Photo by Ryan Larkin, Acoustics First Corporation

# BASIC ACOUSTICS

*by Nick Colleran*

Those of us in the acoustics business often get questions like "What is NRC and how is it measured?" This is a straightforward question with a clearly defined answer: NRC is the Noise Reduction Coefficient calculated as the arithmetical average of Sound Absorption Coefficients at the frequencies of 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz. It is useful in determining the effect of various finish materials over the range of sound interfering with speech intelligibility and most annoying to the listener. It says nothing about the bass range for music or the violin overtones more easily heard by Rover or Fido.

A second question: "What is the ideal NRC?" may follow. The answer will be this: "It depends." To calculate the required NRC or sound absorption (SAC) you need to measure the reverberation characteristics of the space to be treated and the use to which it is assigned.

There are general guidelines for speech and music. The quick answer is, slightly under 1 second of "ring out" for normal speech and just over 1.5 seconds for traditional music. (Here "ring out" is used to mean RT60, the time it takes for the reverberation of the sound to decay from initial impact until it is 60dB down.)

Moving to the "it depends" phrase, modern praise and worship may benefit from being in a clothes dryer, or a less reverberant space, while congregational singing will require a bit more than what is ideal for traditional choir and pipe organ. Passages spoken in ancient languages may have added impact with echo that would be otherwise excessive for clear understanding of a sermon.

One size does not fit all! Prior to installing a sound system, the room acoustics should be evaluated. Before the acoustics can be considered, the type of performance and service should be determined. Far too often, a good sounding room has been destroyed by interior decorating that took naturally absorbent materials such as rough hewn wood and made them acoustical disasters by use of reflective finishes. Adding absorptive acoustical panels to a sanctuary before learning that there is no band or instrumental music yields an equally bad result, although from a totally different room sound. Treatment should not begin until the existing acoustics are known and a desired end result is defined.

The process of assessing acoustics prior to installing a sound system would ideally begin by employing the services of a qualified acoustical consultant.

Their charges are made for room analysis and design and are not dependent upon sales of acoustical materials or sound systems. Often a church is on a tight budget and may want to approach the project as "do-it-yourself". The considerations will be the same but a basic understanding of acoustical principles is needed as well as knowing that the room cannot be fixed with electronics after the fact. Starting with a good room allows the sound system to work to its full capabilities. A bad room will fight it.

Although there are now computer programs to model room acoustics, the basic need for reverberation control can be determined by applying algebra from more than 100 years ago. The data required comes by taking room dimensional measurements and timing the "ring out" of a balloon pop. This information, entered in the Sabine formula, will yield the room absorption in sabins.

Solving the equation for the desired reverberation time and taking the "before and after" difference tells us what needs to be added to the room. In doing this the novice ought to be aware of many factors: Is the room finished? If not, are there going to be padded seats? What is the average attendance? (Both pads and people have acoustical absorption) Environment also affects acoustics, since colder climates bring with them heavier, more acoustically absorbent clothes. Adding acoustical panels over hard surfaces is more effective than covering a wall which already has some absorption.

If by this point the reader is not convinced of the need for professional advice or financial constraints prevent its consideration, some acoustical materials suppliers, including the author's, will take the raw data along with other information and provide a prediction of the acoustical result. However, on-site input must be accurate. Results may vary. With a willing and reasonably competent crew from the congregation, excellent results can be expected. Moving too fast, following the wrong assumptions, or listening to the wrong expert for free acoustical advice will take more time and always cost more money in the long run as the sound system is continually enhanced in an effort to compensate for bad acoustics. ◆

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