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CALCULATION OF GENERAL AVIATION NOISE

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TRAVERS MORGAN PLANNING

1. Introduction

1.1 Recently, there have been several proposals to open new General Aviation airports or increase the level of flying at existing airports. In order to assess the benefits or disbenefits to the community from a new G.A. airfield, one of the factors that has to be considered is the change in noise levels which may occur around the airfield and the flight paths. In this paper we outline methods for calculating the Leq noise level from general aviation activity and in another paper our colleague will discuss the indices used for the assessment of disturbance from general aviation.

2. Manual Method

2.1 In order to calculate the noise level at any location around a G.A. airfield, several operational variables are required which are usually obtained from the aviation consultant concerned with the proposal. These include:

- i) the ground tracks of the likely flight paths
- ii) the frequency of use of each flight path
- iii) the aircraft fleet mix
- iv) the vertical profile of the flight paths for each type of aircraft.

2.2 Noise levels from each type of aircraft are required, together with attenuation rates under normal operating conditions. The information on noise levels is conveniently tabulated for several types of aircraft in a Bolt, Beranek & Newman report, Sound Exposure Level Versus Distance Curves for Civil Aircraft, in which a range of slant distances from 200 feet to 25,000 feet are covered for each type of aircraft. This eliminates the need to evaluate the attenuation rate, as the levels given are based on measured values and this is therefore included.

2.3 To calculate the noise level at a given point for any given day (or average day) using this method, the slant distances from the point to each flight path are calculated and the slant angle checked. The noise levels corresponding to these distances and aircraft types are then read from the tables (for slant angles of less than 15 degrees, the ground to ground propagation tables are used). These levels are then adjusted for the number of aircraft and summed to give the total Lax at the reception point.

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2.4 The total Lax is then converted to an Leq for the period corresponding to the numbers of aircraft in the required day. The calculation can either be repeated for sites of interest or over a grid network to enable contours to be plotted. This is obviously a very tedious exercise and can be greatly speeded up with the use of a computer, storing the tabulated data in matrix form and entering the ground tracks and reception points using a co-ordinate system.

3. Computer Method

3.1 We feel that this simple model could be improved upon in several ways. The BB and N data gives noise levels for aircraft in two modes - take off and landing. Around most G.A. airfields there are a large number of touch and go operations and, especially in the South East of England, G.A. aircraft quickly reach their local operational ceiling which is governed by air traffic control procedures for commercial flight levels. Thus, a large number of properties are overflown by aircraft at cruise power, typically at an altitude of between 1,000 and 2,500 feet. Aircraft also sometimes have restrictions on their power settings on climb-out once a certain altitude is reached. Noise levels for aircraft in these modes are also required.

3.2 Two other factors to be taken into account were the swathe widths of the flight paths and the calculation of Lax values from aircraft on curved paths.

3.3 For our current method for calculating the noise levels at any point we carry out the following operations:

- i) The ground tracks of the flight paths are drawn onto Ordnance Survey mapping and the tracks are then approximated by straight line segments. The segments are digitised, together with the locations and heights of the reception points.
- ii) Enter the vertical profile of each flight path for each type of aircraft.
- iii) Enter reference noise levels in dB(A) at 500 ft. for each type of aircraft for the following flight modes:
 - a) take-off/full power climb
 - b) reduced climb
 - c) level flight
 - d) landing
- iv) Enter the attenuation coefficient for each type of aircraft.
- v) Enter the number of each type of aircraft for each flight path.

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- vi) New segment changes on the ground track of the flight path are generated by the computer at changes in the vertical profile.
- vii) For each flight path, extra flight segments are generated by the computer to simulate the swathe width and number of each aircraft using these segments are calculated.
- viii) We calculate the Lax noise level for each segment by summing noise every half second. This is achieved by calculating the noise level at the start and end of the segment, calculating the time taken to traverse the segment and interpolating to find the noise every half second. These calculations are repeated for each aircraft type and for each segment.

The form of calculation is of the simple Lax type:

$$Lax(s_i a_j) = 10 \log \sum_{t=0}^{t = \frac{d_{ij}}{v_{ij}}} (10^{L_{ij}(t)} + 10 \log \frac{1}{2})$$

where s_i = segment i

a_j = aircraft j

d_{ij} = segment length

v_{ij} = speed of aircraft along segment

L_{ij} = noise level at half second intervals

To limit the number of calculations, segments are ignored if they satisfy certain criteria.

- ix) The total Lax at the site for each flight path is calculated, then these are summed and the daily Leq calculated for the site. This can then be repeated for individual sites or a matrix of sites as for the manual method.

4. Conclusion

- 4.1 We have a computer program for calculating general aviation Leq noise levels which takes into account all the important factors upon which these depend and can be modified easily to accept most other factors that can be important to a particular situation.