THORBURN ASSOCIATES
ACOUSTIC AND AUDIOVISUAL CONSULTANTS

Fall 2002

Welcome to the Fall 2002 Thorburn Associates newsletter! As we write this issue, we're finally getting settled in our new corporate office (please make sure you've updated our delivery address - see back) and life seems to be returning to normal. Steve recently taught a 4-day, standing room only, workshop on "Project Management for the Audiovisual Industry" at Infocomm in Las Vegas. TA is proud to have four other staff presenting as well:

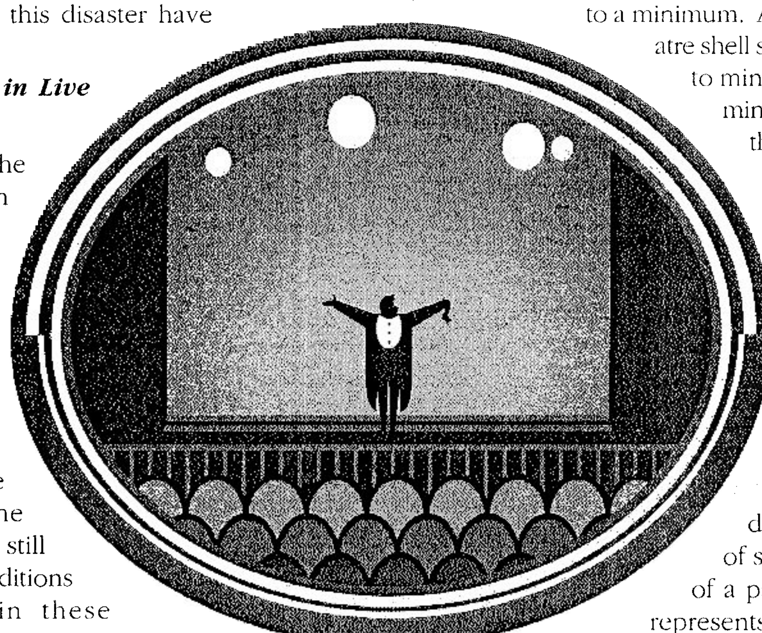
Brandon Haberman taught a 1-day workshop "Essentials of Acoustics: Theory and Hands-On Applications",
Derek Meares taught a 1-day workshop on "Presentation Facility Design and Integration Considerations",
Eric Cronwall taught a 2-hour session "Integrating Dynamic Presentation Technologies Into The Retail Environment",
Jim Horn taught a 2-hour session "Technology for Today's House of Worship".

Please contact us if you are interested in any in-house training. Many of our sessions qualify for AIA/CES credits.

Acoustics for Live Theatre

The lights begin to dim, the audience takes their seats, voices lower, and all you can hear is the quiet rustle of theatre programs and an occasional cough as the audience waits in anticipation for the curtain to rise on the latest, long-awaited Broadway play. The excitement builds as the curtain slowly parts, revealing an elaborately decorated set and beautifully costumed actors. The orchestra begins the prelude and the play begins.

But wait. The actors can barely be heard! The orchestra is drowning out their words! All of a sudden the audience hears the air conditioning units coming on, a ventilation grille is rattling, and you can hear the people in the control room talking! The audience is getting restless and some patrons start to leave before the first act is even completed! How could this disaster have been avoided?



The Acoustical Goals in Live Theatre Formats

The basic shape of the theatre can have an impact on the acoustics. Some shapes work and some don't. You may not be able to change the shape of an existing building, such as a historic restoration, or one that was designed without considering the acoustical impact of the dimensions, but it is still possible to better the conditions while working within these parameters.

There are several acoustical goals when planning for multi-purpose theatres. First, you must provide enough reverberation for the blending of musical performances while still maintaining high levels of speech intelligibility for drama and other spoken events. One option to achieve this is through the use of diffusing panels.

Diffusion is extremely important in rooms used for musical performances. When good diffusion has been achieved, listeners have the sensation of being enveloped in sound. The second acoustical goal is the control of noise from the building's mechanical system (HVAC fan noise, for example) whose noise should be prevented from impacting the theatre. A theatre has to be protected from mechanical noise so the theatre is ideally located as far away from the mechanical unit possible. The remainder of the duct work should be treated with acoustical lining to further reduce the fan noise.

