1 SOUND IN ENCLOSED SPACES (ACOUSTICS)

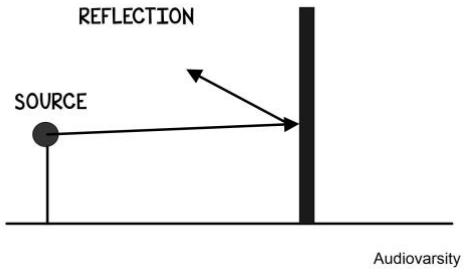
Sound doesn't just travel in a straight line and stop. It bounces, bends, gets soaked up, or spreads out depending on what it hits.

Hard surfaces reflect sound and soft surfaces absorb sound. Parallel surfaces create waves that bounce back and forth (like looking into mirrors that are facing each other). Non-parallel surfaces also create reflections, but they will be scattered rather than bouncing back as a discrete echo.

1.1 KEY ACOUSTIC BEHAVIOURS

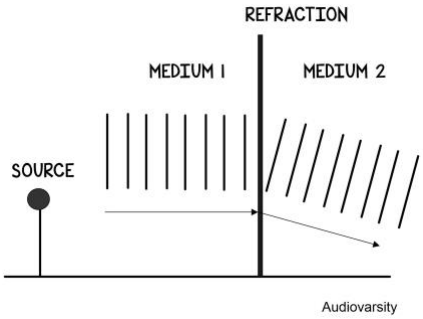
Waves behave in a number of different waves; these ways can be described as reflection, refraction, diffraction and dispersion.

Reflection:



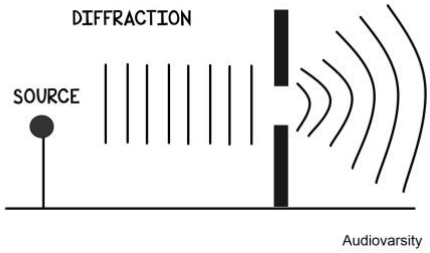
This means that the waves bounce of a surface and changes direction. The shape of the surface will influence angle of reflection, or we can say the angle that the wave bounces of the surface,

Refraction:



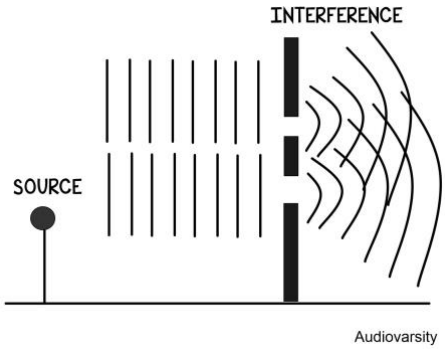
This occurs when the wave changes direction due to entering another medium.

Diffraction:



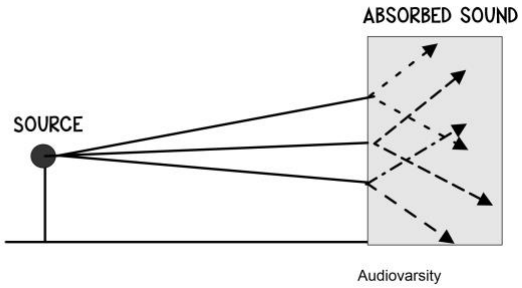
This takes place when a wave spreads out, bends around or moves through an object.

Interference:



This takes place when two waves come into contact with each other and a combination of both of them add up and alters the original form.

Absorption:



This takes place when sound is contained in a material. Soft surfaces generally hold sound.

1.2 COMMON ACOUSTIC PROBLEMS

The following problems may occur if proper acoustic treatment is not done in a particular space.

Reverbaration

Reverberation or reverb occurs when an audio signal bounces off hard surfaces. In a an untreated room, the reverb can cause muddiness in the sound.

Flutter echo.

A flutter echo is a type of echo characterized by a rapid, repetitive series of sound reflections between two parallel, reflective surfaces. It occurs when sound waves bounce back and forth between these surfaces, creating a distinct, staccato-like series of echoes. Flutter echoes are generally considered undesirable in acoustics, as they can negatively affect sound quality and clarity

Standing waves

Another problem created inside is parallel walls and standing waves. Standing waves are when a sound reflects off walls that are opposite each other and a wave equal to the distance is formed.

As you move around a room with standing waves you can hear as you walk in and out of a standing wave. In one spot the bass is booming yet in another there is hardly any bass. Makes it hard to figure out how much bass you have.

1.3 ACOUSTIC TREATMENT SOLUTIONS

What is Acoustic Treatment?

Acoustic treatment refers to the use of materials and design strategies to control the sound behavior within a room.

The goal is to improve sound clarity, reduce unwanted reflections, and create a more accurate listening or recording environment.

Note: It’s not the same as soundproofing (which prevents sound from leaving or entering a room).

Why is Acoustic Treatment Important?

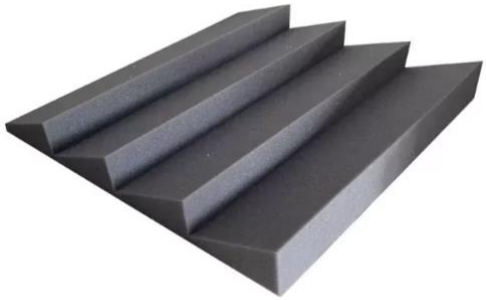
- Prevents echo and reverberation
- Enhances speech intelligibility and mix clarity
- Ensures recordings are true to the source
- Improves mix translation between rooms and speakers

Types of Acoustic Treatment

a **Absorption**

Purpose: Reduces reflections and reverberation by soaking up sound energy.
Materials: Acoustic foam, mineral wool, fiberglass panels, carpets, curtains.
Best For: Mid and high frequencies.
Placement: First reflection points, rear wall, ceiling (cloud panels)

b **Diffusion**



Purpose: Scatters sound waves in multiple directions rather than absorbing them.
Materials: QRD diffusers, skyline diffusers (wood/plastic).
Best For: Retaining a natural “live” sound without harsh echoes.
Placement: Back wall of control rooms, ceiling above mixing position.

C **Bass Traps**

Purpose: Absorb low-frequency sound energy that builds up in corners.
Materials: Thicker, denser versions of absorption materials.
Best For: Taming boomy or muddy low-end.
Placement: Room corners (trihedral), wall-floor and wall-ceiling junctions.

Key Principles of Effective Treatment

- Balance absorption and diffusion: Don’t over-dampen the room; it’ll sound lifeless.
- Treat first reflection points: Side walls, ceiling, and behind the listener.
- Corner traps are crucial: Low frequencies are harder to control.
- Symmetry matters: Especially in control rooms — it ensures stereo imaging is accurate.
- Measure and test: Use room analysis software or test tones to assess room response.

Practical Tips for Beginners

- Start with a reflection-free zone at the listening position.
- Use bookshelves or uneven furniture as makeshift diffusers.
- Add heavy curtains and carpets to reduce flutter echoes.
- DIY panels using rockwool and fabric can be cost-effective and just as good as branded products.
- Don’t forget the ceiling — it's often the most neglected surface in acoustic design.