



CertainTeed
SAINT-GOBAIN
Ceilings

Acoustic Remediation

Addressing noise issues in existing and occupied spaces

whitepaper



Open Offices

Open offices, since their inception, have been known as noisy places to work. This is not a problem that is going to solve itself organically anytime soon. Increased workspace density, the generational shift toward “team spaces” and increased use of speakerphones and the loud speaking voices they inspire all point toward an ongoing need for skillful acoustic design in the workplace.

In a Yankelovich Partners survey conducted for the American Society of Interior Designers (ASID), 70 percent of respondents believe their productivity would increase if their offices were quieter and 54 percent said noise often bothered them. But according to a subsequent study for ASID by L.C. Williams and Associates, 81 percent of business executives polled said that they were not concerned that office noise would affect productivity.¹ The fact that the high-level decision makers are so much less likely to appreciate the value of acoustics than those working in the space day to day goes a long way to explain why proper acoustic measures are often overlooked in the design and construction of some workplaces.

Employee distraction and a lack of speech privacy in the workplace hurt productivity in the short term, and they can quickly lead to shifts in perceived employee satisfaction, negatively affecting talent retention and long-term profitability.

A well-informed interior architect or designer involved in new construction has an infinite variety of products available to create an acoustically optimized space from the ground up.

Acoustics have become such a hot topic in the age of open space design that manufacturers offer noise-controlling versions of many building materials: from floor underlayment to insulation to ceiling and wall panels – even drywall.

Unfortunately, not every new space is built according to acoustically enlightened principles, leaving thousands of offices, classrooms, restaurants and other spaces with poor acoustics and sound control, giving occupants – and owners – a headache.

It can be difficult to fundamentally change the way a built space

behaves acoustically. HVAC systems aren't easily replaced or rerouted. Trendy finish materials won't be abandoned, even if they turn a café into an echo chamber. And the addition of a wall-to-wall suspended ceiling is rarely practical. However, there are steps that can be taken to address noise issues in existing spaces with limited disruption to the occupants and the operating budget.

Common victims and consequences of poor acoustics

Some spaces are more likely than others to suffer from ongoing acoustic complaints. In each case, failure to address them can have serious consequences for the health and well-being of the individual within the space as well as the businesses that own it.

Schools

Acoustic interference undermines effective education, too.

Teachers and students both suffer when classroom acoustics are neglected. Classrooms in the United States typically have speech intelligibility ratings of 75 percent or less, meaning every fourth spoken word is not understood.³ Inappropriate levels of classroom noise can compromise not only speech perception but also reading scores, spelling ability, behavior, attention and concentration in children with normal hearing.⁴



Classrooms lacking in comprehensive acoustic management resources lead to teachers experiencing voice strain,⁵ increasing stress and fatigue, which reduces their performance and satisfaction. This may well be part of the reason

the average teacher leaves the profession within five years from sheer burnout.⁶

Persistent acoustic issues in the classroom become even more problematic when one considers the fact that most American public-school rooms are already fitted with wall-to-wall ceilings.

Restaurants

The restaurant business is all about creating buzz, and at the high end, the ambiance is every bit as important as the cuisine. That ambiance may include

such popular trends as polished concrete floors, exposed ceilings and ductwork, open kitchens and closely packed tables. While some restaurant owners consider a noisy environment a sign of popularity and profit, patrons don't necessarily agree.

After poor service, noise is the most common customer complaint. And in a Consumer Reports survey of nearly 50,000 diners at over 100 restaurants, 25 percent complained about the noise level.⁷ Everyone from professional critics for major metropolitan media to ordinary diners on Yelp and OpenTable® often take noise into consideration in their ratings and reviews, making sound a serious contributor to the success of the business.

Diagnosing acoustical problems

How can you tell when acoustic issues have reached a critical state? On the most basic level, your ears – and the occupants – will tell you. If teachers find they have to repeat themselves or raise their voice to be heard in the back of the room. If employees are turning to headphones in order to think clearly. If Yelp reviews are praising the food and panning the ambiance. All of these are fairly obvious signs. But in situations where expenditures must be approved at multiple levels, quantitative data may be required to justify an investment in acoustic remediation.

