Sound transmission class

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Sound Transmission Class (or **STC**) is an integer rating of how well a building partition attenuates airborne sound. In the USA, it is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations (see ASTM International Classification E413 and E90). Outside the USA, the Sound Reduction Index (SRI) ISO index or its related indices are used. These are currently (2012) defined in the ISO - 140 series of standards (under revision).

The STC rating figure very roughly reflects the decibel reduction in noise that a partition can provide.

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Rating methodology

The ASTM test methods have changed every few years. Thus, STC results posted before 1999 may not produce the same results today, and the differences become wider as one goes further back in time –the differences in the applicable test methods between the 1970s and today being quite significant. [*citation needed*]

The STC number is derived from sound attenuation values tested at sixteen standard frequencies from 125 Hz to 4000 Hz. These transmission-loss values are then plotted on a sound pressure level graph and the resulting curve is compared to a standard reference contour. Acoustical engineers fit these values to the appropriate *TL* Curve (or *T*ransmission *L*oss) to determine an STC rating. The measurement is accurate for speech sounds, but much less so for amplified music, mechanical equipment noise, transportation noise, or any sound with substantial low-frequency energy below 125 Hz. Sometimes, acoustical labs will measure TL at frequencies below the normal STC boundary of 125 Hz, possibly down to 50 Hz or lower, thus giving additional valuable data to evaluate transmission loss at very low frequencies, such as a subwoofer-rich home theater system would produce. Alternatively, Outdoor-Indoor Transmission Class (OITC) is a standard used for indicating the rate of transmission of sound between outdoor and indoor spaces in a structure that considers frequencies down to 80 Hz (Aircraft/Rail/Truck traffic) and is weighted more to lower frequencies.[*citation needed*]

STC is roughly the decibel reduction in noise a partition can provide, abbreviated 'dB'. The dB scale is a logarithmic one and the human ear perceives a 10dB reduction in sound as roughly halving the volume - a 40 dB noise subjectively seems half as loud as a 50 dB one. (For more detail on equal-loudness curves see: Fletcher-Munson curves.) If an 80dB sound on one side of a wall/floor/ceiling is reduced to 50dB on the other side, that partition is said to have an STC of 30. This number does not apply across the range of frequencies, since the STC value is derived from a curve-fit of many datapoints. Any partition will have less

TL at lower frequencies. For example, a wall with an STC of 30 may provide over 40dB of attenuation at 3000 Hz but only 10dB of attenuation at 125 Hz.[*citation needed*]

Sound damping techniques

Typical interior walls in homes (1 sheet of 1/2″ drywall on either side of a wood stud frame) have an STC of about 33. When asked to rate their acoustical performance, people often describe these walls as "paper thin." They offer little in the way of privacy. Adding absorptive insulation (e.g., fiberglass batts) in the wall cavity increases the STC to 36-39, depending on stud and screw spacing. Doubling up the drywall in addition to insulation can yield STC 41-45, provided the wall gaps and penetrations are sealed properly. [*citation needed*]

Note that doubling the mass of a partition does not double the STC. Doubling the mass (going from two total sheets of drywall to four, for instance) typically adds 5-6 points to the STC. Breaking the vibration paths by decoupling the panels from each other will increase transmission loss much more effectively than simply adding more and more mass to a monolithic wall/floor/ceiling assembly.[*citation needed*]

Structurally decoupling the drywall panels from each other (by using resilient channel, steel studs, a staggered-stud wall, or a double stud wall) can yield an STC as high as 63 or more for a double stud wall (see table below), with good low-frequency transmission loss as well. Compared to the baseline wall of STC 33, an STC 63 wall will transmit only 1/1000 as much sound energy, seem 88 percent quieter and will render most frequencies inaudible.[*citation needed*]

Due to their high mass, concrete and concrete block walls have good TL values (STCs in the 40s and 50s for 4-8″ thickness) but their weight, added complexity of construction, and poor thermal insulation tend to limit them as viable materials in most residential wall construction, except in temperate climates and hurricane or tornado-prone areas. Various insulation options can result in higher STC ratings; however, any insulation tends to add little, compared to other aspects of wall construction.

Materials which can improve STCs in walls include mass-loaded vinyl (MLV), standard drywall, "soundproof" drywall (such as QuietRock, Supress, SoundBreak, or ComfortGuard) and damping compounds such as Green Glue.

