

Acoustic Design in Education

Why acoustics in education matter



Noise in education is on the rise, however room acoustics is often the *'forgotten variable'*. Affecting children and teachers alike, poor acoustics in classrooms and lecture theatres results in poor academic performance and workplace stress. Here's why.

Noise affects the youngest the most

It may seem self-evident, but in most educational settings, speaking and listening are the primary communication modes: up to 60% of classroom activities involve speech between teachers and students or between students¹.

While good room acoustics that foster ease of listening and good intelligibility are essential for all, poor acoustics most affect young children, for whom primary school is typically the first experience of formal learning. That's because young children are



inefficient listeners, they're neurologically immature and lack the experience to predict from context.

This means that missing key words, phrases and concepts because of poor listening conditions, can become a long-term problem. In addition, noise levels are reported to be the highest in the classrooms of the youngest children².

In fact, most children under 13 years of age, have an undeveloped sense of hearing, making the impacts of background noise on hearing, comprehending and learning more pronounced for them than for adults.

¹ Accredited Standards Committee, S12, Noise, 2002

² *Investigating the effect of intrusive noise levels on speech perception in an open-plan Kindergarten classroom*
Kiri T. Mealings, Katherine Demuth Jorg M. Buchholtz,, and Harvey Dillon, Macquarie University,
National Acoustics Laboratories

Acoustics in education: why does it matter?

There are also more children with special 'acoustic needs' than you may think, including those:

- + With **temporary illnesses** causing mild hearing loss (e.g., middle ear infections) which have been on the rise ([Nelson, 1999](#)).
- + With **learning, attention, or reading deficits** (Committee to Review..., 2006; [Nelson, 2003](#)).
- + Speaking **English as a second language** (ESL) (Collaborative for High Performance Schools, 2005a; LightSPEED Technologies, Inc., n.d.; [Nelson, 2003](#)).
- + With **hearing-impairments** ([Nelson, 2003](#)).

In Australia, the number of deaf or hearing-impaired children enrolled in Royal Institute for Deaf and Blind Children programs has increased by 40% in the last seven years and more than 12,000 children in Australia have a significant hearing impairment.

New Zealand primary classrooms will frequently have significant numbers of hearing-impaired children in them because of a high incidence of conductive hearing loss associated with middle ear disorder and because over 90% of children with permanent sensorineural hearing loss are mainstreamed.



The academic effects

The problems caused by poor room acoustics — meaning background noise, reverberation, and signal-to-noise ratios — can have long-term effects.

Research shows that it can also inhibit reading and spelling ability, behaviour, attention, concentration, and academic performance. In addition, children who develop language skills in poor acoustic environments may develop long-term speech comprehension problems ([Smaldino & Crandell, 1999](#)).

Success for kids with hearing loss (a 'go-to' site for professionals and family members seeking more information about the learning and social issues of children with hearing loss), distills other research to present four key categories of impact:

1 Rate: In noisy and/or reverberant classrooms the least effects are seen when students are involved in practicing skills they already know, like maths drill problems. The greatest effect is seen when students are introduced to new words or concepts.

2 Persistence: Children who are educated in noisy classrooms tend to give up faster when faced with learning challenges. This lack of perseverance is a serious limitation to a healthy learning attitude and our current need to be accountable for every child's school achievement.

3 Achievement: Students in schools next to noisy freeways or under airport approach flight paths can have a one year drop in grade equivalent achievement scores for every 10 dB increase in traffic noise in the classroom.

4 No habituation: There exists the belief that when a teacher speaks quietly or when noise is present that the children will learn to tune in and focus more intently. This may be true in the short term, but children in noisy educational settings learn to tune out — not tune in. The energy needed to listen more carefully leaves less mental capacity to process the information that is being presented and saps the length of time that students can truly employ.

Noise also affects teachers

It's not only children who suffer from the effects of poor classroom acoustics. A review of the research literature by academics at Macquarie University³, showed that while only 5% of the general population experiences vocal fatigue, 80% of teachers experience it. This increases the risk of vocal abuse and pathological voice conditions.

Noise also raises blood pressure, increases stress levels, causes headaches, and results in fatigue. Teachers in classrooms with poor acoustics are more likely to have sick days off work and believe their job contributes to voice and throat problems.

How learning trends have been creating poor acoustics

It's generally recommended that ambient background noise levels in classrooms should not exceed 35dBA, reverberation times (RTs) should be between 0.4 and 0.6s, and Signal to Noise Ratios (SNRs) should be greater than +15dB.

³ An investigation into the acoustics of an open plan compared to enclosed Kindergarten classroom Kiri Trengove MEALINGS, Jorg M. BUCHHOLZ, Katherine DEMUTH; Harvey DILLON, Macquarie University, Australia, National Acoustics Laboratories, Australia

However, many studies have shown that ambient background noise levels reach 60dBA, SNRs are between -7 to +5dB, and RTs range from 0.4 to 1.2s (2,8,16). In occupied classrooms, student generated noise creates the highest noise levels measuring between 50 – 70dBA (2,15).

Despite already excessive noise levels in traditional, enclosed classrooms with 20 – 30 children, there is a current trend to open plan 'flexible learning spaces' as well as learning done in small groups, with a high emphasis on **incidental learning**. This means that noise levels are even higher than in the traditional, 'didactic' style teaching environment.



New approaches to teaching mean new approaches to education design: how do we design spaces that support collaborative and incidental learning?

Traditional teaching, where the teacher stood at the front of the class and talked at a row of neatly arranged desks and pupils may soon be a thing of the past. One of the key emerging trends is that encouraging learner participation is increasingly important in learning space design.

This means active learning, interaction, and social engagement. However, with these changes come challenges — especially in acoustics. Modern teaching, such as working in small groups, normally involves lively communication. This sets a cycle in motion: although the number of speaking individuals remains the same, the noise level in the classroom rises further and further.



THE KEY ACOUSTIC ELEMENTS TO MANAGE, IN ACOUSTIC DESIGN IN EDUCATION

- 1 Background noise:** dampening background noise and preventing excess noise from outside entering the teaching space. While air conditioning units contribute to this, so too does a trend towards openable windows for cross-flow ventilation.
- 2 Reverberation time (RT):** shortening the RT will help with speech intelligibility, and the added absorption will reduce the overall sound level within the room without adversely affecting the signal-to-noise ratio (SNR).
- 3 Signal-to-noise ratio (SNR):** this generally becomes less favorable for hearing as the distance between the speaker and the student increases. In addition, the noise level in educational institutions can be described as a desired signal with a highly fluctuating fraction of interfering noise, that's largely dependent on the relevant teaching process.

