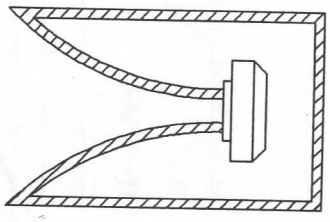


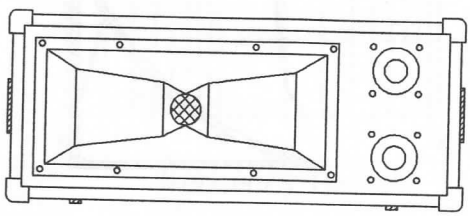
Mid and High Frequency Horn Enclosures

For this application loudspeakers and compression drivers are coupled to a large horn, which would be one of two types, radial or constant directivity. Both of these have varying horizontal and vertical coverage angles and should be chosen according to the manufacturers' specifications. Further details are discussed in the section on dispersion.

1.1.2 Horn and Tweeter Enclosures

All types of compression drivers with their appropriate horns, along with all types of tweeters can be independently mounted in their own, separate enclosure. Because these types of loudspeakers are not dependent in any way on the enclosure for acoustic coupling, the cabinet can be designed simply to support and baffle the units. Total air tight sealing is not required, therefore easy access to the units for servicing is available. The overall external dimensions can conveniently be made to match up with other enclosures in the chosen system.

The manufacturers' specification for the selected horns and tweeters will quote the required cutout dimensions, although in many instances, particularly fibre glass horns, a physical check is recommended as the method of manufacture cannot guarantee the dimensions. It is also suggested that this check is carried out on all fixing hole centres.



1.2.1 Musical Instruments

Amplification systems for musical instrument playback are usually described as nearfield systems, ie. for backline, home or studio use, where the amplifier and loudspeaker are a major part of the sound reproduction sequence. It then follows that the loudspeaker and the enclosure characterise the sound of the final musical output. The extensive tonal qualities available from different types and sizes of loudspeakers and enclosures, enables specific characteristics to be offered according to the preferences of individual types of musical instrument.

Lead Guitar Enclosures

Types of loudspeakers used for the application are often characterised by a description of the sound they produce, ie. 'clean', 'dirty' and 'original 60's'. The output pitches and tones can be further enhanced and modified by utilising effects, pedals and electronics. The frequency response range required for lead guitar is nominally 88 Hz to 6 KHz.

Single 12"	Usually containing an integral amplifier, the 'combo' is commonly an open back design, and used for practice and high quality studio applications.
Dual 12"	Commonly a sealed enclosure design, provides a tight, punchy performance.
Four 12"	The 'classic' lead enclosure for rock applications, used with a separate amplifier and in multiples.

Bass Guitar Enclosures

Loudspeakers for this application are often multi-way to provide the required sound characteristics. The size of a bass rig is determined by the required sound pressure output. For practice and studio work, adequate bass performance can be achieved by using a single 15" enclosure. For full range use, 18" loudspeakers provide the pure deep bass, and 10" loudspeakers are ideal to produce the higher frequencies. These types of enclosures are usually bi-amplified. The frequency response range required is normally 44 Hz to 5 KHz for 4 stringed instruments, and 33 Hz to 5 KHz for 5 stringed.

Single 15" Single 18"	Bass reflex or rear horn 'scoop' enclosures, ideal for pure, deep, warm bass.
Four 10"	Compact bass reflex enclosure eminently suitable for classic 'thumb and slap' bass sound.
Single 15" + 8" Single 15" + 10"	Two way designs with the larger unit usually in a bass reflex enclosure and bi-amplified, suitable for all bass styles.

Single 18" + 10" Single 18" + 12"	Two way designs with the larger unit usually in a bass reflex enclosure and bi-amplified,suitable for all bass styles.
Two Way Folded Horn Combination	High energy, high efficiency deep bass for live work of all bass styles.

Keyboard/Synthesisers/Acoustic

A broad band or full range reproduction is required for these types of instruments. The type of enclosure utilised is dependent on the particular application and as such can comprise a single full range loudspeaker, or be a multiple loudspeaker/enclosure combination. With electronic keyboards, the distribution of power throughout the frequency spectrum can be quite different to that of other instruments or normal play back programme material. Therefore for the safe use of mid and especially high frequency loudspeakers, units should be selected with a power handling capacity twice that for normal use. The frequency response range required is 30 Hz to 20 KHz for optimum use, however for compact disc systems, a compromise of this band width is made particularly at the bass frequencies, where a range of 80 Hz to 12 KHz gives good results. Electronic equalisation can partially compensate if accepted without clipping amplifiers, or exceeding loudspeaker excursion.

