From garage to theatre ...

THERE IS A LARGE RETROFIT MARKET OUT THERE, WAITING TO BE TAPPED, WRITES **ANTHONY GRIMANI.**

Oftentimes, when meeting with a potential new retrofit client, the main issue that arises is where to put the home cinema. Sometimes there's simply not enough room in the house!

In those situations it would be remiss of you to ignore the potential of the garage.

Many of us have so much junk stored in the garage that there's no room left for cars! I totally understand how this happens; I'm as guilty of it as anyone. But, while making room for the family auto may not be enough incentive to discard decades of old belongings, a high-performance home cinema might!

So let's look at how you would go about this.

Let's assume you're dealing with a two-car garage. Step one would be to lay-out the room with all the elements in their proper place: speakers, screen, seats, risers, lighting, etc.

A target ratio for room length to width is 1.3:1. This yields good surround soundfield integration and picture sizing.

From the primary seat, the L/R front speakers should subtend a 45º angle, with the screen slightly less than that at 40º. In the future, 4k video resolutions (4096x2160 pixels) can have larger screens at around 50º.

The screen and front speakers should be near seated viewing height. The centre speaker should go behind an acoustically-transparent screen with adequate space between them. Surround speakers go about 1.8m up on the wall at 90º-110º from front centre, with back speakers around 150º-170º. Also, carve out a space at the four corners of the room to place four subwoofers as research has determined this to be one of the best places for them.

Next, lay in the seats and risers. Ideal seat locations are around 0.55 and 0.68 of the room length. Risers are a great way to ensure clear sightlines without pushing the screen too high. Finally, make sure that lighting fixtures, etc, don't interfere with the performance of the room (e.g. light landing on the screen surface).

Any room with opposing wall surfaces (including non-parallel walls) will have bass resonances that develop between them. There will be a primary resonance plus harmonics for the length, width and height. Your garage-sized home cinema will probably have around ten problem frequencies between 30-120Hz where resonances are most noticeable. Particularly detrimental are resonances on different axes that are less than 5% away from each other, as they tend to reinforce.

Step two is to minimise the destructive nature of resonances by adjusting the room dimensions slightly. The simplest way to do this is with a program that inputs the dimensions and calculates what the resonant frequencies will be. Many of these programs exist as free downloads, although not all will alert you to <5% resonance pile-ups. Go online and search if you don't already have one.

In all likelihood, you will have to go back and tweak the room layout a bit as a narrower width, for example, may require you to drop one chair from a row. Don't worry about repeating work; it doesn't mean you did it wrong the first time. Home cinema design is a highly interactive process that requires lots of give-and-take from start to finish.

Step three is sound isolation. The idea is to keep loud sound from the home cinema from permeating the rest of the house and prevent unwanted external noise from entering the cinema. You have the walls/ceiling of the garage to use as a starting point, but your decision will be whether to add layers of wall surface (sound board, vinyl barrier, and sheetrock) and resilient hanging clips to the interior of the garage or frame in a new shell inside it.

The sound level inside the cinema can reach short term level peaks of 120dB, so we typically target at least sound transmission class (STC) 65 ratings for the walls. This basically means that the

wall will attenuate the sound by 65dB, leaving a reasonable 55dB on the other side. You might get by with less if the garage doesn't share many walls with the house.

Doors should also be sound rated – note that an STC 55 door is a monster – and no windows are allowed. Pass-throughs for power, HVAC, AV, etc, should use sound rated plates and boxes and be sealed with acoustically-rated caulk.

Home cinema sound systems will play loud, but the room still needs to be very quiet to convey all the details in the sound mix. Step four is to control all the noise sources inside the cinema.

The biggest offender is the HVAC system. The furnace should be located far away and suspended using resilient spring hangers to cut down on vibrational noise. Flex duct, in-line duct silencers, and supply/return plenums also help.

One of the best things you can do is oversize the ductwork and increase the number of registers. This will allow the system to move a higher volume of air with lower velocity, resulting in quieter performance. Another common noise source is fans in the electronics. This can be eliminated by locating the equipment in a closet with sound-rated doors, but you must be careful to maintain proper ventilation without leaking noise back into the cinema.

One of my favourite solutions is to create a small projection room at the back of the cinema for the equipment and video projector, which throws into the room through a special optically-treated port glass window. Cooling does not need to be quiet, because it is outside the sound isolation shell. Just make sure that none of the cooling fans are solidly anchored to the walls, or else they will vibrate right through the walls.

Once you have a well-isolated, quiet room, it's time for step five: interior acoustical treatment.

Sound from the speakers reflects off of all the surfaces in the room and combines with the direct sound to create a confusing, jumbled mess. The job of the acoustical treatments is to damp hard reflections and scatter the remainder of the sound to produce a sharply-defined yet enveloping sonic experience.

