Institute of Acoustics

# REVISED ENVIRONMENTAL NOISE GUIDELINES FOR POP CONCERTS

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## INTRODUCTION

It has now been over a decade since the first edition of the GLC Code of Practice for Pop Concerts (CPPC)[1]. Over the past eleven years it has been revised twice and its acceptance by Licensing Authorities, Environmental Health Departments etc. has been widespread throughout the country. As well as giving guidance on noise, the CPPC covers many aspects associated with the safety, health and welfare of members of the audience attending these large scale music events.

With regard to the section on noise, only minor changes have been introduced so far to the Code since 1976. This paper, however, presents suggestions for revised environmental guidelines in the light of new data obtained from concerts held at Wembley Stadium.

## THE CODE OF PRACTICE FOR POP CONCERTS - SECTION 9 - NOISE

The CPPC covers the two major aspects of noise from concerts, they being the potential risk of hearing damage to members of the audience and the potential risk of annoyance to the local community. This paper does not seek to discuss the noise exposure aspect of the code but would recommend its adoption subject to new research particularly with respect to audience attendance patterns.

With regard to environmental noise, the present CPPC criteria are based on obvious physical variables; receiver noise levels, the number of concerts held per year and the time of day the concert is taking place. It recommends that for concerts held on no more than three days per year, the fifteen minute Equivalent Continuous Sound Level ($LAeq_{15}$) during a concert or rehearsal should not exceed the background $LAeq_{15}$ noise level by more than 10 dB(A) from 0700 hours to 2000 hours, and by more than 6 dB(A) from 2000 hours to 2300 hours. For concerts held on more than three days per year, the increase is restricted to 1 dB(A). Outside the quoted times the Code recommends that the sound should be inaudible within any inhabited premises.

It is these environmental criteria that are reviewed in the light of research carried out at pop concerts held at Wembley Stadium and, in particular, at events staged during 1987.

## CASE STUDY - POP CONCERTS AT WEMBLEY STADIUM

During the summer of 1987, eleven late afternoon/evening pop concerts were held at Wembley Stadium within a period of ten weeks. They represented four to five hours of music at each. There has never been this number of open-air pop concerts held in one year at the stadium before and indeed, over the past decade some of the largest venues in the country have rarely held more than three events in any one year. These concerts therefore presented an ideal opportunity to study in more detail the

relationship of the various physical variables (noise level, duration etc.) with the community response to noise, and in particular, assess the environmental impact with concert density.

Site Location and Measurements

Wembley Stadium, one of the largest football stadia in Britain, is situated in a north westerly suburb of London. Most of the premises immediately around the stadium are commercial and industrial. The nearest residential premises are approximately 250 metres to the south.

Detailed objective data which included inside and outside noise levels and hourly wind speed and wind direction data, were monitored and obtained for each concert. The community reaction to noise was assessed by the number of complaints from residents, the timing of complaints and the location of the complaints in relation to the venue. Complaints were monitored by a telephone "hot line". Some of these data are shown graphically in figure 1 for each of the eleven concerts. The typical external noise levels are displayed for the closest site to the stadium. Although there was little variation in noise levels inside the stadium, large variations were recorded outside in the community.

Research has shown, that for occasional pop concerts, allowing the $LAeq_{15}$ to rise by up to 10dB(A) over the background $LAeq_{15}$ is likely to minimise complaints, and that a steep rise in the community response is likely to occur above an increase of 13dB(A)[2]. To examine this relationship as the number of concerts increased in conjunction with other variables affecting the level of complaint, the data from each concert is discussed in turn.