Acoustical performance values such as STC are measured in specially constructed acoustical chambers, and that field conditions such as lack of adequate sealing, outlet boxes, back-to-back electrical boxes, medicine cabinets, flanking paths, and structure-borne sound can diminish acoustical performance. The as-built 'field-STC' (FSTC) is usually lower than the laboratory-measured STC. See data from the National Research Council of Canada.[1]

Legal and practical requirements

Section 1207 of International Building Code 2006 states that separation between dwelling units and between dwelling units and public and service areas must achieve STC 50 (STC 45 if field tested) for both airborne and structure-borne. However, not all jurisdictions use the IBC 2006 for their building or municipal code. In jurisdictions where IBC 2006 is used, this requirement may not apply to all dwelling units. For example, a building conversion may not need to meet this rating for all walls.[*citation needed*]

In serious cases (e.g., a bedroom adjacent to a home theater room, and an inconsiderate nocturnal neighbor,

to boot) a partition to reduce sounds from high-powered home theater or stereo should ideally be STC 70 or greater, and show good attenuation at low frequencies. An STC 70 wall can require detailed design and construction and can be easily compromised by 'flanking noise', sound traveling around the partition through the contiguous frame of the structure, thus reducing the STC significantly. STC 65 to 70 walls are often designed into luxury multifamily units, dedicated home theaters, and high end hotels.[*citation needed*]

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STC	What can be heard
25	Normal speech can be understood quite easily and distinctly through wall
30	Loud speech can be understood fairly well, normal speech heard but not understood
35	Loud speech audible but not intelligible
40	Onset of "privacy"
42	Loud speech audible as a murmur
45	Loud speech not audible; 90% of statistical population not annoyed
50	Very loud sounds such as musical instruments or a stereo can be faintly heard; 99% of population not annoyed.
60+	Superior soundproofing; most sounds inaudible

STC	Partition type
33	Single layer of 1/2″ drywall on each side, wood studs, no insulation (typical interior wall)
39	Single layer of 1/2″ drywall on each side, wood studs, fiberglass insulation [2]
44	4″ Hollow CMU (Concrete Masonry Unit) [3]
45	Double layer of 1/2″ drywall on each side, wood studs, batt insulation in wall
46	Single layer of 1/2″ drywall, glued to 6″ lightweight concrete block wall, painted both sides
46	6″ Hollow CMU (Concrete Masonry Unit) [3]
48	8″ Hollow CMU (Concrete Masonry Unit) [3]
50	10″ Hollow CMU (Concrete Masonry Unit) [3]
52	8″ Hollow CMU (Concrete Masonry Unit) with 2″ Z-Bars and 1/2″ Drywall on each side [4]
54	Single layer of 1/2″ drywall, glued to 8″ dense concrete block wall, painted both sides
54	8″ Hollow CMU (Concrete Masonry Unit) with 1 1/2″ Wood Furring, 1 1/2″ Fiberglass Insulation and 1/2″ Drywall on each side [4]
55	Double layer of 1/2″ drywall on each side, on staggered wood stud wall, batt insulation in wall
59	Double layer of 1/2″ drywall on each side, on wood stud wall, resilient channels on one side, batt insulation
63	Double layer of 1/2″ drywall on each side, on double wood/metal stud walls (spaced 1″ apart), double batt insulation
64	8″ Hollow CMU (Concrete Masonry Unit) with 3″ Steel Studs, Fiberglass Insulation and 1/2″ Drywall on each side [4]
72	8″ concrete block wall, painted, with 1/2″ drywall on independent steel stud walls, each side, insulation in cavities

STC partition ratings taken from: "Noise Control in Buildings: A Practical Guide for Architects and Engineers"; Cyril M. Harris, 1994

See also

- Architectural acoustics
- Impact insulation class
- Noise
- Noise control
- Sound Reduction Index
- Soundproofing

External links

- Article "How Is Noise Tested" (http://tmsoundproofing.com/store/pages.php?pageid=21/)
- STC - diracdelta.co.uk (http://www.diracdelta.co.uk/science/source/s/o/sound%20transmission%20class/source.html) - examples and javascript calculation from 1/3 octave values

References

Notes

1. ^ http://www.nrc-cnrc.gc.ca/eng/ibp/irc/bsi/85-accoustics.html Acoustics in Practice
2. ^ "The Complete Photo Guide to Home Improvement" (http://books.google.com/books?id=jTucFFM9cbIC&lpg=PP1&dq=The%20Complete%20Photo%20Guide%20to%20Home%20Improvement&pg=PA194#v=onepage&q&f=false). Creative Publishing international. Retrieved 2011-10-01.
3. ^ ***a b c d*** "STC RATINGS FOR MASONRY WALLS" (http://www.stcratings.com/masonry.html). Acoustics.com. Retrieved 2011-10-01.
4. ^ ***a b c*** "New Data Shows Masonry Wall and Precast Hollow Core Floor Systems Reaching High STC Ratings" (http://www.maconline.org/tech/materials/sswalls.pdf). Masonry Advisory Council. Retrieved 2011-10-01.

Bibliography

Cyril M. Harris. "Noise Control in Buildings: A Practical Guide for Architects and Engineers", 1994