THE ROOM

BASIC ROOM ACOUSTICS

For us to understand how to set our room up, we must first understand what the sound is doing when it is played within a room.
This in itself is a very large topic that we could go into great detail on, but for the purposes of this eBook we will only cover topics necessary to mixing tracks down at home, or in a studio environment.

Firstly, we can state that when a sound is played in a room, it will bounce (reverberate) off the surfaces of the room. These reflections will alter, as well as colour, the sound in certain ways.

The issue we have, is that different surfaces will reflect or dampen the reverb more efficiently than other surfaces. Also the dimensions of the room will cause certain frequencies to produce standing waves. These come in the form of resonances and room modes. It is almost impossible to completely remove reverb, but what we can achieve is a calculated and equal amount of reverb throughout all the frequencies of the spectrum. We also want a nice flat frequency response with no resonances (peaks) or cancellations.

STANDING WAVES

To understand standing waves, we must understand that a wavelength is inversely proportional to frequency.
This means that the lower the frequency, the longer the wavelength. A frequency of 30Hz will have a wavelength of 11.4m

This can be calculated by the formula:

(Wavelength) λ = (Speed of sound in metres/s) 343 / (frequency) 30Hz

343 metres per second / 30Hz = 11.4m Wavelength

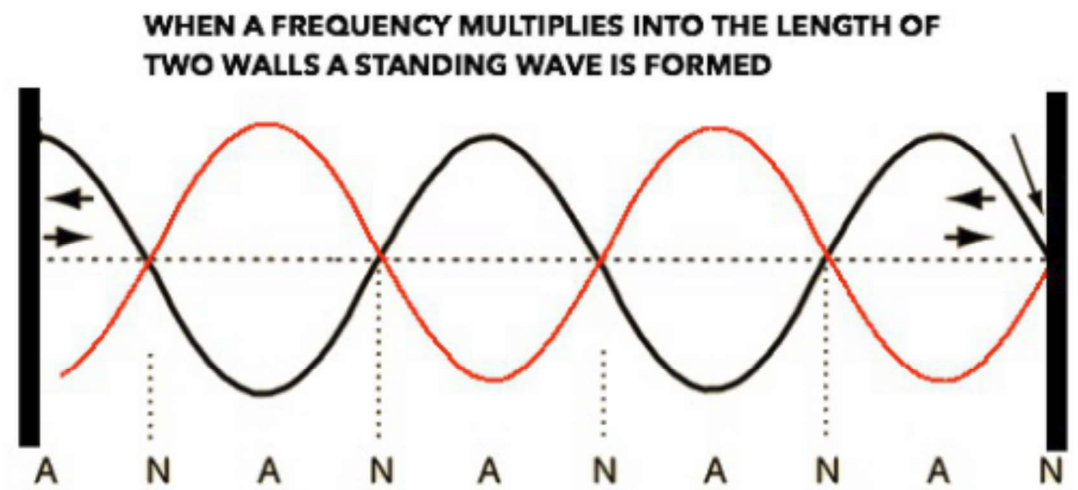
We can see that although standing waves are predominantly a low frequency problem, they can affect any frequency within the spectrum.

When our bass speaker plays a 30Hz sine wave in a room, the wave is going to bounce back and forth off the walls. As it bounces back on it's self, it's going to alter its phase relationship, relative to the part of the wave that hasn't hit the wall yet. This will usually make it out of phase; however, if they are directly in phase, or directly out of phase, then we will get cancellation of frequencies, or we could get a summing of frequencies.

As we walk around the room, certain areas will have almost no bass whatsoever, whilst other areas of the room will have almost double the amount of bass. This is clearly a problem when we are trying to find a tonal balance for our mix, especially when it comes to any parts that are sub 300Hz.

With this knowledge we can do some calculations to ensure our rooms dimensions don't cause standing waves. As a rule of thumb rectangular and odd shaped rooms are quite well suited for monitoring purposes. The worst kind of room shape for monitoring is a perfect square, as this shape causes multiple standing waves at the same frequencies.

ROOM MODES



We can use an equation to find out our room modes and problematic frequencies that will produce standing waves.

In the diagram above, N and A define the nodes and anti-nodes of the standing wave.

