Sounds *Our 25th Year* Issue 5 Summer 2003

A Newsletter from **Stewart Acoustical Consultants**

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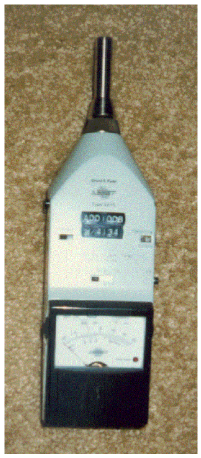
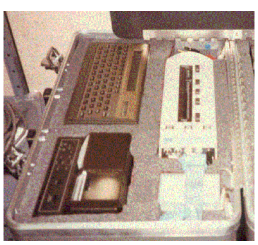
Our Twenty-Fifth Year

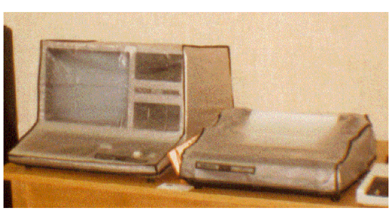
It hardly seems possible, but yes, we are in our twenty-fifth year. Much has changed. A picture of the parking lot of our first office shows not a single Japanese car.



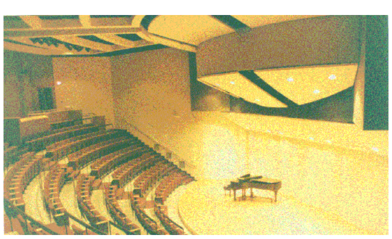
We started writing reports by hand and paying someone to type them. We had to have someone to answer the phone since no one would respond to "voicemail" back then. Measurements were one octave band at a time, with results written by hand. At least our B&K 2215 was a lot lighter than earlier meters. Calculations were also all by hand with the help of our trusty Pocket PC.

1983 was a landmark prosperous year. A late March snowstorm caught us by surprise as we measured airplanes in Charlotte while the Wolfpack was marching to the championship. We thought we were really on our way, but it was primarily three major clients, and two were finished by the end of the year. Some lean years were ahead.





We entered the computer era, with a new instrument that could be controlled by a small computer, and with our trusty Trash 80 that saw us through the rest of the 80's, printing reports on dot matrix printers.



The Squires project at Virginia Tech provided an opportunity to demonstrate our full architectural capabilities, though recognition of the results had to await completion of construction in the 90's.

The 90's brought new computers, computer-based instruments, and an enthusiastic new employee Joe Bridger. Joe started bringing us truly into the computer age.

Business boomed, except for a mysterious eight months in 1996. The internet world arrived. The acoustical consulting community honored us by asking that we lead our national trade association.

We now struggle to meet the demand brought by the confidence you place in us. We thank you for your business and look forward to a bright future.

National Council of Acoustical Consultants - NCAC

NCAC is the international trade and professional association of acoustical consultants. Noral Stewart served as President of NCAC for the 2000-2002 term, and will chair the council of past presidents in 2002-2004. This has been an exciting time as NCAC has celebrated its 40th Anniversary, made the first major rewrite of its Bylaws, developed a new six-panel brochure and revamped its website. Check out www.ncac.com.

Our Website

You can find it at either

www.stewartacousticalconsultants.com or

www.sacnc.com

The site provides not only the kind of information we would normally send a new client, but photographs of some projects, an FAQ on common acoustical problems, and links to many other sites of information related to acoustics. If someone asks you about finding help with an acoustical problem, we hope you might refer them to our website first. Once they call, many of their questions are already answered and we can talk about the specifics of their problem.

Multi-family Privacy Walls and Mill Conversions

Inadequate isolation between units of multifamily housing is a common problem, both in new construction and in conversions of old buildings.

In new construction, walls can be inadequate, or other factors can allow sound to flank around the walls. Some widely distributed test results of wall STC may not represent typical performance of a wall. Many tests with steel studs are based on light gauge studs, and performance will be much worse with heavy gauge studs or wood studs. Some walls that look good to a layman can have inherent flaws. An example is a double wall with a small air space between two layers of gypsum. It is better if the inner gypsum is removed. Even the best wall can provide poor isolation if steps are not taken to prevent flanking. This becomes especially important when walls exceeding STC 50 are used as should be the case between residences. A continuous floor under a high performance wall of STC 55 or 60 can limit apparent performance to around STC 50.