Concert No.1 & 2 - "U2"

The first two events held on a Friday and Saturday, proved successful in terms of noise control inside the stadium and invoked minimal community annoyance. It was surprising, however, that although a low level of complaints were reported, increases of 20dB(A) were recorded at the closest residential property. This increase although higher than expected or measured during earlier tests was due to the change of the wind direction which meant that the closest residential properties were downwind of the noise source. Unusually most of the complaints arising from the first concert came from residents living four to five kilometres from the stadium. Subjectively the low frequency component of the music was the predominant source at their dwellings and was barely detectable on the 'A' weighting scale. The low frequency sound was generated by the sub-base speakers which were turned down for the second performance as a result of the active noise control in operation. In conclusion, therefore, the first two concerts although exceeding the 10dB(A) criterion at the nearest properties, caused a low level of complaints which were mainly with reference to the persistent low frequency beat of the music, particularly on the first night.

Concert No.3 & 4 - "David Bowie"

These two concerts were staged on the following Friday and Saturday evenings. The inside noise level was marginally higher than before, and the downwind sound propagation to the closest housing produced increases in noise level of the order of

20dB(A) on the first night. Most of the complaints arose from this area, but the total number was again relatively low given the high external noise level.

During the following show, the wind direction changed, and with a similar internal level, the receiver level at the closest site upwind of the source reduced by almost 10dB(A). Yet the number of complaints doubled to the highest that had been received for any concert in previous years. The complaints were reported from a much wider area, typically downwind, one to four kilometres due east. Particularly high external noise levels were recorded from this area at a distance of 2 kilometres and the music was audible up to 5 kilometres from the source.

Clearly, at these concerts, climatic conditions had a considerable influence on the long range sound propagation. Even though the music was barely audible at long distances from the stadium, the mere fact that it could be heard so far from the source led to many complaints. It being the fourth concert on consequetive weekends may also have been a factor that accounted for the increased level of complaints.

Concert Nos. 5,6,7,8 - "Genesis"

A gap of almost two weeks occurred before the first of the four Genesis shows, which started mid-week on a Wednesday and continued each night ending on Saturday. These concerts were of great interest and importance as there had now never been this number of concerts at this venue before in one year, almost three times the recommended limit in the CPPC whilst maintaining a 10dB(A) increase, and there had never been this number on consecutive days. An attempt to restrict the concerts to the 1dB(A) increase as specified in the code would have rendered levels in the stadium such that the concert would have been an ineffective form of entertainment for the patrons, i.e. an effective prohibition clause. In this case, the licence had been granted and the concerts went ahead with a 10dB(A) increase permitted. At that time they were the last concerts to be held at Wembley until the following year although, another significant factor likely to increase environmental annoyance was the scheduled finish time 22.45 hours, 45 minutes later than the previous events.

The results were surprising. The wind direction was favourable for the most sensitive premises and the typical increase was 9dB(A) on the first concert rising to about 13dB(A) on the final two nights. The level of complaint was low on all the nights with only one complaint reported on the last performance.

At this point, therefore, eight concerts had been held at the stadium with a much lower than expected number of complaints as the concerts progressed, especially with the later finish time. The low level of complaints are likely to have been due to a number of factors:

1. The 10 - 13 dB(A) increase was met at the closest site for the majority of concerts. Levels in other localities were at or below this margin.

2. The residents thought, at this stage, that these concerts were the last to be held for the year and thus were prepared to accept the disturbance given that they were to have a break from the noise until the next year.

3. A gap of nearly two weeks had occurred since the last pop concert.

The point made in (2) was shown to be significant given the adverse community reaction to the announcement of a proposal for three more concerts to be held six weeks after the 'Genesis' shows. The public reaction against such a proposal was made known by numerous petitions, the number of people who attended the licence hearing, the number of objectors, and the media coverage concerning the environment impact. Despite the adverse public response, the licence was granted subject to various conditions including an early finish time and strict noise control.

