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CONTROL OF NOISE FROM POP CONCERTS AT FOOTBALL GROUNDS

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INTRODUCTION

The number of open air pop concerts held in the Greater London Area has significantly increased over the past four years. Concerts vary from small events staging unknown groups attracting as few as 50 spectators, to large scale events held in football grounds licensed to hold up to 72,000 patrons. Although the concerts differ in size, their effect on the community can be equally disturbing. In fact, smaller less commercial concerts are often poorly planned and as a result are potentially a greater risk, in terms of environmental annoyance to residents, than larger events. Thus the careful planning of all pop concerts is a major part of staging a successful event.

Noise problems associated with pop concerts are primarily divided into two categories: the environmental pollution to the residents and the risk of hearing damage to the audience. The latter is not discussed in any detail in this paper, as it is usually the environmental criterion which dictates the maximum desirable noise level at open air concerts, rather than the hearing damage risk criterion. At indoor concerts, the reverse is often true. The sound insulation and acoustics of the arena reduce the sound transmission to the community and increase the noise level in the arena. The noise levels at indoor events are typically some 5dB(A) higher than at similar outdoor concerts.

Wembley Stadium and Selhurst Park Stadium (Crystal Palace Football Club) have been the main football grounds used in London for pop concerts over the past few years. Wembley Stadium has little or no environmental noise problem due to its tall facades acting as effective noise barriers and the arena being some 250 metres from the nearest residential area. Crystal Palace on the other hand is 100 metres from the nearest housing and offers in some cases very little sound attenuation due to barrier effects. Three of the site boundaries are residential streets, the fourth being a school playground adjacent to further residential housing. Topographically, the land falls sharply to the south west and rises on all other aspects. The use of this ground for pop concerts therefore offers significant noise control problems.

The GLC have monitored the noise from some thirty pop concerts over the past five years. The experience gained from these concerts combined with new noise control techniques were adopted at three concerts held at Crystal Palace Football Ground. The noise control measures carried out at each concert are illustrated in this paper, and although are directly relevant to Crystal Palace Football Ground, they are equally applicable to many other venues used to hold pop concerts.

BEFORE THE EVENT

The GLC (The Licensing Authority) and The London Borough of Croydon (responsible under the Control of Pollution Act) agreed to pool resources to establish a co-ordinated noise control exercise. Before the first concert ever staged at Crystal Palace, it was decided that noise control measures were essential to avoid significant noise pollution for the local community. The following proposals were suggested:-

1) The concerts should meet specified noise criteria.
2) There should be an active form of noise control at source.
3) The maximum sound attenuation from source to receiver should be achieved.
4) There should be a public relations exercise.

These measures were discussed with the Promoters and sound engineers to establish their feasablity and practical limitations. Taking each in turn:

1) Specified noise criteria

The GLC Code of Practice for Pop Concerts[ref 1] was used primarily as the noise guideline, using the part that referred to pop concerts held on no more than 3 days per year. This advocates a maximum permissible increase of 10dB(A) on the background fifteen minute Leq noise level up to 20.00 hours and a 6dB(A) increase from 20.00 to 23.00 hours, measured in the surrounding residential area. The Promoters were unhappy with the late evening constraint insisting that the final band could not become significantly quieter. It was decided to relax the 6dB(A) increase, and agreement was made that the environmental guideline would allow a 10dB(A) increase on the background noise level up to the end of the concerts, the latest finishing at 22.30 hours.

Detailed background noise measurements were made at three community sites close to the stadium a week before the first concert. The maximum acceptable noise levels were therefore obtained in line with the agreed environmental guideline.

2) Control the noise at source

There are four independent noise sources at pop concerts. These consist of the main Public Address(PA) system, the monitor or foldback, the backline equipment and the crowd. The first three, although linked, are controlled from three separate areas. The PA system is controlled by the engineer at the mixer desk in the ground; the monitor system from an engineer back stage; and the backline system is controlled by the band. Little can be done to control directly the noise from the latter two sources, but setting a maximum level at the main mixer and then monitoring and policing can achieve significant noise control. This in itself tends to restrict the noise level from the other two sources, because the main PA system is designed to be the predominant sound source for the audience. Significant contributions from the other sources means that the sound cannot be balanced from the main mixer, and so reduces the sound quality. This is therefore an undersirable situation, and one that the sound engineer tries to avoid.