The third goal for a theatre is to keep the noise out. Through the use of thick wall construction and acoustically gasketed doors and vestibules, the exterior noise should be kept to a minimum. All penetrations into the theatre shell should be acoustically sealed to minimize air leakage, therefore minimizing sound leakage. The theatre shell should have partitions designed to a Sound Transmission Class (STC) of 55 to 65, depending on the seating size of the theatre. Doors into the theatre should range from STC 40 to 55 depending on location and adjacent uses (corridor, mechanical, or outside). The STC is a single rating designed to give an estimate of sound insulation properties of a partition. Numerically, STC represents the number of decibels of speech sound reduction from one side of the partition to the other.

Speech Intelligibility

Speech intelligibility is greatly affected by reverberation. The optimum reverberation time for speech auditoriums vary greatly from churches to opera houses to studios.

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20880 Baker Street - PO Box 20399
Castro Valley, CA 94546-8399
San Francisco Area Office (510) 886-7826
Los Angeles Area Office (818) 569-0234
Raleigh-Durham Area Office (919) 493-6027

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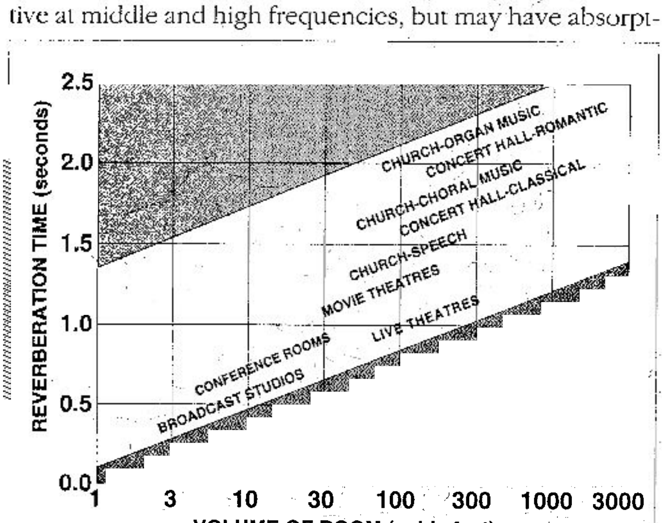
The lower reverberation times for speech auditoriums demonstrate the influences of reverberation on speech intelligibility. The rate at which the reverberant sound dies away is measured by the *reverberation time,* defined as the time required for the reverberant sound to diminish by 60 dB. The reverberation time can be calculated approximately from the formula, $T = 0.05\ V/A$, where V is the room volume, and A is the absorption in sabins, a sabin being the absorption of a square foot of perfect absorber. Certain values of reverberation time have been found acceptable for various applications: for speech the middle-frequency reverberation time should be about one second or less; for solo instruments and chamber music, 1.0 to 1.5 sec; for symphonic music, 1.5 to 2.0 sec; for church music, 2.0 to 2.5 sec. Generally, longer times are accepted in larger halls and with larger musical ensembles. The time should be nearly constant with frequency, although for music a slight rise at low frequencies is desirable. What happens to a sound wave when it reaches a surface depends upon the absorption of the surface. Surfaces such as concrete or masonry that are impermeable have absorption coefficients less than 0.05 and are regarded as almost perfect reflectors. Other surfaces such as thin plywood and plasterboard may be reflective at middle and high frequencies, but may have absorption rates as high as 0.50, due to panel resonances, at low frequencies. On the other hand, a thin porous material mounted against a hard backing will be mainly reflective at low frequencies, but will increase in absorption efficiency with increasing frequency. Acoustical plaster, carpet and wood are typical examples of this type of surface. Draperies also tend to absorb mostly at high frequencies, being practically transparent at low frequencies. To achieve a constant reverberation time, it usually is necessary to adjust particularly the low and middle-frequency absorption. An efficient absorbing system in this range often consists of a slotted or perforated screen over a backspace containing porous material. The backspace, the perforated surface and the absorptive material constitute a resonant system that can be tuned to whatever frequency range is desired. Some commercial acoustical materials combine two of the above features.



Ranges of Reverberation Times based on Activity and Volume of Room

Warm Bodies!

Generally, the audience provides most of the absorption, amounting to about 5 sabins per person and nearly constant over the important frequency range. In an acoustical environment it is unfortunate that we have to depend so much on audience size. Well-upholstered seats and carpet, both partially masked when an audience is present, help to level out the variation with audience.

Seminars at Lunch:

For the continuing education of your staff, Steven J. Thorburn, PE, CTS-D, CTS-I, or one of our senior consultants is available to visit your office and give AIA-approved one-hour seminars on the following topics:

- *Site Planning*
- *Videoconferencing*
- *Plumbing Noise Control*
- *Audiovisual System Design*
- *Office Acoustics*
- *Projection Systems*

CONTINUING EDUCATION AIA

For further information or to schedule a class please call TA at 510-886-7826.