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Managing noise pollution at music festivals

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ENGINEERING | ENERGY | SUSTAINABILITY

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Welcome

We are going to talk about what can be done to improve the noise management process, however part of this presentation is given over to basic issues that cause the most significant environmental noise problems. ***These can be easily prevented***, yet are rarely understood.

We will discuss advances in sound modelling and monitoring

Finally we will touch on personal noise exposure, a matter that has serious long-term consequences for those that attend music events for work and leisure.

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1995 Noise Council Code of Practice - what's the problem?

Much has changed since 1995

Modern music genres focus on very high sound levels with extreme bass content

Audio systems have become much more powerful

Bass beats are a prominent feature

There are many new sound system owner operators, some of whom have limited understanding of even basic acoustics

Guidance is being ignored

Equivalent sound levels are no longer appropriate for assessing noise nuisance - we need better metrics

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Music noise nuisance

The most commonly reported complaint concerns bass beats

The second most reported complaint concerns late night activity/sleep disturbance (also related to bass beats)

Third is overall event duration and lack of respite

Audible vocals and profanity are reported, however this is usually where the PA system installation is inappropriate

Absolute noise levels are not at the top of this list, in fact relatively high equivalent noise levels do not attract large numbers of complaints providing that the sound profile does not include bass beats or vocal content.

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How do we prevent nuisance?

Promoters and organisers can:

Design audio installations that do not propagate far-field bass energy

On festival sites maintain as many managed sources as possible to obfuscate bass beats through mutual interference, even for events that operate past 23:00 hours. Turning off stages may not significantly reduce environmental noise levels but often make remaining stages more audible

Ensure that proper design has been exercised by sound suppliers, especially where line array systems are being deployed, to prevent the propagation of wide spectrum noise

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How do we prevent nuisance?

Licensing authorities can:

Make all relevant parties accountable. Licence review and prosecution is rare, but asking the right questions in advance of each event always reveals shortcomings in the preparation of events

When in doubt seek advice from a consultant. Most will give basic advice without charge, but even when advice has to be paid for it is a lot cheaper than post-event enforcement and public nuisance can be avoided pro-actively.

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Music Festival Noise Management

Work should begin well before the event

Design, planning and preparation is everything

Noise Management should be 90% complete before the event build

Modelling is essential, but it is not infallible

Sound suppliers must be made to justify their intentions

Monitoring should be about confirmation of successful planning

Intervention or enforcement demonstrates failure of process

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The First Law of Thermodynamics

"The total energy in a system remains constant, although it may be converted from one form to another”

more simply:

"energy can neither be created nor destroyed"

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The First Law and Music Noise

"The environmental impact of music noise will be driven by the total sound power used to create it at source"
and
"The more sound power generated on a festival site the more sound energy escapes into the environment"

There are many other factors that affect sound propagation however, particularly at low frequencies where very little energy is absorbed, the above statements are fundamental considerations.

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Bass Loudspeakers

Understanding how bass loudspeakers behave is fundamental to effective sound management.

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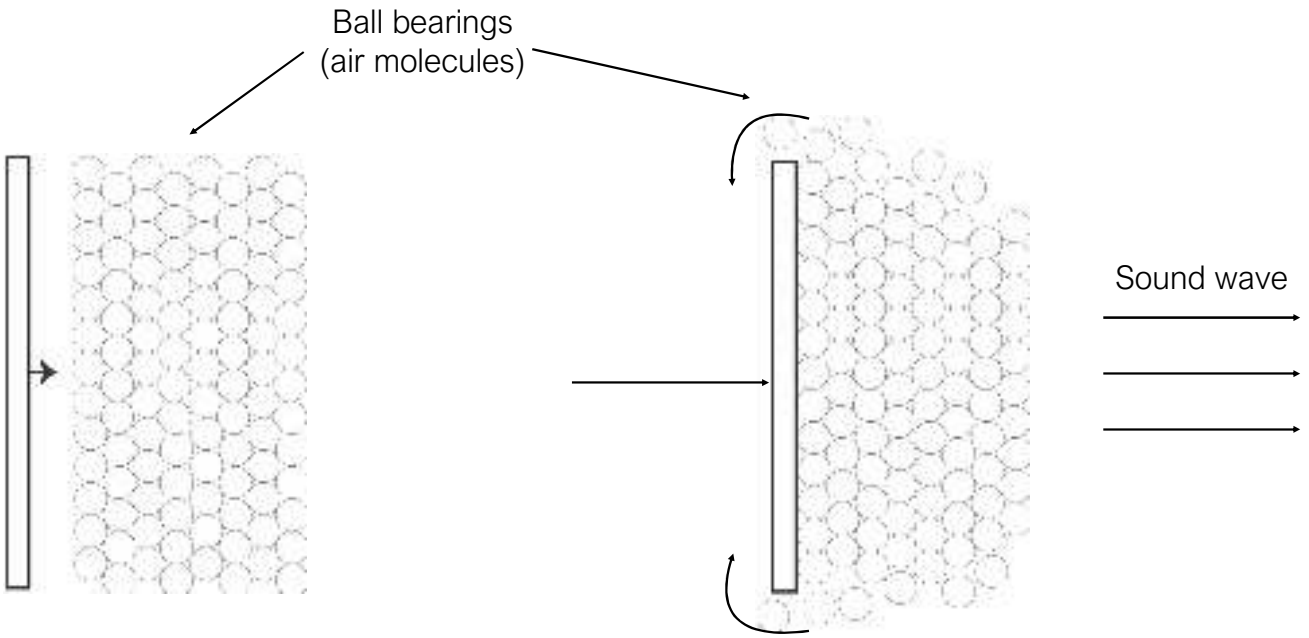
Large loudspeakers



