

Why are Sound Systems so Challenging in Churches?

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Understanding Loudness

Why are Sound Systems so Challenging in Churches?

Sound Pressure Level

The definition of dB SPL is the 20 log of the ratio between the measured sound pressure level and the reference point.

This reference point is defined as 0.000002 Newton's per square metre, the threshold of hearing.



Understanding Loudness

Why are Sound Systems so Challenging in Churches?

Sound Pressure Level

Rocket Launching	180	Hair Dryer	80
Thunderclap	130	Business Office	70
Jet takeoff (60m)	120	Conversational Speech	60
Rock Concert, Disco	110	Soft Whisper (5m)	30
Subway Train	100	Rustling Leaves	20
Heavy Truck (15m)	90	Hearing Threshold	0



Understanding Loudness

Why are Sound Systems so Challenging in Churches?

How Loud is Loud?

When does the sound level double for you...?



Hierarchy of Importance

Why are Sound Systems so Challenging in Churches?

What is the most important part of the sound system? ... and why?

Mixing Desk ?

Microphones ?

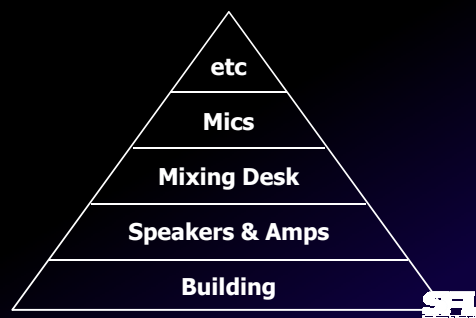
Speakers ?

Something else ?



Hierarchy of Importance

Why are Sound Systems so Challenging in Churches?



The Building

Why are Sound Systems so Challenging in Churches?

Why is the building acoustic so fundamental?

A reverberant Church with the world's greatest sound system will still sound like a reverberant Church!

Too much reverb can destroy a good sound.
Makes it unintelligible.

Reverberance is created by the source sound, so turning it up will not fix the problem.



The Building

Why are Sound Systems so Challenging in Churches?

Level Drop Over Distance

Inverse square law says:
Surface Area is proportional to the square of the radius. Or...

6dB is lost each time we double the distance from the speaker

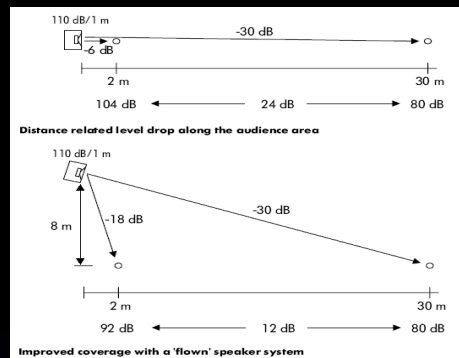
$$10\text{m} = 20\text{dB loss} \quad / \quad 30\text{m} = 30\text{dB loss}$$

What does this look like?



The Building

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The Building

Why are Sound Systems so Challenging in Churches?

Intelligibility

Do you want to hear this in Church?

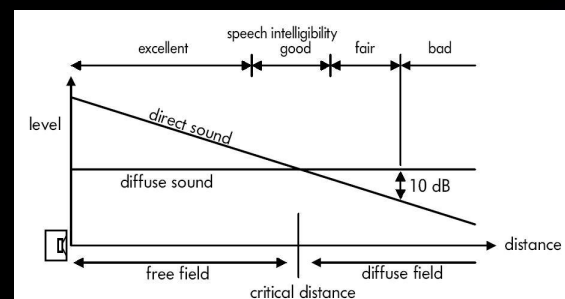
Or...

This?



The Building

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The Building

Why are Sound Systems so Challenging in Churches?

Why is the building acoustic so fundamental?

Diffuse sound is a consistent level throughout the building.

Need to ensure the direct sound is always higher than diffuse

Two remedies:

- Acoustically treat the building
- Add more speakers to increase direct to diffuse ratio



Speakers & Amps

Why are Sound Systems so Challenging in Churches?

Loudspeaker Design Fundamentals:

Dispersion & Pattern Control
Frequency Response
Power Handling
Reliability



Speakers & Amps

Why are Sound Systems so Challenging in Churches?

Dispersion & Pattern Control

We focus the acoustic energy of the speaker at the people.
Can only control the high-frequency dispersion (HF).
This will excite the diffuse field less, reducing reverberance.



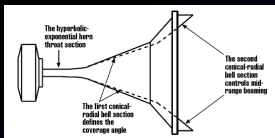
Speakers & Amps

Why are Sound Systems so Challenging in Churches?

Dispersion & Pattern Control

Horn-loaded Loudspeakers

We use the speaker's horn to control dispersion; this "acoustic lens" restricts the projection of the sound.



Line Source Loudspeakers

Use line length to control vertical dispersion.



Speakers & Amps

Why are Sound Systems so Challenging in Churches?

Frequency Response

Smooth reproduction of sound across all frequencies
Don't ask questions of a speaker that it cannot answer:
Big speakers go low = bass
Woofers and Tweeters - getting separation



Speakers & Amps

Why are Sound Systems so Challenging in Churches?

Power Handling

How much volume can we get out of the speaker system?
Maximum dB SPL capability.
Maintaining dynamic headroom of the speaker
Amplifiers and Processing to protect and limit



Speakers & Amps

Why are Sound Systems so Challenging in Churches?

Reliability

Not prone to failure!
Mechanical Tolerance:
- Voice Coil Temperature
- Cone Excursion
- Cabinet Structure



Mixing Desk

Why are Sound Systems so Challenging in Churches?

Finding the right console for your needs:

User-Friendly

- Must be easy enough for use by everyone

Specification

- Number of input channels and output busses

Analogue or Digital?



Everything Else!

Why are Sound Systems so Challenging in Churches?

The Icing on the Cake

Microphones

Cabling

Effects Units

Compressors & Gates

All will impact the final sound, but only once you have the other layers set correctly.



Final Thoughts

Why are Sound Systems so Challenging in Churches?

Don't Forget The People

You might have the best system money can buy, but you can only amplify a great source (musician).

If the singing is out of tune, then you can do nothing technically.

The equipment is only responsible for 50% of the overall sound quality. The Engineer accounts for the other half.



Hierarchy of Importance

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