Bickerdike Allen Partners
Architecture
Acoustics
Technology

Farnborough Airport Consultative Committee
Acoustic Service an Overview

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Introduction

- What is noise?
  - Sound is air oscillation that is propagated by wave motion
  - Frequency between 20 Hz and 20,000 Hz corresponding to low and high pitch sound.
  - Sound is measured in decibels (dB)
  - Noise is unwanted sound
- How do people perceive noise?
  - Noise levels are typically quoted as “A-weighted” for instance dB(A)
  - A-weighting allows for the human ear’s sensitivity to difference frequencies
  - Sensitivity to noise and in particular high frequencies changes with age
- What affects noise?
  - Source noise level
  - Distance
  - Soft vs hard ground
  - Obstacles
  - Weather

Introduction

What do noise levels mean?

- Noise levels of typical experiences
- Government policy and guidance
- Research on impact of different noise levels

What do changes in noise mean?

- A change of 1 dB is the minimum that can normally be perceived in laboratory conditions
- A change of 3 dB is the minimum that can normally be perceived in normal conditions
- A change of 10 dB is typically described as being equivalent to a subjective halving/doubling of noise

Table 3.1: Approximate sound pressure level (LpA) for different activities or situations

Situation	Sound Pressure Level LpA dB(A)
Threshold of pain	130
Threshold of discomfort	120
Chainsaw, 1m distance	110
Disco, 1m from speaker	100
Diesel truck pass-by, 10m away	90
Kerbside of busy road, 5m away	80
Vacuum cleaner, distance 1m	70
Conversational speech, 1m	60
Quiet office	50
Room in quiet, suburban area	40
Quiet library	30
Background in TV studio	20
Rustling leaves in the distance	10
Hearing threshold	0

Source: Airports Commission, based substantially on http://www.sengpielaudio.com/TableOfSoundPressureLevels.htm

Introduction

Typically, noise from airports come from a variety of sources, these include:

- Surface Access Noise
  - Cars from passengers accessing the airport or staff commuting
  - Primarily affects people who live along main roads or airport access roads

- Ground Noise
  - Noise from aircraft using the aprons and taxiways
  - Generally perceived as a relatively continuous background noise, similar in character to the noise from distant busy roads
  - Primarily affects those who live closest to the airport site

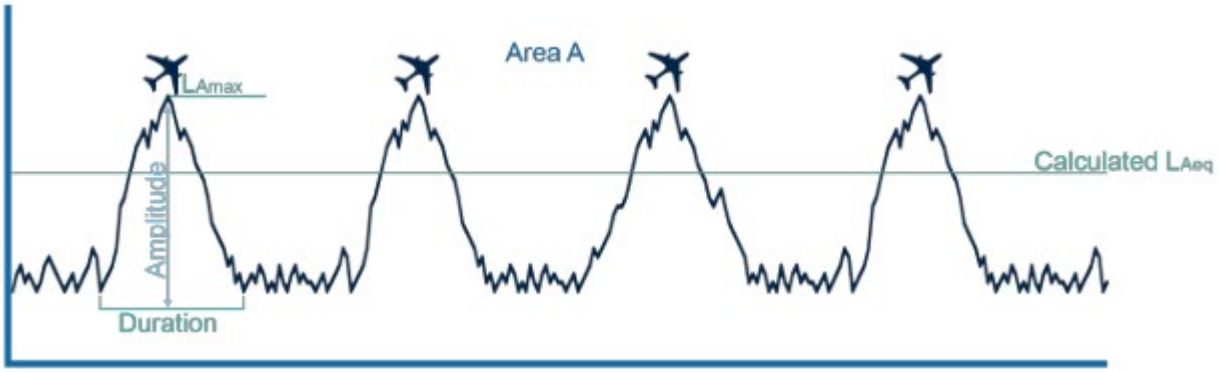
- Airborne Aircraft (Air) Noise
  - Main source of noise from an airport
  - Due to aircraft departures and arrivals (including when using the runway)
  - A series of individual events, generally clearly distinguishable from background noise
  - Can affect people across a wide area