There are a number of tests that can be performed to determine whether a space meets the requirements of acoustic comfort. These tests can be performed by professional acousticians, but technical support teams for acoustic ceiling and wall manufacturers also have the appropriate expertise and equipment to test your facility.

The two most practical measurements are reverberation time and background noise.

Reverberation time (RT)

Reverberation Time is time required for an average sound in a room to decrease by 60 decibels, once the source has stopped emitting a sound. It is expressed in seconds. RT can be calculated mathematically based on the volume of room and the square footage of sound absorbing surfaces within it, or it can be measured with a Sound Level Meter.

Background noise

Background noise is the noise level in a space measured when the specific noise being studied is absent. Major sources of background noise are HVAC noises, outdoor noises, reflected speech sounds (echo) and noise from adjacent spaces. Background noise is usually expressed as dBA, a measure that reflects the response of the human ear, which is less sensitive to low and high frequencies.

Root Causes and Countermeasures

Most noisy spaces can be attributed to two main causes: reverberation and equipment noise.

Reverberation vs. Absorption

Sound reflects readily off of hard surfaces, as relatively little energy carried in the sound wave is absorbed into the surface material. As reflection builds upon reflection throughout a room, a web of competing sound waves gradually decays as it is absorbed bit by bit into the exposed surfaces in the space.⁸

Reverberation is an increasing problem due in part to some current interior design trends. Hard surface floors, the move away from fabric-covered cubicles, glass walls and partitions, open plenums, and exposed structures all add to the reflective surfaces, increasing reverberation times.

Acoustically absorbent materials, such as high-density fiberglass clouds, baffles, direct-to-deck ceiling and wall panels are extremely effective in reducing reverberation time.

When speech privacy is a specific concern, such as in an open office

setting, acoustic masking can be added alongside absorbent installations. This involves introducing finely tuned volume and frequency signatures that fall within the acoustical range of human speech. It doesn't eliminate speech sounds, but rather it reduces the physical zone of speech intelligibility by blending in with them.⁹

The good news is that the more reverberant a space, the more noticeable remediation solutions will be. To achieve a noticeable difference (a "just perceptible" reduction of 3 dB), the absorption in the space must be doubled. To bring the sound down a clearly noticeable 6 dB requires doubling the amount of sound absorption in the space.

Calculating the precise amount of sound absorption in a space using the sound absorption coefficient for each material multiplied by the surface area of that material, then finding the sum of all absorptive materials in the space is more math than anyone but professional acousticians care to do on the subject. Fortunately, there are some general rules of thumb that can be followed to determine how much sound absorption is needed in a given space based on the form the acoustic material takes. Each form has its advantages, depending on the design concerns and structural realities of the space requiring remediation.

ACCEPTABLE ACOUSTIC MEASUREMENTS

	OPEN OFFICE	CLASSROOM	RESTAURANT
Background noise	< 35-39 dBA	< 30-35 dBA	60-70 dBA
Reverberation time	< 1 second	< 0.6 seconds	0.8-1.1 seconds



Direct-to-Deck Panels

Direct-to-deck acoustic panels, which can be glued or screwed directly to the ceiling structure without wires or grid, are one of the simplest ways to improve acoustics in existing spaces. Their versatility and ease of installation maximize sound absorption while minimizing disruption to occupants.

