Sky-high ceiling woes

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HIGH CEILINGS MAY BE A POPULAR ARCHITECTURAL FEATURE, BUT THEY ARE AN ACOUSTICIAN'S NIGHTMARE, WRITES **ANTHONY GRIMANI**.

I walked into yet another tall atrium-like living room the other day, where my client wanted a "killer home cinema with big bass and all-around surround sound!"

Great.

Well, surround sound will probably be constant since the sound will bounce around for three seconds after it leaves the speakers, completely enveloping the listeners in a confused soundfield.

Big bass? That may not be possible because the total volume of the room was about 300m³. And the budget for subwoofers allowed just one 30cm active unit!

And 'killer'? It could be, if they took control of this wild room to reduce the volume and if we significantly beefed up the sound system's power specifications!

The last time I did a killer cinema in an environment like this, we actually ended up suspending a room in the second storey area of the tall-ceilinged living room.

The original room was 6m tall with a staircase up the side that led to a mezzanine and the bedrooms. A bit of brainstorming and convincing led the client to accepting a living room with mere 3m ceilings and a sound-isolated cinema above it with 2.6m ceilings. Not bad!

Granted, it did take a fair amount of construction dust to get there, but now the family has an uncluttered living room and a very nice dedicated and ultra-tuned private cinema!

The inconvenient truth is that not all of your clients are going to give you a significant construction budget, or the patience to have their home destroyed for months on end, so here are other things you can do to make a tall room work.

First, you have to reduce the total amount of reflected sound energy. Ideally the total reflection decay time in a tall room should be no more than 0.5 seconds.

You can reduce sound reflections by applying a uniform stretched fabric layer to the ceiling, and concealing absorptive and scattering materials behind it, such the Dimension4 CloudPanels and Sonata diffusers from my acoustical material company, MSR Acoustics. Plan on covering about 25% of the ceiling area with absorption panels and another 25% with scattering devices. In the image on the next page, the beamed ceiling just looks like painted gypsum board. In reality it's all stretched fabric!

But ceilings don't have to simply be flat areas with fabric. In more classical environments you can create a coffered ceiling system and fill the areas between the coffer beams with fabric and acoustical absorption (see above image). Overall it's the same idea; you need to reduce the reflected energy.

And while you're up there, you can even hide subwoofers and ceiling-mounted surround speakers. Just be sure to use fabric with sufficient acoustical transparency.

In order to achieve a successful installation, you need to realise that sound rays don't only go up – they also travel straight to walls and down to floors. And these sounds need reflection control, too.

I will assume that floors can be carpeted, at least over a central area with thick natural fibre materials, preferably with underlay. But walls are a different story...

For the purposes of this article I will assume we are talking about multi-purposed rooms, not dedicated home theatres. As such, they won't be suitable for the usual complementary absorber and diffuser modules on the carefully-groomed walls. After all, who wants large panels with uniform-coloured fabric all over their living and entertainment environments?

No one, really. So nowadays, you can print decorative images right onto fabric that will then be used to cover the absorptive core of an acoustic panel. The panel can even be framed to look exactly like an art piece.

Once you have taken the necessary steps to tame long sound reflections, it's time to pick the right equipment for the big room.

The front loudspeakers should feature better sound focus than the typical two-way garden-variety alternatives.

Realise that there are lots of ways to accomplish this. The most obvious is to add a horn in front of the tweeter, but that's not enough. The tweeters only function from 20kHz down to 2kHz, and you really need control in the 2kHz to 300Hz region, so even better are front speakers with horn-loaded tweeters flanked by a woofer above and below the tweeter.

This vertical array will get you directional focus in the vertical axis and will significantly improve the dialogue clarity and the imaging across the front soundfield. Another array that works well is a central tweeter flanked above and below by a pair of mid-ranges, or a pair of woofers. I call this a tapered array and the results are similar to the horn tweeter plus two woofers.

Ideally all three front speakers would be of this vertical variety, which means the centre speaker will need to be behind an acoustically transparent screen. You will need to have a bright projector and also have a way to darken the room's ambient lights. You will also need to pick darker colours for the walls in order to ensure decent contrast ratios off the screen.

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It's all doable, but will take a bit more education and convincing of the client than just hanging a big flat screen TV on the wall... and it may even bring you more money in the process. Not a bad thing, right?

The front speakers will of course need to play loud enough to generate at least 105dB SPL at the main seats of the room. This usually means that the speakers need to have at least a sensitivity of 92dB for 2.8V and power amplifiers in excess of 200W per channel.

However, these speakers don't need to play much below 80Hz or 60Hz, as you will invariably want to use subwoofers, so look for manufacturers that have chosen to emphasise efficiency over bass extension. There are a few out there that have achieved the right balance for home cinemas.

Larger room volumes will inevitably require larger and more subwoofers. My rule of thumb is that you typically need one 30cm powered subwoofer per 40m³ of room volume to play bass at the decent level of about 110dB SPL. So a largish living room with 240m³ of volume would take six subwoofers.

Yes, that's right. You can't really cheat the laws of physics; it takes a lot of cone area to move enough air to get that 'killer' big bass sound. So plan on finding good hiding places for all that hardware. I suggest distributing these units in the four corners of the ceiling is a good way to go for even bass performance and reduced seat-to-seat variation. You may find it easier to hide smaller subwoofers, but you will need more of them to make up the total sound pressure. (Where do you hide 16 25cm subwoofers?)

You will also need to be careful when choosing the location of your side and back speakers.

In a large room, you can probably get away with traditional wide-dispersion speakers. The distance to the speakers and the room volume will introduce the envelopment you need to create a life-like soundfield. Do make sure to find locations on the walls to place these units that are about 2m off the floor.

Not too high, and not too low. Of course the little buggers need to create enough sound pressure to reach at least 103dB SPL per channel.

If you don't want to go above 200W for each of these units, you will need a sensitivity of at least 90dB for 2.8V at 1m anechoic. That's very feasible!

Finally, I guarantee that these big rooms are going to impose a very strong acoustical thumbprint on your speakers, so you will need to include an equaliser into your electronic kit. Sometimes the automated systems work okay, but for really good results nothing replaces the human touch. Just like it takes a good chef to prepare fine foods, a fine sound system takes a good audio engineer to tune every fine detail of sound.

With control of the overwhelming acoustical reflections, along with potent power amplifiers and speakers, you can create truly outstanding sound in large rooms with high ceilings. Be prepared to use a lot of creativity to integrate it all into the décor and be prepared to amaze your customers with truly cinematic results! CH

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