To establish a maximum control noise level at the mixer, it is necessary to conduct a sound attenuation test once the PA system has been installed, usually a day before the event. A sound source with similar frequency characteristics to Pop Music (which has been developed from previous concerts) is played through the PA system. Simultaneously the noise level is measured at the most sensitive community site and at the mixer. The control level at the mixer can then be determined so as to comply with the environmental guideline previously established. At the first concert, pink noise was used as a sound source. This was found to over-estimate the source to receiver attenuation due to the different spectral characteristics of pink noise and pop music.

Typically the 10 minute Leq noise level at the mixer desk positioned approximately 20 metres from the stage ranges from 95 - 100dB(A) while a group is performing. Setting a control noise level much lower than 95dB(A) at the mixer is likely to make the concert an ineffective form of entertainment for the audience.

Finally, the noise from the audience is obviously uncontrollable, but the audience are a significant noise source, producing peak noise levels in excess of 110dB(A) in the arena, albeit for a relatively short duration. Although the peak noise levels due to the crowd are significant, in most cases the effect on the fifteen minute Leq is minimal, contributing an additional 1dB(A) to the overall Leq.

3) Achieve the maximum sound attenuation from source to receiver

The erection of sound barriers may have some effect on reducing the receiver noise level. But at Crystal Palace this form of noise reduction has been ineffective. For two concerts a barrier was erected

at one corner of the ground, but it was poorly constructed being too light and too low for any useful effect. Given the usual lack of time and minor importance given to the erection of a barrier by the Promoters concerned, it is likely that barriers at pop concerts will tend to be poorly constructed and hence offer an ineffective form of attenuation.

More success has been achieved using a technique established at Reading[2]. This involves tilting the PA loudspeakers some 20 degrees from vertical towards the audience. This minimises reflected sound from the opposite stand and hence reduces the sound propagation to the community. This technique coupled with sound attenuation tests of the various sets of speakers, can establish which loudspeakers are producing the highest sound level at the receiver. The problem speakers can then be tilted further and carefully positioned to establish an optimum attenuation. Our experience has shown that this technique increases the source to receiver attenuation by, on average, 5dB(A) compared with conventional non-tilted speaker arrangements.

The position of the stage in the ground can have a significant effect on the noise climate for the local residents. Discussions with the Promoters and structural engineers can enable the stage and speakers to be constructed in a position likely to give the best attenuation for the majority of the local community. At Crystal Palace this was considered, and the stage and associated PA system were positioned pointing towards the school playground.

4) Public Relations

A large public relations exercise was mounted by the Promoters. This consisted of:-

a) Arranging meetings with the local residents.
b) Advertising the concert locally as well as nationally.
c) Publishing a telephone number for complaints to be registered.
d) Offering complimentary tickets to residents of noise sensitive dwellings.

NOISE CONTROL ON THE DAY OF THE CONCERT

On the day of the concert, a carefully planned noise control exercise is essential. The noise monitoring programme developed at Crystal Palace has been found to be effective. The main aspects of the operation are discussed.

Automatic noise monitoring equipment was installed on the day before the event at the three community sites surrounding the Crystal Palace ground. The equipment was set to record the Leq and L_{50} noise levels every fifteen minutes. Also, the noise level time history was recorded on a level recorder.

On the day, members of the noise control team met at the Stadium to discuss the monitoring exercise in detail. A control room was set up so that communications could be co-ordinated at one central point. Complaints from the public were directed to the control room via the Metropolitain Police and Borough Council Offices. This aspect of the operation was reinforced by a two way radio link between members of the noise monitoring team and the control room.

To monitor and control the noise from a concert, it has been found advantageous to operate in three separate teams, all in radio contact. The function of each team at Crystal Palace was as follows:-

One team was assigned to monitor the distribution of the sound within a half mile radius of the ground. Eight community sites were selected for this purpose. Spot noise measurements coupled with subjective assessments were made at each site regularly during each band's performance.

The second team regularly checked the three automatic monitoring sites, and remained available to respond to noise complaints. Complainants were visited quickly (long delay times are likely to increase the degree of annoyance regardless of noise level) to measure the noise level and establish if the complaints were justified. Justified complaints or breaches of the environmental guidelines set at the three monitoring sites would be relayed via the radio link to the third team.

