By using sound masking to define and, therefore, know exactly what the background sound level and spectrum will be anywhere in a facility, one can more accurately specify the remaining materials.

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A New Approach to Acoustics

Using sound masking as a design platform

Sponsored by LogiSon Acoustic Network | *By Niklas Moeller*

With mounting recognition of the need to support focus at work as well as to promote wellness, many organizations are looking to improve speech privacy, noise control, and acoustic comfort for building occupants.

Background sound is key to achieving these goals. Indeed, all acoustic design considers this factor—for example, when determining Sound Transmission Class (STC), Articulation Index (AI) or signal-to-noise ratio (SNR). However, building professionals often neglect to use the only reliable and precise means of controlling the background level—a sound masking system—as a design tool. Instead, it is relegated to the last step in the design process, used to either cover up noises remaining after implementing absorption and blocking strategies or as a post-construction Band-Aid when occupants report dissatisfaction with their acoustic environment.

By turning the traditional three-tiered approach of absorb, block, and cover—collectively known as the 'ABC Rule'—on its head and using sound masking as the starting point for interior planning, building professionals can set an assured level of background sound throughout a facility and, hence, more accurately specify the blocking and absorptive elements, allowing it to be delivered in a more cost-effective manner—and with greater assurance of achieving the intended results.

CONSTRUCTING BARRIERS

When attempting to create speech privacy for closed offices, organizations may specify walls with high STC ratings. However, these ratings are lab-tested and frequently overstate real-world performance by five to 10 points. Field testing of spaces, which accounts for direct and indirect (i.e., flanking) paths can be completed using apparent Sound Transmission Class (ASTC) and Noise Isolation Class (NIC) methodologies; however, such assessments are, of course, only performed after the fact.

Another common tactic is to construct full height partitions that extend all the way from the concrete floor to the deck. While

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Learning Objectives

After reading this article, you should be able to:

1. Outline the role background sound plays in achieving effective acoustics.
2. Explain how sound masking reduces sound insulation requirements (e.g., STC).
3. Use Speech Privacy Potential (SPP) to achieve project savings.
4. Understand recent changes to ASTM standards related to sound masking.

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this approach increases isolation, it also raises costs and can impede future reconfiguration of the space. Vigilance must still be maintained during design, construction, maintenance, and renovation to ensure that penetrations in the walls' structure are controlled, because even minor ones can substantially reduce acoustic performance. This level of care can be difficult to sustain over the life of the space.

In any case, modern design and construction standards do not always allow for a high level of physical containment. To preserve flexibility, walls are often built to the suspended ceiling or using demountable partitions. Walls may include substantial windows or even be built-in glass from floor to ceiling. Budget can also limit options.

These challenges raise the question as to whether there is a preferable and more reliable method of achieving speech privacy for closed rooms—an integrated approach that begins with a precisely controlled level of continuous background sound.

THE ROLE OF BACKGROUND SOUND

Many people use the words 'noise' and 'sound' interchangeably. However, not all sound is noise. One can define 'noise' as any unwanted sound. Similarly, 'silent' and 'quiet' have different meanings. A silent space is one with no sound at all, whereas a quiet one is free of unwanted sound.

Understanding these seemingly subtle differences is critical to comprehending the role that sound itself plays in creating an effective acoustic environment. All too often, noise control strategies are mistakenly pursued with the intention of making a facility as silent as possible. However, the more silent one tries to make a space, the noisier it can seem to occupants. This phenomenon can be attributed to the fact that an effective acoustic environment relies in part on the provision of an appropriate level of continuous background sound.

Due to improvements in construction materials, as well as quieter office and mechanical equipment, the ambient level in the majority of facilities is already too low, leaving employees working in library-like environments. The pin-drop conditions allow them to easily hear conversations occurring from a distance and even from within closed rooms. Though occupants typically describe such a workplace as 'noisy,' the root of the problem is that they are, in fact, too 'silent.' Put another way, the absence of background sound makes noises easier to hear.

Credit: Benny Chan/Fotoworks

To preserve flexibility, walls are often built to the suspended ceiling or using demountable partitions. Walls may include substantial windows or even be built-in glass from floor to ceiling.

THE VARIABILITY OF HVAC

Both ASTM E1130-16, Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index and ASTM E2638-10, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room consider background sound when calculating speech privacy.

However, ASTM E2638-10 also reminds readers that the Speech Privacy Class (SPC) is only valid at the time it is measured because the background level is presumed to be provided by heating, ventilation, and air conditioning (HVAC). The principal objective of this equipment is to optimize thermal regulation and maintain standard requirements for air quality. Even if well-designed, its output is only governed in that it is not to exceed maximums defined by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) in Chapter 49: Noise and Vibration Control of the 2019 ASHRAE Handbook—HVAC Applications.[1] It cannot control the minimum background sound level.