Background noise and sound insulation

Sound insulation is the ability of an object to resist sound transmission through it. The greater the sound insulation, the less noise will be transmitted from outside into the classroom and between adjoining classrooms. This is important in preventing unwanted outdoor noise, such as that from road and air traffic, local industry activity, HVAC installations and other children playing, entering the learning space.

The use of high, sound insulating wall and ceiling systems minimises the transmission of noise between spaces and helps reduce background noise levels. There are two main types of sound insulation: airborne and impact.

When **airborne sound waves** meet an obstacle such as a wall, some of the energy is reflected back into the space from the source of the original sound, some of the energy is absorbed by the wall, and the remainder is transmitted to the adjacent space on the other side of the wall.

The amount of energy transmitted, as a ratio of the total energy, is known as the sound transmission coefficient (a non-dimensional value between 0 and

1), which translates into a sound reduction index, R-value, for the wall.

If a wall has a sound transmission coefficient of 0.01 i.e. it allows 1% of sound energy to be transmitted through it, then the sound reduction index (R), is 20dB.

To achieve an R-value of 50dB, the wall must have a sound transmission coefficient of 10 – 5. That is, it should only allow 0.001% sound energy to pass through.



R-values

When a wall consists of many components, like wall, door and power sockets for instance, the sound transmission coefficients for all the components are used to calculate the weighted R-value (R_w) for the composite wall system.

This is because sound waves will find the weakest path to pass. It is therefore important that R-values of individual components in any system do not vary by more than 10dB.

R-values are derived from laboratory controlled tests for all Knauf wall systems, however to reflect the actual sound insulation performance of building components against low frequency airborne noises, building codes may suggest the use of a correction factor for certain applications like external or separating walls.

The correction factor (C_{tr}) is a negative value that takes into account the impact of low frequency noises like traffic and aircraft noise; drums and bass guitars; and surround-sound systems. Two walls can have the same R_w -rating, but different $R_w + C_{tr}$ ratings. The higher the $R_w + C_{tr}$, the better the wall will be at blocking low frequency noise.

“It is easy to understand how impact sound can very quickly be transmitted through a building via connected components.”

However, not only does sound travel through air, it is also transmitted via structures or building components. Structure-borne (or solid-borne) sound is also known as **impact sound**.

Sound travels at different speeds through different mediums. The speed of sound in air is 340m/s, whereas in steel, it is 5000m/s, and in rubber 60m/s. It is therefore easy to understand how impact sound can very quickly be transmitted through a building via connected components: otherwise known as flanking transmission.

Impact sound insulation can be achieved by physical separation, using systems that do not have any rigid mechanical connections between two separate layers, like a staggered stud wall or twin frame wall system for instance. Sound impact insulation is also achieved by placing acoustic dampers such as rubber mats or strips under floors, wall tracks and equipment bases and by using resilient wall and ceiling mounts.

Reverberation time

In an open space, sound energy gradually decays as it travels further from the sound source. In theory, if you double the distance from the source, the sound level is reduced by 6dB.

In closed spaces, sound waves cannot move unrestrictedly and are reflected back from the surfaces in the room. As sound waves get mixed up together to create a concoction of original and reflected sound waves, the overall noise level increases and the sound takes longer to decay. This phenomenon is known as reverberation.

The time it takes for the noise level to fall by 60dB is called the reverberation time (RT) and it's highly dependent on the size of the room.

RT and learning spaces

In a learning space, the reverberation time needed depends on the main function of that space.

Too long and the sound will remain in the space causing unwanted noise, drowning out speech and making concentration difficult.

Too short a time and the sound will be quickly cut short, quiet sounds will be difficult to hear and the use of rhetoric techniques impossible.

However, walls, ceilings and floors can all be used to manage RT; to direct, spread and absorb sound. Both the ceiling and the walls should be actively used in placing sound absorbers: in general, the higher the ceiling, the more absorbers are needed.

Wall and ceiling surfaces that both reflect and absorb sound can provide early reflection of the sound followed by suppression, and in this way achieve good speech intelligibility whilst reducing unwanted noise.

Resonator absorbers, such as panels with perforations, are particularly effective in educational spaces as they work in three ways across the entire frequency range:

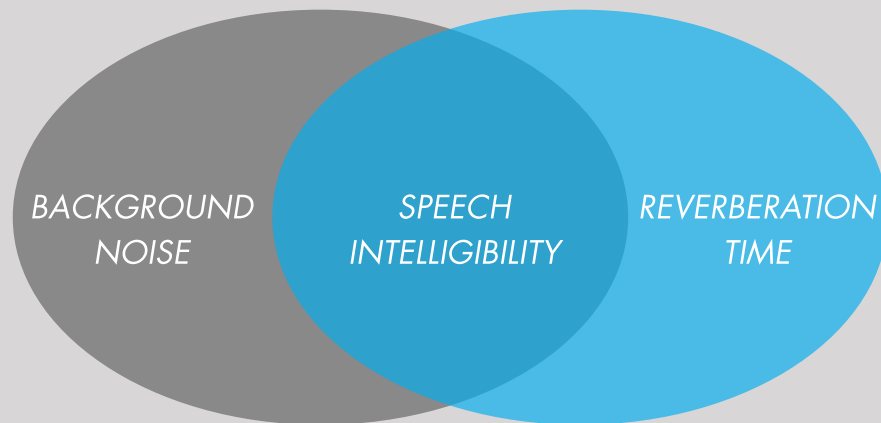
- + As a membrane absorbing the low frequencies
- + As a resonator absorbing sound in the mid-range
- + As a diffuser of the high frequencies.

The number, size and distance of the perforation holes can influence the sound absorbing effect at different frequencies.

Speech Intelligibility — the intersection of background noise and reverberation time

We have established that sound insulation is needed to reduce background noise, and sound absorbing materials to lower the reverberation time, however a balance is needed between reducing noise levels whilst still allowing the important sound to be carried in the room.

When the teacher or the pupils speak, consonants must be clear, some rhetoric should be possible and no-one must have to strain to hear.



Achieving speech intelligibility in classrooms. The target of good speech intelligibility requires attention to both background noise levels AND reverberation time.

However, because consonants are higher pitched than vowels (occurring mostly in the higher frequencies) and typically spoken more softly (have lower decibel ranges), they tend to be masked by background noise. This has a major influence on our ability to understand speech.

It is therefore extremely important to adjust sound in the individual frequencies because if absorption is too effective in the higher frequencies, the speech intelligibility will be lost and pupils will have to work that much harder to hear what is being said.

