Home Theatre Case Study

GETTING STARTED

When starting a new project for a home theatre, there are a few initial measurements we need to get a basic understanding of the room.

We look at the:

- Room dimensions
- Initial background sound level measurements
- Sound transmission measurements
- Room/ building structure
- Location (i.e., close to traffic, under air flight paths etc.)
- Standards requirements

For new (unbuilt) rooms, we look at:

- Dimensions available
- The structure plan
- Location
- External background sound level measurements
- Standards/council requirements

These measurements put together give us a starting point so we can see how to best treat the room.

ACOUSTICS ANALYSIS

To go over the details of the room, scaled architectural drawings and photos taken of the room can help identify problem areas, or different shaped parts of the room.

Once you have the shape, you can identify which surfaces will have different types of treatment applied, and different angles for sound projection and propagation.

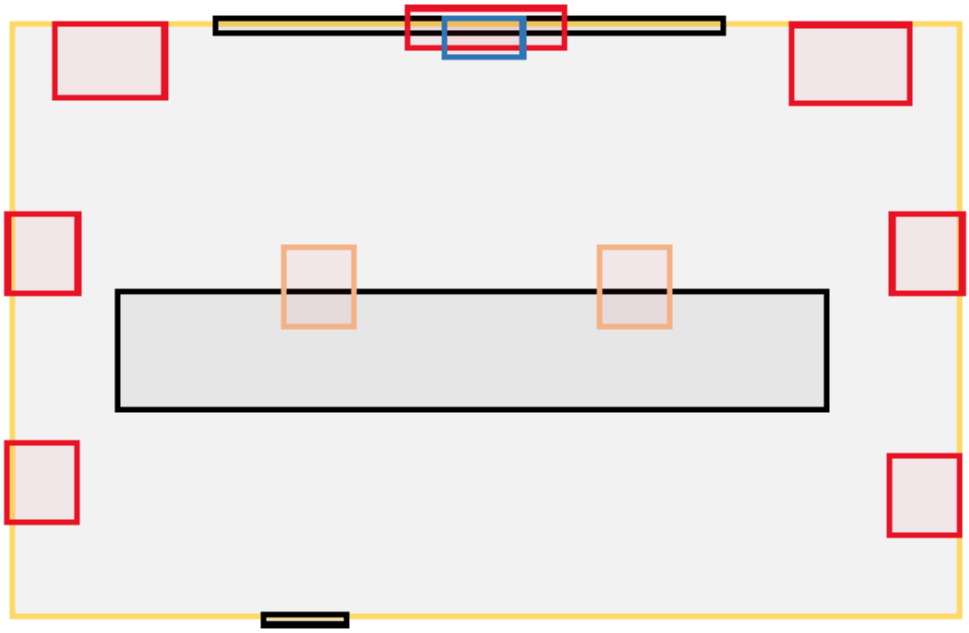
The diagram below shows a basic model of a home theatre, with a 7.2.2 sound system to analyse where the treatment and sound system would be placed.

The yellow outline is where absorptive panels would go, along the walls, over the insulation within the wall system.

The red, orange and blue boxes are where you'd place the sound system (exact locations would depend on the room size and shape).

The blue box is the subwoofer, the orange boxes in the middle would be the speakers in the ceiling and the red boxes are the rest of the speakers spread out around the room: Left, Centre, Right, Left Surround, Right Surround, Left Back Surround, Right Back Surround.

FRONT OF ROOM



Difference between sound treating and sound isolation

Acoustic isolation is the act of reducing sound being transmitted beyond the confines of the room and from other rooms into the cinema.

Acoustic treatment looks to maximise audio performance within the room by normalising (as much as possible) acoustic characteristics in a room namely, reflections, reverberation and resonance.

- Reflections describe when a sound wave hits a surface and is diverted off at a different angle, in a similar way that light reflects off a mirror.
- Reverberation is a build-up of sound due to several reflections congregating, resulting in echoes and decay in sound quality.
- Resonance is the application of room materials absorbing energy (excitation) which can cause certain frequencies to ring out longer than the others, in conjunction with the original sound and reflections.

ACOUSTIC TREATMENT COMPONENTS TABLE

Below we have examples on how we would treat these acoustic issues. However, for more accurate results, each room would have to be measured and tested to treat specific room issues.

Acoustic Characteristic	Material examples	What it does
Reflections	HD Batts	Absorbs the reflected sound waves that could disrupt the ideal sonic environment.
Reverberation	HD Batts	Reduces the amount of waves reverberating through the room, depending on the room size, shape and purpose the placement of absorptive and reflective panels will change.
Resonance	EchoSoft®	Adding mass and absorption to the walls can reduce the resonance point which would make the resonance less disturbing
Noise Transmission	QuietWave® (acoustics membrane) & AcoustiFlex®	Reduces the amount of noise travelling through the wall/ceiling structures.

MATERIAL BOARD

We create a unique design for each customer, but we follow the same process for every job, analysing the problems the space has and determining how to fix them to your satisfaction. The typical home theatre setup is shown below since specific treatments are necessary for appropriate sound isolation and treatment.

Treatment	Systems	Why do we do these?
Sound Insulation Package	• Double door system • Door seals • QuietWave® wall (membrane in wall system)	The insulation package provides an air-tight airgap between the two doors, providing the room with sound isolation so the sounds within the room don't disrupt the surrounding rooms.
Absorption	• HD Batts • Descor® • Kliptex®	These absorption panels and fabrics provide the room treatment to reduce reverberation.