If maximum noise limits are used as a basis of design, then expectations for speech privacy will not be met whenever and wherever the background sound level is below that noise limit. Indeed, HVAC output often varies temporally and spatially by 15 decibels (dB) or more, according to zone, time of day, and season, as well the type of equipment used. Whenever and wherever the background level falls below the 30 dBA on which STC ratings—and, hence, wall choices—are based, occupants can no longer rely on the partition assembly for speech privacy. Furthermore, HVAC does not generate a spectrum conducive to speech privacy or comfort. Instead, it is largely arbitrary and varies considerably from space to space, as well as over time.

Credit: iStockphoto/BrianAJackson

Most people are familiar with the masking effect of background sound. Everyday examples include the drone of an airplane engine, the murmur of a crowd in a busy restaurant, the hum of highway traffic, and the rustling of leaves in the wind.

Consequently, speech privacy levels fluctuate from wall assembly to wall assembly, depending on their performance in the frequencies used to calculate STC, as well as the inconsistent noise level and spectrum generated by HVAC—not to mention sound leakages through various flanking paths. If privacy is achieved, it is likely due to good luck or overbuilding. If not, a sound masking vendor is contacted. In this scenario, the technology is consigned to Band-Aid status, whereas it could have been more effectively used as the starting point for interior planning.

UNDERSTANDING SOUND MASKING

A sound masking system uses a series of electronic components and loudspeakers to distribute a sound similar to softly blowing air, causing many occupants to presume HVAC is its source. However, unlike HVAC, this sound is continuous and precisely controllable.

Though masking technology is often referred to by the term 'white noise,' modern systems do not utilize a particular color of sound. Rather, they are engineered so their output can be tuned post-installation in order to meet a spectrum or 'curve' specifically optimized for comfort and masking of speech.

The premise behind this solution is simple: our ability to discern a sound (e.g., noise or speech) is reduced when its level falls below that of the masking sound level. Moreover, the disruptive impact of sounds that remain above the controlled background sound level is lessened due to the reduction in the degree of change between the baseline and volume peaks. Consequently, occupants perceive treated spaces as quieter.

There are many everyday examples of this effect, such as running water, rustling leaves or the murmur inside a busy restaurant. However, when introducing a masking sound to a workplace, it is vital to ensure that it is also as unobtrusive as possible, making post-installation tuning an essential part of the commissioning process within each facility.

OVERCOMING PRECONCEPTIONS

Considering that sound masking has been available since the late 1960s, one might wonder why the building community has yet to embrace it as the foundation for acoustical design. To understand this delay, one has to consider the technology's history.

Sound masking systems were first adopted to help with the acoustical challenges encountered in an ever-growing number of open plans. This initial application led some to conclude that masking was only intended for these types of areas.

This opinion was also reinforced by a significant technical impediment. Early sound masking systems were designed using centralized architecture, which is very limited in terms of its ability to offer local control over the masking sound because they consisted of large zones that spanned numerous private offices and other closed rooms. This strategy fails to recognize the impact the space's architectural features (size, geometry, furnishings, finishings, etc.) have on the sound being delivered to the space and, hence, provides little to no opportunity to address it via local control over level and frequency. The resulting inconsistencies in masking performance led vendors and dissatisfied customers to conclude that the technology could not be applied in closed spaces.

Modern networked masking architecture addresses these historical objections by providing fine control over both level and frequency within small zones (i.e., one zone per closed office, and adjustment zones no larger than three loudspeakers, or 675 square feet [62.7 m2], within an open plan), but some still argue that closed rooms do not require sound masking because they are afforded sufficient speech privacy and noise control via physical isolation. By the same token, when a closed room fails to provide these attributes for its occupants, it is typically blamed on deficiencies in its design, construction, and/or maintenance.

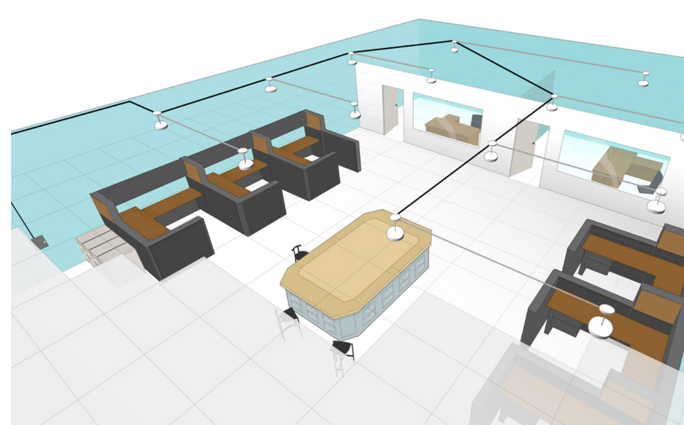
CRACKS IN THE ARMOR

While they might be a contributing factor, this failure cannot solely be attributed to cracks in the walls' armor because speech privacy is not determined by isolation alone. A person's ability to clearly understand a conversation is dependent on two variables: the received level of the speaker's voice and the background sound level in the listener's location. The relationship between the two is called the signal-to-noise ratio.

