A Resource for Solutions

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The STCs of Log Buildings

Every so often, someone contacts the Log Homes Council or others related to the log home industry to ask if there has been any research on STC (Sound Transmission Class) ratings for a log wall. The calls are frequent enough to beg the questions: "What are STC ratings? Why would someone be concerned about them? If one cannot find "sound transmission" or even "acoustical" in the index of either International Residential Code or International Building Code, what is their significance to a log home?"

Extensive study has been conducted and documented on the behavior of sound. Our knowledge of acoustics has enabled designers to create magnificent auditoriums where the spoken word is heard throughout the space without amplification. On a more practical level, we know that an empty room with hardwood floors and bare walls will be extremely loud, almost echoing sound in larger spaces. This is referred to as airborne sound and noise. Designers focusing on isolating and insulating this noise from other spaces in a building use STC ratings to select appropriate methods and materials for construction.

The STC is a numeric value generated by the methods described in ASTM E413-73 Standard Classification for Determination of Sound Transmission Class. The following excerpt from the standard explains it best:

> "1.1 The purpose of this classification is to provide a single-figure rating that can be used for comparing partitions for general building design purposes. The rating is designed to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music and similar sources of noise in offices and dwellings."

ASTM E413 procedures compare the sound transmission loss of an assembly (from test results according to ASTM E90, Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions) to those published in the standard that range from 0 to 70 over frequencies of 125 to 4000 Hz. The sound insulation industry generated the information below to give a better feel for the values associated with STCs.

STC	Speech heard through floor or wall
30	Loud speech understood fairly well
35	Loud speech audible but unintelligible
42	Loud speech audible as a murmur
45	Loud speech barely audible
48	Hearing strained to notice loud speech
50	Loud speech not audible

The STC is a useful design tool when it is desirable for the occupants of one space not to be disturbed by sound from another space. Construction that increases the STC rating may be worthwhile to keep highway or neighborhood noise outside, but it could similarly be used to isolate a teenager's stereo "noise" from encroaching on the other spaces in the house. However, keep in mind that the knock on the door is an impact sound that is not measured by the STC. Nor is the structural vibration generated by the heavy bass from the stereo speakers sitting on the floor.

Party walls between attached dwellings may be the most common application of STC ratings in log buildings. Sound isolation would be as important to the designer as the fire separation requirements would be to the building official.

Log walls are effective in limiting transmission of sound from outside, as the mass of the wall not only provides thermal benefits, but acoustic as well. While any wall surface reflects a considerable amount of the sound, the density of the solid wood will limit transmission much more than the siding and sheathing of an unfinished frame wall. Adding an interior wallboard will trap air in the cavity and improve the performance of the frame wall. Then, adding insulation in the wall cavity equalizes the performance of the two wall types to make both types of exterior walls effective sound barriers. Examples of STC rated assemblies, published by the American Plywood Association (APA) in the publication, *Noise-Rated Systems*, illustrate this.

So how do we hear outside noise when we are inside the house? Wall openings. Sound travels around obstacles, through openings in those obstacles, and is transmitted through the obstacle at points where the assembly has a lower STC rating. Minimizing sound transmission, therefore, becomes the same effort that we use to minimize heat loss. The same qualities that provide better thermal value (i.e., in windows and doors, methods to limit air infilatration) also perform better acoustically.

As with most building topics, sound construction is the best prevention for noise leaks. While landscaping techniques can help block outside noise (earth berms; tall, dense foliage), construction decisions are likely to have a larger impact.

- ☐ Seal all gaps with a sealant or insulating material prior to applying finish trim.
- ☐ Double glazed windows are quieter than single glazed.
- ☐ Solid core doors have higher STC ratings than hollow core. Weatherstipping also reduces sound transmission.
- ☐ Appropriate design and installation of plumbing lines will reduce vibrations and noise.
- ☐ In multi-family construction, avoid using flush-mounted fixtures (e.g., medicine cabinets) that penetrate a party wall while being sure to seal around and insulate behind electrical boxes.

In addition, life-style decisions further affect the acoustics in a home. The type of surfaces that are exposed to sound will control the acoustics in the space. Hard surfaces, such as log walls, wood floors, and glazing, may be desirable to reflect voices and music. In spaces where the occupant requires less reflected sound, sound-absorbing materials can be used.