The measurement of speech intelligibility is complex, but Speech Transmission Index (STI) considers factors such as reverberation time, background noise, room geometry and placement of absorbing, reflecting and diffusing materials.

The index value is from 0 – 1 with 0 as the worst and 1 the best. As a general rule an STI rating of over 0.6 is required for learning spaces. Conversely, as STI increases, speech privacy decreases and vice versa.

Acoustic design becomes even more critical in open plan learning environments. Here the conflicting demands of speech intelligibility and privacy are



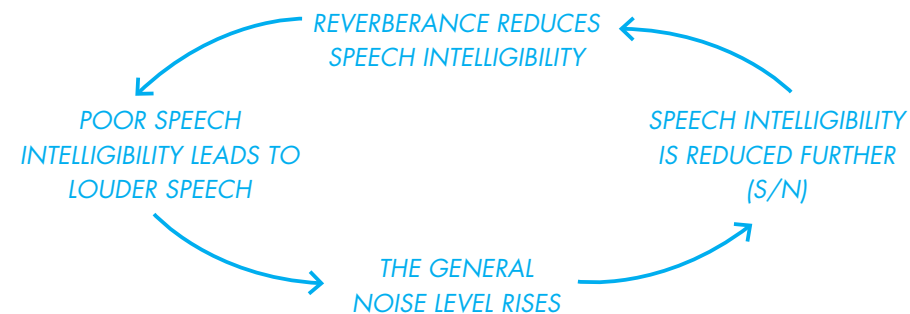
“In modern learning spaces, furnishings and fittings can be used strategically to manage conflicting acoustic challenges.”

heightened. For teachers and pupils to speak to larger groups requires good speech intelligibility or a high Speech Transmission Index (STI) which in turn creates poor privacy. Privacy on the other hand is needed for pupils to be able to work in smaller groups undisturbed or for teachers to talk to individual pupils without disturbing the rest of the class.

In these modern learning spaces, furnishings and fittings can be used strategically to manage these conflicting acoustic challenges. Additional acoustical interventions in the form of partitions and room dividers together with well-considered zoning are essential, but the impact of culture and behaviour should not be underestimated either. Furnishings and choice of colour can be used to encourage and reinforce behaviour patterns that are compatible with the learning space.

THE LOMBARD EFFECT

In modern forms of teaching, a number of working groups may be speaking simultaneously in the same room. This means that the ‘signal’ of one group will be an ‘interference signal’ for the others. A chain reaction is set off in the classroom: the parties will compensate for the speech intelligibility thus impaired in their group by increasing the speech volume, which in turn will lead to a raising of the interference signal level for the others, etc.



The noise level in the classroom is therefore pushed steadily upwards over time, although the number of communicating parties remains the same. This phenomenon is described in acoustics as the Lombard effect.

In this scenario, the particular significance of room acoustics for modern teaching also becomes clear. If, for example, short reverberation times ensure a precise speech signal (especially in the consonant spectrum), the individual parties can make do with a lower signal-to-noise ratio. The build-up of the noise level is substantially less or no longer takes place.



Other recommendations

Acoustic design does not need to be complex. When starting with a space try thinking of the surfaces as mirrors and how they might reflect light: in the same way, these smooth, hard surfaces also reflect sound waves around the room. To modify the sound in a space there are essentially six techniques:

- + Direct the sound in a particular direction
- + Limit the amount of sound
- + Emphasise the sound
- + Spread the sound
- + Dampen the sound
- + "Colour" the sound



PRACTICAL CONSIDERATIONS FOR LEARNING SPACES

- + Use sound barriers in the form of movable partitions or dividers — place them so they are touching and adjacent to walls, ceilings and floors, for maximum privacy effect.
- + Have a central point to which everyone has unimpeded acoustic contact — place sound reflecting materials above it to assist the sound in reaching everyone.
- + Consider the use of microphones if reverberation time is very low — this will ensure that all pupils can hear the teacher.
- + Use furniture, bookcases and other fittings strategically, to spread the sound.
- + Choose furnishings and colours that reflect the ethos and mood of the space and reinforce the desired behaviour.
- + Avoid hollow floors and have soft and absorbing floor coverings — use rubber caps on furniture legs where hard floor surfaces cannot be avoided.
- + Avoid adjoining thoroughfares and corridors and direct noisy traffic away from the open plan area — take care that connecting rooms do not act as amplifiers of sound.
- + Don't forget that all materials, including sound absorbers, must be durable, resistant to wear and tear, and easy to maintain.

AS/NZS 2107:2000 ACOUSTICS REQUIREMENTS FOR EDUCATIONAL FACILITIES

ZONE	CHARACTERISED BY	ROOM TYPE	EXAMPLES	RECOMMENDED DESIGN SOUND LEVEL, L_{Aeq} , dB(A)	RECOMMENDED REVERBERATION TIME (T), s
A	Quiet teaching and/or reading spaces	1	Primary school classrooms	35 – 40	0.4 – 0.5 (Note 4)
		2	Secondary school classrooms	35 – 45	0.5 – 0.6 (Note 4)
		3	Teaching laboratories	35 – 45	0.5 – 0.7
		4	Reading areas in libraries/computer teaching rooms/office areas/staff rooms	40 – 45	0.4 – 0.6
B	Relatively large lecture and speech spaces	5	Conference rooms	35 – 40	0.6 – 0.7
		6	Assembly halls over 250 seats	30 – 35	0.6 – 0.8
		7	Lecture rooms and theatres	30 – 35	0.8 – 1.0 (Note 5)
C	Noisy and/or high noise tolerant spaces	8	Working laboratories/corridors and lobbies	40 – 50	0.6 – 0.8
		9	Audio-visual areas/art and craft studios	35 – 45	0.6 – 0.8
		10	Music practice rooms	40 – 45	0.7 – 0.9
D	Relatively large noisy and/or high noise tolerant spaces	11	Drama studios	35 – 40	0.9 – 1.2 (Note 5)
		12	Gymnasiums	45 – 55	0.9 – 1.2 (Note 5)
		13	Music studios	30 – 35	1.2 – 1.6 (Note 5)

Notes:

1. Recommended reverberation times are referred to the medium frequencies (e.g. 500 Hz or 1000 Hz).
2. For large volumes, the recommended reverberation times assume two-thirds occupancy and it is generally considered acceptable to have some increase in reverberation time towards the low frequencies.
3. For small volumes, it may be more suitable to make reverberation time independent of frequency.
4. Certain teaching spaces, including those intended for students with learning difficulties and students with English as a second language, should have reverberation times at the lower end of the specified range for zone 1 and 2.
5. The recommended reverberation time for lecture rooms and theatres, drama and music studios, gymnasiums, etc. depend on the volume of the space, please refer to AS/NZS 2107:2000 for more information.

