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# HELICOPTER NOISE ASSESSMENT

J.B. LARGE, J.G. WALKER and I.H. FLINDELL

INSTITUTE OF SOUND AND VIBRATION RESEARCH, UNIVERSITY OF SOUTHAMPTON

## INTRODUCTION

Helicopter overflight noise is not as widespread as fixed wing aircraft noise in the U.K. Accordingly, until recently, little research has been done on community response to helicopter noise. Nevertheless, the introduction of regular and frequent scheduled helicopter services on a limited number of routes in the U.K. necessitated the development of an appropriate noise impact assessment method. This paper describes the noise impact assessment method that was adopted for our assessment of the Heathrow/Gatwick Helicopter Service in 1978 and again in 1983. The conclusions of a recent CAA study of helicopter noise (1) supported our own conclusions as did the conclusions of an extensive series of laboratory comparisons between helicopter and fixed wing aircraft noise (2). In addition, a study was undertaken to determine the influence of height and track keeping on received noise levels and this is described below.

## 1978 NOISE IMPACT ASSESSMENT

The Heathrow/Gatwick airlink offers a regular and frequent service connecting the two major London airports. By necessity much of the route overflies rural and outer suburban areas with a large proportion of high socio-economic status housing development. Noise levels were recorded at nine representative sites along the route and a photographic record of height and track was taken using a telephoto lens mounted on a tripod fitted with protractors. Various candidate noise impact assessment methodologies were reviewed and considered along with direct subjective observation of the noise characteristics, as outlined below.

### The Noise and Number Index

The Noise and Number Index (NNI) was adopted as an appropriate index for fixed wing aircraft noise and has been in use in the U.K. for many years. Although no studies had been carried out at that time (1978) into the applicability of the NNI for helicopter noise it was felt that the use of the NNI was reasonable in this case, there being no evidence that helicopter noise had any greater or lesser annoyance potential than fixed wing aircraft noise. In fact the measured helicopter noise did not exceed 35 NNI at any survey site. Further, the helicopter noise was considerably lower than fixed wing aircraft noise (in terms of NNI) at nearly all the sites, none of which had unacceptable fixed wing aircraft noise exposure. It was therefore difficult to conclude other than that the helicopter noise was "not unacceptable" on the basis of the NNI methodology.

### The $L_{Aeq}$ concept

There is considerable pressure, especially in Europe, for the widespread adoption of the equivalent continuous A-weighted sound pressure level ($L_{Aeq}$) as a

universal noise index for all types of noise exposure. This approach has considerable merit from the purely physical point of view. There are unfortunately differences between community reactions to different noise sources at similar exposure levels, but in general these response differences can be attributed to the many non-acoustic variables that undoubtedly come into play.

A comparison between helicopter $L_{Aeq}$, fixed wing $L_{Aeq}$ and the pre-existing $L_{Aeq}$ due to all other noise sources minus the helicopter noise, showed that the helicopter noise contributed only a small amount of the total noise energy received at each survey site. This contribution varied from below 10% up to 30% of the total. In decibel terms this means that the helicopter $L_{Aeq}$ varied from more than 10 dB below up to 4 dB below the pre-existing $L_{Aeq}$. When the noise exposure from a single source is reduced by as much as 30% the sound pressure level reduces by just over 1.5 dB, an amount which would probably pass unnoticed. However, the addition or subtraction of a separate and clearly identifiable noise source would probably be clearly noticeable. Nevertheless there is very little evidence available on which to base a noise impact assessment using these figures.

ISO R1996-1971

ISO R1996-1971 "Assessment of noise with respect to community response" (3), was intended as a guide to community noise impact assessment. It specified a comparison between the $L_{Aeq}$ due to the noise in question and the pre-existing background noise, defined as the $L_{95}$ level. Approval of the Draft was opposed by the U.K. and the U.S.A. on technical grounds. Perhaps the principle defect of ISO 1996-1971 was that it enabled the presence of other, perhaps more intrusive, noises to be completely ignored when making an assessment. In addition, comparison with the $L_{95}$ background level had the effect of deeming additional noise to be more acceptable in areas already having higher background noise levels. This effect is completely in opposition to the comments concerning "creeping growth of the ambient noise level" in the DOE Circular 10/73 (4). The current revision of ISO 1996-1982 (5) no longer specifies comparisons between the specific noise source and the $L_{95}$ level. In addition, "ambient noise" and "residual noise" are defined to include all noises or all noises less the specific noise.