Concert No 9, 10 & 11 - "Madonna"

The "Madonna" concerts were held midweek from Tuesday to Thursday. As shown in figure (1) the inside and outside noise level were much the same as in the case of the "Genesis" show, but the number of complaints were by far the highest ever recorded at Wembley, reaching almost fifty on the first and last night. In general, complaints arose from areas downwind of the source, from as far as 5 kilometres from the stadium. It was apparent that many complaints were arising at lower noise levels (increases up to 5dB(A)) whereas for previous events increases of between 10 and 20dB(A) were tolerated. It is clear, therefore, that a step change in the community response to the concert noise had occurred. This significant change in response is likely to have been due to a combination of the following:-

1. The concert density had now become a significant factor in the disturbance produced by the concert almost irrespective of the receiver level.

2. The extensive media coverage had increased the awareness of the residents to the potential noise and disturbance.

3. The residents expected rest from the concert noise following the "Genesis" shows was short lived. The announcement of an additional three concerts was therefore likely to reduce an individuals tolerance to the noise.

## DISCUSSION FOR THE REVISION OF THE ENVIRONMENTAL NOISE GUIDELINES

Permissible Noise Level Increase

As in previous research[2] the present 10dB(A) guideline was shown to limit satisfactorily the number of complaints up to a certain concert density. In this study the noise level at the closest housing typically rose between 9 & 13 dB(A) with minimal complaints for a given number of concerts and circumstances. Although higher increases of up to 20 dB(A) did occur in the worst case with only marginal increases in complaints, it would be unwise to design to this level. Other factors such as the weather have the potential of significantly affecting the noise climate and these should be taken into account when planning a concert. Indeed, during the two "Bowie" shows (with the same source level) the change in the wind direction produced a 9 dB(A) difference in receiver level.

The reduction from a 10 dB(A) increase to a 6 dB(A) increase specified in the CPPC from 20.00 hours to 23.00 hours was originally included partly to reflect the likely increase in the sensitivity of people that occurs as the evening progresses, and also as a deterrent to the licensee from planning the concerts to continue for too long. In practice it is impossible to change the noise limit at 20.00 hrs. as it is usually in the

middle of a concert. Also the timing of complaints from the Wembley concerts did not show any significant increase between 20.00 hrs. and 22.45 hrs. Indeed to minimise annoyance where possible, most concerts this year were limited to a finish time of 22.00 hrs, but as shown at the "Genesis" concerts, which ended at 22.45 hrs. no substantial rise in complaints were reported compared to concerts with an earlier finish time.

After 23.00hours, it is reasonable to assume that a guideline to preserve sleep is required. Sleep disturbance becomes increasingly apparent as internal LAeq noise levels exceed 35dB(A)[3]. However, given the persistent rhythmic nature of concert noise and the earlier noise intrusion suffered by the residents during the day, it is recommended that a more stringent standard of 'inaudibility' be maintained for open air concerts. This effectively defines the latest finish time.

Number of Events

Clearly, from this study more than 3 late afternoon/evening concerts can be held at a venue in one year with external noise levels rising up to 10 dB(A). In this case, eight concerts produced minimal community reaction although the next three invoked widespread disturbance in the form of petitions and a large number of complaints etc. It is not clear how much the extensive media coverage played a part in the increasing public awareness/complaints. But it is clear that the residents reluctance for any more music events after the eighth show was shown before the extensive press coverage occurred and this was highlighted and used by the media.

The last three concerts being planned after the expected finish of the concert year was also likely to have increased the residents sensitivity to noise. There is a need, therefore, for licensees, promoters, etc. to decide in advance the number of concerts they would like to hold at a given venue. The concert package would, therefore, give licensing authorities, environmental health departments etc, a clearer picture with which to assess the full environmental impact on the community. If all the concerts had been planned in advance and publicised, the public concern is likely to have been reduced and more events could, therefore, have been held with minimal disturbance using the 10 dB(A) criteria.

If a number of concerts are to be held at one venue , as in the Wembley case, a concert package spreading out the events, would help to alleviate annoyance. Concerts following weekend after weekend, as in the "U2" and "Bowie" shows, may have accounted for the rise in complaints on the final Saturday night of 'Bowie'. A gap of nearly 2 weeks before the next concert may well have been one factor accounting for the lower level of complaints during the Genesis shows.

