Environmental Studies
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Reducing noise pollution at Heathrow

This Factsheet:

- Explains how noise pollution is measured
- Describes the arguments for a new airport in the southeast
- Outlines the effect of noise on health
- Explains the sources of aircraft noise and techniques used to reduce aircraft noise

Measuring sound

- For hearing, the unit of measurement of loudness is the Bel
- The quietest sound that can be heard by the human ear is 0Bel
- We normally use decibels where 1bel = 10 deciBels (dB)

Measuring noise pollution

To measure noise pollution (annoying or harmful sounds) we adapt the dB scale to take account of other factors:

The dBA scale is used as a measure of perceived loudness which matches the response of the human ear. The two main features of the dBA scale which enable it to match the response of the ear are:

1. it is logarithmic so can take account of the huge range of sounds that the human ear can detect
2. it takes account of the frequency of the sound. The human ear is not very good at detecting low frequency sounds so the dBA scale lowers the decibel values of low frequency sounds so they have less significance

For aircraft noise we use the Noise and Number Index (NNI). This takes account of the number of aircraft flights and the highest noise levels produced by each aircraft.

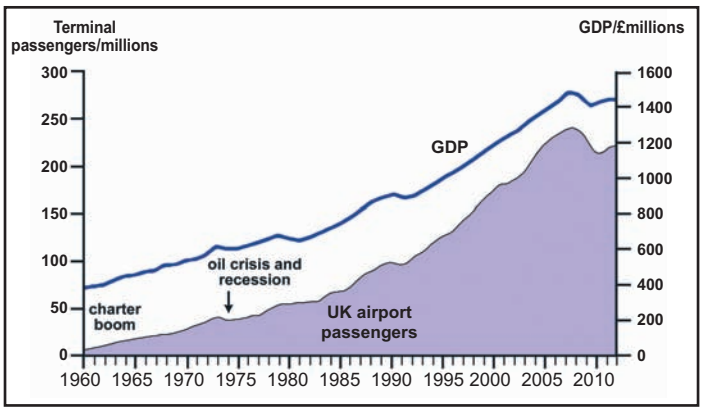
Limitations of the NNI:

- It only measures noise levels of aircraft above 80 dB – aircraft below 80 dB were believed not to cause serious annoyance – but thousands of residents disagree with this!
- It doesn't take account of the duration of the noise
- It doesn't take account of the type of noise e.g. from jets, propellers, reverse thrust but people have different sensitivities to these types of noise

The government produce NNI contour maps showing how many people live within each contour and this information can be used when deciding whether to build new runways or change flight frequency or flight paths for example.

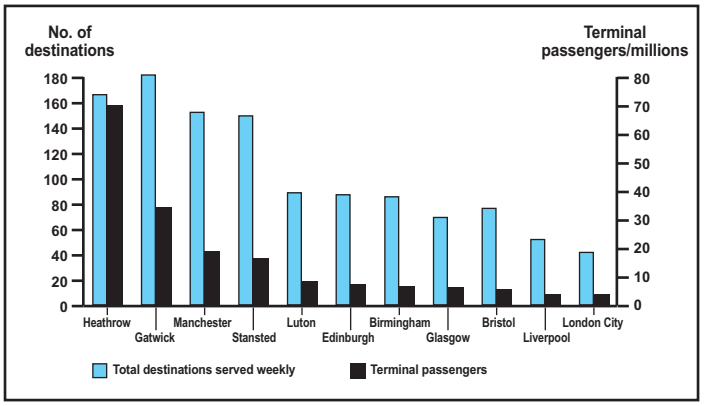
Since the 1960s, UK air travel has rise in line with, and at times slightly faster than, economic growth (Fig.1)

Fig. 1: UK air travel and GDP 1960-2012



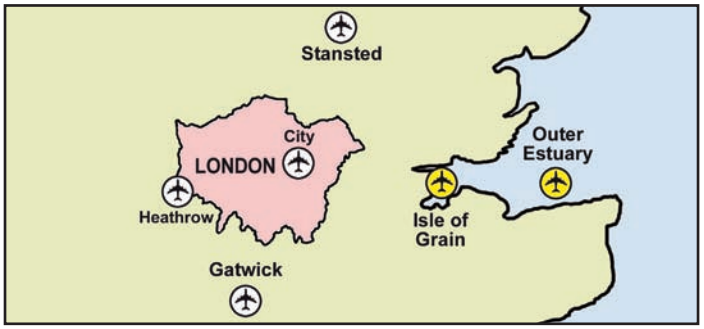
Both passenger and freight travel have increased at all the major and minor airports but passenger demand is highly concentrated on the four biggest airports (Fig. 2).

