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ACOUSTIC, ATMOSPHERIC, PROPAGATION AND APPLICATIONS

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A review of the propagation work at BRS.

W.E. Scholes

Building Research Station, Dept of the Environment.

1. Introduction

BRS has been carrying out research into outdoor sound propagation on and off since 1954. The work has been mainly experimental and has attempted to provide design guidance for use in planning in relation to external noise sources such as aircraft and road traffic. The experiments have covered vertical and oblique propagation from aircraft in flight, near horizontal propagation from a small range of source heights and, more recently, barrier performance. All these experiments have covered a wide range of meteorological conditions and data has been produced to help in the setting up of engineering design rules.

Much of the work has already been published and some of the more recent findings are about to be published. This review will deal broadly with the main results of the research and will also mention the local background to the research, some of the techniques employed, and some of the ways in which the findings have been applied.

2. Vertical Propagation

This experiment used a piston engined aircraft flying at between 100 m and 600 m as the source. The noise levels were measured at 1.5 m above the ground. The attenuation, in excess of inverse square, showed good agreement with the original Knudsen-Kneser results for molecular absorption. No attenuation could be ascribed to turbulence.

3. Oblique Propagation

A helicopter flying on scheduled flights along the line of the Thames at Lambeth Bridge was used as the source. Noise measurements were made over a period of six months at points on the roofs of buildings out to Westminster Square. The ten measuring microphones were spaced more or less linearly along the 1000 m length of the range. Again, excess attenuations could be explained by air absorption only and any attenuations due to turbulence were small. For low source heights, when the propagation path approached grazing incidence with the "ground surface", there was a marked increase in attenuation.

4. Horizontal Propagation

In the case of horizontal propagation close to the ground it was expected that velocity gradients would have a significant effect on propagation, as had been known for some time, and that ground abseption would play a part.

The source was an Avon engined Swift, ground running and eight microphones were spaced logarithmically along a range of 20 m to 1100 m. Besides the expected wind effects the results showed that the ground had a much bigger influence on propagation than had been foubd by previous workers. Ingard had measured a ground attenuation of 7 dB at 300 m, but the results of this experiment gave a ground attention, within the frequency band 250 to 400 Hz, of about 25 dB at a similar distance.

The work on horizontal propagation was transferred to another site, partly to make sure that this ground effect was not peculiar to the first site and partly to make measurements at night. Broad qualitative agreement was found between the results from the two sites although there were small but significant differences in the values of ground attenuation and the frequencies at which they occurred.

Further experiments at the second site were carried out to study propagation under a wide range of meteorological conditions with the source at two new heights giving propagation data from three heights in all; namely 0.9 m, 1.8 m and 4.5 m. For the particular spectrum of the jet engine noise source it was found that the received levels with the source at 0.9 m high were typically 4 or 5 dB(A) lower than with the source at 4.5 m.

5. Noise Barriers

The first barrier experiment used a point source, 0.7 m high at 10 m and 25 m from the barrier. The barrier was 61 m long and separate series of trials were made with the barrier at four heights ranging from 4.9 m to 1.8 m. The sound field on the shadow side of the barrier was measured out to 120 m and up to 12 m high. The experiment showed that even for zero wind there were major discrepancies between theoretical prediction and measured reduction in received levels and that these discrepancies were due to ground effect. These discrepancies could be practically eliminated by basing barrier performance on calculated unscreened levels. Thus it is possible to predict received level in the shadow of a barrier by applying design chart values based on Maekawa's work to calculated unscreed levels based on the level just above the top of the barrier and distance. The effect of wind on barrier performance can also be taken into account.

Current work is directly concerned with the screening of motorway noise. A 305 m long by 3 m high experimental barrier has been built adjacent to the M1 and the traffic noise levels in its shadow are being measured out to 120 m and up to 12 m high, again under a wide range of wind conditions. These levels will subsequently be compared with the results of a further series of trials without the barrier.

6. References

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