The pitfalls and possibilities in MDH acoustic design

Good acoustic design is imperative to maintain harmony between neighbours as housing density increases across our main centres.

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The government recently amended the Resource Management Act requiring councils in Auckland, Christchurch, Wellington, Tauranga and Hamilton to change planning rules to enable the construction of more medium-density housing (MDH). The new rules allow three units per site, 11 metre building heights, 1 metre side yards and 50% building site coverage.

This brings people closer together – a household will typically share a wall or floor with another household – and the potential for acoustic issues will increase. Good acoustic design principles are important to ensure the amenity of the occupants is protected. Here, we provide designers with high-level guidance for improving acoustic outcomes for MDH.

What is required acoustically

Clause G6 of the Building Code is the only part that relates to acoustics in multi-unit housing. The objective of this clause is 'to safeguard people from illness or loss of amenity as a result of undue noise being transmitted between abutting occupancies'.

The minimum performance requirements for walls and floors set by the clause are:

- sound transmission class (STC) of walls and floors – STC 55
- impact insulation class (IIC) of floors – IIC 55.

These requirements are the laboratory performance of the wall or floor assembly. In the Verification Method, a 5-point leeway is provided for on-site performance.

It is important to note that Clause G6 is very limited in scope compared to the range of acoustic issues present in multi-unit housing, including:

- sound insulation between dwellings and common areas such as corridors
- HVAC noise
- plumbing noise
- noise from external sources such as road, rail or adjacent businesses.

A designer should consider all of these when designing a building, not just the Code minimum.

Ensuring acoustic quality

It is well known in the acoustic community that our Code-minimum performance is poor. However, there have been limited user satisfaction studies in Aotearoa New Zealand, which makes it difficult to push for change. This was a main finding in the BRANZ research report ER30 *Acoustical design of medium-density housing.*

Jen Rindel of the Technical University of Denmark undertook a study showing that only 30–50% of occupants are satisfied with our Code-minimum performance. This aligns well with our experience in this market. Anecdotally, when product suppliers from Europe visit Aotearoa, they are often shocked at the level of acoustic performance achieved here.

Higher levels of acoustic performance should be targeted to improve user satisfaction. Ratings of STC 65 and IIC 65 result in greater than 75% of occupants being satisfied with the acoustic performance (Table 1). ▶▶

Sound and impact insulation standard		User satisfaction with acoustical conditions
STC 65	IIC 65	> 75% satisfied
STC 60	IIC 60	50–75% satisfied
STC 55	IIC 55	30–50% satisfied

Table 1: Acoustic levels and user satisfaction.

The number of robust wall and floor systems that achieve or exceed the laboratory requirements of the Building Code have exploded in the last 10 years. However, designers and builders often run into issues such as:

- difficulties combining various wall and floor systems
- material substitutions due to cost or availability
- installation instructions that aren't sufficiently robust.

Flanking sound

The least understood element of the acoustic design of multi-unit housing is sound flanking. An example of this is shown in Figure 1 where the flanking sound is travelling through the floor and bypassing the acoustic performance of the wall.

This can occur in both timber and concrete constructions, cause a failure to comply with the Code minimums and be difficult and costly to remedy after construction.

There are limited resources available on robust details to avoid issues with flanking sound.

Common red flags are:

- concrete slabs with less than 120 mm of solid concrete
- lightweight floors with a continuous floor diaphragm
- solid blocking of double studs at junctions
- rigid insulation – PIR and EPS – in the façade or inter-tenancy walls and floors.

Designing for impact sound

Incorrect installation of acoustic underlays is the most common reason for on-site non-compliance issues with concrete floors. The following can assist with reducing the risk of non-compliance:

- Selecting a lab-tested system with an accompanying report.
- Specifying the glue or adhesive used in the lab test.
- Including a robust detail in the design drawings showing all components – for example, screeds to fall, underfloor heating, waterproofing and acoustic underlay.

It is important to understand that acoustic underlays perform differently on concrete and lightweight floors. An underlay that provides a 20 IIC point improvement on a concrete floor may only provide a 2 IIC point improvement on a lightweight floor.

For lightweight floors, a raised acoustic floor is required to comfortably comply or exceed Building Code requirements. The typical depth of a raised floor is 50–100 mm, which should be factored in early in design.

Internal noise levels

Although the Building Code has no requirements for internal noise levels within a multi-unit household, local councils are starting to implement rules in their district plans. Additionally, points are available in the Homestar and Green Star rating tools for achieving suitable internal noise levels.

The most referred-to guideline for internal noise levels is AS/NZS 2107:2016 *Acoustics – Recommended design sound levels and reverberation times for building interiors*. In most situations, the recommended internal noise levels for dwellings are:

- bedrooms – 35 dB LA_{eq} (equivalent continuous sound pressure level)
- living areas – 40 dB LA_{eq}.