Traditional closed room construction attempts to provide privacy by simply reducing the signal. If a solution has not been implemented to control the minimum background sound level in adjoining areas and it is lower than the sounds passing through the wall or via various flanking paths—gaps along the window mullions, ceiling and floors, as well as through the plenum, ductwork, return air grills, and

Credit: iStockphoto/Alexjay

HVAC levels vary by zone and at certain times of day or year. Furthermore, this equipment does not generate a sound spectrum designed for speech privacy.



Credit: KR Moeller Associates Ltd.

A sound masking system consists of a series of electronic components and loudspeakers that distribute a sound specifically engineered to balance acoustic control with occupant comfort.

open doors—conversations and noises will still be audible and potentially intelligible.

Regardless, unless a sound masking system is implemented—as well as professionally tuned, and its performance verified post-installation—the minimum background sound level is not a known quantity. HVAC and other mechanical systems are sometimes thought to provide masking, but as noted above, one cannot reasonably expect this type of equipment to deliver a consistent level over time/space or to generate a spectrum conducive to speech privacy.

Accordingly, ASTM E1374-18e1, Standard Guide for Open Office Acoustics and Applicable ASTM Standards was revised. The discussion of HVAC noise in the previous iteration, ASTM E1374-18, Standard Guide for Office Acoustics and Applicable ASTM Standards, pertains only to limiting maximum noise levels rather than using this equipment for masking. Further, a sound masking system is identified as the only viable source of a continuous minimum background sound level. As the title change suggests, this standard's scope has also been broadened; it now applies to private offices and conference rooms, not only to open plan.

With the advent of computer-tuned masking systems, a minimum background sound level is now a readily deliverable component of architectural acoustic design. Using it—even to apply a level as low as the 30 dBA on which recommended STC ratings are often based—allows the expected degree of speech privacy to be more reliably achieved.

Building professionals can use this predictable background sound level as the foundation for the remainder of their acoustical plan, allowing more accurate selection of the blocking and absorptive elements—and providing a means of reducing the specifications for the room's physical shell, while still achieving the desired level of speech privacy.

CALCULATING THE BENEFITS

But is an equal or greater level of privacy achievable using this alternative?

One method of resolving this question is to use speech privacy metrics, which allow one to objectively assess the impact of increased attenuation and background sound level on intelligibility. The grandfather of intelligibility metrics is the Articulation Index (AI), defined in ASTM E1130-16, Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index. The calculation methodology for the AI accounts for both aforementioned parameters. And although the standard's title references open plan spaces, it was originally derived, and used, for enclosed spaces as well. That said, some acousticians prefer to use SPC—derived from the same theory as the AI—as defined in ASTM E2638-10, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room to predict "higher levels of speech privacy" or speech security (i.e., when speech tends towards becoming inaudible) for closed spaces. SPC is derived from the same theory as the AI.

Calculation of AI is based on several measurements taken in the space in question, as well as a standardized normal voice level. Onsite testing determines the amount by which voice level is reduced between the source room and the listener location. The difference between the voice level and the background in each of the third-octave frequency bands (200 to 5000 Hz) provides the signal-to-noise ratio in the listener location. Because certain frequencies contribute more significantly to intelligibility than others, the AI method assigns a specific weighting formula to determine an AI contribution within each frequency band, and these are summed to arrive at the AI value. By contrast, the calculation methodology used for the SPC does not discriminate between frequencies.

Using this method, one can quantify the impact of increasing the attenuation of the wall and that of increasing the masking level, allowing comparison of the two strategies. Obviously, as wall attenuation increases, for each decibel reduction there is an increase in speech privacy levels.

Mathematically, the same can be achieved by raising the background sound level by a decibel. To understand why, one need only look to the step in the above AI calculation that determines the signal-to-noise ratio. If a wall decreases the intrusion of voice into the room by a decibel, then the signal-to-noise ratio is reduced by a point. An identical drop occurs when the masking level is raised by one decibel.

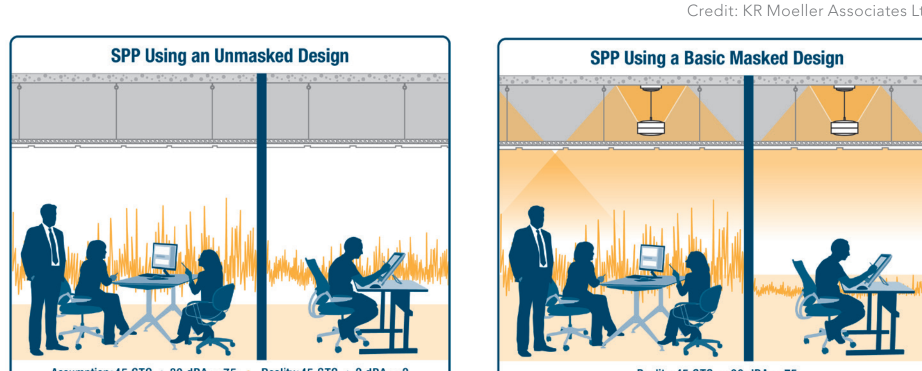
Masking typically adds approximately 5 to 12 dBA of ambient sound to closed rooms.

