Acoustics and the Impact on Corporate Environments

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Achieving High-Quality Acoustics in Corporate Settings

Knowledge is power. Here's what you need to know about sound, noise and creating acoustically beneficial environments in both corporate and hospitality settings.

In corporate and hospitality settings, it's common for spaces to be large and open to accommodate collaborative work and a see-and-be-seen aesthetic. While large and open creates a desirable environment, it also creates a constant humming of sound. Some sounds are wanted and necessary, but sound that is unwanted or in excess is called noise. "Excess noise is disruptive and contributes to loss of productivity and concentration, especially in an open office work environment," says Erik J. Ryerson, INCE, senior associate, acoustics, with Chicago-based Shen Milsom & Wilke LLC.

Sound has two paths: airborne and structure-borne sound. "Airborne sound is what we hear when sounds radiate from a source directly into the air," says Stanley D. Gatland II, CertainTeed Corp., in an article titled "Understanding Acoustics and Sound Control," published on the American Institute of Architect's (AIA) Website (http://www.aia.org/practicing/awards/AIAB025071). "Examples emanating from a building's exterior include passing traffic, aircraft, highway and industrial noise." Voices, music, motors, machinery, and office equipment are sources of airborne noise on a building's interior, depending on individual decibel levels, as is conditioned airflow through uninsulated HVAC ductwork.

"Structure-borne sound, also known as 'impact noise,' is sound that travels through solid building materials," says Gatland. "Examples are the sound of footsteps on floors, door knocks and slams, plumbing and mechanical equipment vibrations, and the impact of rain on a building. Think of the disturbances created by steady rain on a metal roof over a typically quiet building … and one can understand what a disruption structure-borne noise can be."

Enter acoustics — the science of sound, including its production, transmission and effects in a room or building. Acoustics are used to ensure that sound is within acceptable ranges for greater comfort in interior spaces.

MEASURING SOUND

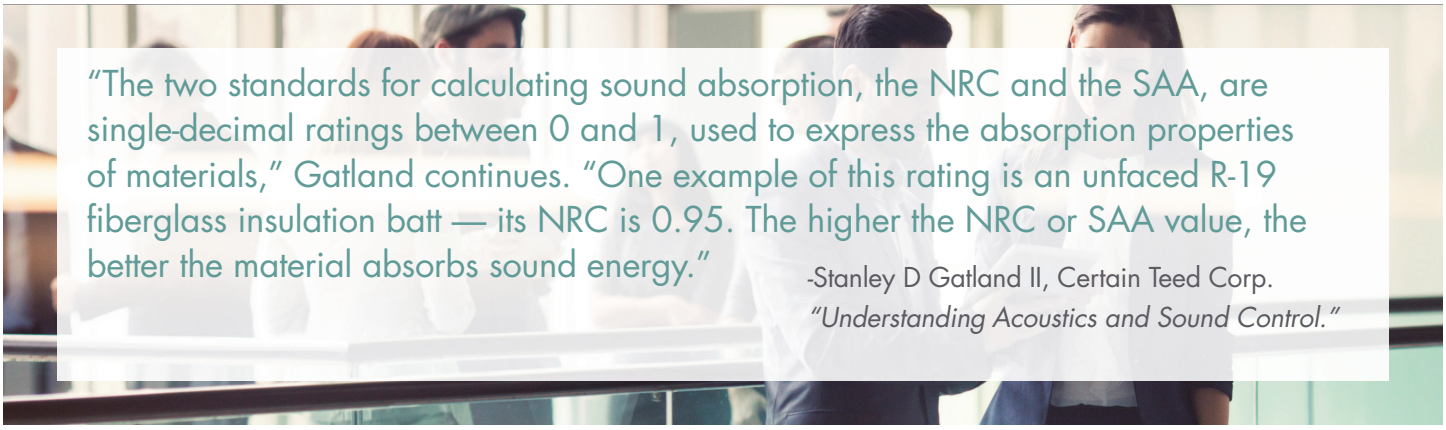
In order to determine how it is being produced and transmitted and its effects, sound is measured in decibels. "When we measure sound, we're actually measuring the sound pressure of a wave, which is the relative amplitude of that sound wave," says Gatland. "The resulting amount is measured in decibels (dB)." Sound pressure levels in decibels ranges from about 20 dB from a whisper to about 120 dB, which is the threshold for pain. "Most activities among people, such as conversations … are in the 50- to 80-dB range," he says. "For example, in an office, or other public place, once sound rises above 80 dB, it becomes difficult to communicate effectively."

