Sounds

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A Newsletter from *Stewart Acoustical Consultants* and F.C.Schafer CONSULTING

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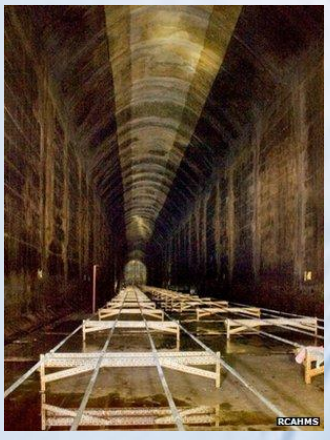
Making our World Sound Better Since 1979

Stewart Invited to Participate in National Academy of Engineering Conference on Future of Noise Control in the Industrial Workplace. – Dr. Noral Stewart was one of four consultants with industrial noise control experience invited to a summit meeting at the National Academy of Engineering to discuss the future of noise control in the industrial workplace. Others participating were from major manufacturing companies, various government agencies, and the NAE. Stewart discussed the history of noise control in the textiles, tobacco, and wood products industries and presented a noise control case history that included improved productivity as well as noise reduction. The industrial workplace of today is very different from 40 to 50 years ago, generally quieter but still having excessive noise exposure in many places. There was a major effort at noise reduction in the 1970's and since then automation and improvements in machinery have reduced noise exposure. Employers have opportunities to include noise reduction in any changes to plant machinery and operation. However, to make major progress the makers of the machinery used in plants need to be including noise reduction in new machinery that also offers other advantages such as improved productivity to entice the users to buy the quieter and more productive machines. The NAE staff and a small committee will be producing a report based on the presentations and discussions.



Two Very Interesting Tidbits – **Flames dancing to music-** The rubens tube shows how standing waves form and due to changes in intensity of gas exiting the tube, cause different height flames. NPR's Robert Krulwich has a video interview found here showing a 2D version created by Fysikshow played to music! **Longest RT ever measured-** Trevor Cox measured a reverberation time of 112 seconds (world record) in a unusual underground storage facility. Find out more here.

Build a Better Wall – The Basics of a Better Partition– Almost every day we see another ad trying to sell the **magic material** needed to build a better wall. The truth is good partitions can be built with common materials. The key is to understand how materials behave and how they interact when combined. Some of these newer technology materials and products are useful and can be used to advantage in some situations. This is the **beginning of a series of articles** on the basic properties of partitions. **This edition** will discuss **basic properties**, **basic effect of cavities**, **studs**, and **absorption in the cavity**. Future editions will explore higher performance partitions created with larger air spaces, extra gypsum, better methods of isolation, and damping in real partitions.

Sound blockage ability is measured by the **transmission loss** of the material or system. The greater the transmission loss, the better the sound blockage. The transmission loss **varies with the frequency** of the sound. Frequency is similar to **pitch**. **Low frequency** sounds are **bass** sounds, and **high frequency** sounds are the **treble** sound. Transmission loss typically **increases with frequency**.