Fig. 2: No. of passengers selected UK airports 2012



In 2013 the government concluded that there was a clear case for at least one new additional runway in London and the South East by 2030, either at Gatwick or at Heathrow. They are also still considering the idea of a totally new airport in the Thames Estuary or on a new island – the Isle of Grain (Fig. 3) – but the environmental and economic impact may be too great.

Fig. 3: Proposed sites for a new airport



A new airport in the Thames Estuary would solve many of the noise pollution problems that affect hundreds of thousands of people living under the Heathrow flight paths. Approximately a quarter of a million people around Heathrow currently experience noise levels in excess of 57LAeq. It would also provide jobs and regeneration for the east of London region including space for 150,000 new homes.

However, it would result in serious damage to UK, European and international conservation designations such as:

Natura 2000 – a EU network of protected areas to protect Europe's most valuable and threatened species and habitats.

It includes Special Areas of Conservation (SAC) to protect habitats, Special Protection Areas (SPAs) to protect birds and their habitats and means that development can only take place in these areas when no alternative exists or where there are 'imperative reasons of overriding public interest' (IROPI) that justify the plan or project despite the environmental damage it will cause.

Critics also argue that it would:

- require closure of Heathrow and its decontamination and preparation as a building site
- harm hundreds of businesses that are located along the Thames Valley corridor in order to be close to Heathrow
- require demolition of existing homes and would be at risk of future flooding

A final decision is expected in 2015.

Why not replace domestic flights with high-speed trains (HSTs)?

The Commission concluded that replacing many domestic flights e.g. Heathrow to Bristol with HST, which would free up slots at both airports for more international arrivals, was inadequate because:

- Not enough slots would become available
- Passengers might not choose the HST
- Passengers might choose to fly to other airports in Europe instead of Heathrow.

Aircraft noise and health

Several scientific studies have shown that there is an association between long-term exposure to aircraft noise and the **risk** of having a heart attack. This does not mean that such exposure **causes** heart attacks.

Several studies have shown borderline statistical significance meaning that the results could have been due to chance. An association is not the same as causation.

Aircraft noise at Heathrow

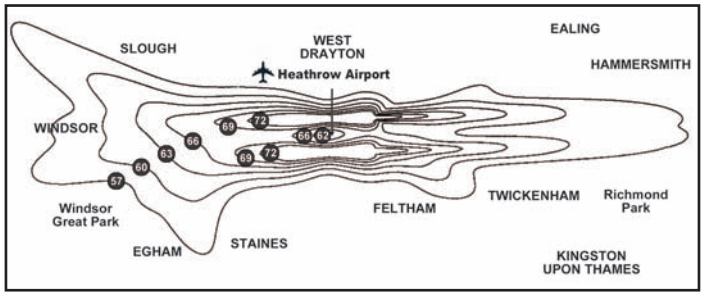
Aircraft noise is calculated by averaging out the noise levels over a 16-hour day (0700-2300) for 92 days in summer. This is known as the averaged-out decibel measurement "LAeq" or "equivalent continuous noise level".

The UK Government assumption is that people start to become significantly annoyed by aircraft noise at 57 dB LAeq. The Civil Aviation Authority produce maps annually which indicate which areas fall within the area subject to 57 dB LAeq.

Exposure to noise is shown on noise contour maps i.e contours joining areas of constant LAeq. LEq contours are plotted for every 3dB rise between 57 and 72 dB.

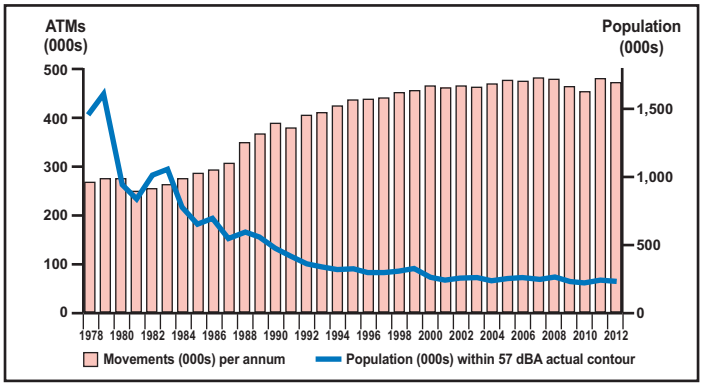
Fig.4 shows a typical noise contour map for aircraft departing west from Heathrow in 2010.