In areas with noise levels outside greater than 50–55 dB LA_{eq}, using open windows for ventilation will mean that internal noise levels will be higher than desirable. In these situations, mechanical ventilation and cooling should be provided so that occupants don't need

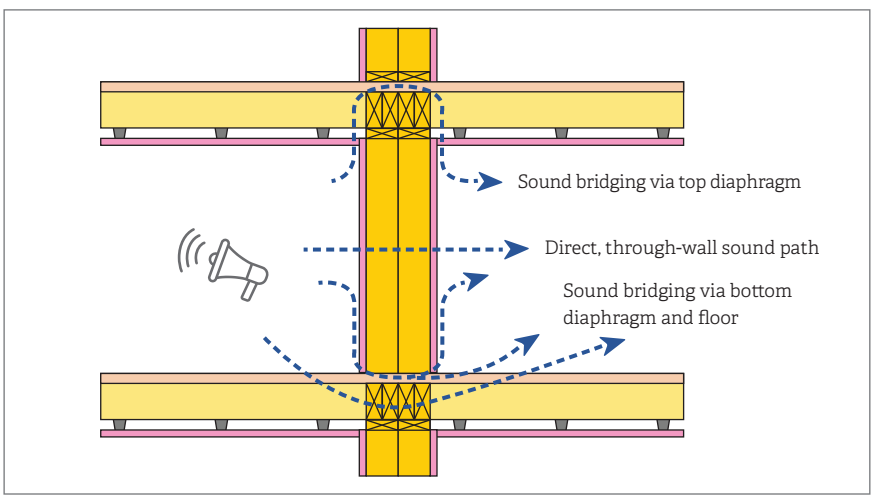
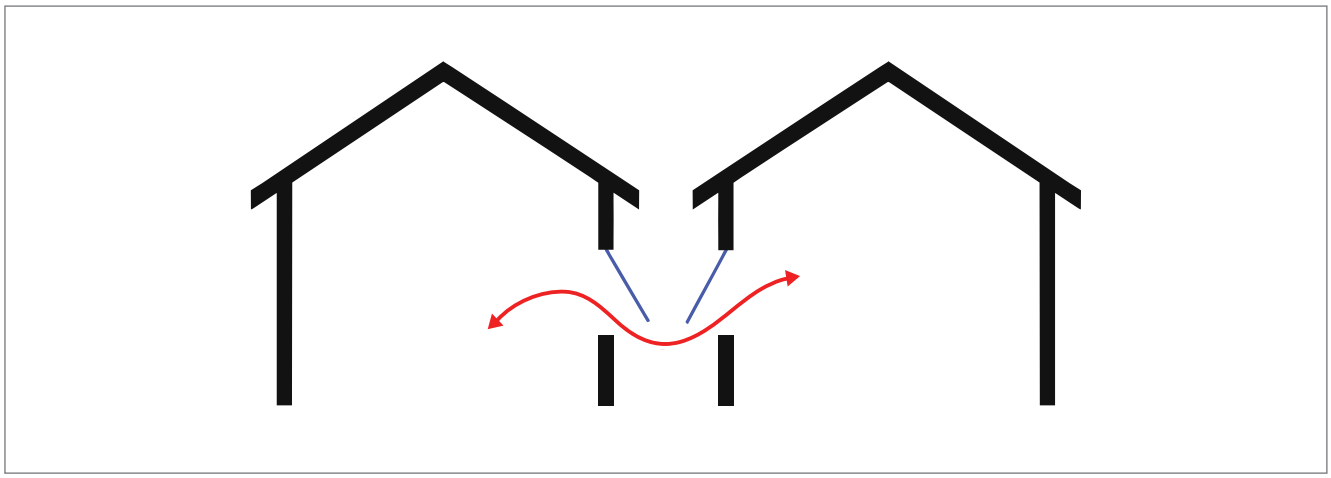


Figure 1: Horizontal flanking paths for airborne sound in double stud walls via continuous floor diaphragms.

Medium-density development arranged around a shared common space.



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to choose between acoustic and thermal comfort.

Mechanical services should also be designed so that they do not exceed the levels specified in AS/NZS 2107:2016.

Plumbing noise

Noise from wastewater pipes is a common cause of disturbance in multi-household units. Design and construction techniques that can minimise the disturbance are:

- vertical-stacked bathrooms and kitchens
- avoiding waste pipes above bedrooms
- using a mass loaded vinyl pipe lagging
- fixing pipes with resilient clamps.

Acoustical benefits of MDH

Clause G6 of the Building Code only applies to attached household units. This means that detached dwellings have no requirements for sound transfer. In a scenario with small side yards and openable windows, performance could be well below Code minimum.

Small side yards are also wasted space that can be repurposed into attractive common spaces. Buildings can be arranged so that outdoor areas are protected from high noise activities such as road, rail or noisy neighbours like industrial sites.

It is a commonly held belief that multi-unit buildings have poorer acoustic amenity when compared with stand-alone dwellings. However, with good acoustic design principles, this does not have to be the case.