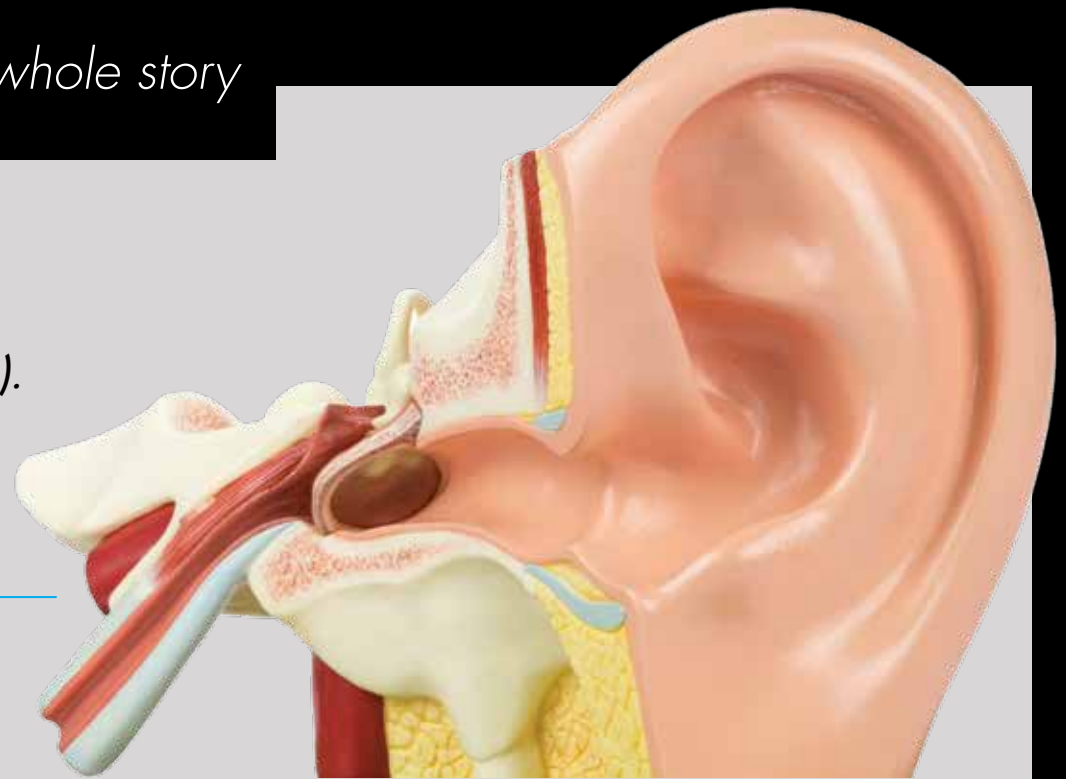
Calculating acoustics: why 'averages' don't tell whole story

One common way to calculate acoustics is to take an average of how a material absorbs and reflects different sound waves (under laboratory conditions). This average is known as the Noise Reduction Coefficient (NRC). But, as with any averaged figure, it doesn't tell the whole story.

In simple terms, an NRC (Noise Reduction Coefficient) is the average of a material's absorbing or reflective qualities at four different sound frequencies (250hz, 500hz, 1000hz, and 2000hz).

However, designing room acoustics based on NRC can deliver poor acoustic performance in practice. That's because different materials can perform differently at different frequencies. As a result, two materials with the same NRC may not perform the same way in reality.

A more sophisticated way to measure acoustic performance is to calculate what is called a weighted sound absorption coefficient (α_w). It's calculated by comparing sound absorption coefficients to a standard curve to give a better picture of a material's



performance across all of the important frequencies. The higher the α_w figure, the more evenly a material absorbs sound across all of the important frequencies.

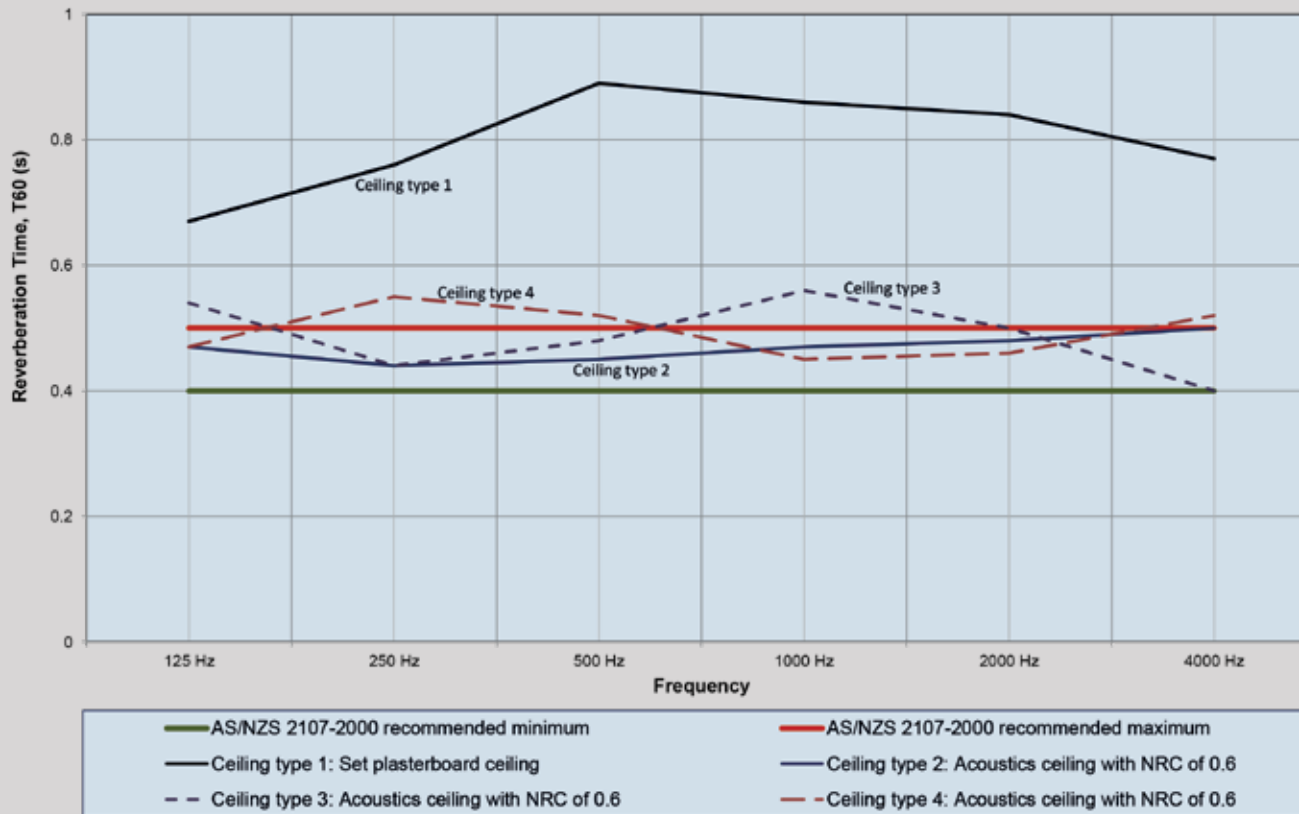
The table overleaf illustrates this point: ceilings 2, 3 and 4 all use a material that has a single number sound absorption rating or 0.7, and yet the results couldn't be more different.