Large radiating surface

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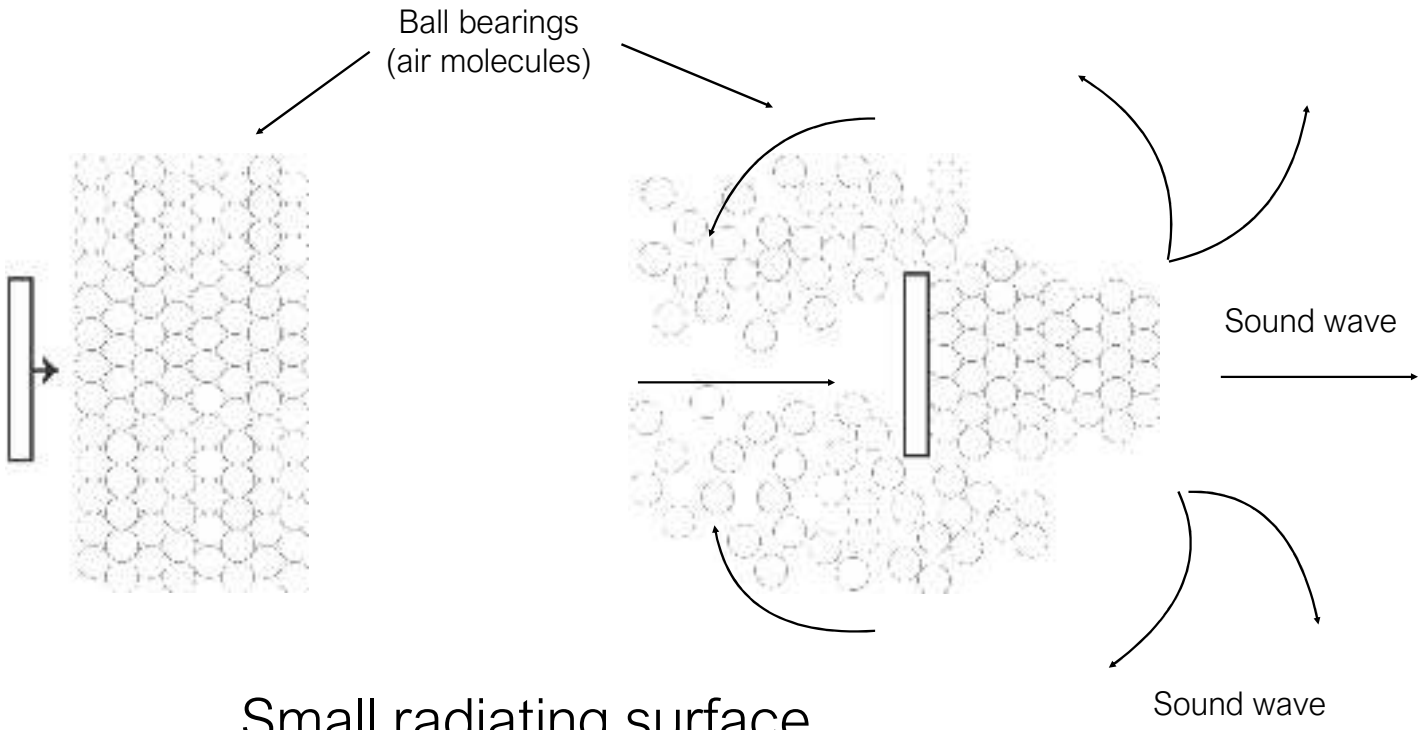
Small loudspeakers



Small radiating surface

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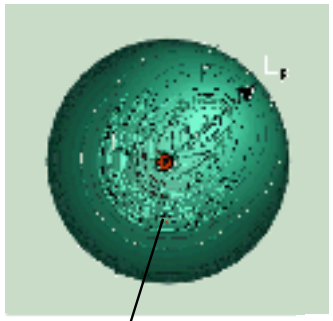
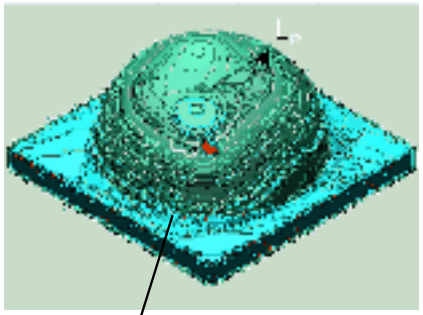
Directivity and baffles

