

Theater Acoustics - An Overview

Designing a home theater is similar to solving a problem with many variables of various weight/significance based on the client's desired outcome. The factors that need to be evaluated are: (This list is presented alphabetically rather than order of importance because the "order of importance" changes with every customer.)

- Acoustics
- Aesthetics
- Automation/User Control
- Electronics
- Function of spaces adjacent to the theater
- Lighting
- Mechanicals
- Number of seats desired
- Picture quality
 - Screen size, type and location
 - Sight lines for each row
 - Projector type and location
- Room construction
- Room dimensions
- Speaker placement and type

In addition these considerations must be evaluated with a budget in mind.

This paper will focus on Acoustics and in particular the control of sound within the room.

There are four broad goals of acoustic design and engineering in the design of a home theater.

1. Control sound within the room
Control sound within the room to maximize the sonic experience. The goal is to have the listener involved in the movies soundtrack and transported into the experience.
2. Reduce outside sound
Prevent sound outside the room (from within the house or outside) from interfering with the listening experience in the room.
3. Isolate mechanical sounds
Isolate the sound coming from the HVAC, plumbing, motors, fans, washer/dryers, garage doors and other household systems.
4. Contain sound generated in the room
Contain the sound generated in the theater so as not to disturb other areas of the house.

Controlling Sound in the room

The Home Acoustic Alliance (HAA), of which we are members, has five sonic goals for a home theater:

1. Clarity

Clarity is the prime acoustic goal because its perfection depends on the successful attainment of all other goals. Of paramount importance is dialogue intelligibility in movies and music lyrics, and the ability to detect quiet background details. Elements that affect this goal are varied, including equipment quality, room reverberation levels, ambient noise levels, and listener position, among others.

2. Focus

Acoustical focus is the ability to precisely locate each reproduced sonic cue or image in a three dimensional space. Recordings contain many such images superimposed side to side and front to back for 360 degrees around the listener. A system is said to have pinpoint focus if, from the listener's perspective, each of these images is properly sized, precisely located, and stable. Good focus also means that individual images are easily distinguishable from others within the limits of the recording's quality.

3. Envelopment

An audio system should reproduce virtual images of each recorded sound to the listener in a three-dimensional space producing a wraparound soundstage that envelops the listener. Proper envelopment requires that the sound stage be seamless for 360 degrees without interference caused by holes or hot spots due to speaker-level imbalance or poor placements.

4. Dynamics

Dynamics is the difference between the softest and loudest sounds reproduced by a sound system. While much emphasis is sometimes placed on high volume, the audibility of the softest sound is of equal importance to the quality of the system's performance. Among the acoustic requirements for proper envelopment, focus, and clarity is the necessity of hearing the sonic cues relating these qualities. If these are overwhelmed by excessive ambient noise or reverberations in a room they are not properly audible. At a minimum, a system must be capable of reproducing loud passages with ease and without excess while soft sounds remain easily audible.

5. Response

A system's frequency response is a measure of the relative levels of all of the reproduced audio frequencies. The response's smoothness can be observed in a variety of ways – including boomy bass, excessive treble, improper musical timbre, or a general lack of realism. It's important to select high quality components and proper system setup including proper listening and speaker positions and the correct use of equalization. The system must also be non-fatiguing at all sound levels so it is both articulate and faithful to the original sound.