For instance, Ceiling 2 meets reverberation time requirements at lower frequencies only and Ceiling 4 meets them at only 1000hz and 2000hz. Only Ceiling 3 meets reverberation time at all frequencies.

Calculating acoustics: why 'averages' don't tell whole story

Reverberation time comparison

Calculated using Knauf Reverberation Time Calculator for 10m long, 8m wide and 3.5m high primary school classroom with timber floor and masonry walls, 30 children, and heavily furnished



Ceiling type 1 does not meet the reverberation time requirements of AS/NZS 2107-2000.

Ceiling types 2, 3 and 4 all have NRC ratings of 0.6, but only the ceiling type 2 meets the reverberation time requirement at all frequencies.

Note: For smaller spaces, AS/NZS 2107-2000 recommends to make reverberation time independent of frequency, which means it is better to have rather uniform reverberation time throughout the frequency range.

Above comparisons also suggest that acoustic designing based on single number ratings like NRC may not yield the desired acoustic environment. Obviously, ceiling type 2 would create a more favourable acoustic environment than other ceiling types.

Quiet teaching and/or reading spaces

SECONDARY SCHOOL CLASSROOMS

- + Interaction — teaching of small groups of approx. 30 people.
- + Dampened sound environment. Excellent comfort for speaking and listening and clarity of speech in terms of consonants (high STI*). Good transmission of light.

Acoustic solutions

- + Suspended acoustic and wall linings.
- + Medium absorption.
- + Light colours with 65 – 75% light reflection.
- + Ceiling: Plaza / Stratopanel
- + Wall: Designpanel / Stratopanel

OPEN PLAN LANDSCAPES

- + Interaction in many small work groups. Presentations to large groups
- + Dampening of noise. Free from disturbance. Excellent comfort in terms of speaking and listening. Good transmission of light.

Acoustic solutions

- + Acoustic ceilings and wall claddings. Sound-diffusing constructions on floor and ceiling as separating elements. Geometric reflection over the teacher.
- + Medium absorption.
- + Light colours with 65 – 75% light reflection.
- + Ceiling: Plaza / Stratopanel
- + Wall: Designpanel / Stratopanel

PRIMARY SCHOOL CLASSROOMS

- + Interaction — teaching of small groups of approx. 30 people.
- + Dampened sound environment. Excellent comfort for speaking and listening plus good light diffusion.

Acoustic solutions

- + Suspended acoustic and wall linings.
- + Medium absorption.
- + Light colours with 65 – 75% light reflection.
- + Ceiling: Plaza / Stratopanel
- + Wall: Designpanel / Stratopanel

TEACHING LABORATORIES READING AREAS IN LIBRARIES COMPUTER TEACHING ROOMS OFFICE AREAS STAFF ROOMS

- + Interaction between two or a few people.
- + Dampened sound environment. Excellent comfort for speaking and listening plus good transmission of light

Acoustic solutions

- + Acoustic ceilings and wall linings. Medium absorption.
- + White painted with 65 – 75% light reflection.
- + Ceiling: Plaza / Stratopanel
- + Wall: Designpanel / Stratopanel

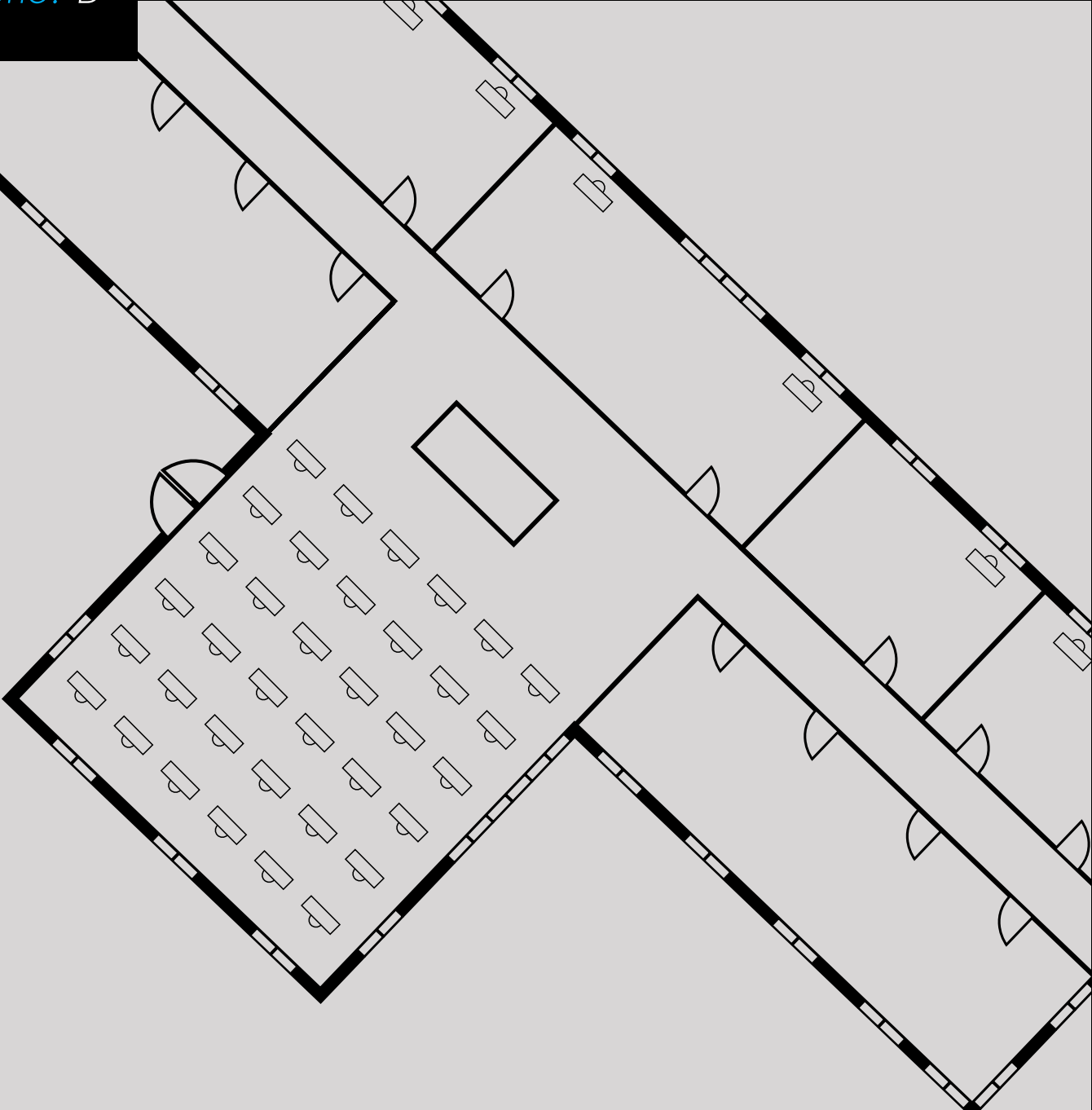
*Relatively large lecture
and speech spaces*