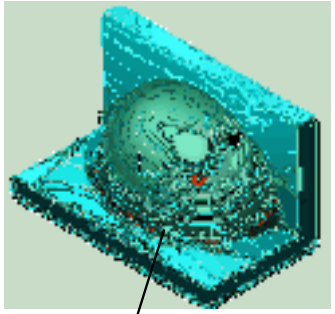
(x)dB



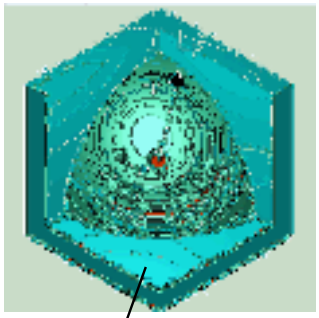
+3dB

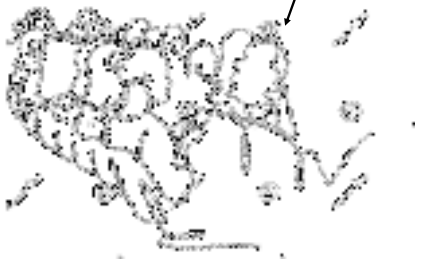


+6dB



+9dB





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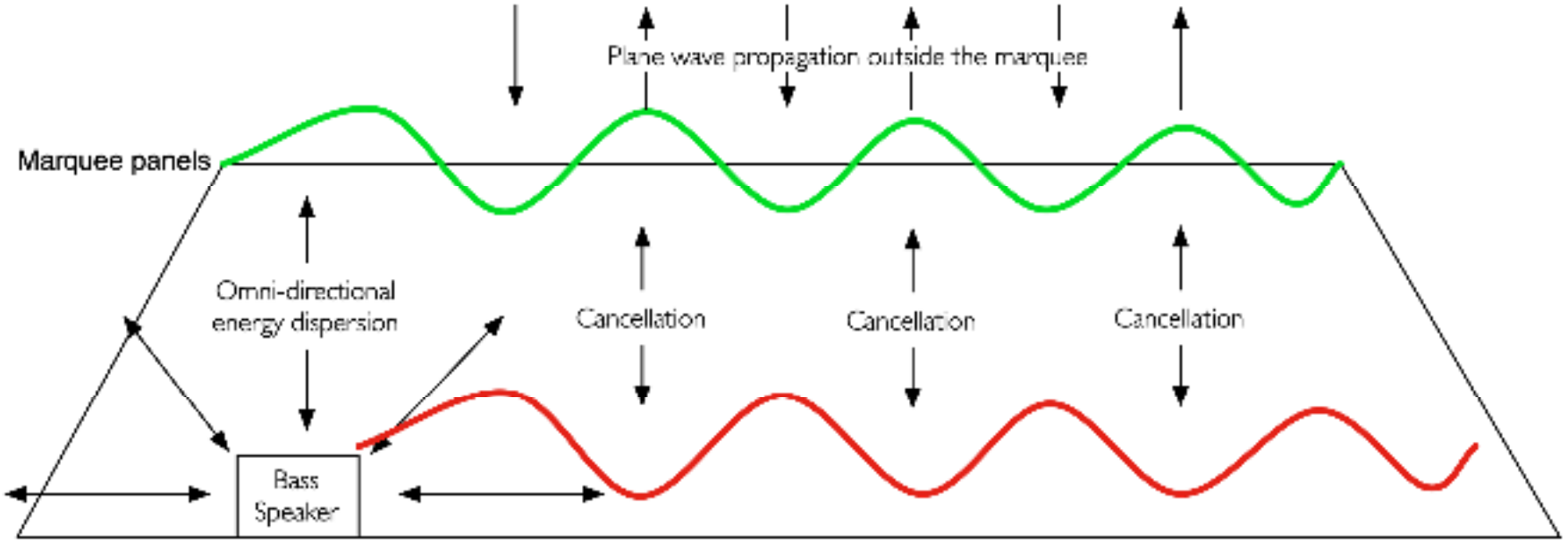
Tents and Marquees



Without baffles - increasing volume reduces bass inside and increases bass outside

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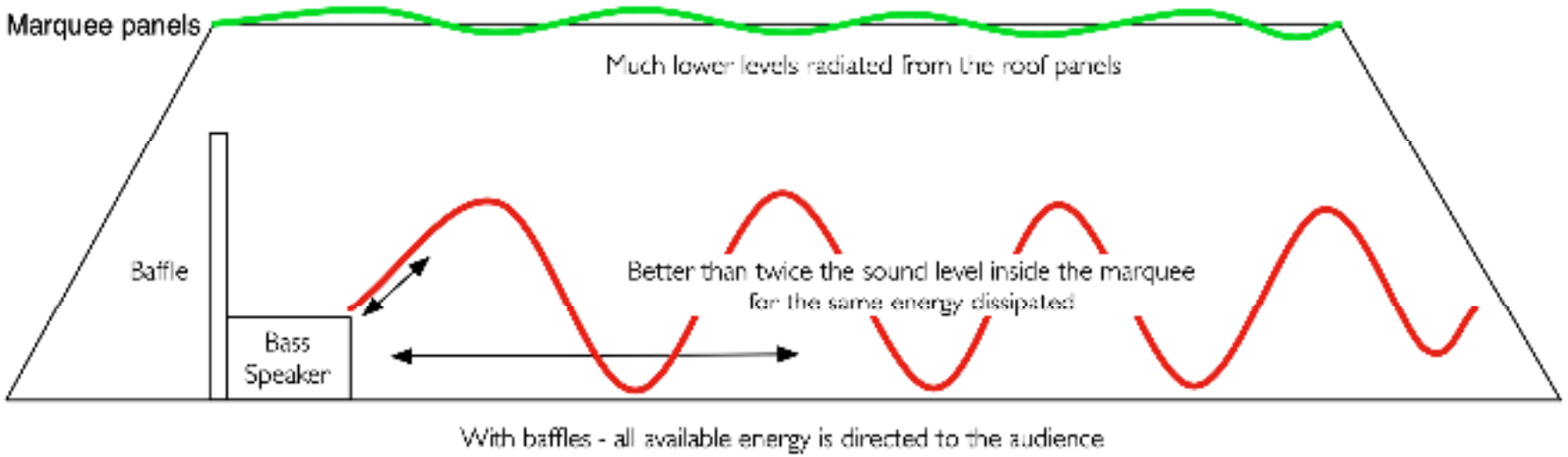
Tents and Marquees with Baffles