As mentioned earlier, all these concerts were held in the late afternoon and evening lasting some 4 to 5 hours. The community response to these types of events is likely to be different to that of so called festivals which often last all day and involve overnight camping etc which often leads to additional community disturbance.

## Noise Control

Essential with the adoption and creation of any guideline, is the implementation of noise control techniques to meet pre-determined criteria. A noise control package for pop concerts as described elsewhere[4] involving continuous monitoring and control was used during this survey. It is essential to adopt such a procedure especially when numerous events are planned. This year, active noise control was successful at all concerts, except during the Bowie shows where control at the mixer desk proved difficult due to an unco-operative sound engineer.

## Conclusions

It is apparent that a much more stringent noise standard such as the 1dB(A) increase recommended in the code, is required where concerts are held on a regular basis. To classify concerts as either 'regular' or 'occasional' though, a number of factors, in association with the number of concerts per year, have to be assessed:-

1) The type of event; afternoon/evening, all day festivals etc.
2) The time interval between events.
3) The noise control procedures in use.
4) The public awareness of the total numbers of events to be held in one year.
5) Physical parameters such as the expected prevailing wind direction and population density around the venue.

In this case study late afternoon/evening concerts with one to two weeks between events, stringent noise control, but a lack of public awareness of the total number of concerts to be held led to eight concerts being successfully held with minimal noise annoyance.

## REVISED ENVIRONMENTAL NOISE GUIDELINES FOR POP CONCERTS

### REVISED GUIDELINES TO MINIMISE ANNOYANCE AT POP CONCERTS

Having regard for the fore-mentioned case study, it is recommended that the guidelines to minimise annoyance (section 9.02) given in the CPPC be superceded by the following:

1. To minimise annoyance to occupiers near the site at which occasional* pop concerts are to be held:-

(a) the LAeq noise level measured for any fifteen minute period of the concert or rehearsal, outside the windows of habitable premises, should not exceed the LAeq noise level measured during a comparable period when no pop concert or rehearsal is in progress by more than 10 dB(A) between 07.00 hrs. and 23.00 hrs.

(b) No sound from the premises should be audible within any other premises between 23.00 hrs. and 07.00 hrs.

2. To minimise the noise annoyance to occupiers near the site, at which regular* pop concerts are to be held:-

(a) the LAeq noise level measured for any fifteen-minute period of the concert or rehearsal, outside the windows of habitable premises, should not exceed the LAeq noise level measured during a comparable period when no pop concert or rehearsal is in progress by more than 1 dB(A) between 07.00 hrs. and 23.00 hrs.

(b) No sound from the premises should be audible within any other premises between 23.00 hrs. and 07.00 hrs.

*The classification of 'regular' and 'occasional' should be made with reference to the number of concerts, the type of concert, the time interval between events, the noise control techniques to be adopted, the methods used to publicise the proposed events in a year and the various physical parameters (prevailing wind direction etc).

### REFERENCES

(1) Code of Practice for Pop Concerts (GLC, 1985)
(2) Noise Control Techniques and Guidelines for Open Air Pop Concerts (J.E.T. Griffiths, PROC IOA Vol7 Part3, 1985).
(3) Environmental Health Criteria 12, Noise (World Health Organization 1980).
(4) A Noise Control Procedure for Open-Air Pop Concerts (J.E.T. Griffiths, S.W. Turner & A.D. Wallis, PROC IOA Vol8 Part4, 1986).