**CONFERENCE ROOMS
ASSEMBLY HALLS OVER 250 SEATS
LECTURE ROOMS AND THEATRES**

- + Gathering place for a large number of people.
- + Excellent comfort in terms of speaking and listening.
- + Identity-creating space.

Acoustic solutions

- + Absorbents such as Stratopanel, mainly on walls.
- + Geometrically reflecting ceilings.
- + Use of colour on ceilings and walls.
- + Low absorption.



Noisy and/or high noise tolerant spaces

AUDIO-VISUAL AREAS ART AND CRAFT STUDIOS

- + Individual and group teaching, i.e. principally one-way communication.
- + Dampened sound environment and noise reduction.
- + Sound reduction in relation to other rooms.
- + Robust and easy to clean.

Acoustic solutions

- + Acoustic ceilings.
- + Impact resistant absorbents on walls.
- + Avoid drumming effect from floors.
- + High absorption.
- + Ceiling & wall: Contrapanel

WORKING LABORATORIES CORRIDORS AND LOBBIES

- + Lots of human traffic.
- + Combating noise.
- + Impact resistant materials.
- + Sound reduction in relation to other rooms.

Acoustic solutions

- + Acoustic ceilings (possibly self-supporting) and wall linings.
- + High absorption.
- + White-painted with 65 – 75% light reflection.
- + Ceiling: Stratopanel / Plaza or Corridor (self-supporting)

MUSIC PRACTICE ROOMS

- + Lively sound environment.
- + Long reverberation time.
- + The room is a kind of musical instrument in itself.
- + Sound reduction in relation to other rooms.

Acoustic solutions

- + Absorbents on walls.
- + Few absorbents on ceiling.
- + Hollow floors.
- + Avoid parallel walls and ceilings.
- + Low absorption.
- + Wall: Stratopanel

Relatively large noisy and/or high noise tolerant spaces

GYMNASIUMS

- + High level of physical activity
- + Muffling of noise.
- + Impact resistant materials.

Acoustic solutions

- + Absorbents on walls and ceilings (must not create shadows).
- + Impact resistant ceilings and walls.
- + High absorption.
- + Ceiling & wall: Contrapanel

MUSIC STUDIOS

- + Dampened sound environment.
- + Reduction of noise in relation to other rooms.

Acoustic solutions

- + Acoustic ceilings and wall claddings.
- + Dampened floors. Inclining walls.
- + High absorption.
- + Ceiling: Plaza Tangent
- + Wall: Stratopanel

When Roseville Girls' College undertook a major library refurbishment, the design had to accommodate a radical change to the way libraries function. The result may be lots of open communal space, but it's also a space that students say they really want to be in.

Libraries are not immune to the changes affecting the way schools function. The brief for the refurbishment of the Roseville College Library reflected quite a radical change. There's less reliance on individual rooms and more reliance on open communal space that accommodates students working together in class mode or in small working groups.

Studio GA architect Paul Gallagher says that acoustic engineer Peter Griffiths from Acoustic Studio, told them to focus on the best performance they could get from the ceiling. "His advice generally, was to work the ceiling hard, as all sound hits the ceiling. That led us to the Knauf product."

Gallagher says that as the project evolved, and after they started construction, they went back to the client





to make sure they fully understood how well they were solving all the long term needs of the school. “Part of that is serviceability,” says Gallagher.

“It’s not just a performance specification or a visual agenda; we wanted to make sure the facility manager had exactly the sort of access that he needed for servicing.”

To achieve that, the team ended up integrating all the access panels — some 46 in all. The contractor had

“The acoustics that this ceiling gives are absolutely brilliant.”

Jeanette Harkness, Head of Library services, Roseville Girls College

to cut in the Knauf ceiling panels and meeting a very tight tolerance — but the result is all 46 access panels are part of the ceiling, with a touch-release drop-down panel, at all irregular service points through the ceiling.

Despite that, Gallagher says that when first entering the space, people aren’t even aware of seeing those in any shape or form.