Mill conversions present a strong set of problems. The first is the attempt to depend solely on a wood floor as the only barrier between units. Wood alone with no air space cannot possibly provide adequate isolation. Wood also has the inherent low-frequency footstep noise problem. If this floor is continuous between units side to side, flanking will be strong between units on the same floor. Leaks between boards above and below the dividing wall are also a problem. Finally, we have the problem of obtaining a seal between the usual brick walls and the interior walls and floors. Large cracks between existing floors and the exterior walls are common. Anyone planning such a mill conversion should seek guidance early in the process.

Local Noise Ordinances - More Stringent

Local community noise ordinances are getting more stringent and difficult to meet. Chapel Hill now requires sound reaching residential properties to be less than 45 dBA at night and 50 dBA in the daytime. This daytime limit is lower than the night time limit in many places. Higher limits are allowed for sound reaching commercial and institutional properties. Durham and Durham County have more typical limits of 50 dBA night and 60 dBA day, but they apply these limits without regard to the use of the neighboring property, and will not even provide an exception for a generator during a night outage.

Field Sound Isolation Measurement

Noral Stewart is currently chair of a task group revising ASTM E336, the standard for measuring acoustical isolation between spaces in the field. This will provide one or two new measures.

One is the Apparent Transmission Loss and single number rating Apparent Sound Transmission Class or ASTC. The actual isolation in the field is often controlled not by the dividing partition, but by flanking paths along continuous floors or other paths between rooms. The ASTC includes this flanking. Thus, it is a rating of the partition performance as actually perceived in the field. This is similar to the Noise Isolation Class or NIC that our firm has recommended, but adds an extra step to minimize the influence of room absorption on the result. Field conditions are rarely suitable for proper measurement of Field Sound Transmission Class, FSTC. Results less than the actual FSTC of the wall have often been erroneously reported. When the true FSTC of the wall is determined, this can be misleading since the isolation is actually less due to flanking.

The task group is also working on a measure similar to the NIC but based on sound levels near the partition rather than averaged over the room, especially for large rooms. Some are advocating the ability to use it also in smaller rooms as an alternative to the NIC.

Classrooms - A Standard Adopted

ANSI Standard S12.60-2002 specifies acceptable levels of reverberation, background noise, and isolation for classrooms.

This new standard addresses the needs of young children, the hearing impaired, and those learning English as a second language who require better acoustical conditions for good understanding. It has been developed partially in response to the prevalence of acoustical conditions in classrooms that are not even suitable for native listener adults with good hearing and language comprehension.

To meet this standard, acoustical ceilings need to be installed as low as practical, with better absorption than traditionally used in most cases, and always for ceilings that are high. No fans can be allowed within, immediately above the ceiling, or in the walls of classrooms. Because of reduced background sound, plenum returns do not provide enough isolation.

The standard is currently voluntary, with efforts ongoing to put it into codes and regulations.

In Memoriam

Bruel & Kjaer 4165 Microphone 775251, 1979-2003

The Stewart Acoustical Consultants family mourns the passing of Bruel & Kjaer 4165 Microphone 775251. "4165", as he was known affectionately in the family and among clients, served for almost 24 years, and was the oldest surviving member of the SAC instrumentation family. 4165 was born in Naerum, Denmark and joined SAC in the old Cary office in May of 1979 as the original microphone of our Bruel & Kjaer 2215 Sound Level Meter. He served well as the primary and senior measurement microphone on successor instruments, first the Larson-Davis 800B, and at the time of his passing with the Larson-Davis 2800. He had survived a major catastrophe that destroyed the Bruel & Kjaer 2215 in 1996 at the hands of a clumsy engineer unaccustomed to such precision instruments.

Being a free-field type, 4165 especially liked the outdoors where he could go straight to the source. He enjoyed wearing his many windscreens and riding the desiccant tubes that kept him dry on humid mornings. Being highly sensitive, this tall guy especially liked quiet places that his shorter sisters could not appreciate. He let them handle the extremely loud jobs that distorted him, and those cases where he could not find his direction to the source. Over his lifetime, he enjoyed the frequent warm embrace of three field calibrators that helped make sure he did not drift. As senior microphone, he had the privilege of annual summer vacations for more thorough physical checkups that he greatly enjoyed. He always returned refreshed, ready for work, and with high marks from his examination.

4165 was unfortunately not as robust or as amenable to surgery for repair as his youngest brother. His death resulted from a fall onto the hard concrete floor of a prison as he was being relieved of duty by a sister more suited to the task at hand.