The third team were posted at the mixer desk to perform a number of functions: to monitor and control the noise level at source and also to act as a point of contact for the outside teams. Noise levels being above the previously set control levels either inside or outside the ground were pointed out to the mixer engineer, who would then be asked to reduce the noise level. The use of headphones for this team to establish a radio link was essential, due to the high ambient noise levels at the mixer.

RESULTS

Histograms of the Leq noise level during the three concerts are shown in figures 1 to 3, and data relating to each concert are given in table 1. The data are relevant to the closest community site to the ground.

Table 1

Concert / Figure No	Start/End Time	Max. Breach of Guideline	No. of complaints	Source to receiver attenuation
1	16.00/22.30	5dB(A)	13	30-32dB(A)
2	14.00/20.00	3dB(A)	2	26-28dB(A)
3	16.00/22.30	2dB(A)	2	30-32dB(A)

Concert No.1

The results show that the environmental guideline was occasionally exceeded by 1 to 2dB(A) during the afternoon and early evening. At night, from 21.00 hours when the last band were performing the guideline was exceeded by 4 to 5dB(A) for an hour. This high increase in the noise level was due to a communication breakdown between the monitoring team and the mixer desk. By the time the communications were re-established the damage had been done, giving rise to a surge of nine complaints during this period compared with thirteen in total. This emphasises the need to maintain communications at all times.

Concert No.2

At this concert, the source to receiver attenuation was not as good as the previous or final concert, likely due to the speakers being tilted some 5 degrees rather than the required 20 degrees. The relatively poor attenuation and thus lower control level of 96dB(A) at the mixer, gave the mixer engineers little tolerance and constant policing by the monitoring team was required. The severe noise constraints could not be maintained, leading to a breach of the environmental guideline of 1 - 3dB(A) throughout the afternoon. Although the afternoon period proved difficult to control, only two complaints were received over the duration of the concert which ended at 20.00 hours.

Concert No.3

This concert had potentially the highest risk of causing annoyance for the local community, due to the final band (Status Quo) demanding very high noise levels (110dB(A) Leq was recorded at an earlier indoor concert). The potential environmental annoyance was averted due to the stringent noise control at the mixer and the good attenuation from source to receiver by virtue of the 15 to 20 degrees tilt on the speakers. The results show that the control level at the mixer was met throughout the concert, and the environmental guidelines were occasionally exceeded by 1 to 2dB(A). Only two complaints were received during the concert.

CONCLUSIONS

The concerts were a success in commercial and general enjoyment terms. Minimal noise disturbance to the the resident population was achieved, while the concerts attracted up to 30,000 spectators.

In most cases, the noise control techniques enabled the pre-determined environmental guideline to be met to within 2dB(A).

The low number of complaints indicate that the environmental guideline used is a good criterion for minimising noise annoyance to the local community from open air pop concerts (although the affect of the public relations exercise must be taken into account). Increases of 1 to 2dB(A) above the guideline produced no increased community reaction, whereas the 4 to 5dB(A) increase invoked significant community disturbance.

The results show that large 'one-off' pop concerts can be held in football grounds in potentially noise sensitive environments without undue disturbance, providing careful planning and active noise control measures are adopted.

REFERENCES

1] GLC Code of Practice for Pop Concerts.
2] D.Wallis and R.Marks 1983 Environmental Health(4) - Why Reading Rock is Not an Environmental Disaster.