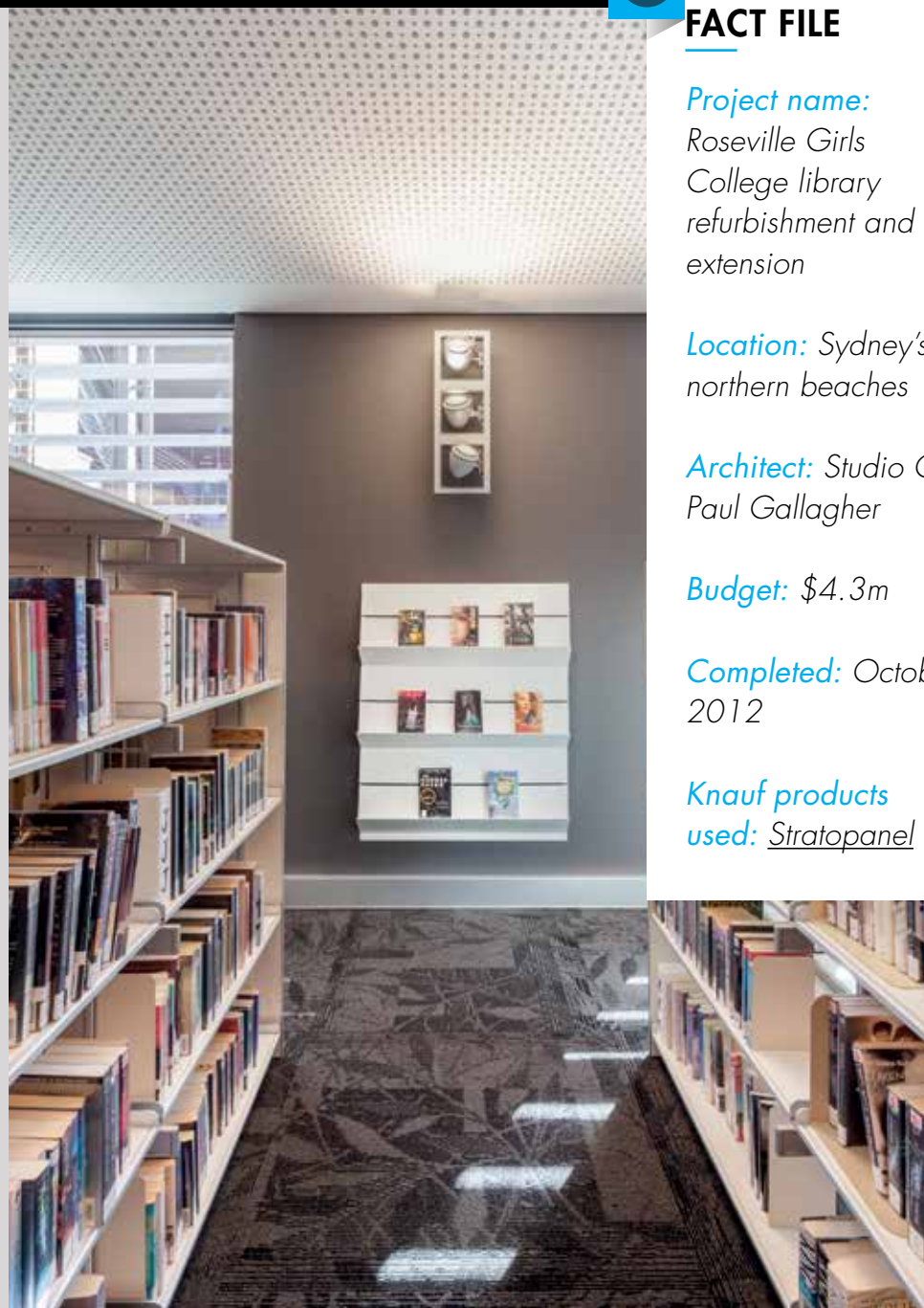
“It’s only on closer scrutiny, when you look at a cassette air-conditioning unit or a control point, that you find where those access panels are. The consequence of that was that we increased the amount of perforated ceilings substantially by some 50 – 60% and we also got a higher individual performance out of the ceiling per square metre as well.”

Gallagher believes that led to the “fantastic outcome”... where there’s a definite hush and quietness to the space even when fully occupied. “We achieved the acoustic performance, we achieved the serviceability,

we achieved the construction tolerance we were after and then on top of all that, there's a beautiful visual outcome. So I think we could not be happier with that as a total product delivery and on that Knauf has been exceptional, so we're very happy."

Head of Library services, and teacher librarian Jeanette Harkness says that before the refurbishment, the library was a static library and didn't accommodate the classes and the student and teacher needs.

"This absolutely does. It's brilliant to have," she says. "I guess the girls have summed it up when they say, 'I can really concentrate in here, I can really study in here, I just really want to be here.' When we have classes booked in which is fairly constant, the girls actually get to the door and they just know where they want to be and they run to it. They really appreciate the furniture. They appreciate the atmosphere. The acoustics! The acoustics are absolutely brilliant here and although people don't sort of say, 'Oh, the acoustics are brilliant', they understand and appreciate the effects of the acoustics."



FACT FILE

Project name:
Roseville Girls
College library
refurbishment and
extension

Location: Sydney's
northern beaches

Architect: Studio GA,
Paul Gallagher

Budget: \$4.3m

Completed: October
2012

**Knauf products
used:** Stratopanel

State-of-the-art learning space

The centerpiece for a progressive learning environment, The Zone, is an adaptive, open learning space for more than 180 students. However, being a large space that's interconnected, meant the ceiling had to work really hard.

Architect Catherine Downie was faced with a brief that involved taking four classrooms on a lower level and a library on a split-level, and completely reworking them to create an agile and flexible space where learning could happen in any place at any time.

“This learning space is for 180 students... Because it's a space for Years 5 and 6, we didn't want it to be too serious, [or too corporate].” says Downie. “It meant that acoustics was a huge concern, with a lot of noisy activities, a lot of energy happening. The acoustics solution had to be able to attenuate that.”

With a set of parameters from the acoustic engineer, the architects also wanted to use some hard surfaces in the space to facilitate certain activities.

“Being a large space that was interconnected meant



State-of-the-art learning space



that the ceiling had to work really hard," says Downie. "I'd seen Knauf's Stratopanel (formerly named Cleaneo) Alternating Perforation, and I really liked it from an aesthetic perspective. When we started to do some more research, we found that it hit all of our acoustic requirements and when I spoke to Knauf, they came in and we discussed everything that the product needed to achieve and there was very hard data so I was able to send that back to the acoustic engineer and they were able to say, 'Yes, let's go with it.'"

Northern Beaches Christian School Director of Development, Anne Knock, remembers her time at school when there was one teacher and 30 kids in



a "box". She believes that we have to think about the world our students are entering and structuring learning to prepare our students to work more effectively in that world.

"That's not just the content and delivery of curriculum," she says "it's also that physical space that they're in... and the furniture and the whole environment they are learning in."