FORMULA FOR SUCCESS

When preparing "Sound & Vibration 2.0: Design Guidelines for Health Care Facilities"—the companion document to the Facility Guidelines Institute's (FGI) 2014 Guidelines for Design and Construction of Hospitals and Outpatient Facilities—acousticians developed a formula that provides a simplified predictive model for this approach. Basically, to "achieve confidential speech privacy the sum of the composite STC and the A-weighted background noise level shall be at least 75," or STCc + dBA ≥ 75. Some refer to this formula as Speech Privacy Potential (SPP).[2]

While the need for speech privacy is obvious to organizations that consistently deal with sensitive information—such as hospitals—most people expect conversations occurring within closed rooms to remain private, making SPP broadly applicable. Even if an organization decides that it is more motivated by the need for a high-performance workplace than speech privacy, taking the steps required to lower

Credit: KR Moeller Associates Ltd.



A design that does not feature sound masking, but rather relies on HVAC to provide an assumed minimum background sound level leads to over-specification of the room's physical structure, while still leaving its actual acoustic performance up to chance (left). A design that utilizes sound masking to establish a known minimum background sound level—even as low as 30 dBA—as well as a spectrum or 'curve' designed for speech privacy, eliminates the variability of HVAC sound, allowing acoustic goals to be more reliably achieved with the stated STCc (right).

speech intelligibility allows them to reap both rewards.

SPP considers the contribution of both room-to-room insulation and background sound level. While different organizations apply different metrics to these two elements, the STCc and dBA metrics outlined by the FGI Guidelines are particularly useful to the design process when the spectrum of background sound is also known in advance because it is to be provided by a correctly implemented sound masking system.

It is also important to note that this formula is based on the Composite STC (STCc) of the partition assembly rather than the wall rating alone—a distinction often lost on those untrained in acoustic design. STCc includes the negative impact on acoustic performance when elements such as doors and windows are added to the partition. For example, an STC-50 partition can degrade by as much as 23 points when an ungasketed door is installed that covers 20 percent of the wall.

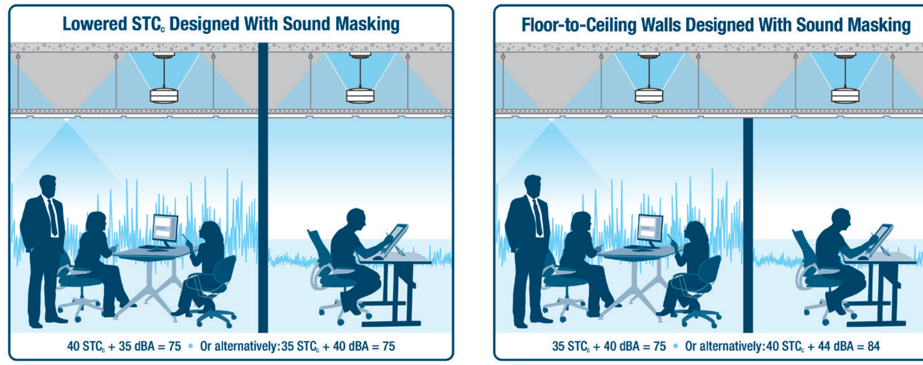
Because dBA is often assumed to be 30, STCc must be at least 45 to achieve the combined total of 75. Using masking to apply a continuous level of 30 dBA eliminates the variability of the source, and speech privacy is more reliably achieved with the stated STCc. The curve generated by a professionally tuned masking system is also precise; therefore, the speech privacy it provides is greater than the typically erratic spectrum produced by HVAC, even at the same volume.

VALUE ENGINEERING

In the above scenario, the masking sound is set to a level far below that used in traditional applications. The sound is barely identifiable and yet provides the minimum necessary to accurately plan the remaining design elements. However, while the established maximum levels for HVAC can form the basis for the controlled minimum background sound provided by the sound masking system, there are significant opportunities for further value engineering because the predictable overall volume and spectrum allows one to reduce the specifications for the room's physical shell.

If speech privacy equals STCc + 30 dBA ≥ 75, then, for every 1 dBA increase in the background sound level, it is possible to reduce STCc by one point and achieve the equivalent level of speech privacy. Were the background sound to be increased from 30 dBA to 35 dBA, for instance, construction costs for partition types would start to drop significantly because the STCc could be reduced by five points.

Again, 30 dBA—and, indeed, even 35 dBA—is well below typical masking levels in closed rooms. Usually, they are set to between 40 dBA and 43 dBA in such spaces.



