Reducing Noise in Buildings

Design Considerations for Wall & Ceiling Systems

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INTRODUCTION

Acoustic comfort is a fundamental quality of daily life. How we perceive sound in an indoor setting has a direct impact on our health and wellbeing. It is especially important in areas where the quality of the sound is essential to the operation of the space, like offices, hospitals, classrooms, and shared common areas.

The detrimental effects of subpar acoustic environments have been the subject of an enormous amount of research over the years. These effects can include poor academic performance,[1] diminished productivity at work,[2] negative impacts on patient recovery in healthcare settings,[3] and physical and mental health complications.

Designers and specifiers must consider acoustic design early in the planning and design process to create healthy sound environments. The objective is to align the space's acoustical characteristics with its planned purpose using the right materials, products, assemblies and installation methods. Among the most important design elements that contribute to good acoustics are walls and ceilings, whether they are blocking unwanted noise from entering a room or reducing the effects of excess reverberation within the room.

To help ensure occupant comfort and privacy, the National Construction Code (NCC) contains requirements for the acoustic performance of wall and ceiling systems. Meeting these requirements goes beyond simply selecting the right acoustic materials. Sound flanking, the quality of the workmanship, caulking, the existence and treatment of penetrations, and the incorporation of bridging items and structural elements can all have an impact on the assembled system's overall performance.

Below we examine some of the key design considerations for wall and ceiling systems in relation to acoustic applications.

DESIGN GUIDELINES AND REGULATIONS

The NCC is a performance-based code that governs the design and construction of buildings. A building solution will comply with the NCC if it satisfies the Performance Requirements. The NCC requires a level of sound insulation that represents the minimum acceptable building standard.

Multi-residential and commercial buildings are covered in the NCC Volume 1. In general, building elements must safeguard occupants from illness or loss of amenity as a result of undue sound being transmitted between adjoining spaces.

The NCC deals primarily with sound transmission and insulation. There are other guidance documents and standards available to help designers and specifiers understand the additional requirements (e.g. sound reverberation) of a healthy acoustic environment for different industry settings. These sources include the Guidelines prepared by the Association of Australasian Acoustical Consultants, and AS/NZS 2107:2000 “Acoustics—Recommended design sound levels and reverberation times for building interiors”

ACOUSTIC WALL AND CEILING MATERIALS

As sound waves pass through wall, floor, and ceiling assemblies, they lose energy. The plasterboard lining and insulation within walls and ceilings do much of the heavy lifting when it comes to resisting the transfer of vibrations that cause noise.

Specialty lining materials, such as acoustic plasterboard, are available that are suitable for spaces with heightened acoustic requirements. There are two types of acoustic plasterboard: those that are intended to absorb sound and those that stop it from spreading. Products designed to reduce sound transmission are made with a denser core, which acts as a physical barrier to stop sound from entering adjacent spaces. Perforations are a common feature of sound-absorbing plasterboard products, which aid in reducing echo and enhancing room acoustics.

Acoustic plasterboards, insulation, and studs all work together to dramatically lessen sound transmission through walls and ceilings. Certain acoustic design strategies alter the amount, size, or properties of essential materials—for example, by adding more layers of plasterboard lining. Other approaches modify the installation, structure, or composition of the wall or ceiling assembly. In most cases, the best approach is to combine a few different strategies to achieve the acoustic performance required for the specific application.

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FLANKING PATHS

Sound can inadvertently enter spaces through cracks and gaps and around the edges of building elements. These “flanking paths,” as these noise paths are often called, contribute significantly to poor sound control.

In addition to gaps in and around building elements, flanking paths can occur due to incorrectly sealed junctions between two materials, penetrations in building elements from building services, and weaknesses around building elements. It is possible to clearly hear a conversation that is occurring on the other side of a wall if a small hole has been cut through the wall. If a wall has unobstructed flanking paths surrounding or through it, adding soundproofing capacity will be ineffective.

Below are some common scenarios where flanking may occur:

- plasterboard wall systems that stop before the soffit or suspended ceiling;
- around isolated ceilings and floors;
- around light fixtures and other services;
- doors and openings that are not properly sealed; and
- low-CAC ceiling tiles.[4]

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PLUGGING THE GAPS

All windows and doors should have acoustic seals around the perimeter; however, these seals will only work as intended if they are installed correctly. Seals should be chosen for their longevity, ease of use, low maintenance requirements, and performance.

A wall or ceiling system's design should account for any penetrations and services. A system's acoustic performance may be compromised by penetrations, so they must be carefully considered as early as possible.