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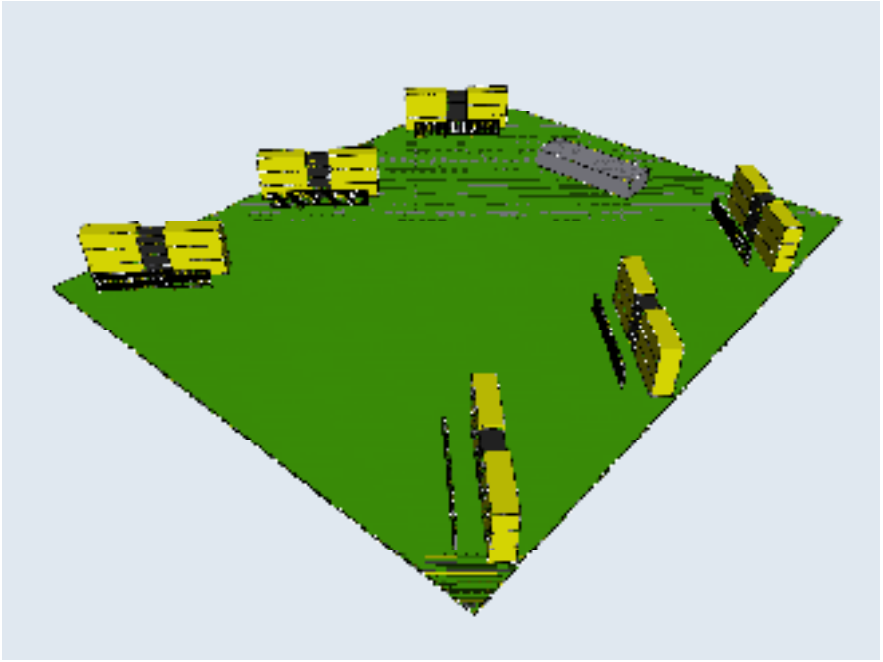
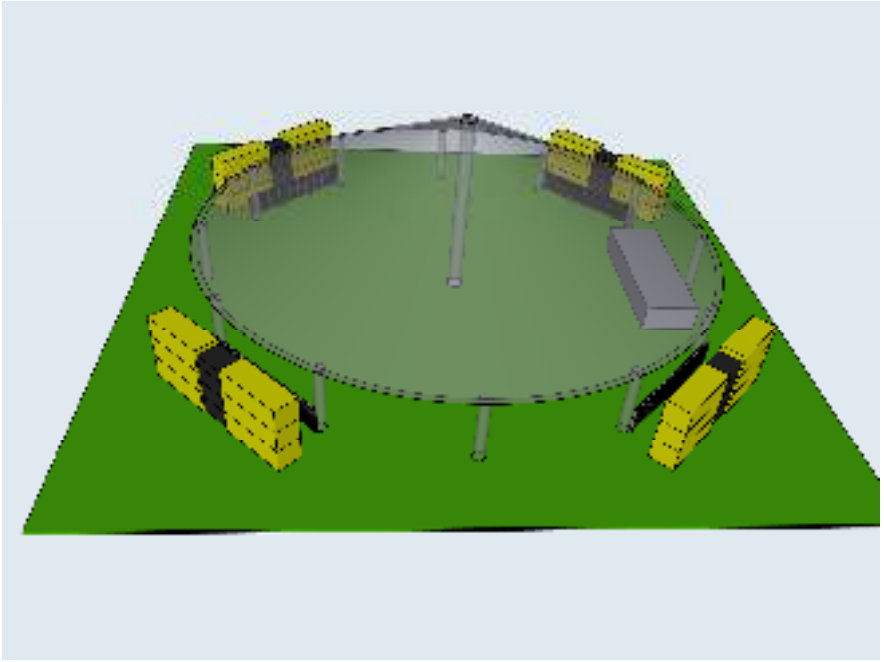
Using Baffles





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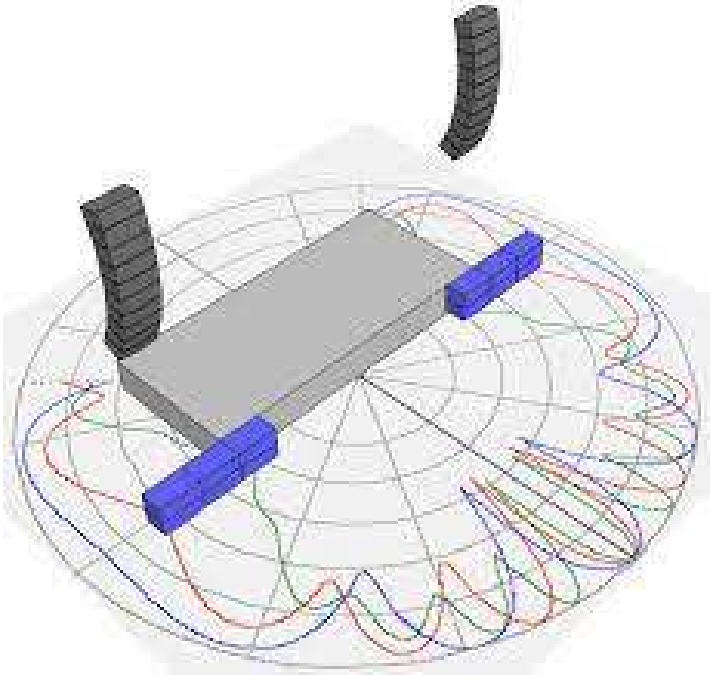
Don’t allow this