1.2.2 Sound Reinforcement

The sound reinforcement system can consist of the smallest full range enclosure for background playback use in shops, restaurants, clubs etc. through to huge multiple enclosure stacks for concert use. The designs within this handbook for sound reinforcement each have their relevant use described, and can be selected to provide the coverage and projection required. The sections describing coverage and projection will provide guidance in the selection and use of enclosures for these applications. For compact enclosures a frequency response of 80 Hz to 14 KHz gives acceptable results, but larger systems are necessary for good, deep bass where ample size and quantity give the best results.

1.3 - dispersion and coverage

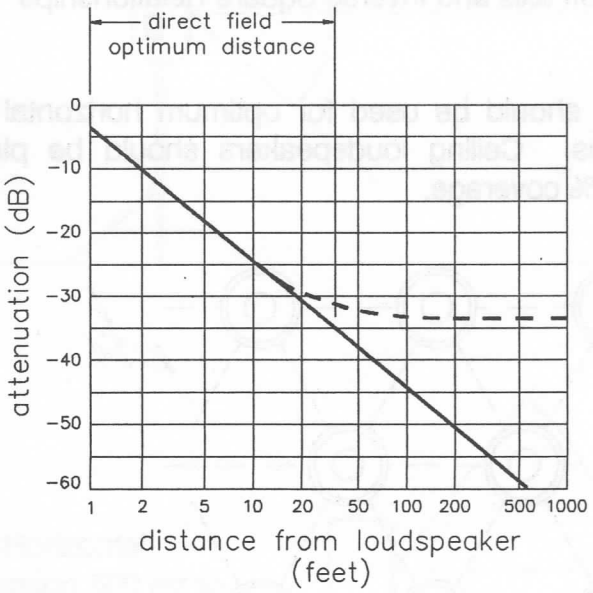
The major objective of any sound system is proper coverage of the audience listening area, with the full audio spectrum, in the correct balance and ideally at a uniform sound pressure level over the entire area.

The correct balance of the audio spectrum is achieved in a multiple component system by ensuring that the relative outputs of the various frequency band sections is within the scope of the system equalisation capability. Ideally this balance should be made within the design of the system as excessive equalisation can damage loudspeaker drivers. The relative power requirement for each frequency segment is indicated in the section on power distribution. Of course a one-box system or full-range loudspeaker would already have been balanced by the manufacturer.

In a multiple component system utilising bass enclosures, mid-range enclosures and various types of horns it is necessary to study the various dispersion parameters of the components and use the information to determine the correct angles or position of cabinets to give the best, even coverage.

Most bass systems are omni-directional up to 500 Hz, ie. their sound wavefront is a constant level for a 360 degree circle around the enclosure. Above this frequency all speakers and higher frequency reproducers are characterised by a narrowing of the beamwidth with increasing frequency.

The sound output from the source point is also decreasing according to the inverse square law, ie. dropping 6dB with every doubling of distance away from the source.