ACKNOWLEDGEMENTS

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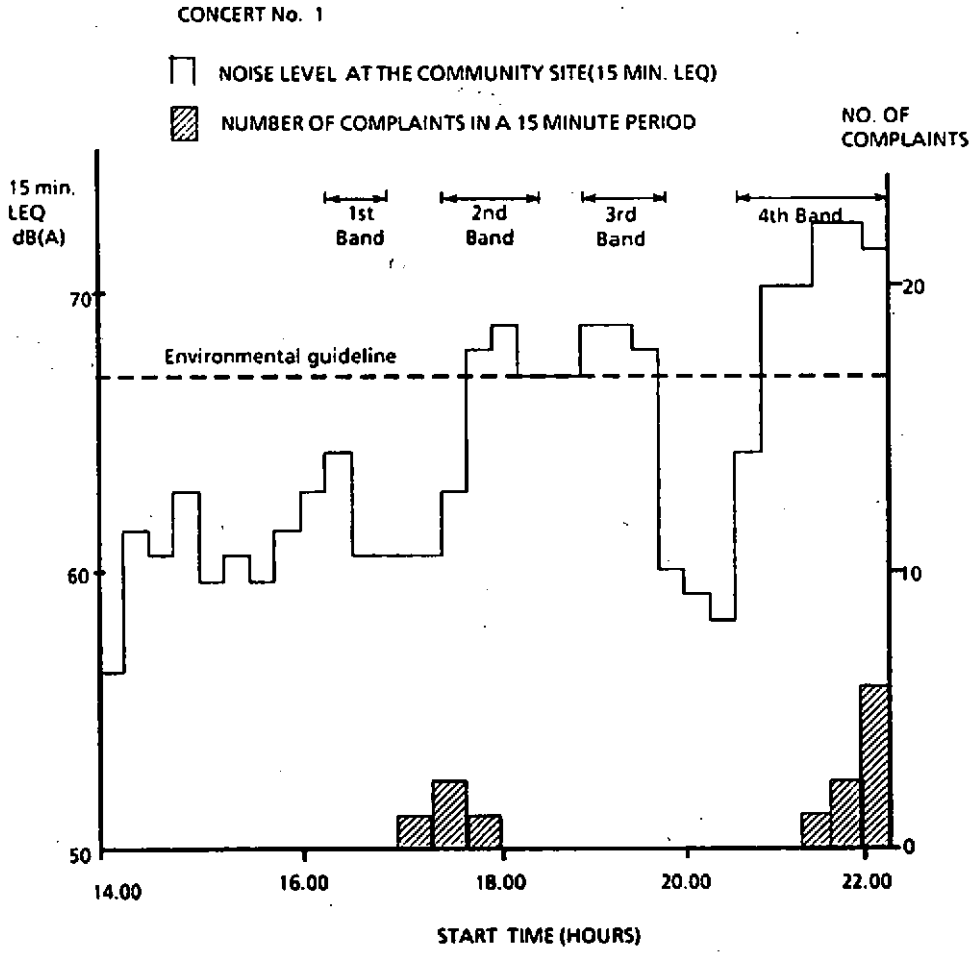
FIGURE 1 HISTOGRAM SHOWING THE NOISE LEVEL AND COMPLAINTS OVER THE DURATION OF THE CONCERT



NOISE LEVELS AT THE MIXER TOWER AND AT THE NEAREST COMMUNITY SITE

FIGURE 2

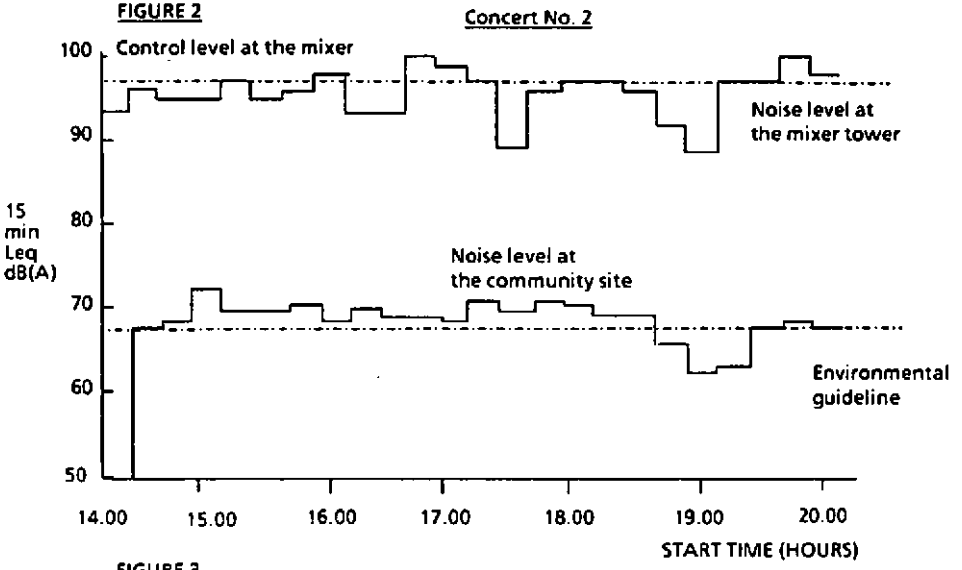


FIGURE 3