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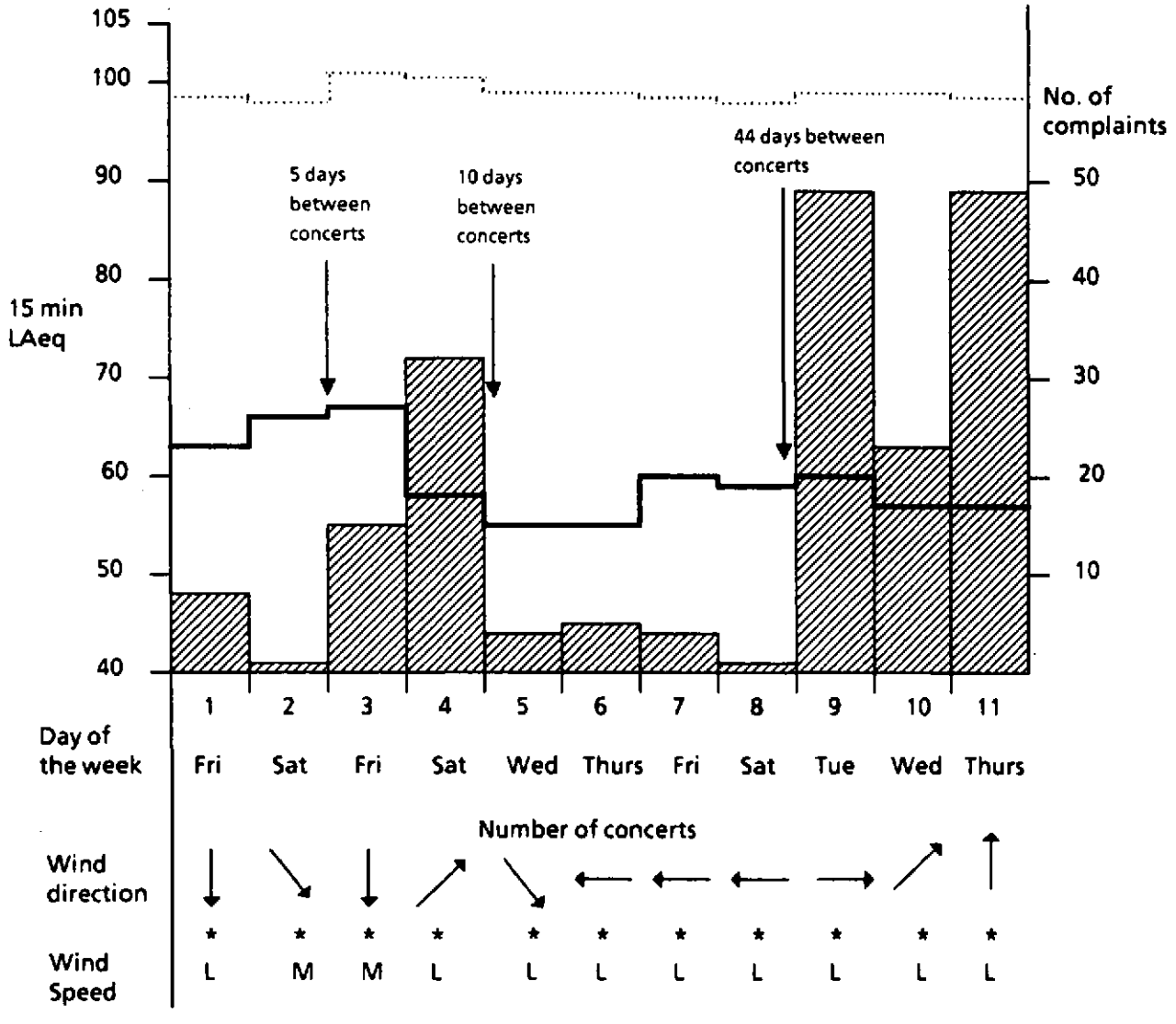
Figure 1 DATA FROM ELEVEN POP CONCERTS




Key

Typical 15 min LAeq noise level at 50m from the stage

Typical 15 min LAeq noise level at the closest side to the stadium (200 metres due south)

Number of complaints during the concert

Wind direction

L,M Light, moderate wind speed

* Relative position of receiver site