ACOUSTICAL PERFORMANCE

Acoustical test methods are used to measure sound for building materials and systems. Gatland indicates that, "The most common method, ASTM testing, falls into four categories: sound absorption, airborne sound transmission, impact sound transmission, and airborne sound transmission through suspended ceilings."

1 | SOUND ABSORPTION (ASTM C 423)

Sound absorption is the ability of a material to absorb sound waves rather than reflect sound waves. All materials that go into the construction of a facility have acoustical properties — some better than others — including masonry materials, such as concrete and stone; wood; steel; drywall and plaster; roofing; transparent materials, such as glass; insulating materials, such as foam and fiberglass, plastics and rubber; mechanical and plumbing materials, such as ductwork, and metal and plastic pipes; soft materials, such as fabric; specialty acoustical products. "Most building materials are measured for their noise reduction coefficient (NRC), but sound absorption can also be calculated with the sound absorption average (SAA)," says Gatland. "Sound absorption has to do with controlling sound energy within rooms and enclosed spaces.



"The two standards for calculating sound absorption, the NRC and the SAA, are single-decimal ratings between 0 and 1, used to express the absorption properties of materials," Gatland continues. "One example of this rating is an unfaced R-19 fiberglass insulation batt — its NRC is 0.95. The higher the NRC or SAA value, the better the material absorbs sound energy."

-Stanley D Gatland II, Certain Teed Corp.
"Understanding Acoustics and Sound Control."

2 | AIRBORNE SOUND TRANSMISSION (ASTM E 90)

Sound transmission loss is the decrease in sound energy, expressed in decibels of airborne sound, as it passes through a building element or envelope," says Gatland. "The metric used to quantify that reduction is sound transmission classification (STC). The STC value indicates how well sound is controlled from room to room, or outdoor to indoor, including through walls or through floor/ceiling assemblies. ASTM E 90 is the standard addressing airborne STC. This is a single number rating that evaluates the efficiency of systems in reducing the transmission of airborne noise. In this class, the higher the STC rating, the better. The rule of thumb is that a 10-point increase in STC means a decrease in the perceived noise by half."

3 | IMPACT SOUND TRANSMISSION (ASTM E 492)

"Impact sound-transmission loss is expressed in decibels of airborne sound," says Gatland. "This decrease in sound energy is measured after the impact noise that is generated above transfers through the floor-ceiling assembly and is transmitted into the air below. Imagine someone hopping around upstairs. That is impact sound transmission, rated using an impact insulation class (IIC) number. The standard for impact sound transmission measurement is ASTM E 492. The IIC number is a single number rating that estimates the impact sound insulation performance of floor and ceiling systems. The number is an estimate of how much the sound energy is reduced. The higher the number, the better the system."

4 | AIRBORNE SOUND TRANSMISSION THROUGH CEILINGS (ASTM E 1414)

Typically, airborne sound transmission through ceilings occurs when there are adjacent spaces connected by a common air plenum," says Gatland. "The specification is the ceiling attenuation class (CAC). It is similar to STC, but in this case, the measurement is specific to controlling sound transmission from one space to another through the ceiling."

DESIGNING FOR SOUND CONTROL

Within building assemblies, sound is controlled in many ways. "With any facility, there are three prongs to acoustics," says Ryerson. "The first is acoustical separation of adjacencies, which is making sure there are appropriate boundary conditions and that floor/ceiling assemblies, etc., are designed to minimize sound intrusion from adjacent spaces. The second is interior acoustics, which is how sound behaves in the space, such as the reverberation or reflection of sound off the boundary elements of walls, ceilings and floors. Reverberation must be kept low or else it contributes to less-than-ideal speech intelligibility." Acoustic panels are often used to keep reverberation times low. Panels must undergo tests in a reverberation chamber and be certified in order to prove their ability to perform well. Building owners are often misled to poor performing panels because of their low cost, thereby proving the adage you get what you pay for. "The third is background noise," Ryerson sums, "which is the noise within the space. It's most commonly about reducing noise from the HVAC equipment that serves the space."