A top-notch acoustical design will use 10 to 15cm deep resistive absorber and diffuser panels for mid and high frequencies, with some kind of mechanical or resonance-based absorber for bass. Usually only 20% of the wall surface needs to be absorptive. For best results, these treatments should be evenly-dispersed around the room.

Clustering one type of treatment in one area can cause some undesirable acoustic consequences. Using advanced equations and modelling, it is possible to predict the amount of treatment needed to control reflections and bring the reflection decay time down within industry standards. However, pre-engineered treatment packages that work quite well are available. Take a look at the Dimension4 systems available through Wavetrain Cinemas.

Step six: Now you can start looking at equipment choices. The front speakers should have the right dispersion, directivity, sensitivity, and power handling to project the frontal soundfield into the room. The same is true for the side and back speakers.

For subwoofers, you're looking at four 30cm units to get a good tactile feel to the bass in your soon to be ex-garage.

Next, pick the amplifier size to drive each of the speakers to the requisite sound level of 105dB. For speakers that claim to have a sensitivity of 87dB at 2.83V/1m you will need about 350W. For 90dB you will need about 200W, and for 93dB you will need 100W. You will also need an equaliser to voice the speakers to the room.

Choose the surround decoder with the appropriate number of inputs, speaker setup choices and AV processing.
On the video side, you will need the aforementioned acoustically transparent screen, along with a high-contrast, high-light-output projector. Be absolutely sure that the projector has the right lens and vertical lens shift for your application. This is especially true if you have a long throw from a projection room.

Watching movies is all about the experience, which is where step seven comes into play. You may think that all the gear and acoustic treatments are cool to look at, but other people will find them ugly and distracting.

To keep everyone engrossed in the movie, you need to hide or disguise all the gear. Most people prefer to place everything behind a stretched-fabric wall. However, not just any stretched fabric will do. You want the fabric to be acoustically transparent so that the sound from the speakers will be clear and the acoustic treatments can work their magic.

Simply looking at the fabric isn't enough, as some visually occlusive fabrics are quite acoustically transparent while other patterns that you can easily see through wreak havoc on sound.

One last gotcha: Some equipment has flashy lights and/or shiny finishes than can be seen through the fabric wall or acoustically transparent screen. Make sure that these are properly treated so they don't distract anyone during a movie.

Step eight, installation, should be pretty straightforward, but let me offer some important reminders.

First, a good installation is a clean installation. I see all too many jobs where equipment was installed hastily. For example, speakers that are cut into walls imprecisely may rattle, buzz or leak sound into unwanted cavities. Audio lines that run too close to power may result in hum or buzz. Racks wired carelessly put undue strain on connections that will eventually cause connectors to come loose or fail. Equipment placed into closed racks without proper ventilation can cause heat-related failures.

So take the extra time and install the system cleanly.

Second, document what you're doing by creating diagrams of the wiring hook-up! Some systems have complex wiring that runs through walls to destinations that aren't easily traced. Route cables in a neat, orderly fashion, and label everything on both ends with the type of signal, origin and destination. It is a few extra steps now but it will save valuable time in the future when maintenance or upgrade work has to be performed and no one remembers how the system was installed.

Next up is system control. Most people already understand that logical, easy-to-use control is essential to wrangling in all of today's complicated electronics, so I will only mention a couple of pet peeves.

1. Always program in a set of installer pages with full access to setup menus and OSD for AV signal properties for every component. No one seems to do this, yet it is essential for configuration, calibration, diagnostics and troubleshooting. Every time I visit an installation, we waste valuable time hunting down the remote controls for specific equipment because the functions aren't programmed into the control system. Hide or password protect these controls to keep prying fingers away, but don't leave them out.
2. If the control system doesn't control it, don't include it in the control interface. Does the system actually dim the lighting? Can you really adjust the HVAC temperature? If not, don't put a page for that on the touch screen! If you do, it appears that you aren't finished with the job or can't make everything work as designed.

Finally! Step 10! Last but certainly not least is system commissioning and calibration. Every piece of equipment you put in a home cinema requires setup. Most of it will have multiple functions that affect sound and picture quality beyond just whether or not it passes signal from input to output.

Problems can exist inside the equipment itself, whether from abuse or manufacturing defect. There are also connections between equipment where problems occur. Then you have the performance of the room as a whole and parameters in the equipment (like EQ, levels and signal delays) designed to match the system to the room. All of this has to be configured and examined in detail to ensure that every part of the system is functioning as it should.

And there you have the process of turning a garage into a home cinema. Now, it's time to kick back, relax, and enjoy the show! CH