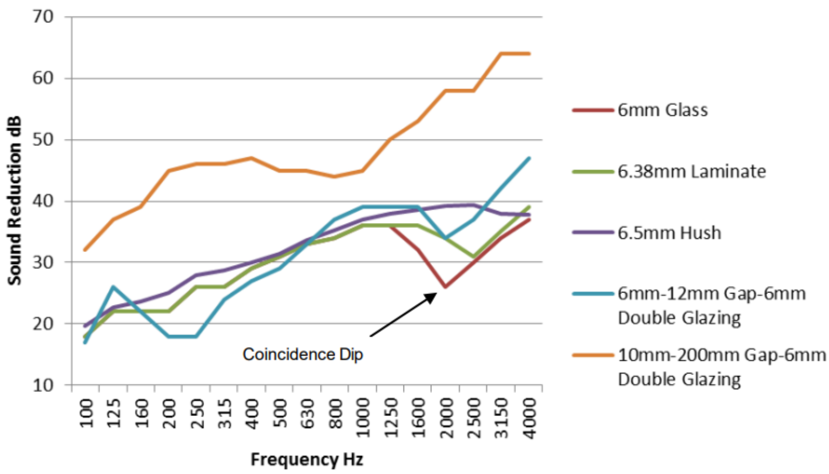

Figure 3. Coincidence Dip

3. SOLUTION

What sounds acceptable to one person may be intrusive to another, which is why relying solely on an Rw (sound reduction) rating can be misleading. A comprehensive acoustic solution requires assessing both the type and intensity of the noise source and selecting barriers that perform effectively across the full frequency range.

It's also important to consider the impact of other building materials and structural elements, remembering that glass is only one component of the overall acoustic system. Full acoustic assessments can be time-consuming and costly, so Rw values are commonly used to provide a general indication of performance across frequencies.

For road traffic noise - which accounts for a large proportion of acoustic enquiries and is typically dominated by low-frequency sound - a qualifying "Ctr" value is often provided to indicate performance more accurately. For example, if a window or glass type has an Rw rating of 36 dB and a Ctr correction of –5, the effective reduction for road noise is more likely to be around 31 dB.

Glass Thickness

Thicker glass generally provides better reduction of low-frequency noise, such as traffic. However, it is also important to understand the "coincidence dip," a point where standard glass transmits sound more easily due to resonant vibration. This dip varies with thickness and typically appears at higher frequencies. Using laminated glass options can significantly reduce the coincidence dip and improve acoustic performance across the spectrum.

Laminated glass

The interlayer in laminated glass is highly effective at dampening vibrations, offering better sound reduction than monolithic glass of the same thickness. Additionally, it minimizes the "coincidence dip" at higher frequencies, making it an ideal solution for reducing aircraft and voice noise.

Double glazing

It is a common misconception that standard insulating glass units (IGUs) inherently provide high levels of noise reduction. While two panes of glass do offer twice the mass of a single pane, in many cases the upgrade is from a single 4 mm pane to an IGU comprising two 4 mm panes. The relatively narrow air gap between these panes offers little acoustic benefit, as its primary purpose is to reduce thermal transfer rather than sound transmission.

For a more significant improvement in acoustic performance, the most effective approach is to incorporate a laminated pane—ideally an acoustic VLam Hush™ product—into the IGU configuration.

	Single Glazed			Double Glazed		
	4mm	6.38mm	6.5mm	4mm/12mm Cavity/4mm	4mm/12mm Cavity/6.5mm Hush	6mm/100mm Cavity/4mm
Rw	31	33	36	32	36	46
Ctr	-3	-3	-4	-4	-3	-7

Figure 4. Comparative Rw and Ctr for centre of glass only

To achieve substantial noise reduction from the air cavity alone, the gap generally needs to be in the range of 50 mm to 100 mm, which is far greater than that found in standard IGUs.

Relevant standards include:

- **AS2021:2015 – Aircraft Noise Intrusion – Building Siting and Construction**
  This standard may need to be referenced if there are intentions to undertake constructions or demolition work at an airport.
- **AS/NZS2107:2016 – Acoustics – Recommended design sound levels and reverberation times for building interiors**
  Outline of design criteria for acoustic conditions affecting building interiors.

These standards provide a range for the “Design Sound Level” for a variety of occupancies and activities. The lower level of the range is the most desirable while the upper level should be seen as the least desirable.

4. CONCLUSION

To reduce sound transmission through glass, several methods can be used, including laminated glass with a sound-absorbing interlayer, and double or triple glazing with air gaps that dampen sound vibrations. Varying the thickness of glass panes and using specialized acoustic glass can further enhance soundproofing. Additionally, applying acoustic films, ensuring proper window sealing, and using insulated frames can improve noise reduction. Increasing the air gap between panes and filling it with gases like argon or krypton also boosts acoustic performance, creating a more soundproof environment.

Sound is an ever-present part of our environment, capable of providing both enjoyment and annoyance. Glass plays a key role in buildings, and when designed properly, it can help create a comfortable acoustic environment. With the right selection, glass can effectively solve noise problems while meeting other building requirements.