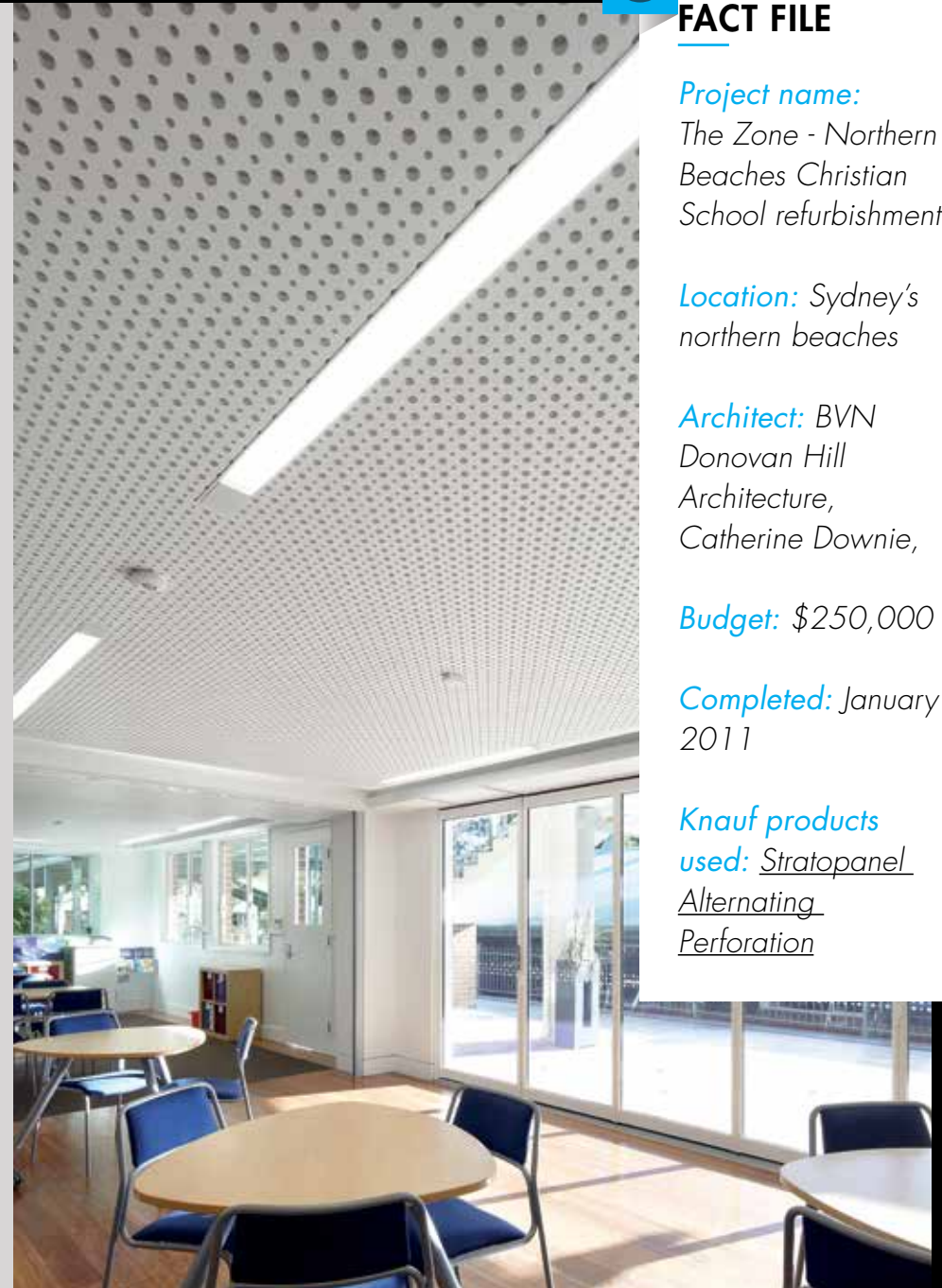
“Often the key to this space working so well is the last thing that you’ll notice.”

Anne Knock, Director of Development, Northern Beaches Christian School.

The Zone accommodates 180 students and six teachers and is where those students spend 75% of their day.

“They work in small groups, they work individually, they work as a whole group sometimes. So being able to hear one another or not hear one another is really crucial,” says Knock. “I often have visitors from all over Australia here, so I’ll have a group of five or six people and we’ll walk into the space and they just look around and they’ll see students engaged. They’ll look at every corner and see students working in small groups and individually.

“But I’ll say to them, ‘Often the key to this space working so well is the last thing that you’ll notice’, and I’ll point up and we’ll notice the acoustic panels that are here because they are crucial to making this space work.”



FACT FILE

Project name:
The Zone - Northern Beaches Christian School refurbishment

Location: Sydney’s northern beaches

Architect: BVN
Donovan Hill
Architecture,
Catherine Downie,

Budget: \$250,000

Completed: January 2011

Knauf products used: Stratopanel
Alternating
Perforation

If you'd like to go beyond NRC and use a reverberation time calculation on your next project, or learn more about acoustic solutions for walls and ceilings, don't hesitate to ask.

Both the Specification and Commercial Sales Team and the Knauf Tech Team work with architects, acoustic engineers and builders throughout the specification and construction process. In addition to advice on the right product to meet your specific acoustic requirements we also offer:

K-Spec Pro

A custom design specification proposal for your project, developed by Knauf and catered to your project's requirements. Knauf engineers can develop a project-wide proposal that details the most cost-efficient wall and ceiling systems for each and every wall and ceiling in your building, ensuring a first-class system selection and reducing time and effort to design and specify.

BIM Wall Creator (Revit add-on)

The first Australian Revit wall creator that intelligently generates Revit-based wall types with detailed specification information. Creates wall types quickly and easily using performance parameters, including FRL, R_w , wall width and performance requirements and is compliant with all AS/NZ BIM standards.

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Project-specific supply and installation cost estimations, developed to help you decide between similar systems to meet project requirements. Simply contact Knauf and we can develop an estimate from a single wall, right through to an estimated project-wide approximate cost.



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BEN WRIGHT

Technical Services Manager

Ben is a qualified Civil Engineer from the University of Western Sydney and he leads Knauf Technical Services team. His employment history includes

project engineering roles, marketing roles and also technical engineering support roles for manufacturers of concrete and steel products as well as plasterboard and associated products. He has worked for building material manufacturers for 14 years. As well as his interest in steel structures, he is also experienced in fire and acoustic engineering, the Building Code of Australia and also has a particularly keen interest in training.



ERIK MONEY

Technical Services Engineer

Erik graduated from Materials Science at UTS in Sydney. He has worked for building materials manufacturers for 19 years specifically fibre cement

and plasterboard. His employment history includes roles in research, product development, building system development, customer technical support, technical documentation, process engineering and engineering projects. Erik has hands on experience in a wide variety of materials and systems testing in areas such as mechanical properties, durability, impact, acoustic and fire performance. While providing customer technical support for the building industry, Erik has gained an interest and wide general knowledge in construction techniques, building physics and in particular, fire protection.



SHAILESH KOIRALA

Technical Services Engineer

Shailesh is a qualified Civil Engineer with extensive knowledge of lightweight building construction and building physics like

architectural acoustics and thermal insulation. He has worked for different building material manufacturers for more than 14 years, mainly in technical support and management roles including the last 10 years with Knauf. He has a strong command of Chinese Mandarin language and very keen interests in computer programming. He has personally developed several Windows based engineering application tools such as the Knauf Bracing Calculator, Knauf Reverberation Time Calculator, and Knauf Proposal Writer.



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