home toys
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Tales from the Input Side
by Nick Colleran, Acoustics First

One of the most effective bass traps is the polycylindrical diffuser. These are large curved surfaces, bowed out from the wall at their center.

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Sometimes the sound just isn't there.

Back in the eighties when I was on the board, and later president, of SPARS (The Society of Professional Audio Recording Studios), we would occasionally talk about consumer audio, which has now evolved into home theater. There were many anecdotal observations, an occasional interesting discovery, and many times things that just mystified us.

One of the guys was a maintenance engineer for a large, famous and successful, west coast studio. On one occasion in a store, while listening and observing the new and different items available in home audio, he overheard someone offering a critique of the low-end bass on an album. Realizing that his studio had recorded that artist, he listened more closely to the nearby conversation, all the while resolving to not get into the discussion.

Finally, it got to be too much for him and he said something like this: "I'm sure you are hearing something there. I'm not disputing that, and I know it may sound good, but I have to tell you that my company recorded that album. I'm the maintenance engineer and I have measured everything in the recording chain. Our mixing console cuts-off a full octave above what you are hearing. It isn't there!"

Sometimes you can hear what isn't there.

Back in what I call the "polyester period" or "disco daze" one of the favorite speakers was the ALTEC A7 "Voice of the Theater" It looked huge, especially in 1978, had a big high-frequency horn and a horn-loaded bass reflex cabinet. It had to be a great dance music speaker. Not really!

A clue comes from the trademark phrase "Voice of the Theater".

Movie sound was stored on an optical soundtrack, literally a photograph of the sound modulation. The range was about 80 Hz to 8 kHz. There was not much point in adding a tweeter to 20 kHz or sub-woofers to amplify empty bandwidth. So how come the movies sounded good? It's the engineer's art.

One of the loudest dance records I ever mixed was an instrumental of Peter Gunn. As fate would have it, I was at a music convention in Miami with the producer when he decided to audition the mix at a local Disco. As luck would have it, their speaker of choice was the Altec A-7. When the needle went down (remember those) the bass was huge.

How is this possible? I think the word is psycho-acoustics. Knowing the odds were good that the record would be played back on a big but restricted bandwidth system, I cut the bass off at 80 Hz with an 18 dB per octave filter. (There's no point in filling bandwidth that won't be heard.) To offset this, the range around 100 - 120 Hz got a big boost. The listener recognized there was a bass player and a bass drum and the listener's ear and brain created the fundamental frequencies from their multiples.

Sometimes its there and you hear the room instead.

So far I've talked about equipment and its effect on the sound. It has been reasonable and predictable, something to work with, or around. But what happens in the component that cannot be predicted or controlled: The other guy's listening space. Although most readers will be interested in the home environment, lessons learned in the professional world apply there.

At one time in my early career, I recorded big name acts for radio and television, mostly before they were big names. It was then that I found just how bad it could get for me after the mix left our building.

Hearing that something wasn't right with the vocal and orchestra mix, I had recorded for television, I ventured to the broadcast production facility for a listen. Sure enough the mix was thinner than no-fat milk. However, by chance before I left, I heard the tracks playing in a different control room within the same facility. This time the bottom was too heavy. It was now time to check the room itself.

Low cost analyzers, used to set third octave equalizer-filters were becoming available by then, so I took one with me and headed back to the station. Sure enough one room was "River Deep" and the other was "Mountain High" at the same frequency by 6 dB. That's a 12 point spread in one direction or the other depending upon where the recording originates and where it plays back!

It was time for the third octave equalizers to fix the room. As I have written elsewhere, I was to find this doesn't work to fix the listening space.

It would seem reasonable at first to expect that a "hole" in the frequency response of a listening room could be fixed by an electronic boost at that frequency. Indeed there may be a sweet spot in the room where that will happen but it will be a very narrow area.

The reason is this room's dimensions. If a wall, or other boundary surface, is one half wavelength away from the source of the sound, it will see its reflection out-of-phase and cancel. For 40 Hz this is approximately 14 feet. There will be similar effects on multiples of that fundamental frequency. A boost with electronics will also serve to boost the out-of-phase reflection by an equal amount. It's a zero-sum game. The solution is a bass trap.

The word bass-trap itself is counter-intuitive. By trapping the bass, you are preventing it from reflecting back on itself and canceling. What is often described as bass build-up in the corners of a room is really the result of bass absence in the middle of the room, due to out-of-phase cancellations.

As a side note, what are often referred to as "corner bass traps" are really broadband absorbers, which, although they extend into the low-bass range, also absorb all of the energy above 250 Hz as well.

A bass trap needs to be big since the bass waves are big. One of the most effective traps is the polycylindrical diffuser. These are large curved surfaces, bowed out from the wall at their center. The center frequency of absorption is dependent primarily upon the surface size. A four-foot by ten- foot piece of Masonite®, or other flexible material, bent to form a "poly" absorbs everything around 40 Hz. Similarly, four by eight's get 63 Hz, two by four's; 125 Hz and so forth.

These devices appear as open windows to the bass. Of course, an alternative is to open the window but this requires understanding neighbors, preferably miles away. Long waves "cycle" far down the road! If you are old enough to remember Elvis in New York, you may have seen polycylindricals on the wall of the RCA studios where "Hound Dog" was recorded. They are also still prominent on the movie scoring stage. Now made of fiberglass and easier to obtain and install, without hand building, these devices are making a comeback in auditoriums and theater applications.

The photos show us building these the hard way in 1971 and a commercial unit installed on the wall of a home theater today.

Poly above the screen in Home Theater.
Sound Exchange photo.

Polycylindrical diffuser in a home theater.
Photo courtesy of Jerry Robbins, Intelligent Home Theater.

On the back wall of a Granada Hills Church in California.
Photo Courtesy of Apex Audio.

Custom unit built into the wall by the author in 1971.
Alpha Audio Studios photo.

Engineer (Joe Sheets) cutting polycylinder forms.
Alpha Audio Studios photo.

The author resting on a piece of a floating floor after installing polys.
Alpha Audio Studios photo