Noise Metrics

Noise can be expressed using various noise metrics. In the UK, the primary metric used to assess aircraft noise is $L_{Aeq,T}$:

- Government policy and guidance and research largely relate to the L_{Aeq} metric
  - Research into effects of aircraft noise on people are based on surveys of people living near airports, takes into account the intermittent nature of aircraft noise.
  - Metric has shown best correlation with response

- L_{Aeq} expresses noise as an average noise level over a period
  - 16 hour daytime ($L_{Aeq,16h}$) 07:00-22:59
  - 8 hour night-time ($L_{Aeq,8h}$) 23:00-06:59



Noise Metrics

- Although expressed as an average noise level, it is a measure of total noise
  - Measured over standard daytime period rather than operating hours to allow for direct comparison with guidance and research on effects
  - If measured based on operating hours would suggest closing earlier was not be a benefit. Longer operating hours with the same number of flights would show a “lower” noise level
- Aircraft noise usually assessed over the 92-day summer period
  - 16th June to 15th September inclusive
  - This is a particularly sensitive period, generally more people open windows in the summer and it is typically a busy period for airports

Noise Metrics

Airports often produced other supplementary metrics, these include:

- Number above (Nx)
  - Measures the number of events above a certain maximum noise threshold. For instance, N65 measures the number of events above 65 dB L_{Amax}
  - Intended to be easier to understand than L_{Aeq}
  - Changes in N contours can be complicated to understand, as they can be disproportionate

- L_{den} and L_{night}
  - Commonly used in Europe
  - L_{night} similar to $L_{Aeq,8h}$ used in the UK, except based on annual rather than summer period
  - L_{den} combines a 12 hour day, 4 hour evening, and 8 hour night noise levels; with a 5 dB penalty applied to evening and 10 dB penalty applied to night

Noise Metrics

Some other common metrics include:

- L_{Amax} and SEL
  - Used to measure discrete events, such as aircraft overflights
  - L_{Amax} measures the maximum noise level of an event
  - SEL measures the total noise energy from an event and expresses it as an average noise level over 1 second. Similar to L_{Aeq} but for single events
- L_{A90}
  - L_{A90} is often used to describe background noise
  - Measures the noise level exceeded 90% of the time
- $L_{A10,18h}$
  - Used to assess road traffic noise in the UK
  - Measures the level exceeded 10% of the time across 18 hours

Noise Modelling

It is not possible to measure noise at every house. Assessment of future noise is often required, which can't be measured. Therefore, noise modelling is used. Aircraft noise modelling typically uses specialist software, such as:

- Integrated Noise Model (INM)
  - Produced by the USA's Federal Aviation Administration (FAA)
  - Used for many years at Farnborough and was used to calculate the current noise budget
  - Incudes details for many common aircraft types, including many of those used at Farnborough
- Aviation Environmental Design Tool
  - Also produced by the FAA, replaced INM
  - Includes newest aircraft types
  - Used to produce contours for the recent planning application
- ANCON
  - Produced by the UK's Civil Aviation Authority (CAA)
  - Not commercially available
  - Primarily based on noise measurements around Heathrow, Gatwick and Stansted airports

The various noise models produce broadly similar results when the same inputs are used