Or this



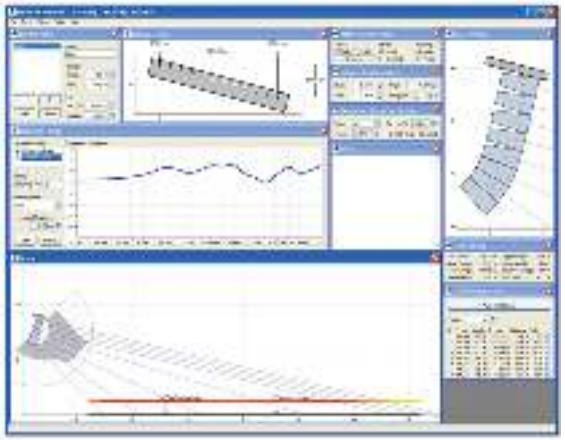
This is an outdoor photo, but don’t allow this design under canvas!

Line Array Systems

Line array systems are very popular however they cause severe environmental issues if not used correctly. Most common errors are:

a) System is too large or rigged too close to the ground
b) Overshooting the audience due to (a) or other poor design
c) Failure to anticipate wind effects

If a line array system looks as though it is not pointing into the audience it will likely overshoot. Do not be persuaded by technical arguments that digital steering can contain the output of an improperly rigged system.



Array design software predicts the coverage of line array systems, however it is inaccurate if the system is too large or is flown too close to the ground.
A useful rule of thumb is that the height of the rigging beam should be 2.5 times the length of the array e.g:
If the array length = 4m the rigging beam should be at least 10m above the audience plane.

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Line Array Systems

A favourite ‘how not to’ event from 2022. This was the Killers at Doncaster Keepmoat Eco-Power Stadium. More than half the line array system and all of the flown bass cabinets were rigged above the height of the stadium roof. Noise levels at a hotel 400m from the audio system were 95dBA with sub-bass shaking the building. Click the video (right) to hear the impact.
Headphones recommended for the full experience!

The sound company in this case were very uncooperative. It took firm intervention with all stakeholders to bring the matter to a head and force them to turn off upper sections of the PA system.

Click image to play

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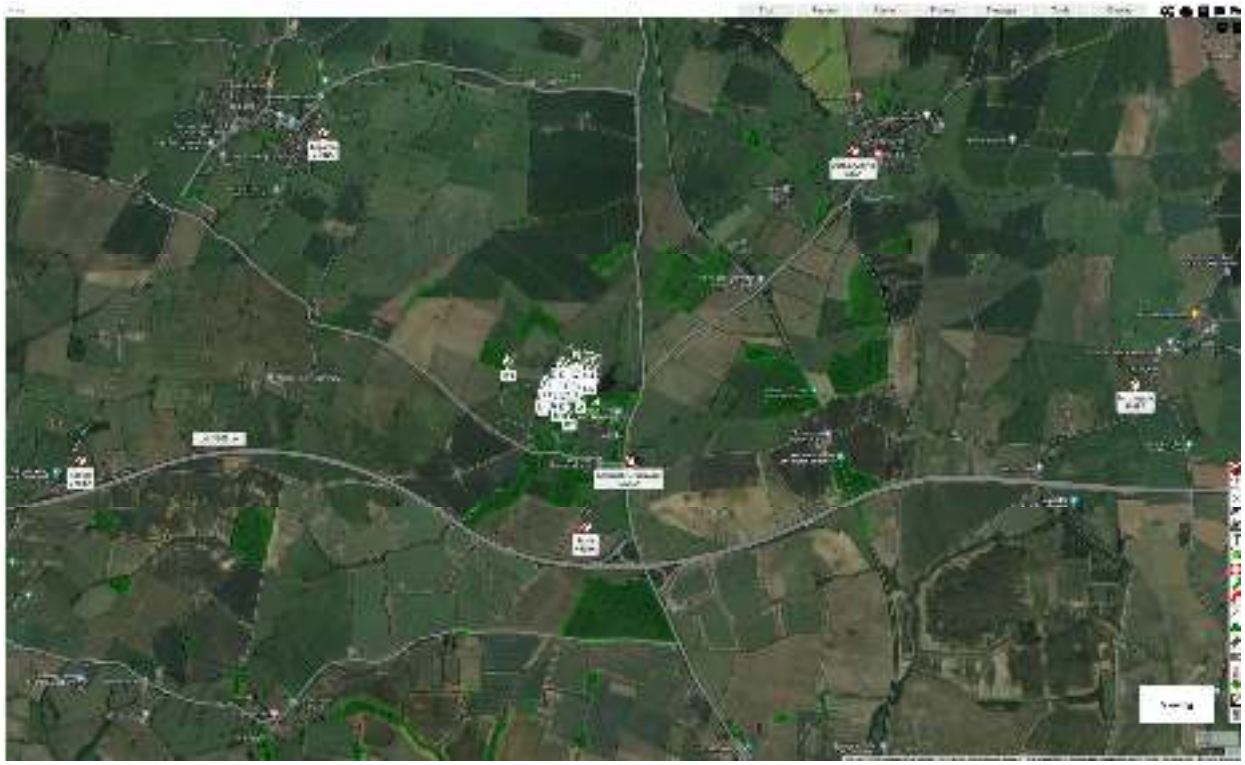
Modelling

