Technical Features − Sound Construction
Acoustics In Hotels − Technical Feature:

"STEREO TV, A NEW CHALLENGE IN HOTEL SOUND ISOLATION."

by Stan Roller, Principal Consultant, Stan Roller, Inc., Consultants in Acoustics, Naperville, Illinois.

(Editor's Note: This article originally appeared in the 1988, Issue 4 of Form Function. Some pictures, graphics or charts may not appear in this version. Printed copies of this article, or information about the products mentioned in it, can be obtained by writing: Editor, FORM FUNCTION, 125 South Franklin Street, Chicago, IL 60606−4678.)

Televisions with stereo sound, video cassette recorders, compact disc players and powerful, full−frequency−range stereos have become commonplace in the home. And the quality of TV sound is quickly becoming comparable to that of the compact disc (low background noise, reproduction of total audible frequency range, etc.). These improved systems are also finding their way into hotel rooms. As TV sound becomes more sophisticated, it puts greater demands on the sound isolation partitions between hotel guest rooms.

Basic Considerations
Acoustic privacy between two spaces is determined by the simple arithmetic relationship of three factors: the sound source, the sound resistance of the separating structure and the background noise in the space receiving the intruding sound. While this relationship is logical and easy to understand, sound, like light, is difficult to deal with in detail.

We hear sounds over a frequency range that spans somewhat over 10 octaves. Our hearing sensitivity varies with frequency. Each sound has unique characteristics as to energy content in each octave. Loudness varies. One sound at a given loudness may not be noticeable while another sound at the same loudness level may be irritating. Hearing acuity is not the same for everyone. Sound constructions vary considerably in their sound isolation characteristics.

To help make acoustical design more manageable, various rating systems have been devised. While there are many such systems, we will use only four:

1. STC−−Evaluates a construction's effectiveness at isolating speech sound sources;

2. MTC−−Evaluates an construction's effectiveness at isolating music and mechanical equipment sound sources;

3. dBA−−Loudness level that is frequency weighted similar to the human response to sound; and

4. RC−−Evaluates the constant background noise in a space from a source such as an air handling system

Although single number rating systems are useful for simplifying the design process, refinements are lost. Octave or third octave band calculations should be used as a final check of a design in close or critical situations.

Equipment Frequency Spectrums

The sound spectrums produced by five types of sound equipment that may be used in hotel guest rooms are compared in the graphs in Fig. 1. (See original article) Music is the source, and it is reproduced at 75 dBA. Fig. 1a shows the sound pressure level in the octave centered at 250 Hz (middle "C" is 256 Hz). Fig. 1b shows the level in the 125 Hz octave and Fig. 1c, the 63 Hz octave. We will use the top source, a typical hotel portable mono (monophonic, monaural) TV, as the basic reference source because the industry has so much experience with the success or failure of their isolation systems with this equipment.

It can be seen in Fig. 1a that all the equipment easily reproduces the energy in the 250 Hz octave band. The differences begin in the 125 Hz octave (Fig. 1b). A top of the line, 1988 27−in. portable stereo TV performs about the same as a standard portable mono TV in the 125 Hz octave. The console TV and full range sound system (bass controls set on flat) are 4 or 5 dB louder in this frequency range. A full range system with controls set to boost bass will be at least 10 dB louder than the portable mono set.

The most significant differences in performance occur in the 63 Hz octave band. The sound produced in the 63 Hz octave band by a typical portable mono TV generally is insignificant. The portable stereo TV is 10 dB louder and the full range system (bass boost) can easily be 35 dB louder than the mono portable! The amount of sound isolation required at 125 Hz and lower increases as the equipment capabilities to accurately reproduce the recorded music is improved. High quality stereo equipment, including the portable stereo TV, also produce significantly more sound energy in the 2000 Hz octave band. This fidelity improvement could cause some speech intrusion problems where they may not have previously existed since the portable mono TV produces little sound at 2000 HZ and above.

Speech and music will have about the same spectrum shape on the typical portable mono TV. There will be considerably more energy in the 63 and 125 Hz octave bands for music than speech in high−fidelity systems.

Sound Source Loudness

The dBA level of some subjectively described speech and music sources are shown in the table in Fig. 2 (See original article). It may seem strange, but TV and radio usually broadcast speech and music at about the same loudness levels in dBA. Speech at 75 dBA is rather loud but 75 dBA is only modestly loud music. If a typical TV program with music is set for "live level" music listening, any narration will sound like shouting.

General TV viewing will not exceed 75 dBA very often. Recorded music (not background music) playback levels generally will be judged as indicated in Fig. 2.

Background Noise

Whenever activity is taking place in a hotel room, background noise can be rather high. Sound isolation usually is not a problem during these times. The need for high isolation occurs when activities in adjacent rooms are radically different. For example, sleeping in one room; loud TV or talking in the adjacent room. In this situation, the inactive room must rely on some constant background noise source to mask intrusive noise.

Typically, the only constant source of significant, undisturbing, background noise is the room ventilating system. Background noise is an important sound isolation consideration since for each decibel (dB) background noise is reduced, the sound isolation provided by the separating structure must be increased 1 dB to maintain the same degree of privacy. See Fig. 3 (See original article) for design guidelines for background noise in hotel rooms.

Speech Privacy

Intrusive speech intelligibility (sentences) is usually in the 0−10% range when the achieved STC plus the RC background noise level equals the speech source dBA level. The graph in Fig. 4 (See original article) shows the combinations that will result in this degree of privacy. Also included in this figure is a description of the degree of privacy achieved when the sum of the STC and RC is 5 and 10 dB greater than and 5 and 10 dB less than the speech source.

Music Privacy

Intrusive music is barely audible when the achieved MTC plus the RC background noise level equals the music source in dBA. The combinations that will result in this degree of privacy are shown in Fig. 5. Privacy descriptions when the MTC and RC sum is 5 and 10 dB greater than and 5 and 10 dB less than the music source are also included in this graph.

Sound Flanking

Sound flanking is beyond the scope of this article (sound flanking is described in some detail in a FORM FUNCTION reprint article, entitled "Design Aid for Office Acoustics," FF 86−4A) but, of course, is a crucial consideration whenever sound isolation is involved. An acoustical consultant is specially trained to deal with this complex issue and should always be part of the design team working on a hotel project. One of the acoustician's important functions is to identify, evaluate and deal with all building elements that can impact individual component or system acoustical performance.

Conclusions

The quality of TV sound has improved significantly during the last few years with the playback equipment, rather than the broadcast or recorded signal, the factor usually limiting the frequency range reproduced. The newer portable stereo TV's extend the frequency range about an octave lower and an octave higher than the typical portable mono TV of the past. The frequency range of stereo TV (broadcast or VCR), albums, cassette tapes and CD's are similar when played back through a high wattage, full−frequency−range stereo audio system. There may be issues of the quality of sound but the quantity can be very similar.

It should be expected that stereo TV's will require partition systems with MTC ratings of 4 to 5 points higher than the partition systems used with the older mono systems to achieve about the same degree of acoustical privacy. The table in Fig. 6

shows that reasonable results can be achieved with STC−50/MTC−45 isolation with the portable mono TV. An STC−54/MTC−50 is required for similar privacy from a stereo TV. Special, high−performance designs are needed when full−frequency−range systems are installed in luxury hotels.

For more information about the partition systems described in Fig. 6, write to Editor, FORM FUNCTION, U.S. Gypsum Company, 125 South Franklin Street, Chicago, IL 60606−4678, and request information on "Drywall Sound−Control Systems".