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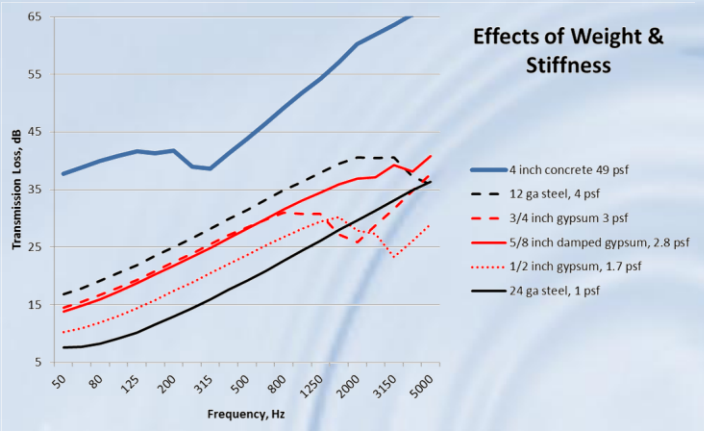
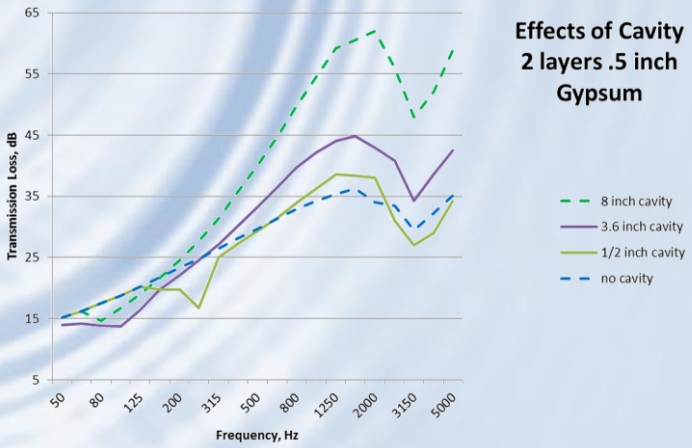
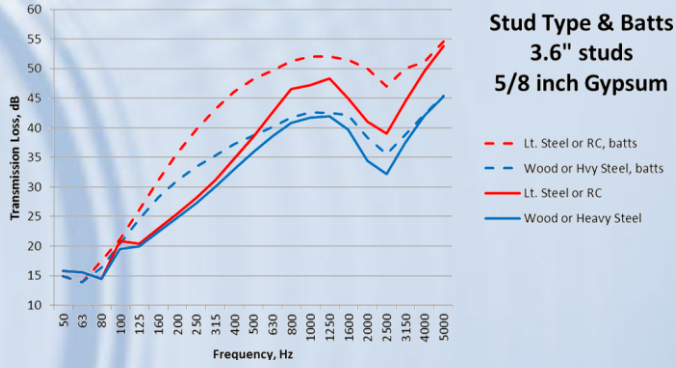


The first thing to consider is the effect of **weight** and **stiffness** on basic materials. The **plot to the left** shows the transmission loss of several materials. Notice that at **low frequencies** (left side of graph), the bass region, the sound blockage is directly related to the **weight of the panel**. The heavier the better. As you go up in frequency, the sound blockage generally increases, but **at some point there is a dip or weakness**. This does not show up in the plot to the left for the thinnest most flexible panel the 24 gauge steel. It actually does occur, but at a frequency greater than 5000 Hz. As the materials become **stiffer, generally thicker**, the frequency of this dip or weakness **shifts to a lower frequency**, being the lowest for the concrete. Note the solid red line which is for a **damped gypsum** product. "Damping" refers to a vibration absorbing property. Normally, 5/8 inch gypsum would have a dip around 2500 Hz, between that of the ½ inch and ¾ inch gypsum. This **damping material** incorporated in the middle of the gypsum **limits this dip**. The same thing happens with the material used in the middle of a sheet of **laminated safety glass**.



Next consider what happens when material is split into **layers with a cavity** between. The **chart at right** shows the performance with **two layers of half-inch gypsum and different cavities**, including no cavity. The blue dashed line is no cavity. The solid red line is a half-inch cavity between the two layers. Notice improvement at some frequencies, but an actual decrease in performance at some frequencies. Overall, such a small cavity actually weakens the sound blockage. This is most commonly seen when people make the **mistake of sandwiching resilient channel between two layers of gypsum**. As the cavity **depth is increased**, the **sound blockage improves** at most frequencies, but there is **always a weakening at low frequencies**. This is the effect of a resonance or natural tendency of the system to want to vibrate at that frequency determined by the depth of the cavity and the weight on each side. The wider the cavity and the heavier the materials, the lower that frequency. This **mass-air-mass effect** is one of two resonances at low frequencies that affect performance.