Project	Shambala 2023			
Barriers	2	ON		
Roads	40	ON		
Buildings	110	ON		
Forests/Woodland	57	ON		
Sources (23)				
Source	SPL (A)	Duty Cycle	dBLwA	Distance
Stage	93.0dBA	100%	139.1	56.7m
Back-a-yard	98.0dBA	100%	123.0	5.0m
Data Mine	98.0dBA	100%	123.0	5.0m
Reflex	98.0dBA	100%	135.4	21.0m
House Party	98.0dBA	100%	133.5	16.8m
Roots Yard	95.0dBA	100%	130.3	16.4m
House Party	98.0dBA	100%	133.5	16.8m
Windy Van Hootens	95.0dBA	100%	120.0	5.0m
Phantom Laundry	98.0dBA	100%	133.0	15.8m
Compass	95.0dBA	100%	125.2	9.1m
Wonky Cock	90.0dBA	100%	115.0	5.0m
Rebel Soul	95.0dBA	100%	126.8	10.9m
Sankofas	90.0dBA	100%	125.0	15.8m
Imaginarium	95.0dBA	100%	129.1	14.3m
Swingamagig	98.0dBA	100%	132.8	15.5m
Chai Wallahs	92.0dBA	100%	134.0	35.7m
Pinky Promise	90.0dBA	100%	110.5	3.0m
Flamingo Jazz	90.0dBA	100%	122.4	11.8m
Puppet Parlour	40.0dBA	100%	69.2	8.2m
Waiting Room	40.0dBA	100%	70.0	9.0m
Hertz so Good	40.0dBA	100%	69.1	8.1m
Enchanted Wood	95.0dBA	100%	133.5	23.9m
Naughty Morty's	95.0dBA	100%	132.1	20.2m
Receptors (6)				
Receptor	Cumulative dBLAeq(t)	Rating dBLAeq(t)	Residual dBLA90(t)	Var.
Arthingworth [E]	35	0	35	0.0
Clipston [E]	35	23	35	0.0
Farm [E]	46	39	45	1.0
Naseby [E]	50	12	50	0.0
Harrington [E]	40	0	40	0.0
Kelmarsh Crossroads [E]	55	54	50	5.0



Real-time monitoring

Shambala 2023

6 x Offsite monitors

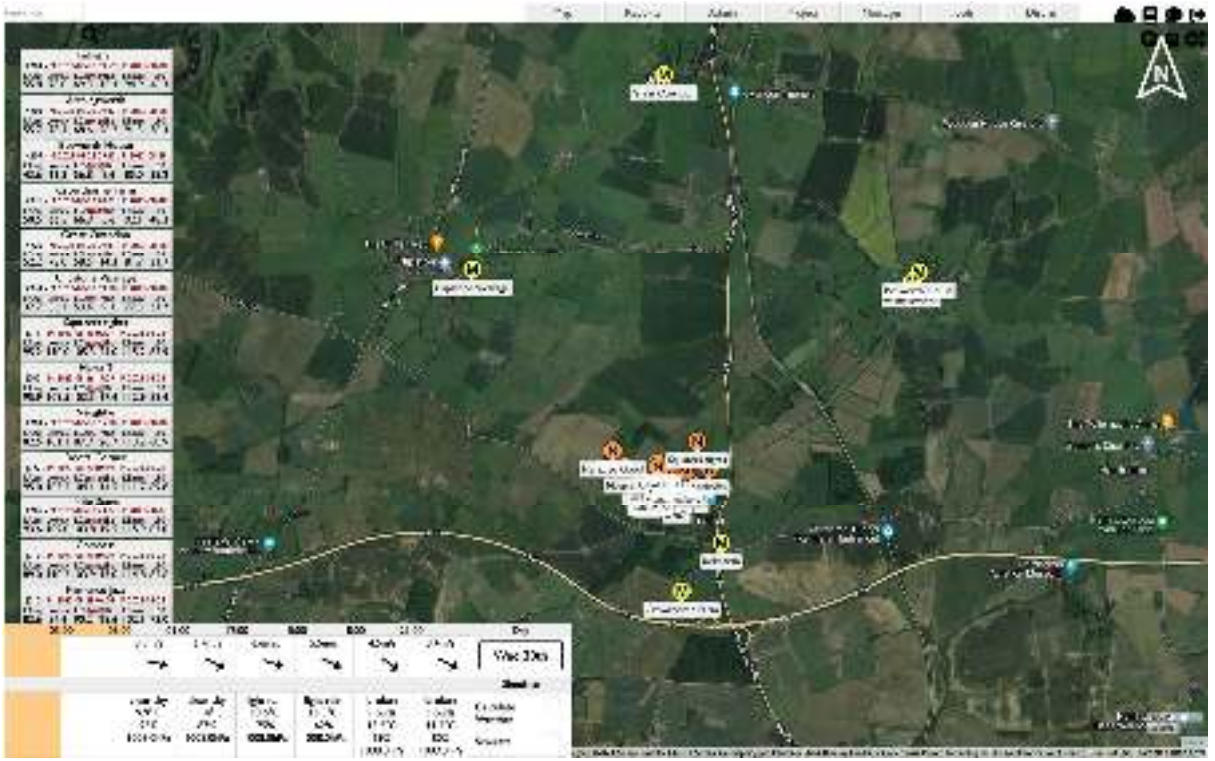
19 x Onsite monitors with head-up displays for engineers