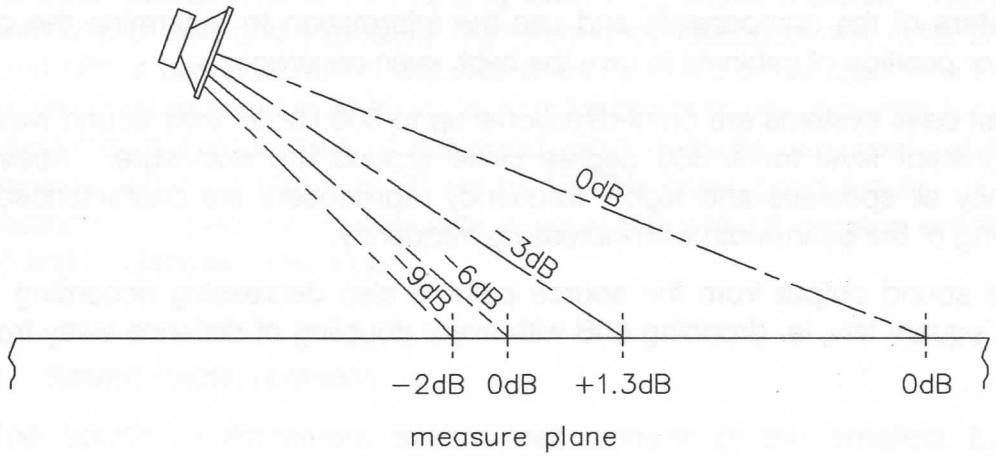


----- Effect of Reverberation

Attenuation with Distance in a Larger Venue

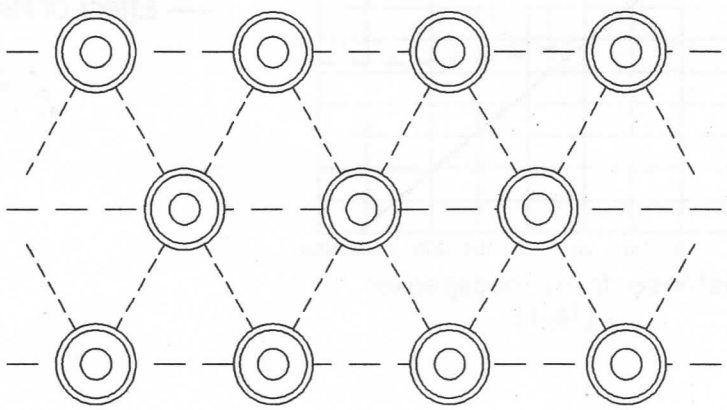
It is the reverberant effect of a room that causes sound to become a jumble of sounds, this is because the sounds heard are a combination of the direct, plus reflections from the ceiling, walls and floor all arriving at slightly different time intervals. Therefore it is very important to avoid excessive dispersion coverage, particularly overlapping beams of sound; careful selection and placement of mids, horns and tweeters can greatly improve the intelligibility of the system. Of course, an outdoor sound system is simpler as it is relatively free of reflective surfaces.

For installations requiring even background music over large areas such as shops, restaurants, public places etc., the best results are achieved using a large number of small enclosures or loudspeakers having a similar coverage area. These are best elevated and angled to take advantage of off-axis as well as inverse square law decay -



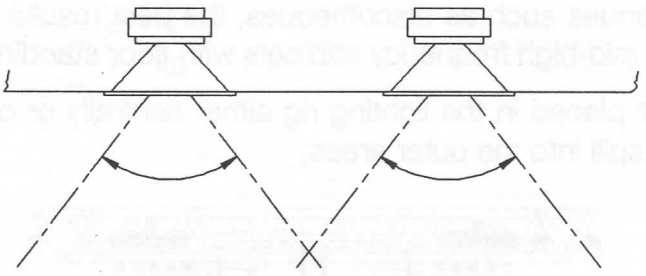
Relative Levels Resulting from Off-axis and Inverse Square Relationships

The centre frequency of 5 KHz should be used for optimum horizontal and vertical (as above) coverage angles. Ceiling loudspeakers should be placed hexagonally to give approximately 90% coverage.



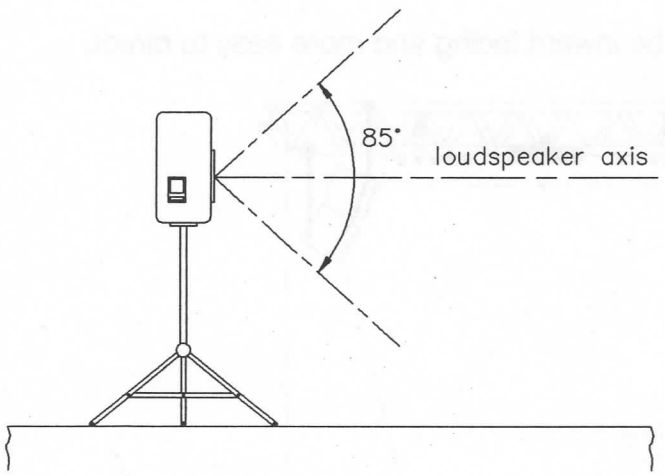
1.3 - dispersion and coverage

The nominal angle of coverage in the crucial 5 KHz region should be used to work out the spacing requirement.

