How Building Codes and Standards are Driving Acoustic Solutions
In recent years, architects and interior designers have strived to create spaces that focus on optimizing occupant comfort. Their focus areas include:

- Acoustic comfort
- Visual comfort
- Air quality
- Ergonomics
- Thermal comfort

Are you surprised to find acoustic comfort is a top factor? Perhaps because sound is not visible, designers tend to underestimate its effect on occupants. However, compared to environmental conditions such as lighting, air quality, and thermal comfort – which is notoriously dissatisfying – problems with acoustics are a leading source of complaints, according to a white paper published by the General Services Administration.
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Because acoustic comfort and, more precisely, sound attenuation or reduction is recognized as being a critical factor in occupant comfort, health and productivity, it is being addressed more often in building certification programs and in building codes and standards.

Effective building design can help control sound to ensure a space will achieve the purpose for which it was designed, whether to promote sleep, healing, learning or worker productivity.
Understanding Sound Transmission Class Ratings

Sound Transmission Class (STC) is an integer rating of how well a building partition attenuates or reduces airborne sound. STC ratings designate the decibel reduction an assembly can provide – the higher the rating number, the lower the transmission of sound. Interior partitions, ceilings/floors, doors, windows and exterior wall configurations all carry STC ratings.

ASTM, which in the past stood for the American Society of Testing and Materials, is the not-for-profit organization whose 30,000 volunteer members from 140+ countries develop international consensus standards for materials, products, systems and services. ASTM publishes two standards for determining STC ratings in the U.S. These are:

- E 413–04: Classification for Rating Sound Insulation.

Outside the U.S., the Sound Reduction Index (SRI), ISO index or its related indices are used.

Though ASTM standards are not mandated, government regulators often cite them in laws, regulations and codes.

In the following sections, let’s explore which of these standards reference sound attenuation.
LEED v4 Offers Credit for Acoustic Performance

LEED® (Leadership in Energy and Environmental Design™) is a rating system devised by the U.S. Green Building Council (USGBC) to evaluate the environmental performance of a building and encourage market transformation towards sustainable design. LEED certification is voluntary and the program is points-based, allowing projects to earn points for environmentally friendly actions taken during construction and building use.

Based on the number of points achieved, a project then earns one of four LEED rating levels: Certified, Silver, Gold or Platinum.

Buildings earn credits in nine categories ranging from energy and atmosphere to location and transportation. Credit for acoustic performance is addressed within the Indoor Environmental Quality criteria for all projects using the BD+C (Building Design & Construction) rating system. The guidelines are intended to help ensure spaces promote occupants’ well being, productivity, and communications through effective acoustic design. One credit is available for buildings that address acoustics.

To earn this credit, LEED project managers must calculate and measure sound levels emitted and must meet Sound Transmission Class (STC) ratings listed here, or their local building code, whichever is more stringent.

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The credit language for LEED’s Indoor Environmental Quality criteria also explicitly defines reverberation time requirements by room type. Reverberation time is understood as the length of time required for sound to decay 60 decibels from its initial level. For example, architects strive to design classrooms that achieve reverberation times in the range of 0.4-0.6 seconds; however, many existing classrooms have reverberation times of 1 second or more.

WELL Building Standard In the same vein as LEED, the WELL Building Standard is focused on optimizing our built environments to advance human health and well-being. Covering seven core concepts of health and hundreds of features, WELL is a flexible building standard in which the reduction of noise also provides credits.

The Comfort concept places emphasis on creating distraction-free, productive and comfortable indoor environments. Several features regulate noise, either externally or internally generated, including specific guidelines for schools.

Credits for acoustic performance are addressed within in both LEED and WELL Building guidelines.

Operation of heating, ventilation and air-conditioning (HVAC) equipment is one of the major sources of interior noise, and its effect on occupant comfort is undeniable. In addition to noise, operation of HVAC equipment can also result in mechanical vibration that may cause discomfort and create secondary of noise from vibrating walls, floors and ducts.