Nodes are where the standing wave will be at minimum amplitude. The anti-nodes will be where maximum displacement will occur within a cycle. A good way to imagine this is that the standing wave in the diagram is a set of skipping ropes. Only the anti-nodes will fluctuate in value.

The nodes and antinodes are always going to be located at the same position along the space/medium, hence the term "standing wave."

Frequency = Speed Of Sound / 2x Distance (between parallel walls)

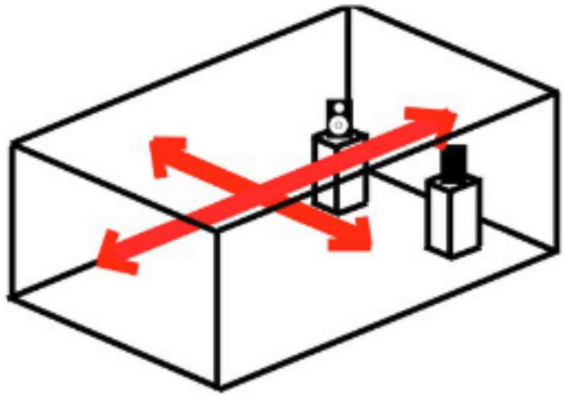
Frequency of standing wave = 343 / 2m x2

In this case we have a standing wave at 85.75Hz.
We can now also multiply this frequency by itself, to get the room modes for the harmonics as well, which will also have an uneven response.

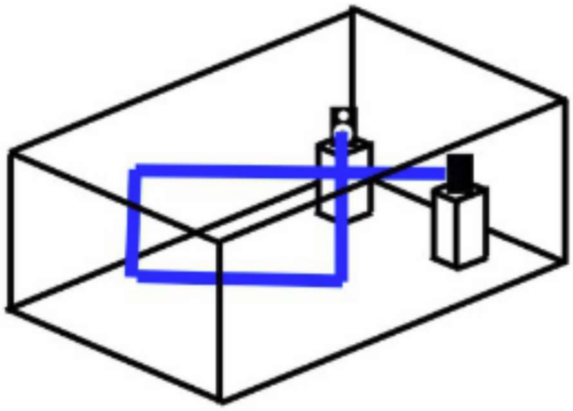
These problematic frequencies only really occur up to around the 300Hz mark. After this point, there are so many standing waves and resonant frequencies, that they actually smooth back out again and don't cause much of an issue. Our main room modes to be concerned with are axial, tangential and oblique.

- Axial room modes hit on two surfaces crosswise
- tangential room modes hit on four surfaces crosswise
- oblique room modes hit on six surfaces crosswise

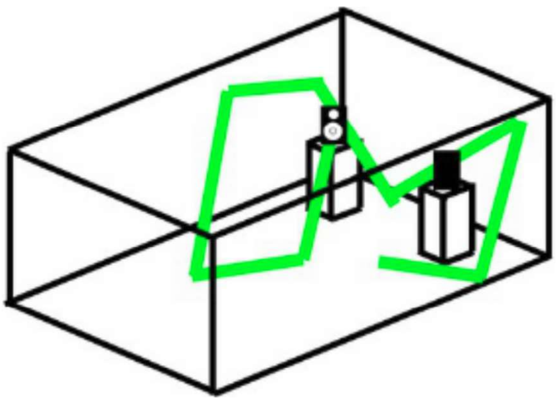
These can easily be calculated using your room dimensions with free online software.



Axial room modes



Tangential room modes



Oblique room modes

THE ROOM SUMMARY & KEY POINTS

- Sounds will bounce and reverberate off the walls and surfaces of a room
- We want to achieve a flat frequency response within our room
- Standing waves are caused by sound waves cancelling each other out or Summing together as they reflect back on themselves
- Wavelength = speed of sound / frequency
- Bass tends to build up in the corners of a room
- Standing waves are most prevalent at lower frequencies
- There will be multiple standing waves within a room
- We can calculate standing waves using this formula
- **Frequency of standing wave = Speed of Sound / 2x Distance (between**
- We can calculate velocity, wavelength and frequency by transposing this formula

Frequency (Hertz) = Velocity (Meters/Second)/ Wavelength (Meters)