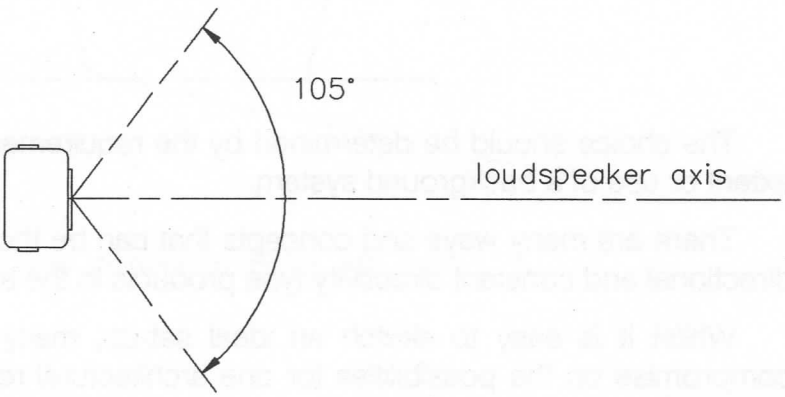


Ultimate control is achieved using an individual constant impedence attenuator for each loudspeaker (low impedence systems) in a central control box, or in the case of 70V/100V line (high impedence systems), a good multiple tapped Audio Transformer, to allow individual adjustment at the loudspeaker.

So in order to be able to use the principles of coverage and dispersion it is necessary to elevate the mid and high frequency sections of the system. This is achieved in smaller venues using loudspeaker stands. However it is not necessary to elevate the bass section and this can remain on the floor.



85° Vertical Dispersion 500 Hz to 20 KHz

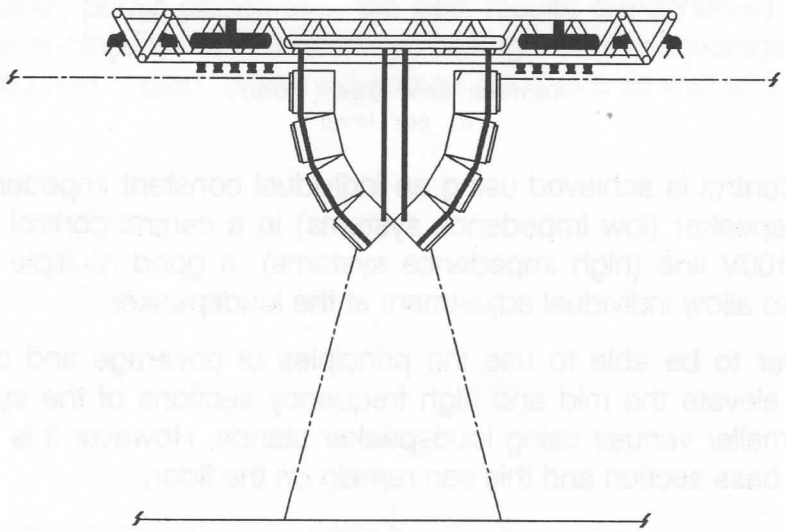


105° Horizontal dispersion 500 Hz to 20 KHz

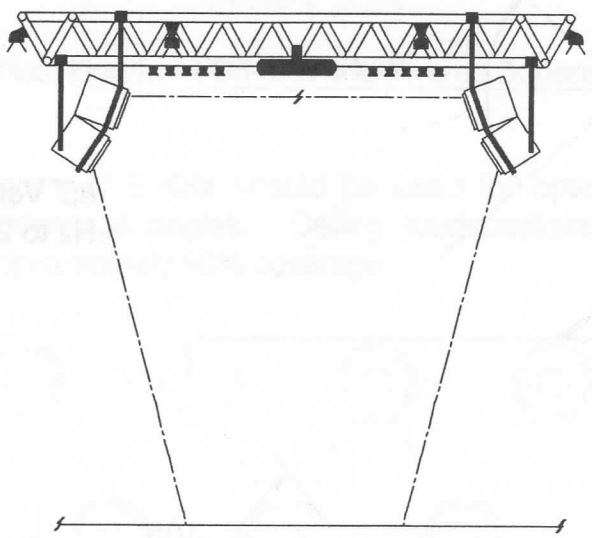
This has led to the development of bass enclosures with integral pole stand facilities. Crossovers can be housed in the bass enclosure and a link out used for the high frequency section.

In mid-sized venues such as discotheques, the best results are achieved using flown (ie. hanging) mid-high frequency cabinets with floor standing bass enclosures.

