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AN IMPROVED METHOD OF PREDICTING THE REFLECTION OF ROAD TRAFFIC NOISE BY BUILDINGS

D.C. Hothersall and S. Simpson

School of Civil & Structural Engineering, University of Bradford, Bradford, West Yorkshire.

INTRODUCTION

The current method of predicting the L_{10} and L_{10} 18hr noise level from road traffic in the U.K. (1) provides allowance to be made for the reflection of sound from vertical surfaces. Simple, single figure corrections are specified to allow for these effects. If the reflecting facades cover more than 50% of the road length on the opposite side to the reception point then a correction of 1dB(A) is added. If a façade exists 1m behind the reception point then a correction of 2.5dB(A) is added to the L_{10} or L_{10} 18hr noise level.

Although these corrections are undoubtedly of the correct order their simplicity leads to some difficulty of interpretation in practical site conditions. The main sources of problems are a) that the distance of the opposite reflecting facade from the traffic stream is not considered, b) that no intermediate correction values are available for cases where only a proportion of the opposing frontage along the road reflects. Finally, c) conditions in which a reflector is in the vicinity of the receiver, but not 1m away, are difficult to interpret.

This paper discusses a simple expression for the reflection correction which allows for some of the effects described above. The correction equation is derived from the general approach used in the U.K. traffic noise prediction method.

THEORETICAL CONSIDERATIONS

The U.K. prediction method provides equations for the attenuation of sound propagating over hard surfaces and grassland. An expression is also given to allow for the angle of view of the traffic stream at the reception point. Using these results with a simple ray tracing method of describing the reflection of sound it is possible to derive a simple arithmetic correction to the L_{10} or L_{10} 18hr noise level. The

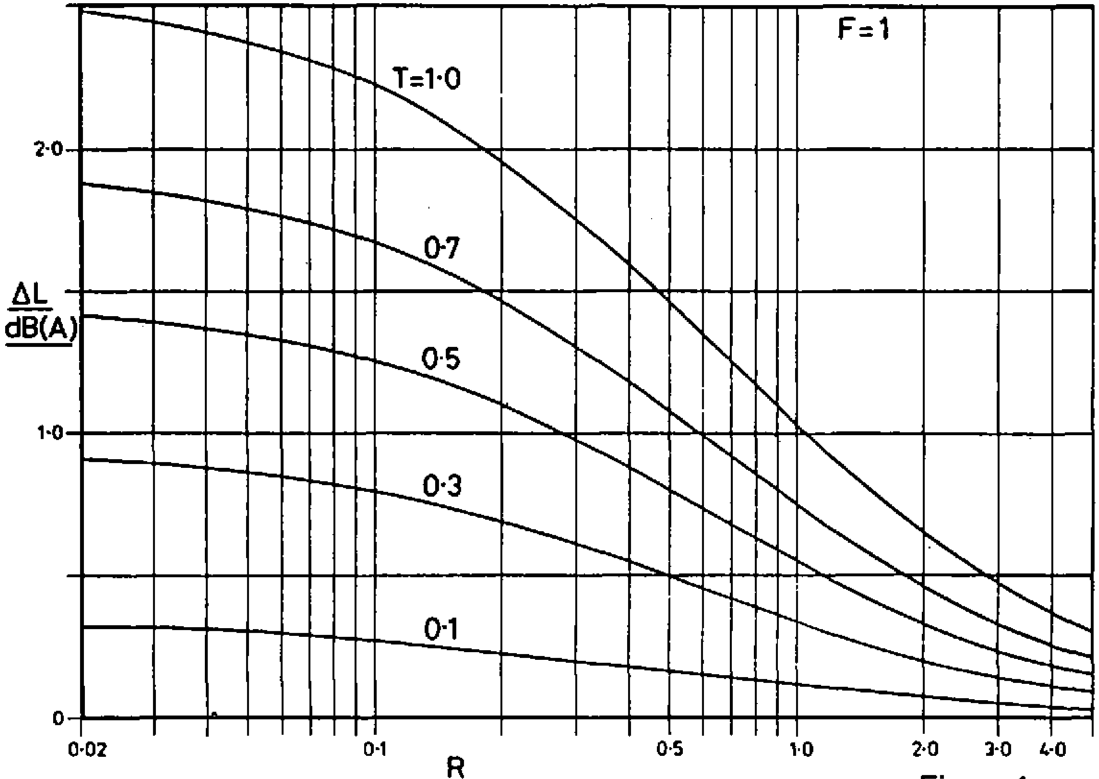

Figure 1

reflection correction is given, by (2)

$$\Delta L = 10 \log_{10} \left(1 + \frac{0.8T}{(2R+1)^F}\right) \text{dB(A)} \qquad (1)$$

and this value directly replaces the single figure corrections described in the introduction.