4165 is survived by sisters Bruel & Kjaer 4134 and ACO Pacific 7013, brothers ACO Pacific 7046 and Larson-Davis 2541, four first cousin electret microphones, and a second cousin Rion accelerometer.

He rests in a place of honor in his original mahogany case. Memorial contributions are suggested to the scholarship fund of the North Carolina Regional Chapter of ASA, or to the Newman Student Award fund for students of architectural acoustics.

Joe Bridger - School Cafeteria Noise at Pittsburgh ASA Meeting

As part of his MS program at NCSU, Joe Bridger did a research project on noise in school cafeterias. His work was presented at the June 2002 meeting of the Acoustical Society of America.

School cafeterias are loud for many reasons, and some are much louder than others. Children usually talk louder than adults. Part of that may be just nature, but part is that they have more difficulty understanding what is said under difficult conditions. Achieving ideal conditions in cafeterias is almost impossible because of the typically crowded conditions. Joe researched the variation in cafeteria levels and the factors influencing that. He surveyed about 20 cafeterias. Then, the cafeteria with the loudest levels was treated with more absorption. The noise reduction was more than would have occurred due to the material alone. The students also lowered their voices.

Cafeterias should have low and highly absorptive ceilings. Even a moderately absorptive low ceiling is usually better than a room with a high ceiling. A high ceiling increases reverberation, another factor that makes it difficult to understand and encourages louder voices. Cafeterias with high ceilings usually require significant wall treatment.

Book Review -

The Soundscape of Modernity - Architectural Acoustics and the Culture of Listening in America, 1900-1933,

by Emily Thompson, MIT Press, 1999.

In 1900, people listened to music and speech in largely reverberant rooms without amplification. By 1933, amplified sound in very dead rooms was common. The general noise level in our environment had also increased drastically. Emily Thompson traces this period of major change starting with the development of reverberation theory by Sabine that lead to the over reaction against reverberation by the end of the period. Contributing to the change was also the development of amplified sound. By 1933, the acoustical expectations of the developed world were very different than in 1900. We were expecting a clear and distinct, non-reverberant sound. This lead to concert halls and churches being designed with more acoustical material than appropriate, problems still being corrected today.

Worship Space Acoustics

Spaces for Worship are a major part of our work. The acoustics of these spaces vary widely, depending largely on the type of music used in the worship and the degree of auditory participation by the congregation. A church with a strong traditional musical liturgy of choral and organ music will want some significant reverberation, though this interferes with the clarity and comfort of listening to speech. At the other end of the spectrum are the contemporary music churches where reverberation is undesirable but some support of congregational singing is usually desired.

Reverberant churches as illustrated by St. Francis of Assisi Catholic Church in Raleigh have a reverberation

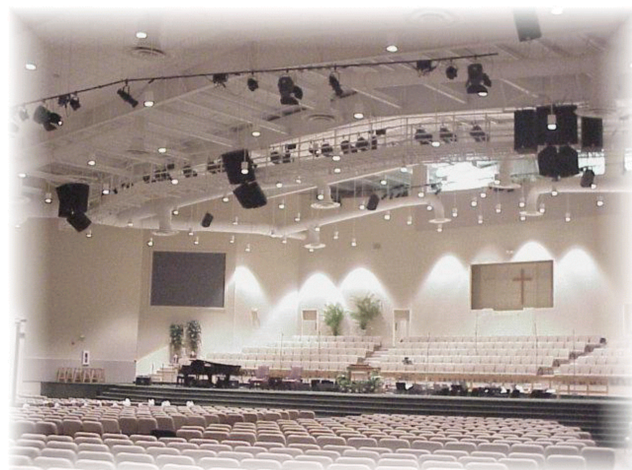
time approaching two seconds, and more when empty or sparsely occupied.

These rooms provide a reverberant blend of performed music and are very supportive of congregational singing. Organ music and some choral music such as Gregorian chants can sound better with even more reverberation, and some churches ask for more. We try to discourage more than about two seconds of reverberation because of concerns about speech clarity, the comfort of listening to speech, and reverberated noise of intermittent sounds generated within the congregation. The speech clarity can be brought out with a very carefully designed sound system. However, the other problems persist.

St. Francis is a little unusual in the lack of pew cushions and the carpet under the pews but not elsewhere. The open-back pews with carpet help reduce the variation of the reverberation with the number of people present. Pew cushions do a better job. To compensate for the lack of low-mid frequency absorption from the carpet, some tuned absorption is hidden in the ceiling area along with the loudspeakers.

