Quiet Solution

Mass Loaded Vinyl

A review of the performance and cost in acoustical applications

Overview

Driven by building codes and occupants' expectations, many rooms in commercial and residential construction require superior sound isolation between rooms. Room-to-room noise reduction is rated in terms of a sound transmission class (STC). Without attention to noise control, the acoustical performance of common walls will typically yield an STC rating of 34. In simple terms, that equates to an equivalent loss of 34 decibels (dB) between rooms. Many tenants, owners, builders and specifiers have come to the painful and often costly realization that 34 dB of isolation is unacceptable. At that level of performance, noise from loud conversations, music, and traffic will negatively impact adjacent living environments. With this in mind, builders and architects often look to soundproofing construction materials to address acoustical issues. One of those potential options has been a heavy vinyl barrier installed in a stud wall cavity sold by many internet retailers. While few tests have been conducted on complete wall assemblies using this material in the past, a lab test has been conducted recently to provide more detail. The principals and performance of these vinyl treatments are reviewed here.

Acoustics and Vinyl

Sound is often attenuated with the application of heavy materials. A limp and dense material is desirable and, before environmental impact of lead became a concern, thin sheets of lead were used as noise control materials. Heavy vinyl has become a common replacement to those lead sheets. Many companies make vinyl sheets weighing about one pound per square foot. In some cases, thick vinyl sheets can weigh up to two pounds per square foot. Although some vinyl manufacturers report performance superior to lead sheets, it is only the case when the vinyl weighs more than the lead sheet in comparison. For this type of acoustical treatment, the mass of the materials is the only important factor. However, keep in mind that a wall already weighs around 6 pounds per square foot (the entire assembly must be considered), the extra pound added by the vinyl provides only an incremental acoustical benefit.

Building off the premise that weight is critical to noise control, vinyl retailers report that their materials "reduce sound transmission by as much as 30 db depending on the frequencies" and also display transmission loss data of bare sheets showing an STC of 26 or more. Presenting their performance in this way is not a fair representation of the performance in a wall. Due to the behavior of sound, the acoustic ratings or decibel reduction of materials cannot be added to an existing wall as they propose. For example, a single sheet of ½ inch thick gypsum board has an STC of 28 – 2 points higher than that of one pound per square foot vinyl. However, when that same gypsum sheet is added to a standard wood stud wall, the STC rating for the wall increases from an STC 34 to an STC 37; a difference of 3 points. Of course, gypsum is a much cheaper material than the proposed vinyl treatment.

Table 1: Comparison of vinyl barrier and standard gypsum board panels

Freq	125	250	500	1000	2000	4000	STC
1 pound per sf Vinyl barrier	13	17	22	26	32	37	**26**
½ inch thick Gypsum board	15	20	25	29	32	27	**28**

The majority of retailers of mass loaded vinyl regularly display the STC of the raw materials, but fail to have the typical independent large wall assembly tests that are required by acoustical engineers. Anyone considering any product for soundproofing should look for multiple independent lab tests on 8' x 12' walls, as well as verifiable independent field tests, all performed to a current ASTM test method. Also, direct comparisons of (for instance) a single stud wall with, and without, the acoustical treatment material should be compared side by side on the same chart. An STC value for the individual element is completely useless when considering total wall STC values.

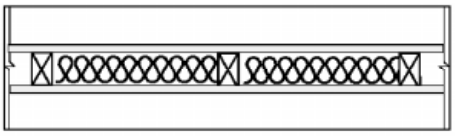
Sound Transmission in Walls

In designing walls with higher STC values, one needs to look deeper into how sound passes through the wall. Specifically, one must consider the major transmission path of sound in each wall assembly. In a single stud assembly, one major path of sound transmission is directly through the structure of the stud framing. Wood (or metal) studs are essentially a direct connection between both sides of the wall. The addition of a vinyl layer does very little to change this. Specifically, vinyl is screwed into the studs, and the final gypsum board is also screwed into the studs, through the vinyl and sandwiching it in place. The frequencies of noise that transfer via the studs often limit the STC performance of the wall. Knowing this, one must change this path fundamentally to significantly raise a wall's STC rating. One must create a connection system that is either not connected (or resiliently connected) to the studs, or is an internally damped structure, which can damp the energy directly. Vinyl has only limited effectiveness at changing the nature of this connection. However, the vinyl introduces a dissimilar material (from fiber glass and gypsum) into the stud cavity, and so benefit may be found through an impedance change. With this in mind the actual STC value achieved in the assembly is a combination of adding the additional mass and the additional loss from adding a different material in the cavity. Again, this must be measured as a complete wall assembly, not as individual components.