Fig. 4: Noise exposure at Heathrow in 2010



Although Heathrow has become busier and busier, the numbers of people who live within the 57LAeq45 contour, the standard UK metric for assessing aviation noise impacts, has fallen (Fig.5).

Fig. 5: No. of people living within 57 dBA contour and air traffic movements (ATMs)



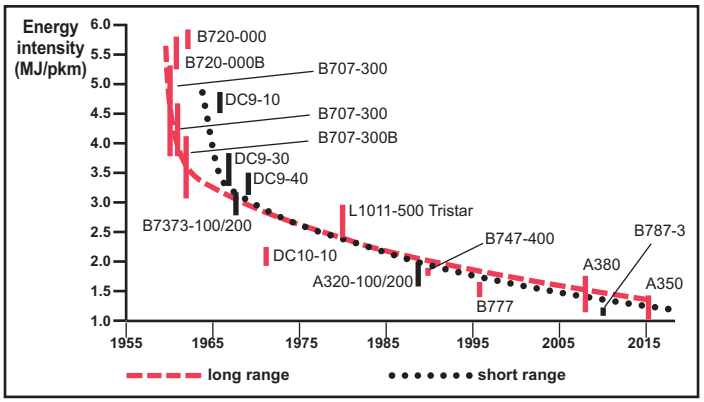
This has been due to:

1. Improved aircraft technologies and
2. Takeoff and landing procedures designed to reduce noise

1. Improved aircraft technologies

Aircraft have become more fuel-efficient (Fig.6) and quieter, trends that are expected to continue.

Fig. 6: Aircraft fuel efficiency



Improved aircraft design has done much to reduce noise generation:

- Improved aerodynamic features such as fairings – cone-shaped, moulded surfaces on the cockpit, wheels and wing ends that make them more aerodynamic, reducing turbulence and noise.
- Most engine noise is caused by the fans drawing air into the engine and the jet of air that propels the aircraft forward. In modern, high bypass ratio turbofan engines most of the incoming air bypasses the engine core, reducing jet noise, thus making the engine quieter and more efficient.
- Acoustically absorbent material is used to line the air intakes and exhausts, absorbing noise.
- Engine hush kits on low-bypass engines mix exhaust gases with surrounding air, reducing exhaust velocity, thus turbulence and noise. Adding more exhausts or spreading the area over which exhaust gases are emitted will also reduce noise (but decrease thrust and reduce fuel efficiency).
- Improved alloys have enabled lighter aircraft, needing less powerful, quieter engines.

2. Takeoff and landing procedures

Alternation of runways for landing

Heathrow has two parallel runways which are alternated for incoming aircraft to provide relief from noise for residents living under the final approach path into Heathrow.

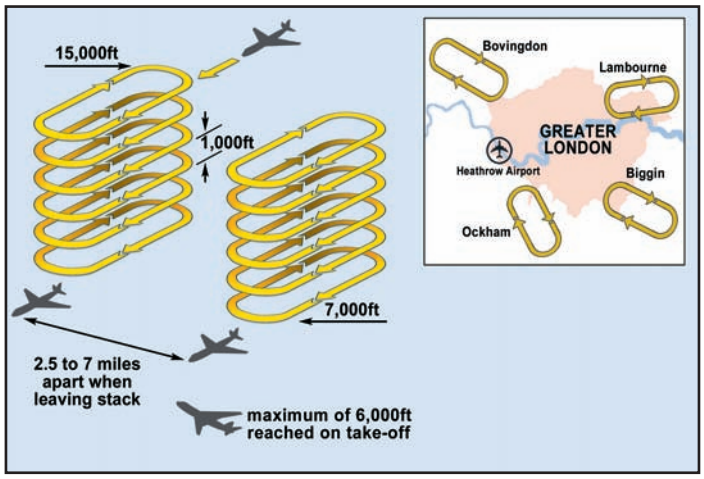
However, there are some who argue that both the north and south runway should be used for both arrivals and departures at the same time – mixed mode operations. This would enable arrivals and departures 24 hours a day and would significantly increase the exposure of the local population to noise. As expected, local action groups are vigorously opposing mixed mode operations.

Reduced aircraft stacking

A stack is a fixed circling pattern in which aircraft fly whilst they wait for a chance to land. At busy times there is often a build up of aircraft waiting to land and Air Traffic Control (ATC) allocate each plane to one of four stacks at Heathrow (Fig. 7).

Since the minimum height of aircraft in the stack is 7,000ft this doesn't create much of a noise problem but planes leaving the stack to start the final approach to Heathrow can be heard.