If the background sound level is set to 35 rather than 30 dBA, STCc can be lowered to 40. Alternatively, using a still moderate level of 40 dBA permits STCc as low as 35 while maintaining a Speech Privacy Potential (SPP) of 75. In fact, value can still be derived by the most cautious of specifiers, even if they take only half the increment in background sound as an STCc reduction. For example, with masking at 40 dBA, rather than drop STCc from 45 to 35, an STCc of 40 plus masking at 40 dBA yields an SPP of 80 (left). Further value engineering and site flexibility can be achieved by specifying room construction with walls built to the suspended ceiling rather than structure. With STCc at 35 and the masking level reliably set to 40 dBA, SPP is 75. If the STCc is increased to 40 and the masking level is raised to 44 dBA, SPP is 84 (right).

	HVAC		Sound Masking	
Type of Room-Space	Recommended NC Level	Equivalent (Maximum) Sound Level	Recommended (Minimum) Sound Level	Usable Range
	NC Curve	dBA	dBA	dBA
Hotels/Motels				
Individual rooms or suites	30	35	35	35-50
Meeting or banquet rooms	30	35	35	35-40
Halls, corrridors, lobbies	40	45	45	45-48
Offices				
Conference rooms	30	35	35	35-40
Private	30	35	35	35-43
Open-plan areas	40	45	45	45-48
Corridors and lobbies	40	45	45	45-48
Hospitals and Clinics				
Private rooms	30	35	35	35-50
Operating rooms	35	40	40	40-45
Wards	35	40	40	40-45
Corridors	40	45	45	45-48

The long-established maximum levels for HVAC systems can form the basis for the continuous minimum background sound produced by the sound masking system. While the background sound can be maintained at a fixed and unwavering level, there is also an opportunity to raise the masking if the partition construction fails to live up to the rated design as a consequence of common deficiencies such as flanking paths.

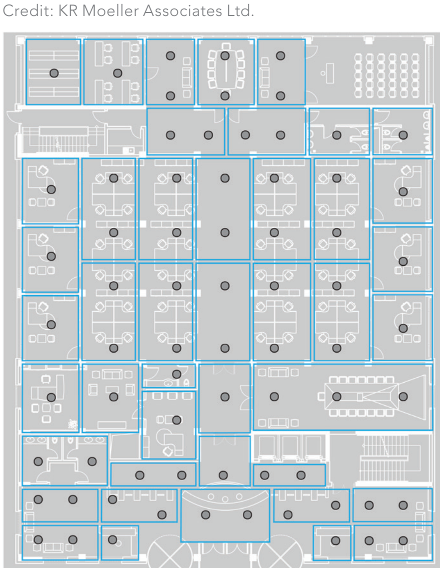
Depending on various factors, including occupant comfort, they may be set higher. Therefore, although 30 dBA can be used as a design benchmark, the lowest STCc rating possible to achieve an SPP of 75 is actually determined by the highest comfortable level of continuous minimum background sound.

ADDITIONAL SAVINGS

Sound masking can also be used in combination with walls (or demountable partitions) built to a suitably Ceiling Attenuation Class (CAC)-rated suspended ceiling in order to provide a cost-effective and more flexible alternative to deck-to-deck construction. Budget wise, sound masking may represent 1 to 2 dollars of cost per square foot of space, but it offsets much more than that in terms of construction above the ceiling. The ability to provide private rooms with walls to the ceiling also increases the ease and cost-effectiveness of relocating them to suit future needs.

For example, the University of Southern California was struggling with how to achieve privacy between medical exam rooms within a healthcare consultation center. With an open plenum, they attempted a number of successive design interventions to improve speech privacy. The addition of plenum barriers—effectively extending the walls to the deck above—did little to address the problem. According to Curtis Williams, Vice President of Capital Construction, it was the addition of masking that "greatly reduced the intelligibility of conversations between the exam rooms, allowing patients and doctors to talk with peace-of-mind knowing that their discussions could not be understood in adjacent rooms."

Credit: KR Moeller Associates Ltd.



Providing sound generation, volume, and frequency adjustment in small control zones addresses the tuning challenges posed by large ones. For example, this masking design features 44 zones, allowing the technician to adjust the sound according to local conditions so they can meet the specified curve across the entire treated space.

In another example, a major American healthcare provider changed its construction standards for medical office buildings away from deck-to-deck construction. After significant testing of mock-up facilities, the company determined they achieved as good or better speech privacy with ceiling-height walls and sound masking. They reported cost savings of hundreds of thousands of dollars for a project of just over 30,000 sf (2787 m2).

There are some cases where one may want to implement both deck-to-deck construction and sound masking; for example, in spaces where raised voices or high-volume media will be used, as well as in areas with high security needs. Also, if the facility features an open ceiling, full height walls are recommended to ensure some degree of inter-zone isolation.

FUTURE FLEXIBILITY

The fact that a range of adjustment is 'left on the table' provides an additional advantage.