SOUND PROPAGATION

Sound propagates in a number of ways, and it's worth knowing the main ways sound travels through a room. Lower frequencies tend to take more space and tend to travel like waves, this can make them harder to control. This is where sound insulation comes into play, by insulating the room, we work on getting the low frequencies maintained in the source room. Whereas mid-high frequencies are more direct and tend to travel like rays as they're more direct and easier to control.

Sound Reflection -
Sound reflection is the act of sound bouncing off hard surfaces, this creates the reverberation within a space. A small amount is good for any room otherwise the room can sound dead (which is ideal for only a few purposes, such as studios). These sound waves can bounce off from any angle and can create.

Scattering & Diffusion -
Whilst both rely on the sound waves are based on soundwaves being reflected, the difference between scattering and diffusion is based on how the sounds are reflected. Scattering refers to the general act of a non-specular reflection of sound, whereas diffusion refers to how even the non-specular reflections are.

NOISE ANALYSIS

Once we can establish what the sound issues are for the space in which we intend to build the home theatre, we look into finding the most effective and efficient way to fix them. The most common acoustic issues we find are:

Internal and external noise transfers (Transmission Loss) -
Noise can transfer through the building structure, leading to sound leaking in from outside, and can also lead to sounds travelling from different rooms in the same building. This can impact the results of the home theatre if not taken into consideration and could also lead to the theatre impacting the rest of the building.

By limiting how much sound can travel through the building structure, we can limit how much the home theatre is impacted and does impact other nearby spaces. External noises could be traffic, people walking or talking outside, or weather. Internal noises could be generated by impacts both purposeful and accidental such as walking, dropping things, or doors slamming etc.

Background noise (internal and external) -
The background noise level is very important for a well-functioning home theatre. If it is too high, it would create an unclear sonic atmosphere when using the home theatre. And if it is too low, it would allow for more sound sources to be audible – i.e., equipment hums and buzzing.

SPECIFICATIONS: WHAT DO THE GUIDELINES REQUIRE?

There are specific ISO and ASNZ standards we follow to ensure the client receives a room that is completed to a reasonable standard. As well as regarding the NCC (National Construction Code) (Building Code of Australia) for new builds and retrofits. These each require specific measurements, testing methods and results to be completed in order to comply.

The main topics we use standards as guidelines for are:

- Reverberation
- Absorption
- Sound isolation (proofing)
- Background noise levels
- Construction

TESTING

Multiple tests are conducted before and after the construction and installation, these are done to figure out what the issues are, and if they are resolved once the room is completed.

These following tests can be done:

- Impact noise
- Airborne noise
- Background noise levels
- Reverberation test

CONSTRUCTION: WHAT'S THE PROCESS?

Each construction will be unique since various building types and geographic regions call for various methods. However, for projects of a comparable nature, the procedures are relatively similar.

Building upon existing spaces:

The first step is to survey the area and take some preliminary measurements to see how big the space is;

- How are the background levels?
- Does this room have any particular sonic/acoustic issues that need to be investigated i.e., standing waves?
- Is there a lot of reverberation?
- Is there a lot of noise transference?
- What is the construction like for the room and how easy is it for it to be enhanced?

Once we have the initial measurements, we are able to design a model of the room with treatments to achieve the standard levels required. These designs would need to aim for target levels so as to comply with acoustic standards, and the NCC in regards to safety.

Once the design is finalised and approved, the AV (Audio Visual) system can be installed. First all the wiring and brackets are put in the walls to get the positions in order. Then the treatments can be installed. This step can take a varying amount of time, depending on the amount of treatment and insulation needed.

Once all of the treatments are in place, the room is tested one more time to ensure compliance and determine whether any adjustments are required.

Building room from scratch:

The initial step is to design the walls, floor and ceiling that would stop noise transfer between spaces. This could be done with double stud walls filled with insulating membranes, and thick underlay beneath the floors.

Then the acoustic treatment would be designed to be placed on these structures. These would need to be designed to comply with acoustic standards and the NCC, in regards to fire resistance and safety. The sound system would also need to be designed so as to fit in the room and give the room the desired sound of a home theatre.

Once the design is approved, it can be built. This can take a number of weeks, the amount of which depend on the build itself. While the construction is being built, the wiring and electricals can be put in for the audio and visual system. This would include the flooring underlay.

Once the building structure with the wires and basic electrical components are completed, then the actual sound system and visual system can be installed. Finally, after the AV (Audio Visual) systems are in, the acoustic treatment can be installed. This would be all the extra absorption panels that you would place onto the wall structure.

Once that installation is complete, the room can be tested one final time to check it complies with standards.

SOUND SYSTEM DESIGNS

Depending on the size of the room, different sound systems can be installed to achieve an immersive atmosphere. For smaller rooms, you'd be able to apply a surround sound system (5.1), which comprises a Left, Centre, Right, Left Surround and Right Surround speaker setup with one subwoofer.

For those with even bigger spaces, or after the most immersive atmospheres, one can apply a Dolby Atmos sound system. This comprises of speakers surrounding the viewer on the walls and ceiling, as well as subwoofers, such as 7.1.2.