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BIRMINGHAM INTERNATIONAL AIRPORT NOISE MONITORING SYSTEM: SPECIFICATION OF REQUIREMENTS

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Introduction

Other papers [1, 2] describe the system recently installed at Birmingham International Airport (BHX) and its operation. This paper summarises the work undertaken in 1983 to develop the system specification. This involved detailed reviews of then existing airport noise monitoring systems (ANMS) and practice, the noise abatement options at BHX, the noise impact studies performed by Professor Large for the 1979 new terminal inquiry, and the merits of alternative noise monitoring strategies. The system specification was issued in July 1983

Objectives

Airports install ANM to help reduce aircraft noise nuisance. Potentionally this can be done by using the system

- to monitor adherence to noise limits and/or noise abatement flight procedures
- to aid development of and encourage use of improved noise abatement procedures and
- to monitor long-term trends in noise exposure, providing data to planning and management authorities, to operators and to the public.

In these regards the system can be of considerable benefit to the area as a whole. It can also help in the investigation of specific noise complaints and provide a basis for operational noise abatement incentive schemes.

At Birmingham, previously existing noise control measures included noise preferential routings, noise abatement departure procedures, restrictions on hours of operation, ground running and training activities, and a noise insulation grant scheme. All noise complaints are reported and investigated [1].

Existing Practice

Although airport noise monitoring is far from universal, most major airports in the developed world practice it to a greater or lesser extent. Typical systems involve a number of remote noise monitoring terminal (NMTs) distributed in the residential areas surrounding the airport and

connected by data transmission lines to a central computer. Systems vary greatly in size and cost with numbers of NMTs between one and about thirty and with a wide range of data processing and output facilities. Some simple ones are assembled from 'off-the-shelf' components; some complex ones are purpose designed and built. To be useful, the noise monitoring process has to relate individual flight noise levels to specific aircraft movements. Most simply this is done by manual comparison of noise records and runway logs. In more elaborate systems it can be done automatically by linking the system to air-traffic control computers although this is not permissable in many countries including the UK.Most practical procedures involve some manual intervention such as real-time input of information by observers.

Most direct uses of airport noise monitoring can be divided into two approaches:

(1) Set aircraft limits (universal or varying with position) and monitor infringements.

(2) Accumulate noise statistics for individual aircraft types so that noisy operators of the type can be identified.

It is usual to publish regular bulletins to advise airlines of their performance. The information may also be used as a basis for penalty or incentive schemes.

Design Criteria

(i) Cost

(ii) Ability to measure

(a) aircraft adherance to specified noise abatement procedures

(b) noise exposure in specified

(iii) Freedom from extraneous noise.

(iv) Accessibility for maintenance.

(v) Flexibility of use and scope for development especially to accomodate future changes in traffic, routes etc.

Criteria (i) and (ii) inevitably conflicts since the cost is apporximately proportional to the number of NMTs.

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System for Birmingham International Airport

Figure 1 shows the location of the main runway (15/33) to the east of the city. Northerly departures from 33 overfly fairly heavily populated areas; population to the south is much less. At present some 2/3 of flight origins and destinations lie to the south and about 75% of operations occur on runway 33 (i.e. take off and land to the north). The departure tracks to the east are to be preferred from a noise viewpoint although many navigational and air traffic control constraints prevent their general use at present and a significant number of departures turn to the west. Community noise impact is very dependant upon accurate track keeping; unfortunately this cannot be monitored directly at BHX because no suitable (secondary surveillance) radar is available at present.

Selected Noise Monitoring Option

The overriding criterion was that of cost; restricted resources limited the system to a handful of NMTs and the main taskgoverning system design was to dispose these so as to maximise the benefit. The option of locating them in known noise-sensitive locations was rejected on the grounds that although this might reduce the number of noise complaints initially it would not necessarily lead to a reduction in noise impact in the area as a whole - indeed the opposite might occur. Instead our aim was to position the NMTs so that (a) all aircraft noise emissions could be accurately assessed, even if departures from track were significant and (b) adherance to noise abatement procedures could be checked.

Minimum nuisance departures involve the implementation of 'noise abatement climbs' following precise power/configuration/climb profiles along 'noise-preferential' ground tracks. Full noise monitoring of any such departures would require an extensive array of NMTs along the track; as a minimum it is desirable to use two NMTs, one on each side of the flight path. Provided this NMT 'gateway' is properly spaced the arithmetic average of the two measured levels (termed the 'gateway level') is relatively insensitive to aircraft deviation from the (centre) track. On the other hand the difference in the two levels indicates the extent of the deviation.

The selected array, shown in Figure 1, involves seven NMTs, six of them arranged in two triangles making up four gateway pairs. The two apex units are located on the extended runway centre-lines 6.5 km from the start of roll; this distance is used in international aircraft noise certification measurements and will normally lie beneath a reduced noie climb segment. The outlying NMTs are 1600 m from the apex at an angle of 120 degrees. Each gateway covers a wide range of possible departure tracks.