When sound masking is incorporated into the facility design, one also has the opportunity to increase the background sound level if the partition construction fails to live up to its rated level—for example, as a consequence of common deficiencies such as flanking paths—and remedial action would be cumbersome and/or costly. While the minimum planned level should be at least 30 dBA, as noted above, the level traditionally recommended in most closed rooms is 40 to 43 dBA, leaving a range of adjustment at the facility manager's disposal.

Of course, this rationale can also be applied to existing spaces that are not performing as expected. However, by waiting to install masking post-occupancy, an organization forgoes the opportunities to reduce construction costs and the specifications for other acoustic treatments.

DESIGN, TUNING & REPORTING

It is important to note this type of integrated acoustic design is only viable when the minimum background level is precisely generated and consistently delivered by the sound masking system. Once constructed, the acoustical properties of walls and ceilings cannot be easily changed—and, once engineered and installed, neither can the sound masking system's architecture.

ASTM E1111-14, Standard Test Method for Measuring the Interzone Attenuation of Open Office Components acknowledges variations as small as 2 dBA can significantly influence speech privacy, while other studies indicate even a single dBA affects comprehension by up to 10 percent and, in almost every situation, impacts the Articulation Index by 0.0333. Variations in spectral quality can have similarly negative effects.

Therefore, it is incumbent on those responsible for acoustical planning to ensure the sound masking system is designed and implemented with due consideration for these stringent requirements. A poorly designed or improperly tuned system can allow as much as 4 to 6 dBA spatial variation, meaning the system's effectiveness is halved in unpredictable areas within the facility.

CLOSED ROOMS

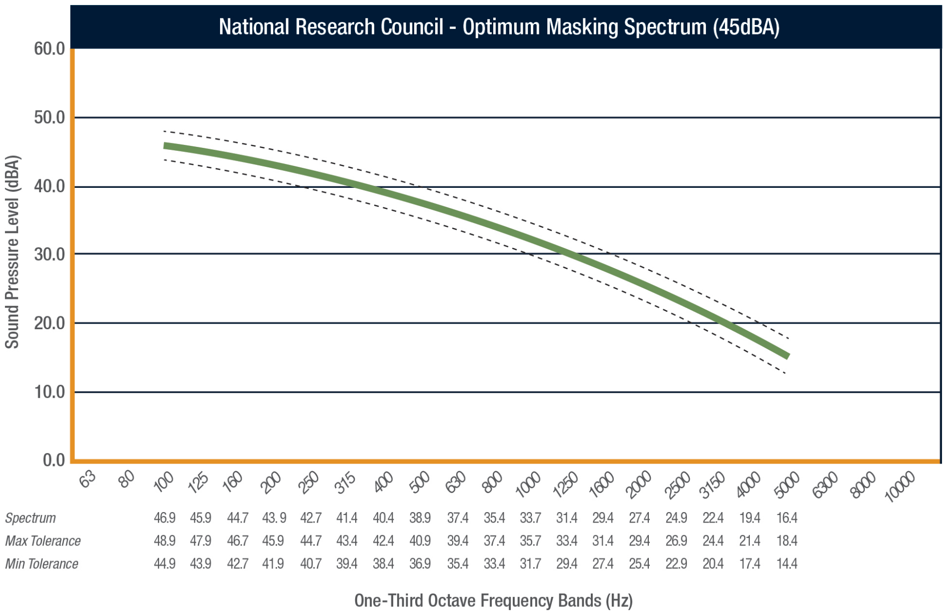
As noted earlier, not all system architectures can provide effective and comfortable masking sound in the fragmented and individual environments presented by private offices and other closed rooms. So, what is current best practice in these areas?

First, each room should be provided with its own loudspeaker. In open plans, loudspeakers are typically located according to a standard grid at 15-foot (4.5 m) spacing. Including closed rooms in this pattern reduces localized control because one loudspeaker may span more than one room. Zones within open plan should not exceed three loudspeakers or 625 sf (58 m2).

Second, the loudspeaker should be allocated to its own control zone. Ideally, this means that it is fed by a dedicated masking sound generator and that it also has dedicated volume control and third-octave equalization. Having a number of loudspeakers connected to a shared set of controls inherently limits the system's ability to meet the specified masking curve in each closed room.

Third, each zone should offer precise output adjustments for both volume (i.e., 0.5-dBA increments) and equalization (i.e., third-octave over the specified masking spectrum, which is typically from 100 to 5000 Hz or higher). Following installation, the vendor should tune each zone at ear height (i.e., where occupants experience

Credit: KR Moeller Associates Ltd.



The National Research Council's (NRC) optimum masking spectrum, as well as one-third octave band tolerances of ±2 dBA.

the masking effects) and provide a detailed report of the results.