These are best placed in the lighting rig either centrally or on the periphery. A central system will spill into the outer areas;



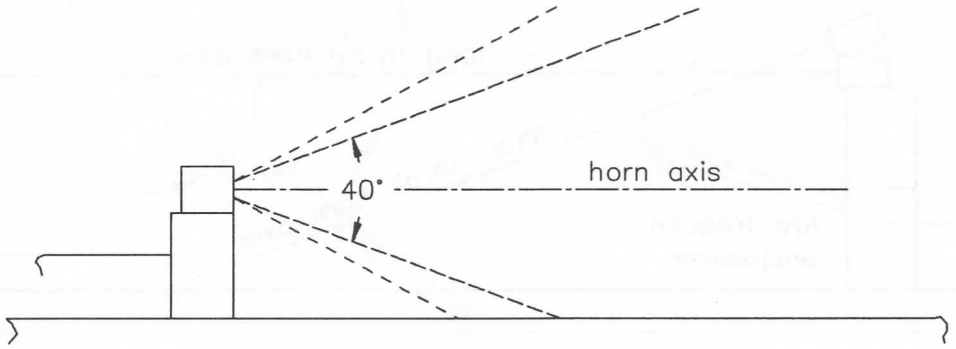
whereas a peripheral system can be inward facing and more easy to direct.



The choice should be determined by the requirements of 'quiet' zones and the extent or use of a background system.

There are many ways and concepts that can be thought out to use the various directional and constant directivity type products in the aforementioned manner.

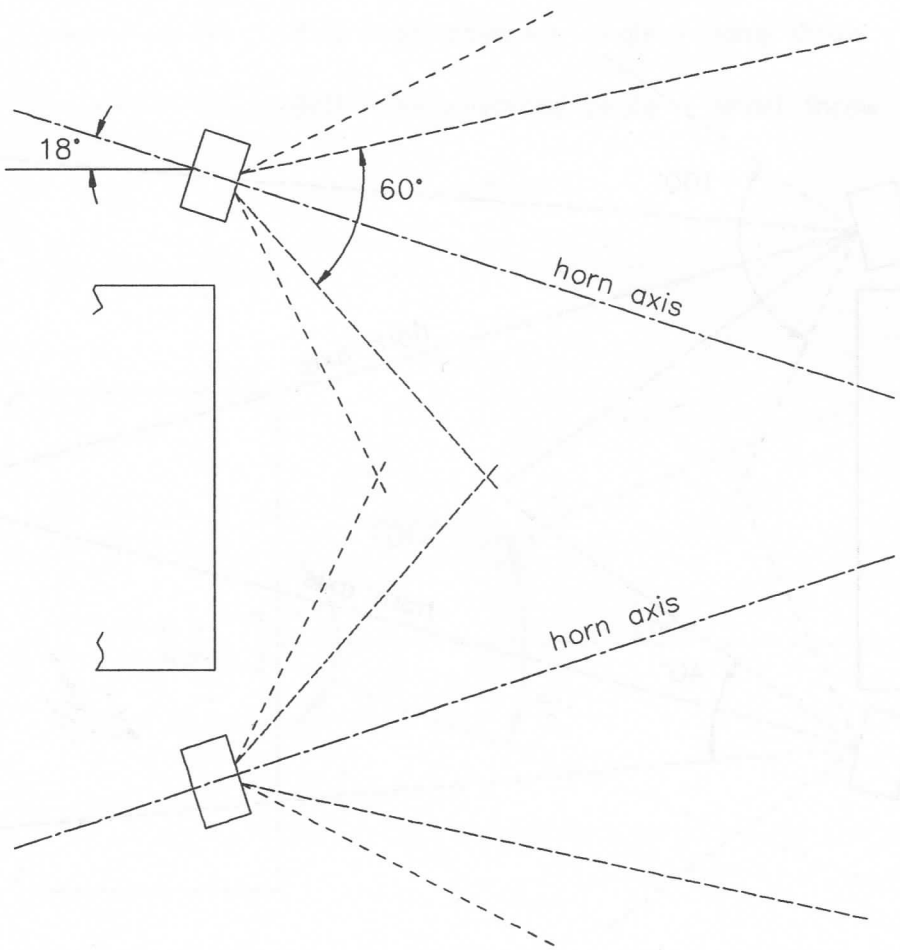
Whilst it is easy to sketch an ideal set-up, many venues impose their own compromise on the possibilities for one architectural reason or another, but these diagrams should be useful in helping achieve better results.