Our 1978 assessment employed ISO R1996-1971 merely insofar as to demonstrate that the helicopter noise was considerably less intrusive than fixed wing aircraft noise and road traffic noise at many sites.

$L_{Amax}$

BS4142-1967 (Amended 1975) (6) was intended to apply to noise from factories, industrial premises and other fixed installations only, and was thus not applicable by definition to helicopter noise assessment. Comparisons of typical $L_{Amax}$ levels from helicopter flyovers showed that they did not exceed fixed wing aircraft $L_{Amax}$ levels or even road traffic $L_{Amax}$ levels.

Subjective impressions

Field observations showed that the Sikorsky S61N helicopter used for the airlink service did not exhibit strong impulsive characteristics. In addition,

the field measurement team on occasions had considerable difficulty in hearing it coming in order to start up recordings before the maximum noise level occurred. Notwithstanding the somewhat innoccuous nature of the noise, a considerable number of complaints were directed to the appropriate airport and airline managements and the licensing arrangements were opposed by objectors at a public hearing.

## 1978 conclusions

In 1978 we placed most weight on our observations that the NNI values were low and that the helicopter made only a very small contribution to the ambient noise along its route. We concluded that its noise impact was "not unacceptable" and rationalized the complaint history in terms of the repetitive nature of the complaints from an articulate minority of those overflown. In our view, adverse reactions to the noise were strongly associated with visual intrusion, misfeasance, fear of crashes, an assumed invasion of privacy in previously secluded back gardens and similar factors. Further, there had been occasions when air traffic control restrictions had obliged the helicopter to fly particularly low which could have given rise to higher noise levels. Some complaints concerned track keeping and so a subsidiary study was undertaken to determine the relative effects of height and ground track.

## HEIGHT AND TRACK AND NOISE LEVELS

Figure 1 illustrates the results of the height and track study. The helicopter was flown past the measurement position at specified heights and minimum ground ranges and photographic records of flight path made. It was concluded that the maximum noise level was primarily dependent on height, not on minimum ground range provided that the angle of elevation was above $30^{o}$. This implied that the directivity pattern of noise radiated from the helicopter had broad lobes off to each side with reduced radiation vertically downwards. At the normal flying heights track appeared unimportant up to over 1 km either side.

## 1983 NOISE ASSESSMENT

An application for a renewal of the airlink operating licence led to a further public hearing. Our 1978 impact assessment was reconsidered in order to determine if any changes of circumstances necessitated any revision. Sample measurements showed that, not surprisingly, noise levels were little different in 1983 from 1978. The results of laboratory studies (2) showed that helicopter flyover noise was judged about equally as annoying as fixed wing aircraft flyover noise for noise exposure levels some 2 dB higher. In addition, the CAA field study (1) of helicopter noise in Scotland and the London area showed that where only one type of operation was common there was little difference between exposure-response relationships to helicopter and fixed wing operations. In areas having both noise sources, helicopter noise was rated more annoying than fixed wing aircraft noise but the additional annoyance is independent of the relative exposure levels of the two noise sources. However, total annoyance appeared to be consistent with total exposure using generalized exposure-response relationships in terms of NNI or $L_{Aeq}$. The CAA study suggested that higher socio-economic status was associated with a significant increase in reported annoyance

to helicopter noise and this suggestion was consistent with the observed complaint response from the Airlink helicopter. Accordingly, there was no reason for deviation from our 1978 assessment of "not unacceptable".

## CONCLUSIONS

Reasonable assessments of helicopter noise impact can be made on the assumption that the annoyance potential of helicopter noise is broadly similar to fixed wing aircraft noise at similar exposure levels. In this case a Sikorsky S61N flying a regular and frequent scheduled Airlink service did not give rise to unacceptable noise levels in the context of the environment along its route despite complaints from an articulate minority of those overflown.

## ACKNOWLEDGEMENTS

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Figure 1. Relationship between maximum noise level, height and track