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LONG RANGE PROPAGATION OF AIRPORT GROUND NOISE

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Introduction

Airport ground noise is often present within 1-2 km of the perimeters of major airports. Nevertheless, airborne aircraft noise would normally be present at higher Leq levels. For this reason noise assessments often overlook airport ground noise and concentrate on airborne aircraft noise.

Recent laboratory work (1) has shown that continuous type noises, such as airport ground noise, may make a greater contribution to overall noise annoyance than occasional event noises, such as airborne aircraft noise, when both are present at similar Leq levels. This implies that airport ground noise is worthy of greater consideration than it has been given in the past.

Airport ground noise is caused by aircraft taxiing and APU operation, reverse thrust applications, take-off rolling, and engine testing. In order to make assessments of the effects of these noises in nearby communities, a reliable prediction technique is required. Reference levels are available from a number of documents (e.g. 2), but there is little information available on the propagation characteristics of these types of noise. A great deal of the work reported in the literature tends to concentrate on the theoretical aspects of various excess attenuation effects. However, in practical situations, the nature of the terrain can vary tremendously around the airport, and meteorological conditions are never constant. Thus, although relatively precise predictions of received noise levels can be made in respect of tightly specified conditions, actual received noise levels will vary tremendously.

It was therefore felt worthwhile to group together a number of measurements of the long range propagation of engine test running noise, in order to derive a "grand mean" attenuation rate, which will show the normal trend, over distances up to 3 km.

Data Collection

The data were obtained on a number of separate occasions at both Stansted and Gatwick airports. Engine test running was used as the noise source simply because of its relatively high level when compared to taxiing and APU operation. Reverse thrust and take-off rolling noise involve moving sources, and are thus unsuitable for this type of analysis. Tape recordings were made at reference positions close to the aircraft and at distant positions located in the nearby communities. In each case radio-telephone contact was established in order to enable the tape recordings to be synchronised. In order to avoid directionality effects, the measurement positions were located in similar orientations relative to the aircraft on each occasion. Measurements were always obtained under relatively calm weather conditions.

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The data are shown at Table 1 and plotted at Figure 1. The noise levels relate only to maximum thrust engine power settings, as on many occasions lower thrust engine power settings were completely inaudible at the distant sites.

Three sets of measurements were made at Gatwick with the aircraft behind hangars, but with the nearest measurement position located on the aircraft side of the hangars. Two sets of measurements were made with aircraft coupled to exhaust mufflers, in order to investigate their effectiveness.

Discussion

Figure 1 illustrates the general trend of the data. Ignoring directivity, rural vs urban terrain, aircraft type, screening by hangars, and weather conditions, the mean attenuation rate was 11.99 dB per doubling of distance. All the data are contained within a band of ± 10 dB either side of the regression line. The Pearson product-moment correlation coefficient between log distance and dB(A) noise level was $r = -0.958$.

The effect of screening by hangars, (or exhaust mufflers) appears to be insignificant at typical distances for nearby communities, although of course, properly designed screens can give considerable benefit to nearby receivers. Recent measurements at Gatwick of the performance of a 10 m high earth bank surrounding a holding area at the western end of the runway, showed a maximum excess attenuation of 4 dB relative to a receiver distance of 1 km. These measurements were made by employing an observer on the earth bank in contact with the measurement location by radio-telephone in order to report when aircraft moved past the end of the earth bank during taxiing and take-off rolling.

There appears to be no significant difference between typical urban and typical rural terrain, although the presence of housing might have been expected to give greater excess attenuation.

Conclusions

Actual measurements of the long range propagation of engine test running noise, when averaged over a variety of conditions, gave a mean attenuation rate of 12 dB per doubling of distance. Therefore, if an attenuation rate of 10 dB per doubling of distance is used in prediction techniques, this will give a useful margin for error in terms of predicting a worse-case. A rate of 8 dB which is often used will give an even greater margin for error in the prediction. There appears to be no significant effect due to screening by aircraft hangars, dwelling houses, etc., at typical community distances.

Engine test running noise drops to about 50 dB(A) or less at distances in excess of 3 km. This must define the maximum distance at which airport ground noise (except take-off rolling or reverse thrust noise) can have any effect, under normal conditions.

Acknowledgement

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References

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Table 1 - Noise levels dB(A) and distances from the source (Max. thrust engine test running).

Measurement	Distance(m)	Noise Level dB(A)	Remarks
Stansted B707	350	69	Rural, 7 knot wind
	550	72	Angles from 0° to 80°
	950	62	to the tail.
	1750	47	
	2650	46	
	3250	35	
Gatwick B707	100	107 M	Urban, no wind
	1000	66 M	20° to nose
	100	108	behind hangars
	1000	67	
	2500	55	
Gatwick DC-10	70	100	Urban, no wind
	1000	56	20° to nose
	2500	46	behind hangars
Gatwick B707	80	105 M	Urban, no wind
	900	50 M	90° to nose
	2500	45 M	behind hangars
	80	106	
	900	55	
	2500	53	
Gatwick DC-10	180	99	Rural, no wind
	975	72	60° to 115° to tail
	1000	69	

Note: M indicates exhaust mufflers used during test.

dB(A) Noise Level = 39.8 log d + 181.4   r = -0.958

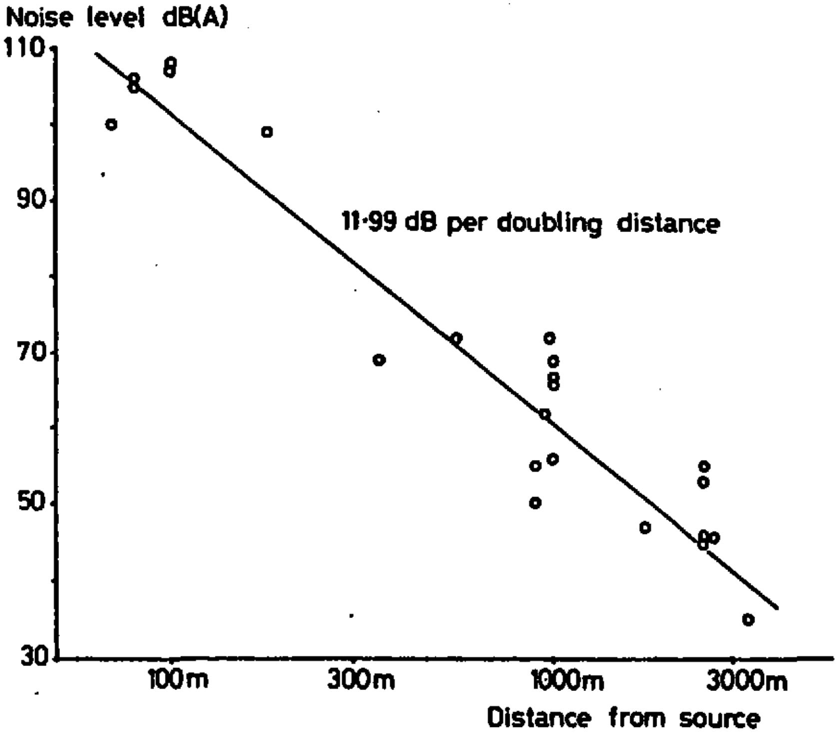

Figure 1 Noise levels measured at different distances from the source (maximum thrust engine test running) and the mean attenuation rate.