Noise Modelling

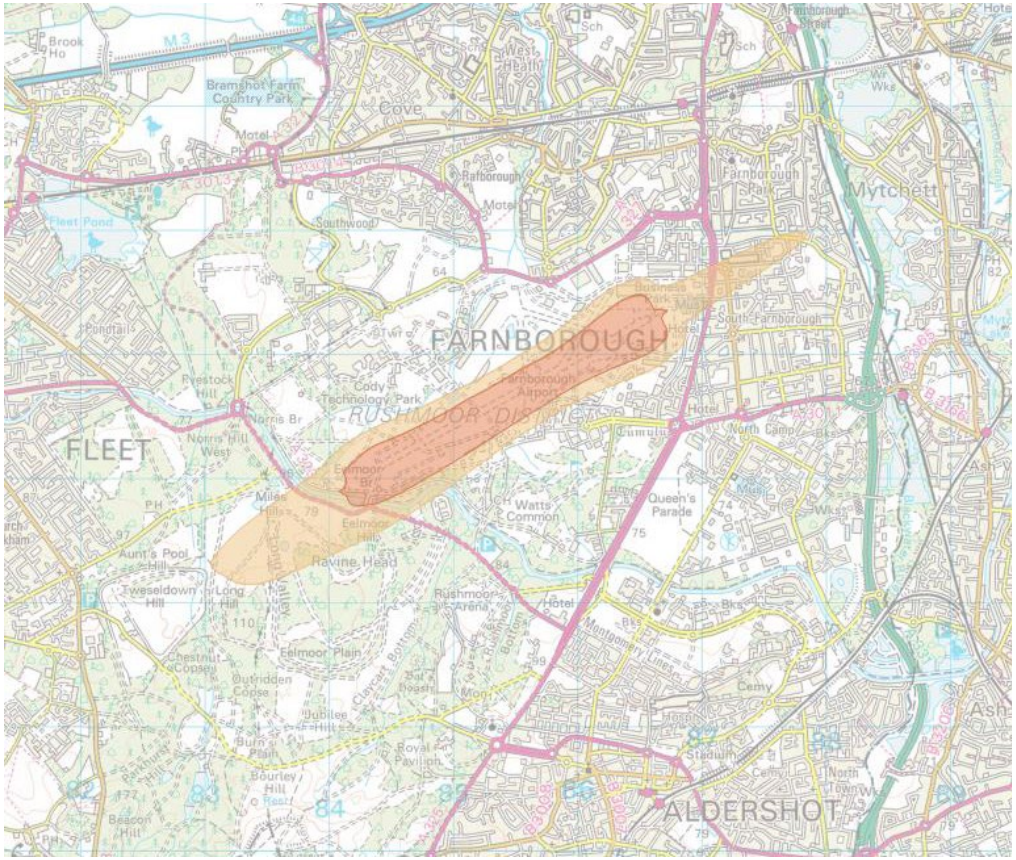
The results the noise models produce are based on the data input into the model. This can include:

- Details of the airport
  - Location of runway(s) and their usage
- Details of aircraft movements
  - Number of movements
  - Aircraft types
- Aircraft flight tracks and procedures
  - Based on radar data including position, altitude, and speed
- Aircraft noise levels
  - From the airport's noise monitoring terminals (NMTs)
- Weather
  - The AEDT noise model includes 10 years of weather data
  - Used to more accurately model how noise propagates through the air
- Terrain

Noise Modelling

The noise models can give various outputs, these include:

- Noise contours
  - Show a line of equal loudness or an area within a noise band, i.e. 55 dB to 59.9 dB (orange)
  - Area of 55 dB $L_{Aeq,16h}$ annual day contour is limited by the current noise budget to 6.58 km^2
- Spot Noise levels
  - Representative locations
  - NMTs
  - Buildings



Noise Measurements

The airport measures noise in a number of ways, including:

- Permanent fixed Noise Monitoring Terminals (NMTs)
  - One for each runway end, located at Farnborough College and at Tweseldown Racecourse
  - Measures noise from each arrival and departure
  - Used to validate the INM/AEDT noise models
- Mobile noise monitor
  - Can be located in various locations
  - Can be used to monitor in areas where there is a specific community concern
- Consultants
  - Can be appointed to undertake noise surveys, such as that undertaken recently in Churt

Noise Measurements

The noise measurements from the airport's NMTs are used to validate the predictions from the INM and AEDT aircraft noise models.

- Validation conducted every year
- Validation covers the 20 most common aircraft types
  - These types are typically responsible for over 90% of the noise
- Measured noise levels from the NMTs are compared to the default predicted noise levels from the modelling software
  - Where necessary adjustments are made to noise model to better reflect the measured noise levels
- Ambient noise doesn't generally significantly affect aircraft noise measurements at the NMTs
  - Aircraft are relatively loud close the airport
  - NMTs are deliberately located in relatively quiet areas away from major roads
  - Can have more of an effect further from the airport, survey sites need to be chosen carefully to avoid ambient noise issues