vertical dispersion 60° x 40° horn

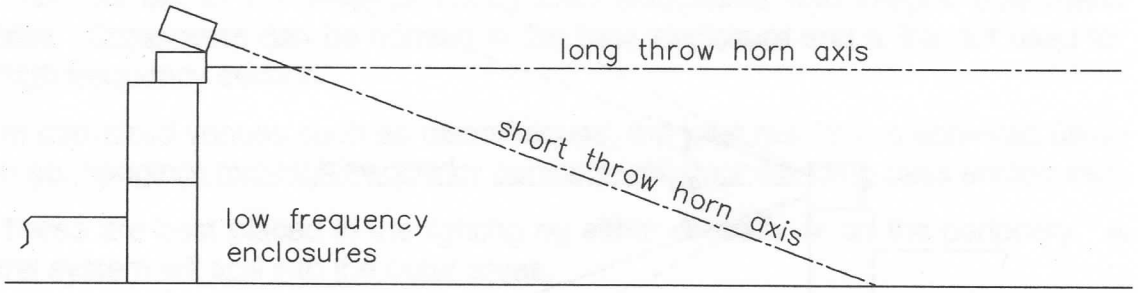
---------- –6dB main coverage angles

---------- close up coverage at reduced level but with uniform response



horizontal dispersion 60° x 40° horn

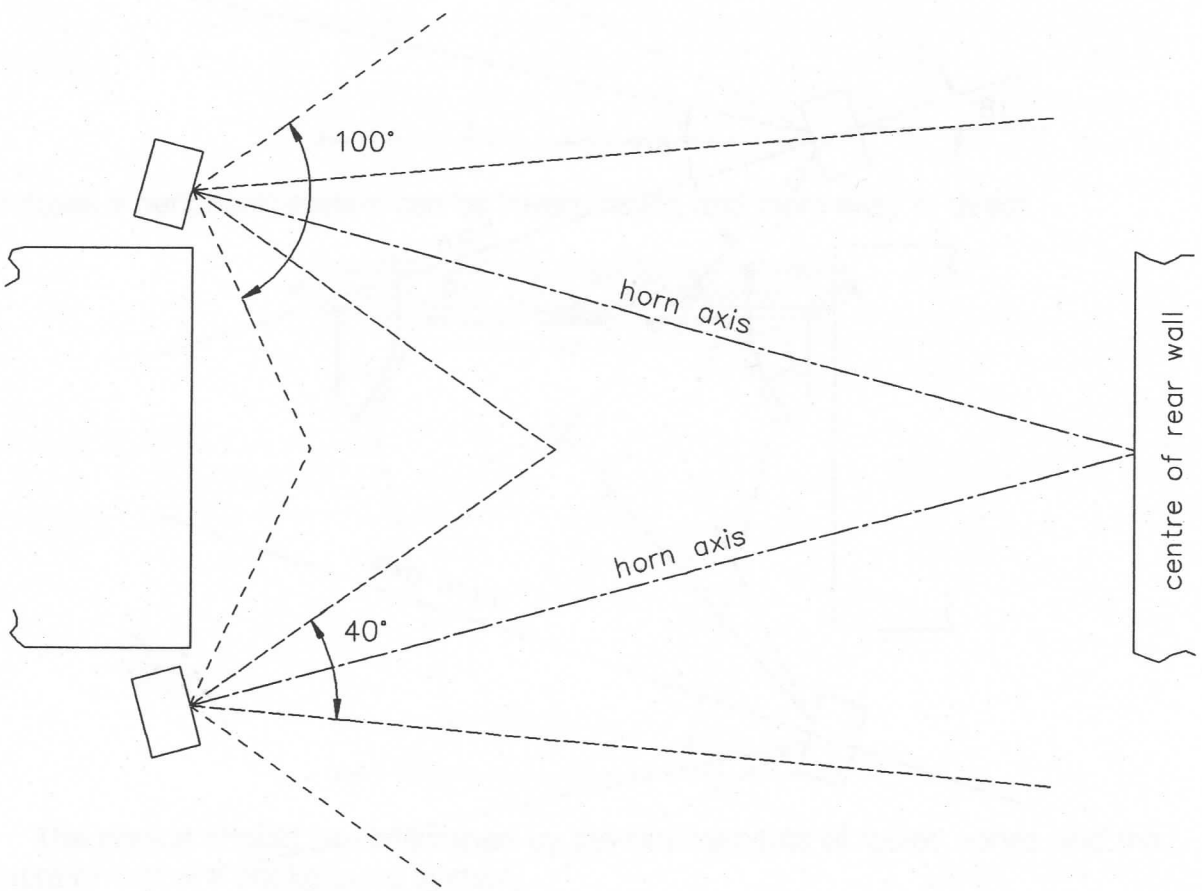
2 way system utilising 60 x 40 Horn.