- ☐ Placement of furnishings, wall hanings (pictures, tapestries, hunting trophies), and fixtures in a room disperse and absorb sound by intruding into the space and interrupting the size of flat room surfaces.
- ☐ Floor treatment: Options include sound-deadening underlayment under wood floors; using carpets and carpet pads.
- ☐ Window treatment: Use drapes, valences, or even open blinds will reduce reflection of sound from flat glazed areas or closed blinds. For draperies to absorb sound, condider using heavy textile material, fuller than usual, and closing them for maximum effect.
- ☐ Ceiling treatment: Acoustical tile, exposed beams (trusses, joist, or rafters), and textured ceilings will help disperse sound reflected from one of the largest flat surfaces in the room. Vaulted and cathedral ceilings deflect sound, and they can be used to alter acoustics in a room.
- ☐ Consider insulating interior partitions to isolate the sound from the media or music room from other living areas. Using a double, staggered stud framing method will eliminate vibration noise through the wall.

One of the most often mentioned acoustical issues arising in log and timber frame homes is the sound transmission through 2x6 T&G subfloor decking used as the finish floor when applied directly to structural timber floor joists. While this is a very popular decision, it will promote transmission of all impact and vibration sound from above to the space below. Many suppliers of this material provide the v-groove finish only on one side, so that the square edges of the other side will match to provide a uniform subfloor for carpeting, tile or other flooring material. Carpet and padding will significantly reduce sound transmission, but sound-deadening underlayment is suggested under other types of flooring.

Many researchers have tested various construction assemblies to achieve greater sound transmission ratings. For example, with the same floor covering and framing method, adding insulation can increase the rating up to 10%, but fixing the ceiling to a resilient channel vs. against the structural joist can increase the rating up to 15- 35%. The Canadian Housing Information Center summarized some research findings on their website, http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/96224.htm. They recommend STC ratings of 50 and greater for good control of sound transmission, and they show STC ratings for various assemblies. Another reference, *Sound Transmission Through Building Components*, by J.D. Quirt, is published at http://www.nrc.ca/irc/bsi/85-3_E.html. This paper discusses how stiffness and mass combine to increase transmission loss (or increase STC); how the connection between layers of materials affects transmission; and how cavity construction uses the airspace to reduce transmission but "…vibration transfer through the structure is the acoustical equivalent of an electrical short circuit... The most effective means of reducing the transfer of sound energy into the structure is the use of a 'floating floor'. A layer of concrete supported on a resilient layer or special resilient mounts is one common form of floating floor… Dividing a floor into two isolated or resiliently connected layers decreases the transmission of vibration between them and thus reduces both the impact and airborne sound radiation on the other side. Sound-absorbing material inside properly isolated floor cavities has the same beneficial effect for impact noise as shown earlier for airborne sound reduction."

To isolate sound between floors, designers may opt to use "beam and deck" style construction with 2x sleepers over the tongue and groove decking. The decking now only provides the ceiling rather than acting as the subfloor as well. The choice of subfloor over the sleepers can vary from wood plank, tongue & groove decking, or OSB or plywood sheathing with any desired floor covering applied over that. The cavity between the sleepers benefits sound transmission, but it also provides a chase for electrical, plumbing, and air handling. To break the "acoustical wick" from the subfloor through the sleepers, a 1-1/2" wide strip of dense, closed cell gasket (about 65% compression at 15psi, similar to Norton's Log Home Gasket) could be attached to the sleepers before they are set in place. The disadvantage of building a cavity floor is that adjustments will be necessary elsewhere to accommodate the additional height of the overall floor assembly.

The acoustical benefits of a log wall, therefore, are the reduced transmission of solid wood and the sound deflection characteristics of the profile of the log. The angle, shape, and texture of the log surface impact the quantity and direction of the reflected sound, which can be beneficial to the internal acoustics.

RobPickett &Associates consults on technical matters relating to the homebuilding industry, specializing in heavy timber and log construction. For independent research and analysis of any technical issue or process, including operations management and design services, contact Rob Pickett at 802-436-1325 or email at robpickett@vermontel.net.