The masking spectrum in closed rooms should be identical to that used in open plans; however, the overall sound level will typically be several decibels lower. This provides a good degree of consistency between the open and private spaces, but addresses the occupant's expectation that the ambient levels in smaller rooms are lower than in large open venues. Overall masking levels in private offices usually range from 42 to 45 dBA, but as stated above, benefits can even be realized at lower volumes.

A well-designed and professionally tuned system is able to keep variations in masking level to ±0.5 dBA and those in frequency to ±2 dB per third octave, providing dependable coverage throughout treated areas.
ASTM E1573-18, The Measurement and Reporting of Masking Sound Levels Using A-Weighted and One-Third-Octave-Band-Sound Pressure Levels is predominantly be used by acousticians tasked with verifying the performance of an installed and calibrated sound masking system against a specification outlining such target levels and tolerances. However, sound masking vendors should also follow this standard to ensure they provide good data for the verification process.[3] As with the aforementioned ASTM E1374-18, this standard's title has also been updated to reflect the fact that sound masking is used in closed rooms as well as open plans.

Indeed, the debate over whether sound masking should be included in closed rooms should be put to rest. In almost all situations, it is better to combine a reasonable amount of isolation with a reliable ambient level, allowing organizations to save on wall construction by reducing the STC ratings of walls and/or using floor-to-ceiling rather than deck-to-deck construction. As long as the system is properly engineered for this type of environment, it is possible to provide the client with a suite of acoustic benefits that could not otherwise be achieved in private offices and other closed spaces, and also prevent the noticeable voids in the background sound level that are created when masking is only applied to open plans.

PROVIDING OCCUPANT CONTROL

An in-room control can permit occupants in closed rooms to regulate the masking level, as well as paging and background music. While such individual control is undesirable in shared open plan areas, closed rooms should afford a measure of personal control.

In-room control can be provided via hardware, such as a programmable keypad or rotary volume control, a software application, or integration with third-party equipment. However, when such controls are offered, there are additional functional considerations. For instance, the user should not be given unfettered control over masking level. If an occupant is allowed to mute or lower the volume beyond a certain limit, others' speech privacy will suffer. Also, frequency control should not be included because the user has neither the tools nor the training required to make informed adjustments to the masking spectrum. If occupants are given control in closed rooms that are shared, it may also be desirable to have those user adjustments reset automatically at certain times, restoring masking and paging levels to default settings.

It is important to note that the masking level in a private office will not interfere with communication inside the room itself. The average level of a typical voice is 55 to 65 dBA

Credit: Zahid Ghafoor

If occupants are given personal control over the sound masking level using programmable keypads, the system should prevent them from setting it lower than the minimum previously established for speech privacy within the facility.

THE ABC RULE

The traditional message is that creating an effective acoustic environment relies on three strategies: A, B and C, which stand for absorb, block, and cover. However, there are a few letters missing from this alphabet.

'R' is for Reduce

Reduction is a key element of acoustical design. It addresses the noises in your space that simply do not need to be there. Think of loud and endless ringtones, speaker phones, office or other equipment out in the open, improperly designed or balanced ventilation, squeaky filing cabinets, and so on. Sometimes these sounds can be reduced or even eliminated by the simplest interventions.

'E' is for Etiquette

Etiquette is a subset of the reduction strategy that involves our ability to behave in an 'acoustically sensitive' manner. There are habits we all fall into at one point or another that we should be more conscious of because they disturb others: tapping your pen, having an impromptu meeting over someone's workstation, talking to someone across the hall through your open doorways, leaving your phone at an emergency evacuation volume and giving yourself a dozen rings to answer it.

'D' is for Density

Density has a critical impact on acoustics and our ability to control them, but it is rarely included in the ABC discussion. The fact is, the tighter we space people, the tougher it is to design spaces that work well acoustically. In open plans, the average number of square feet per person has dropped dramatically in recent years. There's not only less distance between people—meaning any noises they generate reach more listeners at higher volume—but many more people within the same area, producing more noise overall.

Organizations placing more people into a smaller space need to take greater care with acoustical design, but the trend seems to be not only to increase density, but to systematically eliminate most methods of acoustical control. Given that people usually cost 10 times more than the building and its maintenance combined, it is worth questioning if this is really the right course of action.

'A' is for Absorb

Absorptive materials reduce echo and overall noise levels by decreasing the energy of sounds that would otherwise bounce off hard surfaces and back into your space. Because they only work on sounds that reflect off their surface, they typically have greater influence on noises created farther away from you. In other words, absorption requires some distance to take effect and cannot control noises directly transmitted between nearby occupants.

'B' is for Block

Blocking works at shorter distances because its effect is immediate. However, walls, windows and doors will not completely stop noise transferring from one side to the other. Rather, they will lower their volume as they pass through them.

Though primarily used in the construction of closed rooms, blocking is also a relevant technique for open plans, unless partitions are below seated head height, nullifying their acoustical value. Layout can also be used to isolate noise. For example, the originators of the open-plan concept, the Quickborner Team, used break zones that were separated from workgroups, offering an inviting space in which to come together for ad hoc meetings, fostering interaction while not disturbing those in surrounding areas.