The other end of the spectrum is illustrated by the Biltmore Baptist Church near Asheville. The sound of these rooms is typically dominated by the sound systems for both music and speech. The rooms are very

Photo courtesy RealWorld Audio, Asheville



friendly to speech and to the sound system. Large amounts of wall treatment prevent reflected sound that can be a problem and allow use of music speakers that often do not have as much directional control as speakers used in more lively rooms. While these rooms for contemporary music are not usually very reverberant, they can be supportive of congregational singing with a hard ceiling of appropriate height.

Biltmore is one of only two churches where we have used a full or almost full acoustical ceiling. This became necessary at Biltmore because of the very high ceiling height that could not be lowered. Without the acoustical ceiling the room would have been very reverberant. Because of the very large amount of absorption, the materials had to be carefully controlled to assure balance. The audio systems designer considered this the best room he had ever tuned because the room basically disappeared acoustically.

Environmental Noise -

Impact versus Compatibility

Environmental noise projects often involve evaluating the effect of existing noise on a proposed development, or the effect of the project noise on existing neighbors. An example of the first case is determining whether a new building can be compatible with existing transportation noise, and any extra steps such as improved windows needed to make it compatible. The second situation involves determining the impact of noise from a new project or expansion of an existing source on existing neighbors.

These are not the same. In the first case the opportunity exists to design the new building to be compatible with the noise. In the second, the building and community already exist, designed for a particular degree of noise and occupied by residents with a particular expectation. Extra noise can be an impact even if the increased noise is supposed to be compatible with residential use.

Clients dealing with properties potentially impacted by changes to transportation systems should be aware of the major differences in the methods used to evaluate noise by the agencies dealing with rail, road, and air transportation. Be careful when you review reports of these various agencies.

The rail agencies have the newest and best procedures for evaluating true impact of new lines or changes to operations of existing lines.

The highway agencies have procedures for determining if a property qualifies for a barrier wall, based on many factors in addition to noise impact. A property may be severely impacted by a road project and still not qualify for a barrier, while another property with much less impact might qualify.

For airports, the Federal Aviation Administration (FAA) misapplies compatibility criteria originally developed by the Department of Housing and Urban Development as an indicator of impact. As long as the noise of an airport does not exceed the level normally acceptable for HUD financing, the FAA assumes no impact has occurred, even if noise increases drastically. Once this level is exceeded, even a very small increase in noise qualifies as an impact by the FAA criteria.

Federal criteria generally strive to equalize noise everywhere, increasing it in quiet areas up to a level typical of areas with populations of 20,000 people per square mile.

Band and Choral Rooms

Many band and choral rooms are far too small with ceilings too low. This creates very loud conditions and poor distribution of sound around the room. Attempts to control the loudness leave the room very dead and with an even poorer blend of sound. Attempts to put these rooms below or especially above other spaces create extremely difficult isolation problems.

Planning for these spaces should start with a single floor location away from other spaces wherever possible. This should allow for a high ceiling. Some type of buffer space such as storage should be provided between the band and choral rooms. Otherwise, a very good wall will be needed, and a break will be required in the floor and ideally the roof, with the dividing wall extending through the roof. Allow at least 25 and preferably 30 square feet or more per person in band rooms, and at least 15 and preferably 20 square feet or more in choral rooms. Ceilings should be at least 16 feet high, and up to 20 feet or possibly more in band rooms that have small floor area per person. In middle schools, the floor area can be reduced about 15%, and the ceiling heights a foot or two. With these basics, we can provide the details to make a good room.

Fellowship Halls, Dining Rooms

A most common problem we continue to have to address after construction is the church fellowship hall or other social and dining areas, including the ballrooms of private clubs. These rooms should have acoustical ceilings and often some wall treatment. Please let us help you with any new fellowship hall, social hall or dining room before it is built.

Contacting Us: E-Mail and Fax

Drawings and Photos via E-mail

Please e-mail your questions, comments or communications concerning projects to sac@sacnc.com. Our recent conversion to broadband internet access allows us to receive larger files of photographs and drawings. We do still prefer scaled hard copy for actual working drawings, but can view electronic drawings for proposals and print small areas of drawings for emergencies.

We receive faxes at our regular phone number, 919-781-8824, whether we are in the office or not. Please let us know if you have trouble sending a fax or do not hear back promptly.