The best acoustics are achieved when it is taken into consideration during the design phase of a building and its rooms, Ryerson advises. It is expensive and time consuming to correct for acoustic comfort after construction is complete; however, it is possible. In such cases, conduct in-depth acoustic analyses and/or take measurements to determine the reverberation time in order to develop suitable solutions based on the activities being performed in each space.

ACOUSTICAL TREATMENTS IN SPECIFIC SPACES

Let's take a closer look at achieving high-quality acoustics in specific corporate spaces including offices, meeting rooms, and conference halls

OFFICES: The quality of the speaker's intelligibility and privacy, the distance of distraction and the diffuse sound field all contribute to acoustic comfort in offices. When analyzing the acoustics of an open space office, assess the distance between the work stations and the height of the partitions between the stations. The acoustic requirements may vary in this type of environment. For example, certain offices require good intelligibility to encourage communication among employees, so there should be fewer and lower partitions. However, this reduces the speaker's privacy, and less privacy means more distractions. Therefore, in environments where concentration is more important, greater attention must be paid to the layout and partition sizes, as well as the partitions' ability to absorb sound.

MEETING ROOMS: The acoustic comfort of a meeting room is an essential requirement for productive and efficient meetings. With the wrong reverberation times, problems occur with the sound waves reflected off walls, ceilings and the ground overlapping with the incident sound wave, causing a clear loss of intelligibility, a difficulty in following dialogue and the subsequent mental fatigue of keeping high concentration levels. When designing a meeting room, pay the utmost attention to the choice of finishing materials, including sound-absorbing panels, to guarantee low reverberation times.

"When it comes to designing any of these spaces," says Ryerson, "it comes back to the three prongs. For separation of adjacencies, look at the quality and sizing of metal studs that support layers of drywall, and then applying layers of drywall on the partition, because that adds mass to increase sound absorption. Regarding interior acoustics, one consideration is adding an appropriate level of sound absorption products, which is driven by aesthetics and costs, and the quantity depends on the volume. There are also sound masking products available, such as machines that make white noise to mask background sound. For background noise, sound from HVAC systems is reduced via duct liners and sound attenuation devices that reduce sound flow enough to meet a certain threshold for comfort and to encourage speech intelligibility within the space or privacy between spaces. These are a few available options; count on an acoustical consultant to present additional options, based on the need."

CHOOSING AN ACOUSTICAL CONSULTANT

Speaking of acoustical consultants, you may need the assistance of one if you're preparing to construct a new facility or need to address acoustics problems in an existing facility. Here are six recommendations for choosing an acoustical consultant, as indicated in "What Sets an Expert Apart," an article published by National Council of Acoustical Consultants (NCAC).

1. Determine the nature or scope of the assignment.

2. Ask colleagues for recommendations of acoustical experts with whom they have worked. Alternatively, check the NCAC Website (http://ncac.com/) for experts in your area.

3. Provide identified experts with your project details, and request the following from each: "statements of qualification, including a complete description of the firm, previous assignments and clients, names and biographies of persons who would be working on the project, anticipated time schedules involved, and other factors which relate to the quality of work to be performed."

4. Review applicant firm's credentials and experience to identify the firm most qualified to serve your needs.

5. Contact representatives from the chosen firm to begin financial negotiations.

6. If negotiations are satisfactory, retain the acoustical expert to ensure the firm's availability for your project. If negotiations are not successful, start a conversation with most qualified firm. "It is to be noted that most successful consultants pride themselves on their ability to tailor their efforts to the scope of the project and the budget available for services, as well as for implementation of the recommendations resulting from their services."

In the corporate industry, environments that meet acoustic comfort standards reduce stress and also improve listening, teaching and learning, thereby creating more productive and efficient spaces. With the proper planning, it is possible to have large, open spaces for collaborative work and a see-and-be-seen aesthetic and acoustic comfort that ensures ease of listening for greater concentration and productivity.

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FOR MORE INFORMATION:

There are a number of resources for additional information about sound control in building design. They include the following.

- Acoustical Society of America (ASA): acousticalsociety.org/
- National Council of Acoustical Consultants (NCAC): http://ncac.com/
- ASTM E 1374, Standard Guide for Open Office Acoustics and Applicable ASTM Standards: http://www.astm.org/Standards/E1374.htm
- North American Insulation Manufacturers Association's (NAIMA) Insulation Institute: http://insulationinstitute.org/

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