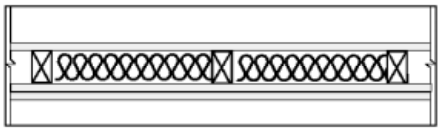
Performance

The following wall drawings and performance charts compare four similar wall assemblies in a side by side manner as recommended earlier. The four walls are:

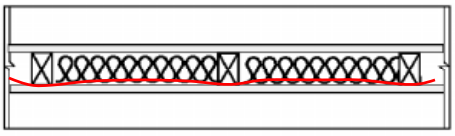
- a standard single stud interior wall with 5/8" thick gypsum each side,
- a wall with a layer of 5/8" gypsum added on one side,
- a standard single stud interior wall with a mass loaded vinyl barrier, and
- a wall with QuietRock QR530 added on one side.
- Two ultra-high performance walls using QuietRock QR545 are also added for comparison



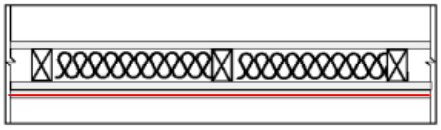
5/8" on both sides (Tested STC 34)



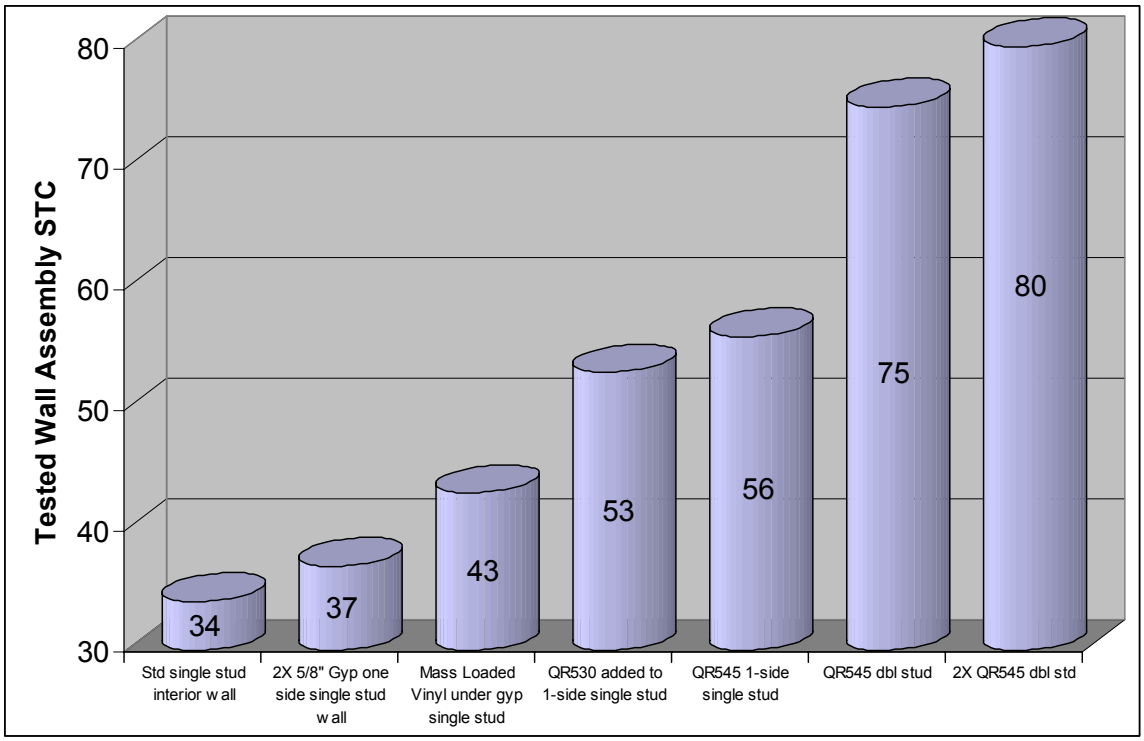
5/8" one side and double 5/8" on other side (Tested STC 37)



Vinyl barrier assembly (Tested STC 43)