6 x Workplace dosimeters

4 x Staff operating in two shifts

Weather monitoring

Public complaint mapping



Reporting

$dBLA_{eq(t)}$

$dBLAF_{max(t)}$

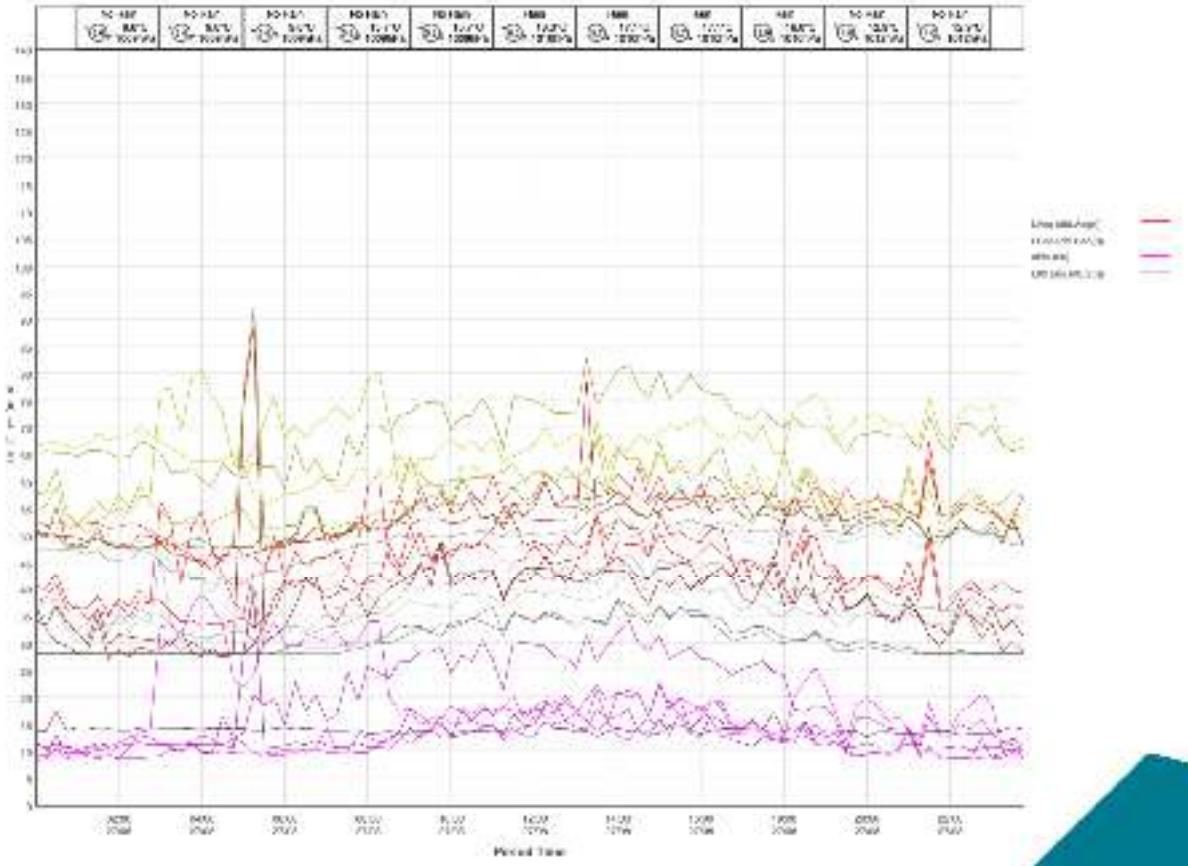
$dBLC_{eq(t)}$

$dBLA_{90(t)}$

$dBLZ_{eq(t,octave)}$

$dB_{b(t)}$

dBb is a rolling dBL_5/dBL_{99} for frequencies below 100Hz. This metric was devised by SPLtrack to observe the impact of bass beats.



Noise meters

Reliable data collection and real-time view are fundamental to the noise management process

Granular monitoring - lots of meters are required

Portable metering is fine for spot checks but many points of fixed monitoring are far more accurate than a small number of portable meters

New MEMS technology provides Class 1 compliant meters at much lower cost, enabling many more meters to be used

Real-time monitoring requires failsafe connectivity. 4G, WiFi and LoRaWAN wireless technologies facilitate this

Batteries must support long periods of monitoring. ADA meters operate for 14 days without external power

Head-up displays for engineers are essential. System operators must be provided with full information in order to meet sound limits.