The **type of stud** used in a wall is **very significant** when the gypsum is attached to each side of a single stud. **Sound travels** through a stud cavity wall through two paths: through the cavity and **through the stud**. The solid blue line below represents a stud wall with no batts in the cavity, with **wood studs or heavy steel studs**. What are heavy steel studs? Any stud 20 gauge or heavier is essentially equivalent to a wood stud. **Most test data** for walls with **"steel studs"** is actually for walls with **25 gauge** steel studs. People often assume such data is valid for any steel stud and it definitely is not. A **25 gauge stud is flexible** enough not to transmit much sound through the stud. The solid red line represents a wall with such as stud and no batts. Note the **improvement at higher frequencies** but not at lower frequencies. The same kind or result can be obtained with wood studs or heavy steel studs by using **resilient channel** on one side. However, either of these partitions is relatively poor due to the poor performance at low frequencies. The **dashed lines** show the **effect of adding batts** to each partition. Note that for the **wood or heavy steel wall the batts provide significant improvement at the low frequencies, but not much at the higher frequencies**. This is because of the sound transmitting through the studs. Now, notice that **with the 25 ga. steel studs or resilient channels, the batts**

provide a significant improvement over a broad frequency range. Basically, the **batts improve the path through the cavity and the light studs or resilient channels improve the path through the studs**. Whe gypsum is directly attached to studs, there is a **structural resonance at low frequencies** that overrides the mass-air-mass resonance. When studs are spaced at 16 inches, and gypsum is directly attached, this resonance rises to around 125 Hz and reduces the STC compared to similar walls with studs on 24 inch centers. (To be continued in next issue.)

Finally – We have a standard for testing doors in the field – People have been asking us for years to test and verify door performance in the field and we have had to tell them we had no real practical way to do it. We could evaluate the overall performance of a partition containing a door, but not the door itself, and in many cases due to circumstances we could not even do that. Often all we could do was to measure the overall noise reduction between two spaces. If you are really interested in overall performance which is often the case, this is fine. However, many people want to write a specification for the door performance itself and evaluate that. A **new standard** just **adopted by ASTM** developed by a **task group led by Noral Stewart** provides a method. The method was first developed by consultant Michel Morin of Montreal. It is better than anything that has been available. It **eliminates almost all influence of the room effects without requiring a measurement of the reverberation time**. It also **minimizes** but does not totally eliminate the **effects of flanking**. Thus, unless the partition is much better than the door and flanking by other paths is limited, **there could still be some flanking influence** reducing the apparent performance of the door. It has been shown in laboratory tests where there is no significant flanking, that the new test gives results that are typically equal to or not more than one point less than the STC measured of the same door in the same installation. The quantity reported as single number rating is the **Door Transmission Class, DTC**. An appropriate use would be to write a specification that a door as installed in a building would test at or above a specified DTC. Normally to **allow for some flanking and deterioration of the performance in the field**, the specified DTC would be less than the measured laboratory STC, perhaps 5 points less for instance. The standard will be available shortly as **E2964 Standard Test Method for Measurement of the Normalized Insertion Loss of Doors**.

Acoustical Society of America forms subcommittee on Hospital Acoustics – The Technical Committee on Architectural Acoustics of ASA has formed a subcomm ittee to address **hospital acoustics**. Under the leadership of Gary Madaras, the group is considering more realistic objectives for **acoustical conditions in hospitals.** There is a **belief among many of the members that the goals stated by the World Health Organization are idealistic and not realistic**, and thus preventing progress at reaching more realistic goals. Both Noral Stewart and Joe Bridger are participating in this effort.

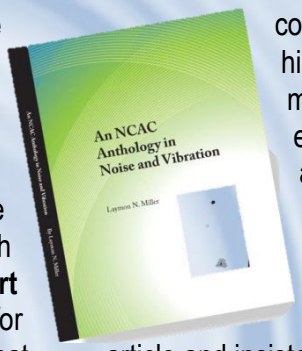
Sound & Vibration Magazine – a great free resource – Since 1967 Sound & Vibration magazine has provided a monthly update on a wide variety of topics in sound and vibration. The coverage is so broad that probably no one will find something of interest in every issue, but just one or two issues of interest a year is worth the price – FREE! You can subscribe here.

National Task Force on Acoustics for Elders in Residential Care Communities- **Noral Stewart** has been invited to participate in a task force to develop guidelines for acoustics for Residential Care Communities for Elders. This is part of the **Facilities Guideline Institute** activities recognizing that residential care facilities have needs different from hospitals and other medical care facilities.