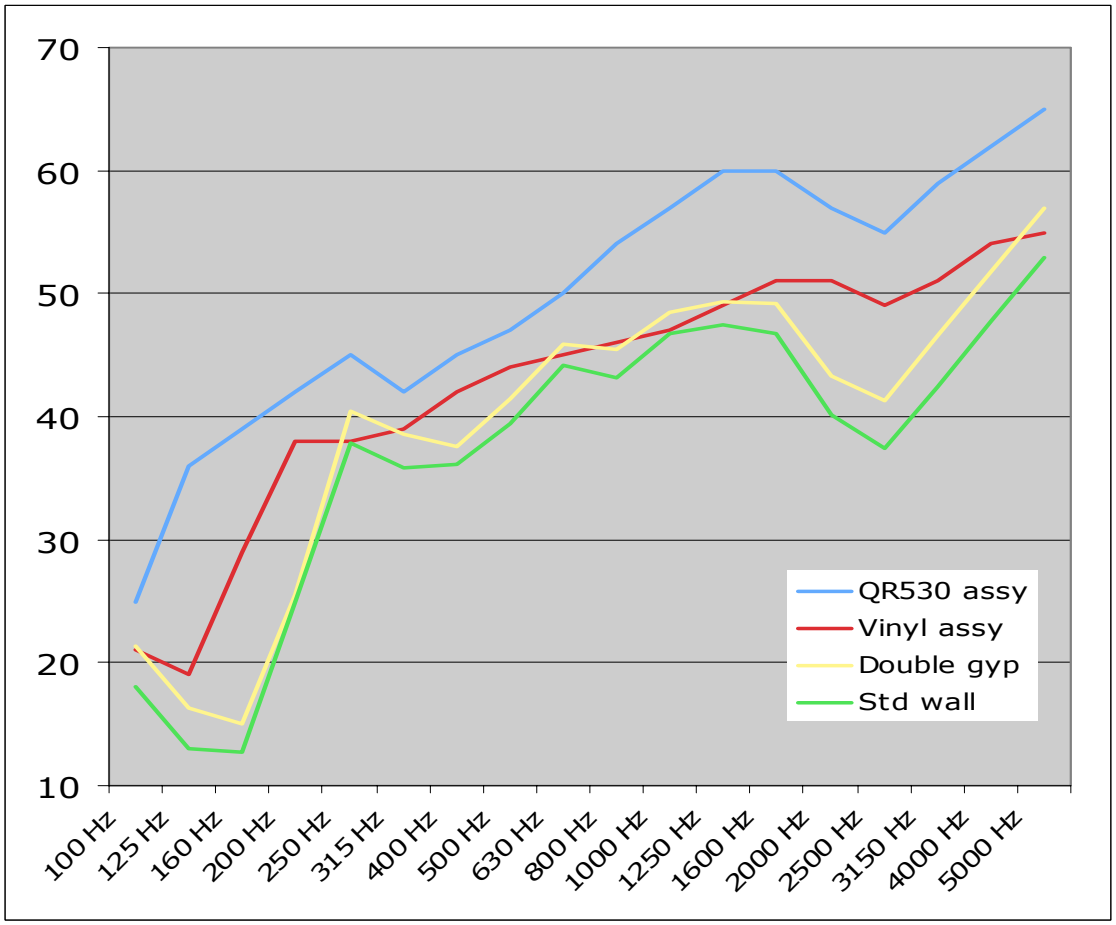


QR530 assy - QuietRock added to 1 side (Tested STC 53)



Single-stud Wall Assemblies

Independent Laboratory Test Results (TL Curves)



- Tests conducted at National Research Council of Canada and Western Electro Acoustics Laboratory

Vinyl Challenges

Vinyl installation is labor intensive. The sheets need to be applied directly to the studs in a specific manner. Vinyl retailers have detailed installation instructions and even videos to describe the multi-step process. In effect, the vinyl needs to be unrolled, cut by hand around obstacles, attached with fasteners and carefully taped along every seam prior to the installation of the drywall layer. If any steps are omitted or overlooked, the drywall must be demolished to remediate the installation.

Cost should also be a consideration when considering vinyl barriers. One pound per square foot vinyl sells for $1.50 to $3.00 per square foot at many online stores plus shipping (add about $1 per pound for UPS). So the delivered material cost averages $2.50 to $4.00 per square foot. Calls to several subcontractors that would install vinyl (few have experience) quoted between $1.00 and $2.10 per square foot for installation (in addition to the material cost). Thus, in reasonable sized projects, one can expect an increase in wall costs of $4.00 to $6.00 per square foot. Consider a base of about $3.00/sqft if it is brand new construction for the studs, gypsum, and standard labor, and it this results in a solution that approaches $9/sqft. This will result in an STC 43 wall assembly, which is 6-9 points higher than a standard wall, but may not provide a significant level of improvement for demanding applications such as home theaters and studios. One must compare this to other assemblies, including those with QuietRock, which may cost less and produce higher STC values.

Conclusion

Vinyl barrier sheets have been sold for several years to help with sound isolation between rooms. Though these products were not specifically designed with architectural noise control in mind they can provide limited increased STC values by adding additional mass and impedance changes to the wall. However, the effort, cost and detail required to use these materials needs to be carefully considered and compared to other more established and tested methods. Based on the physics of sound transmission and supporting lab test data, mass loaded vinyl may not be the most cost effective method for an STC performance improvement.