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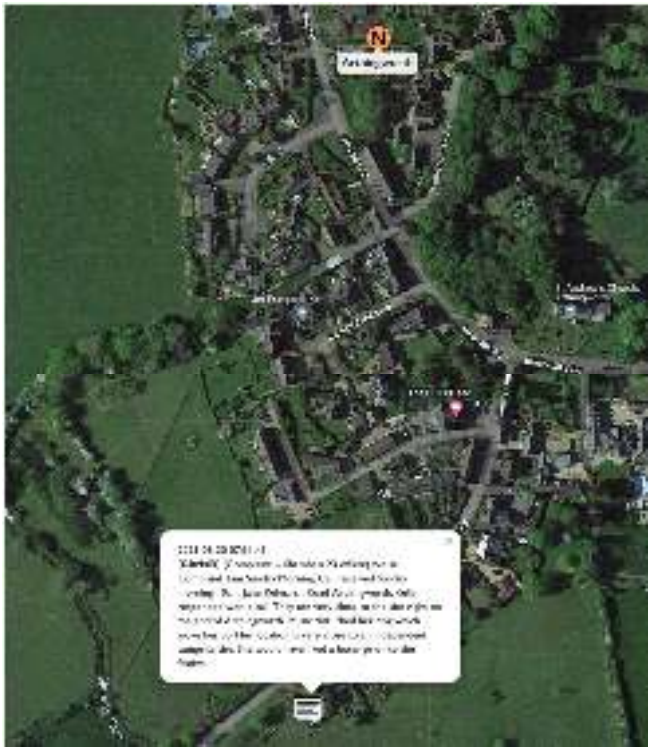
Public communications

Website links allow residents to submit comments without using the public complaints line. This does result in a greater number of complaints and a proportion of rants/threats etc., however it helps in the assessment of noise impact and provides an understanding of local sensitivities. Public response is one of the more useful metrics!

Automatic mapping of complaints speeds up the response process

The log includes on-site operational events or interventions and automatically logs technical issues such as meters offline or battery levels



Control of Noise at Work

6 hour measurement taken in servery area during performance

97dBLAeq(6h)

Combination of music noise, crowd noise and persons shouting drink orders

Recommended maximum exposure time at this level is 20 minutes

In this case there was no warning signage or provision of earplugs.

Not enough is being done to protect working staff or customers.

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Protecting the Audience

This can be seen at a great many events

Sound levels merely centimetres from a loudspeaker cause severe hearing damage

Some loudspeaker manufacturers advertise a capability of 150dB$_{SPL}$ at 1 metre!

There is no legislation to prevent this

Guidance for separation of the public from loudspeakers is rarely followed

Deafness will be common in later life

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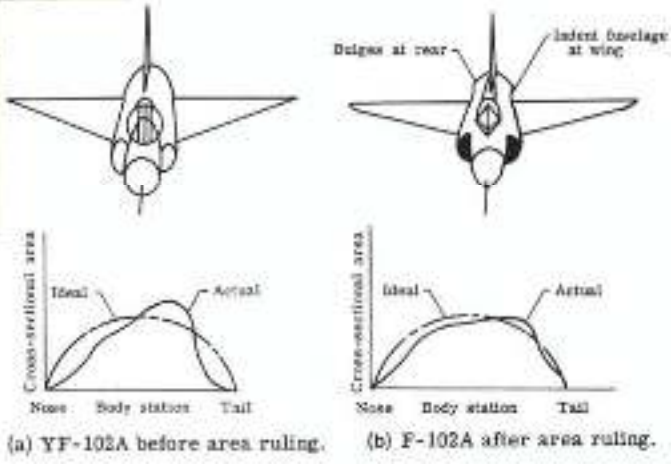
Breaking the rules to obey the law

Richard Whitcomb



Busemann: "Some people come up with half-baked ideas and call them theories. Whitcomb comes up with a brilliant idea and calls it a rule of thumb."

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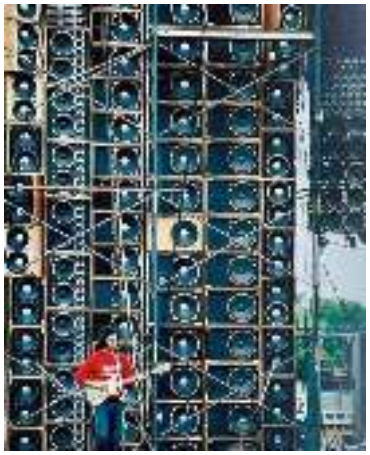
There is nothing new

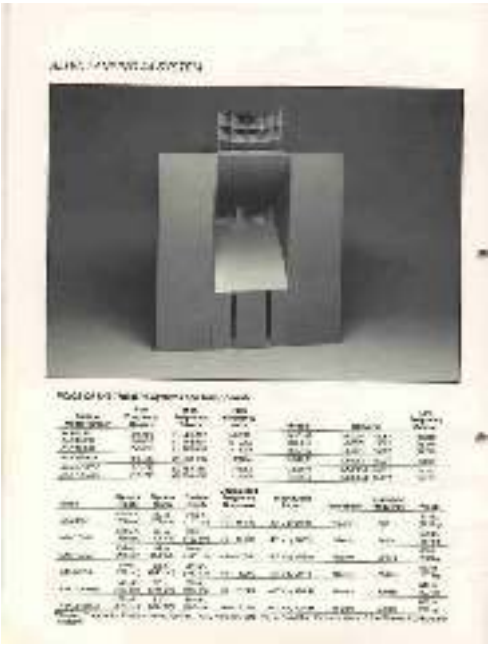
Baffles were in use in the earliest cinemas. Loudspeaker and amplifier power was at that time minimal, therefore all available sound energy had to be harnessed for the audience.

The Grateful Dead were using Line arrays in 1973 and column loudspeakers were in use in the 1920's.

Most of the mitigation techniques we have discussed in this presentation were understood before loudspeaker manufacturers realised that portable-high power equipment would lead to more sales, therefore physics was abandoned in favour of products with huge power specifications and glossy brochures.

Whitcomb showed us that power is not the whole answer, but intelligent use of airflow (and directivity) achieves a great deal.





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