Wind noise in buildings

As more construction occurs on steep sites, one consequence is buildings prone to wind-induced noise. Design and mechanical solutions can reduce the effect.

‘When the wind blows, the cradle will rock...’ goes the lullaby. But for some, the sound of the wind heralds a nightmare rather than a good night’s sleep. Wind can generate all sorts of noises in a building, from bangs and rattles to whistling, humming and vibrations.

More often than not, these sounds seem to occur in the dead of night when it’s too dark to easily identify the source of the noise.

What causes the noise?

As wind blows over and around a building, positive pressure is applied to the windward side of the building and negative pressure – suction – to the other sides (see Figure 1). Where these pressure zones meet, the wind velocity increases, producing air turbulence and sometimes noise. Wind speed, and therefore the risk of wind-induced noise, is influenced by both topography and building shape.

NZS 3604:2011 Timber-framed buildings identifies wind zones as part of bracing design. The zones relate to the expected wind speed at a given site. The higher the wind zone, the greater the anticipated wind speed.

As the availability of greenfield building sites decreases, more buildings are being constructed on steep sites where unpredictable wind speeds may be common. However, control of wind-induced noise is not a specific requirement of New Zealand’s building standards or the Building Code.

Many types of wind noise

Wind noise in buildings includes several common mechanisms:

- Air movement through building openings such as gaps around windows or open joints in cladding.
- Air movement over irregularly shaped building surfaces or attachments.
- Buzzing, roaring or rumbling caused by loose components such as loose metal roofing or guy wires for roof-mounted elements.
- Squeaking and creaking traced to wind-blown items attached to the building exterior such as signs, satellite dishes, aerials, weather vanes or perhaps insufficient stiffness of the structure.
- Tonal wind noise, normally associated with cavities or structural resonances of flexible components.

Solutions

Some suggested solutions are listed below to different noise sources.

Whistles
- Ill-fitting windows or doors – check window stays, install or replace seals.
- Warped or out-of-square sashes – adjust or replace.
- Wind blowing across a narrow gap, such as between decking or vent blades – adjusting the gap may be practical in some situations.

Vibrations
- Downpipes and guttering – decrease the spacing between support brackets, and check fixings.
- Aerials – check the restraints.
- Window sash seals – replace.
- Glazing – replace the glazing seals or reglaze with thicker glass.
- Wall underlay not installed taut – no practical remedy so ensure the underlay is installed taut with sufficient restraint.
Squeaks, bangs and rattles
● Loose fixings on roofing, flashings and aerials – check and adjust.
● Loose door latches – check and adjust.
● Some synthetic wall underlays can rattle as wind blows across the base of the wall cavity – no practical remedy once the underlay is installed.

Humming, whining, singing
● Wind blowing across an open vent or chimney – similar to blowing across a bottle. A rotating cowl or H cap may help.

Creaking
● Make the building stiffer by increasing bracing – this may be feasible in the roof or subfloor but will require more effort if walls need to be stiffened.

Design to reduce issues
On some sites, the best location for sun or spectacular views may also be the windiest location. Wind speed increases over hilltops, ridges and coastal escarpments. The steeper the hill and the closer to the top, the greater the effect.

Design decisions can mitigate potential wind noise problems, for example:
● consider the topography of the site
● identify the direction of the prevailing and strongest wind
● locate rooms where wind noise could be a problem such as living rooms and bedrooms on the leeward side
● locate outward-opening doors on the windward side, where the positive wind pressure will push them against the door seals
● locate inward-opening doors on the leeward side, so that negative wind pressure will suck them against the door seals
● provide shelter for outdoor living areas with a wind screen or planting – screen or fence with up to 50% porosity allows some wind to pass through but deflects much of the wind over the top, providing shelter on the leeward side
● specify a rigid wall underlay.

Think about form and detailing
Building form and detailing can greatly affect wind-flow patterns and speeds:
● Row effect, where the wind falls over a long, narrow building, creating turbulence on the

Figure 1  Wind applies positive pressure to the windward side and negative pressure (suction) to the other sides of a building.

Figure 2a  Row effect – a long, low building can create wind turbulence.

Figure 2b  Adding projections to the leeward façade can reduce turbulence.
leeward side. The effect can be mitigated by adding one or more wings on the leeward side (see Figure 2a and b).

- Wake effect – turbulence caused by the changes in pressure as wind swirls around the building. The effect is increased if the building is at an angle to the prevailing wind.

- Courtyard effect – courtyards can provide sheltered outdoor living, but the proportions must be carefully considered otherwise wind can tumble into the courtyard, creating disturbing eddies and vortices (see Figure 3). Openings in the courtyard wall should be located on the leeward side, and the total opening size should be less than 25% of the perimeter dimension.

**Figure 3** The proportions of a courtyard influence whether the wind will flow over or tumble into it.