Beware of Lightweight Gypsum – All the manufacturers of gypsum wallboard are introducing lightweight panels, from **15 to 30% lighter** than regular gypsum. The primary incentives are reduced shipping costs and **LEED** incentives from the use of less fuel for shipping. Some are claiming these light panels perform equal to regular gypsum. Unfortunately, there is no getting around the basic laws of physics. **Weight is the primary factor that determines sound blockage**. STC ratings may not be very different in some cases, but if you examine the sound blockage overall, it will be

seen that partitions with these panels are weaker at the lower frequencies at least. There is still very limited data on these new panels. Thus, their use is **risky in critical applications** unless perhaps a layer is added to bring the weight back up.

Laymon Miller Book – Laymon Miller was a long-time consultant with Bolt Beranek and Newman who developed a course on noise control and with his wife Lucy toured the country giving the class. He was the master in teaching this material in a short period of time. After retirement, for many years he wrote articles on his experiences for the NCAC Newsletter. Before he passed away late last year, he edited these articles into a book along with some of his earlier writings and a few articles from others he considered important. **"An NCAC Anthology in Noise and Vibration"** is available through NCAC. Around the middle of the book without explanation there is an **article by Noral Stewart** regarding the importance of good communication that was written as a "President's Message" for the Newsletter during period when Stewart was President of NCAC. Miller was impressed by that article and insisted on including it in the book.

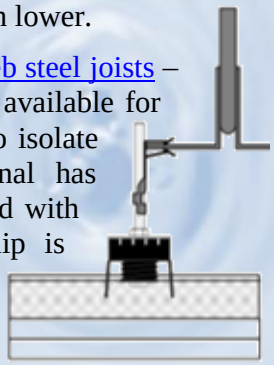


Acoustical Product News

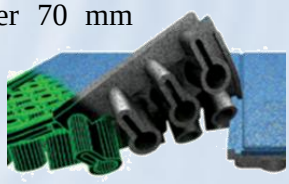
Ecoustic Moov wall panels – These unique panels are made of a back chamber that attaches to the wall or ceiling, with a non-woven shaped facing that is attached to the surface covering the chamber. This combination of the non-woven with variable cavity gives very good broad band absorption with a very unique and interesting curved surface.

STC 56 1.75 inch thick steel doors by Soundproof Windows – Sometimes it takes a fresh look at a problem to make a breakthrough. Soundproof Windows best known for their interior storm windows tackled the high STC door problem with fresh thought and achieved the highest STC ever achieved in a 1.75 inch door. Further they have done it with a combination of multiple seals that do not depend on extremely careful adjustment and pressure on them. As a result, these doors are performing well in the field, something most high-performance doors often do not. They do this with a frame and seal system that preserves a wider opening, with an easily installed frame and with a lockset bought at Home Depot, nothing special. Best of all, the price is lower than many doors rated much lower.

Pac-Intl isolation clip for open web steel joists – Rubber isolation clips have been available for use with wood joists or trusses to isolate ceilings. Now, Pac International has introduced a clip that can be used with open web steel joists. The clip is basically hammered onto the side of the flange of the truss as shown at right. It supports a hat channel and gypsum as with the clips that are used on wood systems.



Pliteq FIT isolation for gym floors – More gym spaces are showing up where they should not be on upper floors of buildings. Isolating gym activities from the floor has been a challenge. Pliteq has introduced two unique isolation systems that should solve many but not all such problems. The thicker 70 mm (2.75 inch) can provide significant benefit even for heavy weight drops on thick concrete floors, but is not sufficient on all lighter floors.



Armstrong Soundscape Blades – These are basically fiberglass baffles with the Optima finish on all surfaces and edges giving them high absorption. They are also available in colors with a slight reduction in absorption.

Armstrong Optima with Plant Based Binder – Armstrong is using a plant based binder in selected sizes of their Optima fiberglass panels.

Armstrong Lyra – Smoother finish than Optima, more like drywall.

Armstrong Calla – Very absorptive (NRC 85), very smooth, lower density mineral fiber panel, available in colors.

Armstong IIC Clip for suspended drywall ceilings – It is known that wire suspended drywall ceilings though not widely used are an effective way to improve the impact isolation of floor ceilings, but that when the floor surface is not isolated, a rubber isolator in the wire can further improve the performance. Armstrong has introduced as soft clip to isolate the wire from their drywall grid. Testing has shown benefit of several points for a vinyl floor applied directly to a 6 inch concrete floor.