The correction applies only to reflections from facades parallel to the source line which lie either i) on the opposite side of the road to the receiver, or ii) behind the receiver on the same side of the road. In case i) the term R is the ratio D_R/D_O where D_R is the perpendicular distance from the traffic source line to the reflector and D is the distance from source line to receiver. In case ii) R is defined differently, as D_S/D_O where D_S is now the distance from the receiver to the reflector. T is given by θ_R/θ_S where θ_S is the angle subtended by the source line at the receiver. θ_R is the angle subtended at the receiver by the image of the source line which is produced by the reflecting surface. Often θ_R will be the angle subtended by the reflecting facade at the receiver, but in some cases, where the reflector is near the end of a source line the more rigorous definition is required. The index F has the value of 1 if the ground cover is predominantly hard and 1.52 if it is predominantly soft. The expression is applicable when the height of the reception point h is within the limits $1\text{m} < h < D_O/3$ and $D_O > 7.5\text{m}$. It is also obvious that for the result to apply the facade must be of sufficient height for a geometrical reflection approximation to be reasonable.

Equation 1 is plotted as a function of R for various values of T with F=1 in figure 1, and F=1.52 in figure 2.

DISCUSSION

In conditions when the distance D_S becomes small the value of ΔL approaches 2.5dB(A) as required. It can also be seen that the 1dB(A) correction currently used for reflection from opposing facades is a good single figure average of the values covered by the curves in figures 1 and 2. The curves tend to zero as the reflector distance becomes large with respect to D_O.

The reflection correction values are not large and direct experimental confirmation of the equation (1) would be difficult. However, the expression has been validated by means of computer simulations (2).

REFERENCES

(1) The Calculation of Road Traffic Noise, Department of The Environment, HMSO, (1975).

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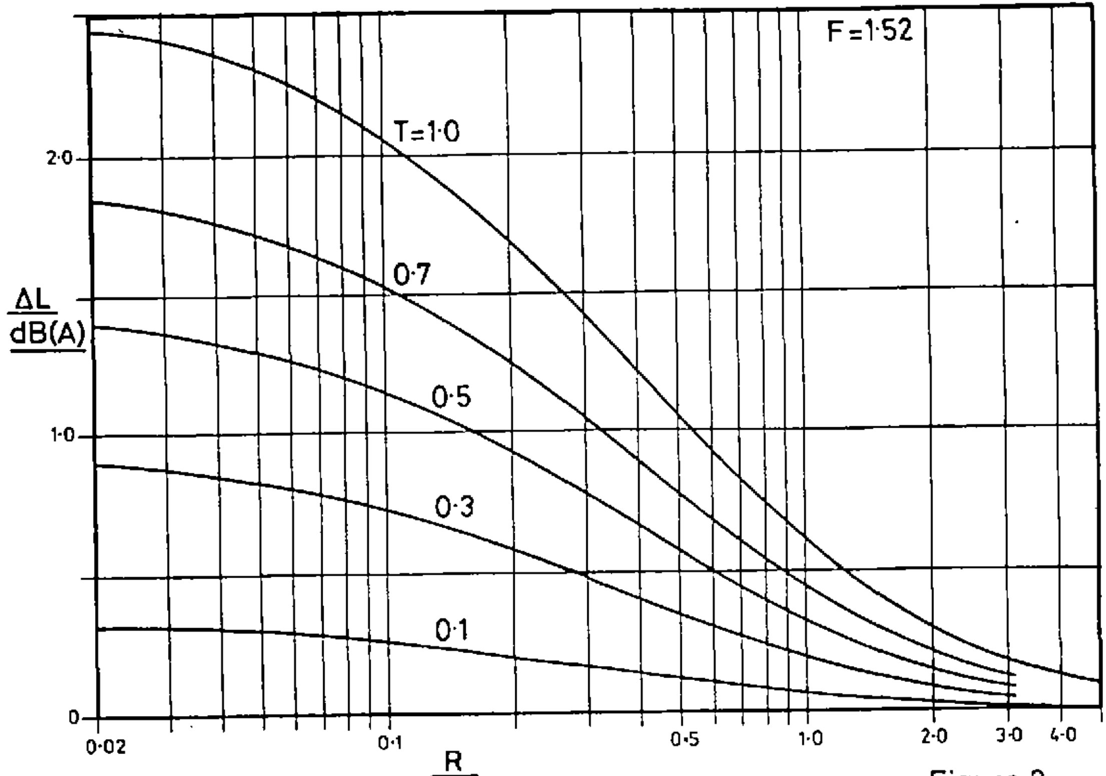

Figure 2