'C' is for Cover

Because many believe that noise is only truly under control when a space is as silent as possible, they tend to try to enlist the above strategies in pursuit of the old adage 'silence is golden.' However, just as with light and temperature, there is actually a comfort zone for sound—and it is not zero. If a facility's background sound level is too low, conversations can easily be heard from a distance and occupants are even disturbed by lower-level noises.

To ensure the space has an appropriate minimum background level and spectrum conducive to speech privacy at all times, use a sound masking system. This technology uses a system of loudspeakers to distribute a comfortable sound similar to softly blowing air, covering up conversations and noises occurring at a distance and reducing the intelligibility and disruptive effect of those happening closer to you, making them less distracting.

Sound masking is the only acoustical technology that can accurately control the background sound by adjusting both the volume and frequency within your space. When properly implemented, it is highly effective at covering speech and noise and, in the case of loud noises, diminishing their impact on occupants by reducing the amount of change between baseline and peak volumes.

Many assume that providing effective acoustics is a single design requirement. Unfortunately, this notion leads to the misconception that any acoustical element can yield the desired results on its own. For example, one might install an acoustical ceiling and believe their job is done. But a well-performing space uses all of the described strategies—reducing, absorbing, blocking, and covering—because each one performs a unique role in the final result.

In fact, it is even more effective if you turn the traditional 'ABC Rule' on its head and start with 'C.' By using sound masking to define and, therefore, know exactly what the background sound level and spectrum will be anywhere in the facility, you can more accurately specify the remaining materials, such as the walls' STC rating. That can also reduce costs by lowering STC requirements and allowing walls to be built to the suspended ceiling rather than to the deck. Once the space is complete, if the walls' real-world performance doesn't live up to their lab-tested results, you can increase the masking level (within comfortable limits) to make up for that deficiency—a flexibility uniquely afforded by this technology.

at conversational levels, and the distance between two people talking in a private office is not sufficient for the masking to interfere with intelligibility.2 Also, if the masking in a conference room is tuned to 42 dBA or in-room control enables occupants to adjust the level, it should not conflict with the signal-to-noise ratio required for good microphone response during video or teleconferencing.

In order to maintain the SPP of various adjacencies, the continuous minimum background sound level cannot be set below the defined minimum. However, there are conditions under which it may be advantageous to allow occupants to increase it. For example, sleep disruption is one of the greatest design challenges for hospital patient rooms and hotel guest rooms. A significant number of arousals and awakenings occur as a result of noises originating both inside and outside the room. While the minimum background sound level must be maintained to ensure speech privacy between adjacencies, it is possible to empower the occupant to raise their room's masking above this level in order to cover or lessen the disruptive impact of noises. Indeed, due to its ability to reduce the quantity and severity of volume changes (i.e., dynamic range), sound masking has been shown to be an effective method of improving sleeping conditions.

IN CONCLUSION

Closed offices and meeting rooms are built with the intention of providing occupants with both visual and acoustic privacy. While the first goal can easily be achieved, the latter often proves elusive because of the many ways in which sound can transfer from one space to another. Each crack in a wall's armor facilitates the transmission of sound to and from neighboring spaces. But, ultimately, the lack of sufficient background sound is what allows conversations to be overheard.

While acoustic professionals have always advocated the ABC Rule of absorbing, blocking, and covering unwanted noise, listing 'C' last reinforces the notion it is a final consideration and perpetuates the misplaced emphasis on isolation and absorption strategies. Instead, the approach should be CBA: cover, block, absorb. By using sound masking to define and, therefore, know exactly what the background sound level will be anywhere in a facility, one can more accurately specify the remaining materials. Further, the level can be increased (within comfortable limits) at a later date if more acoustic control is needed in order to compensate for deficiencies in partition assemblies—a flexibility uniquely afforded by this technology.

Building professionals should not hesitate to take advantage of this value-engineering opportunity by employing a judicious balance of controlled minimum background sound and isolation in all facilities where speech privacy and noise control are priorities.

END NOTES

[1]The recommendations for maximum noise limits are reported using a single-value metric known as the Noise Criteria (NC), which uses a reference contour to approximate the overall shape and level of the ambient acoustic environment. Because the NC rating does not tell one the overall dBA level or spectrum of the noise, in practice most simply estimate that the actual A-weighted overall sound level is 5 points higher than the NC value (e.g., NC-25 is approximately equivalent to 30 dBA).

[2]Because peaks in speech are around 65 to 75 dBA, the SPP formula considers the value of 75.

[3]The vendor must ensure the sound masking system's design is able to perform to the standard to which the system will ultimately be assessed for compliance. At a minimum, control zones should be smaller than specified test area(s) to ensure any test areas that fail to meet specified targets and tolerances can be adjusted without negatively impacting other test areas.

Take the quiz at ce.architecturalrecord.com

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