inter-noise 83

AIRPORT GROUND NOISE IMPACT - PRACTICAL VIEW ON EVALUATION

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INTRODUCTION

With the recent extensive Public Inquiries concerning developments at the London Airports for a Second Terminal at Gatwick, a Fourth Terminal at Heathrow and a vast expansion at Stansted, the subject of impact from aircraft noise has been widely discussed. Noise from aircraft in flight has received much attention due to the large areas affected. In contrast the continuous hubbub from aircraft on the ground affects fewer people, but the noise can be a serious disturbance for those unfortunate enough to live within a few km of the airport boundary. For these people, the sound of an aircraft taking off can come as a relief, when it has been taxiing and holding while waiting for clearance to depart.

There is no generally accepted way of assessing the impact of ground noise. No reliable social surveys have been carried out to correlate subjective response with measured aircraft noise levels. Therefore attempts at determining the impact of ground noise from future airport developments have produced vastly different approaches ranging from the standard noise intrusion assessment methods to new types of annoyance assessment based on absolute Leq levels.

NOISE PREDICTION AROUND AIRCRAFT

Various investigations have been made to quantify the noise from ground operations. The activities normally considered under this heading are:

- Taxiing
- Engine run-up on the apron
- Auxiliary power unit operation
- Engine testing after maintenance
- Application of reverse thrust

o Take-off roll

Much of the available data has been produced in order to assess the impact of ground noise for particular proposed developments at airports.

Noise levels have been measured by numerous researchers at a variety of distances from the source, but using distance attenuation data it is possible to compare measurements made at different distances. 8dB per doubling of distance is an average appropriate figure, although 6dB and 12dB have been suggested. For comparison purposes a reference distance of 152m (500ft) can be used, which conforms to the reference distance used for calculating noise levels on the ground for over-flying aircraft. This procedure allows the peak noise level to be calculated for each activity, and the equivalent continuous sound level (Leq) can be predicted if the duration of each noise event is known with the time periods and the number of events.

Compared with the noise level for take-off roll, typical values for other activities for a large aircraft are:

Taxiing/low thrust engine running	−22dB(A)
Auxiliary power unit	−28dB(A)
Engine maintenance	−9dB(A)
Reverse thrust	−7dB(A)

These figures enable the different sources to be viewed in perspective. Take-off roll creates the highest noise level but lasts for a short time, similar to reverse thrust. Engine maintenance can occur for long periods and often happens at night. Individual auxiliary power units produce the lowest level, but when a number of aircraft are using APUs simultaneously, the total level can be much higher, e.g. for 10 aircraft the reference level would be 86dB(A).

It is difficult to obtain reliable data on the duration of each type of ground operation without continuous observations. If the level and duration of each event are known, the Leq level can be easily calculated over a period of time.

SUBJECTIVE REACTION

The subjective reaction of people to noise from airborne aircraft has been studied in depth around many airports, leading to the development of NNI type indices. NNI gives a reasonable indication of subjective response to airborne aircraft noise at Heathrow but there have been many criticisms in the past and NNI has continued to be accepted because of the absence of any better alternative assessment procedure. One of the main criticisms which is of relevance to ground noise, is that the index does not take account of background noise as a fundamental factor in assessing community response to new noise sources.

Recently, the idea has been suggested that subjective reaction to intruding noise is independent of background noise. This has been explained by hypothesising that although audibility and intrusion depend on the difference between the peak noise level and the background noise, annoyance is the resentment of the intrusion and does not necessarily relate to the background noise level. Therefore the interesting idea is put forward that, even though a noise can be intrusive, it is not necessarily annoying even when it is, for example, the noise of jet engines. The same school of thought suggests that annoyance can only be determined by relating noise levels to social surveys or laboratory studies to gauge reactions to noise. This idea is in direct opposition to the principles of BS4142 (the British Standard for assessing industrial noise) which has been successfully used for many years to relate likelihood of justifiable complaints to the difference between the intruding noise and the background. The main criticism of BS 4142 is that it is sometimes not sensitive enough to identify complaints. The possibility of complaint should be viewed as the ultimate stage in the reaction to a noise problem (although sometimes complaints may not be justified).

Generally subjective reactions to noise can be said to depend upon the level, duration, and acoustic frequency content of the intruding noise, its relation to the background noise, and the condition of the recipient.

Annoyance due to noise can be defined as the resentment at an intrusion. The methods of assessing indutrial noise referred to above, link the intrusion of a noise above the background with the likelihood of complaints, a complaint being made as a final result of a state of annoyance. It therefore seems logical to link intrusion with annoyance as long as the noise in question is obviously something that can be regarded as unpleasant such as airport ground noise. Other environmental sources such as singing birds can be intrusive but are rarely considered annoying, although this is a situation which can occur. The intrusive noise of a cockerel in the early morning is an obvious example.

The authors have assessed ground noise by predicting the level of the new noise sources in terms of peak levels or Leq and comparing them with either the background L90 noise level, the existing ambient Leq or the future L90 and future overall Leq level. A number of receiver sites around the airport were selected and the peak noise level of each event and the continuous noise level Leq over a period of, say, 1 hour can be tabulated as follows in this example for a residential site affected by a recent airport proposal:

Taxiing		APU		Engine running on apron		Engine maintenance		Reverse thrust	
Peak	Leq(1hr)	Peak	Leq(1hr)	Peak	Leq(1hr)	Peak	Leq(1hr)	Pk	Leq
56	52	52	52	56	55	69	56	63	49

In this case, the existing average daytime background L90 was 40dB(A) and the daytime Leq(1hr) was 50dB(A). At night the L90 background noise was as low as 29dB(A). A comparison of before and after levels shows the magnitude of the impact.

It can be seen that similar Leq noise levels can result from different peak levels and durations of noise events, and the subjective reaction to these stimuli would be likely to be different. The unqualified reference to a variety of different noise events, solely in terms of a combined Leq would neglect important factors such as rise time, intermittency, and duration.

Subjective response to ground noise is different from other noise sources, whatever noise unit they are expressed in. Units such as Leq tend to hide the real nature of a ground noise event.

One's expectation of future acoustic environment governs reactions to noise. For example, no-one living around Heathrow expects the problem of aircraft noise to be eliminated completely. However, people living around lightly used airports will be greatly upset at a projected change in their environment, when the change is obviously for the worse.

In the present state of knowledge the only realistic way of assessing airport ground noise is to measure existing noise levels and predict future levels using conventional descriptors. Then professional judgment is required to assess the likely effects of a proposed airport development.