With this arrangement a single gateway noise level may be defined for any departure, i.e. the highest pair average. The tracks followed by departing aircraft can be assessed from the difference between the two gateway levels with the highest average. If required, noise levels of approaching aircraft would normally be monitored at the centreline NMTs only (in instrument flight the straight in approach path is very accurately maintained). The purpose of the seventh NMT, located on the airfield alongside the main runway, is to monitor airfield noise, to help identify individual aircraft movements through their precise time of departure or arrival and to exclude extraneous noise events

at the main NMTs which may have been erroneously identified as aircraft. We advised BHX to concentrate their initial resources into the NMTs and their data link relatively inexpensive central processor would suffice durint the early stages of the systems use. There is no standardised approach to aircraft noise minitoring; the system and its use should be allowed to evolve on the basis of local experience. Individual events are measured in terms of both LAmax and SEL so that NNI and Leq can be calculated over suitable periods of time. Since noise contours around the airport are broadly oval in shape (elongated along the runway axis) the NMT array is suitable for checking the overall dimensions on the current noise impact area.

The specification developed was aimed to provide BHX with a relatively inexpensive ANMS that can be operated in a flexible manner to provide the best control over aircraft noise that available resources allow. The actual installation is described in reference 2.

References

[1] Lambert, R, 'The Airport's Response to Environmental Issues', IoA Conference paper, October 1986.

[2] Myles, A. J. I, 'Multi-Channel Airport Noise Monitoring", IoA Conference paper, October 1986.

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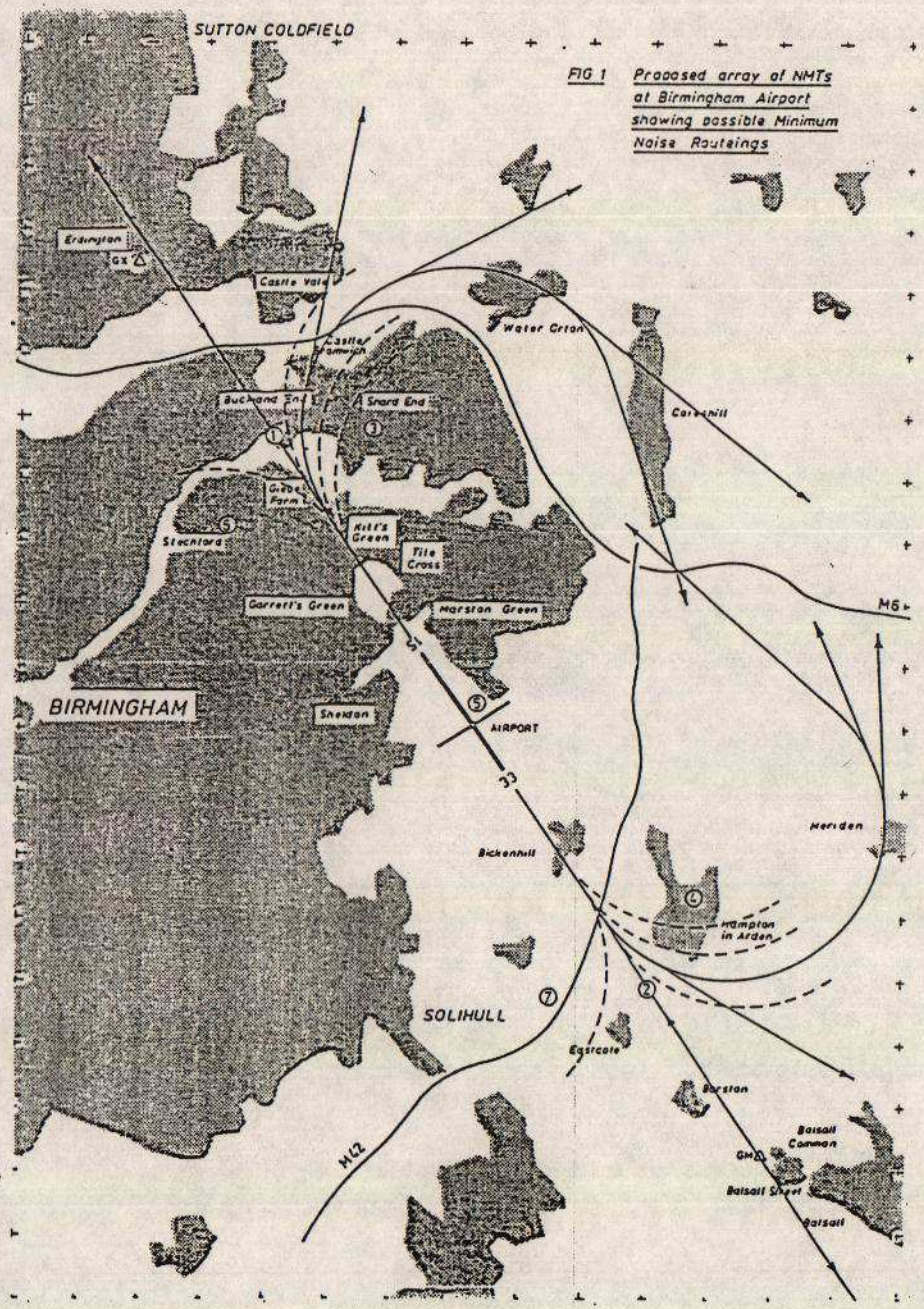

FIG 1 Proposed array of NMTs at Birmingham Airport showing possible Minimum Noise Routeings