ASHRAE, known as the American Society of Heating, Refrigerating and Air-Conditioning Engineers, publishes standards for HVAC-related background sound in various spaces. For example, ASHRAE’s guidelines state that wall and floor-ceiling assemblies separating hotel rooms, motel rooms, and patient rooms in nursing homes and hospitals shall have a composite STC rating of 45 or greater. Wall and floor-ceiling assemblies separating classrooms from rest rooms and showers shall have a composite STC rating of 53 or greater. Complete guidelines regarding noise and vibration control of HVAC systems are available here.
ISO Standards

ISO is an independent, non-governmental international organization based in Geneva, Switzerland, with a membership of 162 national standards bodies. Members develop international standards for products, services and systems.

The standard ISO 717-1:2013: defines quantities for airborne sound insulation in buildings and building elements such as walls, floors, doors and windows. It takes into consideration sound levels emanating both from within and outside a building. Comprehensive standards are outlined in this document.
ANSI Guidelines for Classrooms

The ANSI/ASA S12.60-2010 American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools (Parts 1 and 2) sets specific criteria for maximum background noise and reverberation time (how long noise persists) in classrooms with the goal of creating a classroom environment that optimizes speech understanding.
The American Speech-Language-Hearing Association’s (ASHA’s) Working Group on Classroom Acoustics endorses the ANSI standard and recommends the following criteria for classroom acoustics:

- Unoccupied classroom levels must not exceed 35 dBA.
- The signal-to-noise ratio (the difference between the teacher’s voice and the background noise) should be at least +15 dB at the child’s ears.
- Unoccupied classroom reverberation or persistence of sound (the length of time required for sound to decay 60 decibels from its initial level) must not be longer than 0.6 seconds in smaller classrooms or 0.7 seconds in larger rooms.

Note that these standards are enforceable under the ANSI A117.1 Accessible and Usable Buildings and Facilities - 2017.

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ICC Standard Addresses Classroom Acoustics

The International Code Council (ICC) A117.1-2017 publication (Accessible and Usable Buildings and Facilities) also addresses acoustic standards for classrooms. Like ASHA recommendations, it stipulates that classroom ambient sound levels shall not exceed 35 dBA both for noise from sound sources inside the classroom and intruding noise from sources outside the classroom.
Sound is similar to light and water. It will enter a space when given even the smallest opportunity. When considering the acoustical performance of a space, doors are critical. The most important thing to remember is that a door’s sound rating is only as good as its frame, perimeter seals and threshold. To uphold a door’s STC rating, architects, building owners and installers must ensure the following basic criteria are met:

- Walls must be constructed to match the acoustic specifications of the space and to uphold the weight of acoustical doors. A high-end acoustical door (STC rating of 48 or higher) will not compensate for thin walls.

- Depending on the STC rating, the backs of frames must be filled with either a mineral wool or lightweight grout.

- The threshold must be installed on a finished floor, not on carpet.

- Installers must take the time to adjust the door’s seals to ensure the door swings freely with minimal gap. Unsealed gaps and clearances in door assemblies effectively cancel out the noise reduction benefits of acoustical doors. For example, a 1/8-inch clearance around a door’s perimeter drops an STC-52 rated door to a 21.

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It is worth noting here that walls, windows and doors designed to be exterior facing also contain an outdoor-indoor transmission class (OITC) rating. The OITC rating is calculated in accordance with ASTM E1332 guidelines, originally published in 1990. The OITC rating provides a single number rating for exterior walls, windows and doors that are subjected to exterior noises emanating from aircraft, trains, automobiles and other sources. Similar to STC ratings, the higher the number, the better the noise isolation.
Acoustics is a Science: Enlist Experts to Assist with Your Project

If you’re confused as to how best to navigate code, standards and certification criteria for acoustics in building spaces, it’s important to first determine which guidelines, standards or certification criteria the project will subscribe to.

Project managers should consider engaging an expert such as an acoustician or mechanical engineer who specializes in acoustics. These individuals understand how people hear and perceive sound and can partner with project team members to help conduct a site analysis, implement strategies, perform calculations and take field measurements as the project progresses. In fact, modern day computer modeling tools enable acousticians to generate virtual sound pictures of a space during the design phase.