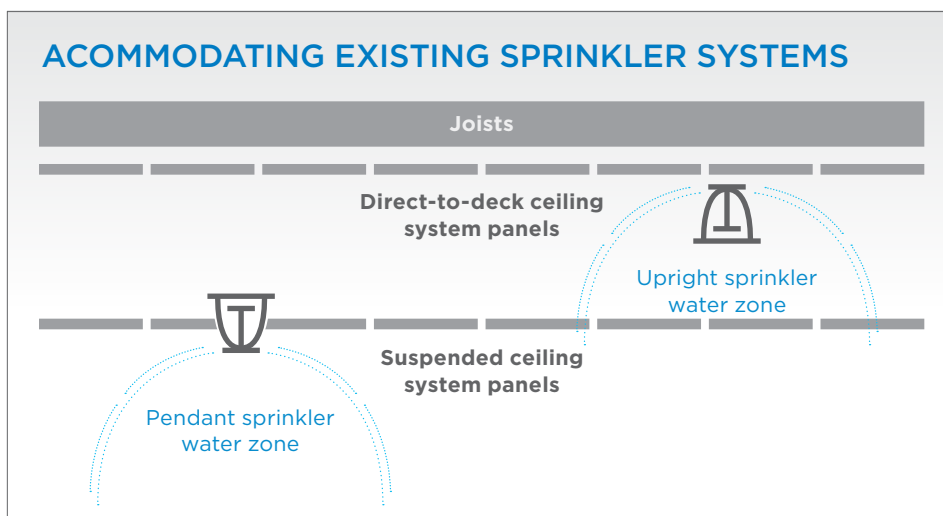
Because of their minimum overall system depth, they can be attached to low ceilings or even angled ceilings. Full coverage installation can mimic the clean look of a traditional drywall ceiling while providing the acoustic benefits of a suspended ceiling. They can also be installed in fields or as single panels. With absorption levels similar to standard suspended ceiling panels, direct-to-deck solutions should be installed to cover as much of the ceiling area as possible.

Beyond ceiling height, the fire protection and suppression system in a given space can be a key factor in the selection of direct-to-deck solutions. Systems with pendant sprinkler heads can accommodate both traditional suspended ceilings and direct-to-deck panels, but upright sprinkler heads require a solution with a shallower system depth, such as CertainTeed Ceilings Ecophon® Focus™ B, F or SQ.

Clouds & Baffles

Because free-hanging clouds absorb sound from both sides – direct from the source as well as sound reflected from the deck above – they offer the most efficient sound absorption option. Installation is extremely flexible, allowing clouds to be placed at varying heights, in tiers, and even angled. They can even be installed in addition to full suspended ceilings in particularly challenging spaces like open offices. Clouds are also offered in a wide variety of colors, shapes and sizes, offering the freedom to work within the design aesthetic of an existing space. CertainTeed Ceilings Ecophon® Solo™ clouds are available in 16 standard colors and 11 different shapes – everything from squares and circles to triangles and hexagons.

Similarly, baffles provide double-sided absorption, but with a smaller overall system depth than clouds. Baffles can also keep sight lines clear in high ceiling areas,



maintaining the very openness that otherwise would add to the acoustic challenges.

Because clouds and baffles absorb sound from both sides, installing products equal to 40 to 60 percent of the square footage of the space will bring reverberation times down to comfortable levels.

Wall Panels

Wall panels excel in smaller spaces with reflective walls such as conference rooms. Academic settings such as libraries and classrooms are prime candidates in that they often already have full suspended ceilings.

The design flexibility of wall panels has improved tremendously in recent years. Beyond simple 4 ft. x 8 ft. panels, circles, squares and

rectangles in a variety of sizes and colors are now available. CertainTeed Ceilings Ecophon® Akusto™ One SQ wall panels can even be custom printed, disguising the acoustic performance behind photos or artwork.

Where to begin?

There are always multiple paths to solving noise problems in an existing space, but there's no need to jump to the most elaborate or disruptive. It's surprising how much can be accomplished with relatively simple fixes. Rather than dive in with extreme measures, start small with the least disruptive or invasive options. If that's not enough, move on to the next solution. Whether it is a few simple wall panels, a field of direct-to-deck panels, or a collection of clouds, the right solution for the space is out there.

For help finding an acoustical solution, talk to the experts at CertainTeed Ceilings, by calling 800-233-8990 or visiting CertainTeed.com/AcousticalDesign.

Notes & Sources

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