vertical dispersion

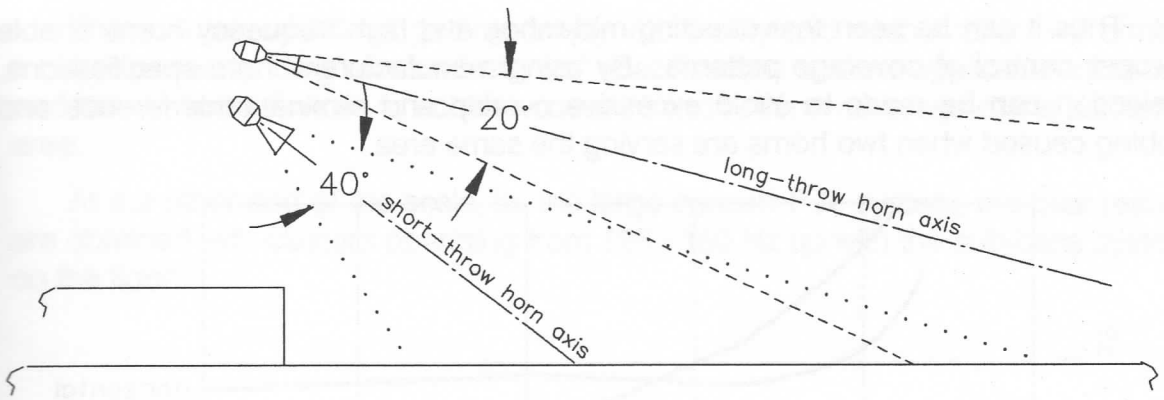
———————— –6dB main coverage angle – long throw

– – – – – – – – – – –6dB main coverage angle – short throw



horizontal dispersion

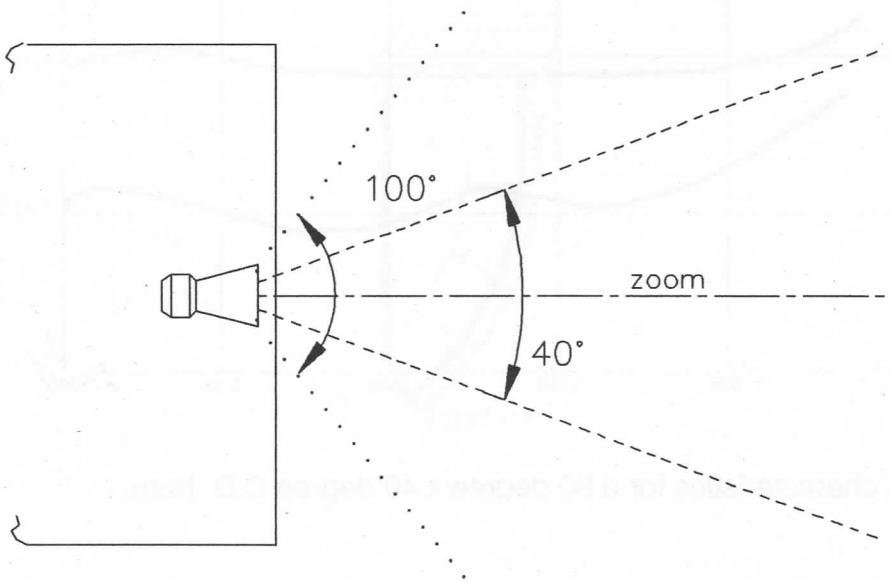
System utilising 100 x 40 C.D. Horn with long throw bullet horns



vertical dispersion

---------- –6dB main coverage angle – long throw

. . . . . –6dB main coverage angle – short throw



horizontal dispersion

Permanent installation using a flown central cluster of Horns.