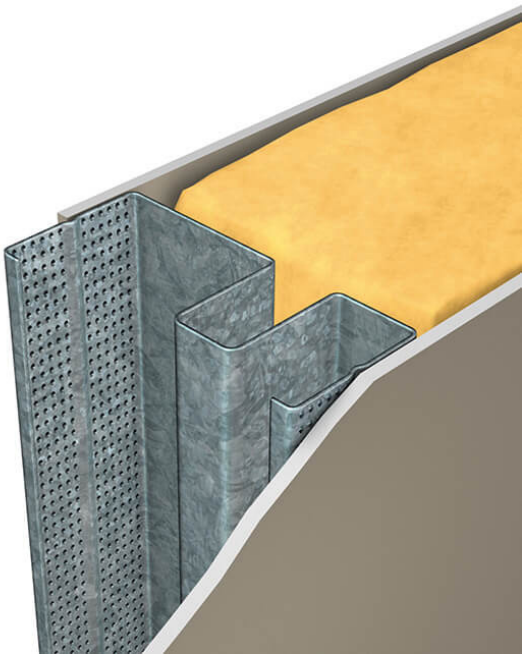
Every penetration made in acoustic-rated building elements needs to be carefully drilled or cut. It is good practice to avoid excessively large penetrations. Make sure that all penetrations, joints, and junctions are sealed airtight with a flexible caulking compound to minimise noise transfer via flanking paths.

DECOUPLING RIGID CONNECTIONS

Sound waves can travel through hard connections made between the plasterboard panels on either side of a wall and the framing materials. A common way to address this is by decoupling these rigid connections.

Better acoustic performance can be achieved by ensuring that the plasterboard panels on one side of the wall are fastened to a different set of studs than the plasterboard panels on the opposite side. Gyprock recommend staggering plasterboard joints on either side of wall. Direct structural coupling can also be broken by using resilient channels to attach the gypsum panels on one or both sides of the wall to the studs.

Another approach is to use an acoustic stud. A normal stud conducts the vibration across its web, and sound is transmitted via anything that reacts to it by vibrating. Specially designed studs weaken this vibration to deliver a more acoustically efficient wall system. Rondo QUIET STUD®, for example, provides an overall larger surface area than a standard wall stud. This means that sound vibration has to travel further and tends to weaken in intensity across the wall. Studs are still staggered using QUIET STUD®.



RECOMMENDED PRODUCTS FOR ACOUSTIC DESIGN

Gyprock has developed a broad range of acoustic systems to help specifiers and builders meet the NCC requirements with confidence. A range of Gyprock's acoustic products are also suitable for use in areas where enhanced acoustic performance will improve the experience of the space.

The Gyprock range of plasterboard with enhanced acoustic properties for use in homes includes **Soundchek™** and **Superchek™**, which can reduce sound transfer between rooms and the storeys of a home. Combined with acoustic insulation, they are ideal for creating quiet spaces around bedrooms, studies and home theatres.

Gyprock Perforated Plasterboard can be used in spaces such as rumpus rooms and home theatres. The panel perforations, together with insulation, reduce echo and noise reverberation to create more comfortable environments for work and leisure.

For multi-residential and commercial buildings **Soundchek™**, **Fyrchek™**, **Fyrchek™ MR**, and **EC08™ Complete** all offer enhanced acoustic absorption and can be used in walls and ceilings to reduce sound transfer between offices, rooms in apartments, classrooms and other commercial applications. Controlling reverberation is also important in commercial buildings to improve occupant comfort. Gyprock's Perforated Plasterboard range offers a range of high performance and attractive options suitable for foyers, theatres, libraries and gymnasiums.

EC08™ Extreme has been specifically designed to meet the highest standards across a broad range of performance requirements. This product helps combat sound transmission in commercial spaces while being suitable for demanding applications that pose hard body impact risks.

To maximise acoustic performance, these products can be used in conjunction with the **Rondo QUIET STUD® Acoustic Wall System**. The design of QUIET STUD®, combined with the appropriate lining board system, forms an effective buffer against unwanted noise. It is suitable for fire and non-fire rated applications, inter-tenancy walls and any other application requiring heightened acoustic control and performance.

Fast and simple to install, QUIET STUD® leaves more usable floorspace in a similar footprint and is almost exactly the same as standard drywall construction. This results in lower installation costs and a fail-safe acoustic wall system.

REFERENCES

1 Shield, BM and JE Dockrell. “The effects of environmental and classroom noise on the academic attainments of primary school children.” Journal of the Acoustical Society of America, Vol. 123, No. 1 (2008):133–144.

2 Mak, C and Y Lui. “The effect of sound on office productivity.” Building Services Engineering Research and Technology, Vol. 33, No.3 (2012): 339–3455.

3 Joseph, A and R Ulrich. “Sound Control for Improved Outcomes in Healthcare Settings.” Center for Health Design. https://www.healthdesign.org/sites/default/files/Sound%20Control.pdf (accessed 26 October 2023).

4 Ceiling Attenuation Class (CAC) determines how well a suspended ceiling attenuates sound entering a plenum when the wall does not extend full height. High CAC values signify superior levels of sound insulation between rooms.

All information provided correct as of November 2023

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