Fig. 7: Stacks at Heathrow

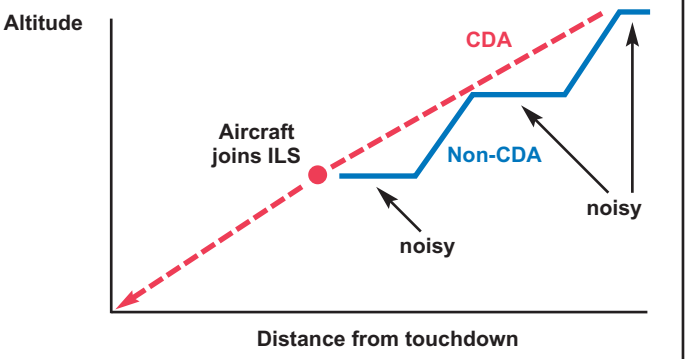


The need to stack can be reduced by ATC informing pilots about possible stacking delays earlier e.g. by requesting pilots to slow down in-flight in order to "absorb" delays. This also reduces noise, fuel consumption and emissions.

Greater use of Continuous Descent Approach (CDA)

In a CDA a pilot tries to achieve a continuous descent to join the instrument landing system glide-path to landing, avoiding the need for extended periods of level (i.e. noisy) flight (Fig. 8). A CDA keeps the aircraft higher for longer, using reduced thrust and thus reducing arrival noise.

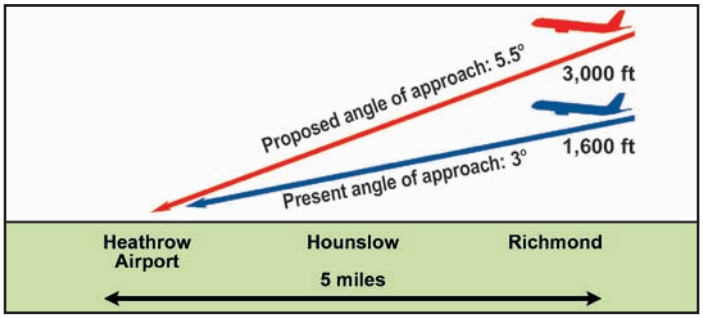
Fig. 8: CDA v a non-CDA



Increasing the angle of descent

Aircraft currently descend into Heathrow at an angle of 3°, flying at about 1,600ft as they pass over the suburb of Richmond. There are proposals to increase this to 5.5° which would mean incoming aircraft would then pass over Richmond at 3,000ft, reducing noise impact (Fig. 9).

Fig. 9: Increasing the angle of descent to decrease noise



Limiting the use of reverse thrust

Reverse thrust is a way of slowing down planes once they have landed. Sometimes, for example, on a wet runway, reverse thrust must be used for safety reasons. However, to reduce disturbance in areas close to Heathrow, pilots are asked not to use reverse thrust after landing between 23:00 and 06:00 hours local, unless they need to for safety reasons.

Departures via Noise Preferential Routes

All aircraft leaving Heathrow Airport should follow flight paths known as Noise Preferential Routes (NPRs) up to an altitude of 4000ft. NPRs were designed to minimise over-flying of built up areas. Any flight leaving a departure route below 4,000ft (called a track deviation) is automatically tagged by the Noise and Track Keeping System at Heathrow and deviations are analysed to check the reasons for this.

Restricted night flights

Night flights are not banned at Heathrow but the government impose restrictions on the numbers and types of aircraft that are allowed to operate between 23:00 and 06:00. On average there are 14-16 arrivals between 04:30 – 06:00 with the first scheduled arrival at 04:50 although aircraft arriving into the UK from North America frequently encounter tail winds that result in them arriving earlier than this.

Similarly, flights sometimes arrive after 11:00 as a result of bad weather or technical problems.

Increased landing charges for noisier aircraft

Heathrow charge more for a noisy plane to land than a quieter one, in order to encourage airlines to use their quietest fleets.

Careful siting of test areas and power units

Engine testing pens are located as far from residential areas as possible and are shielded by noise-absorbing pen walls. Their use is restricted by time and duration.

Restrictions on use of noise auxiliary power units for air-conditioning etc whilst aircraft is on the ground.

How else is airport noise pollution reduced?

- acoustic walls/baffle mounds/embankments/trees that absorb/deflect sound
- double/triple glazing on affected homes to absorb noise.

Trade-off between noise and emissions

Changes to aircraft that reduce noise result in that aircraft releasing more greenhouse gases.

So reducing one problem may increase another. For example in order for the A380 airbus to meet noise restrictions at Heathrow it is fitted with a nacelle which has the side effect of reducing fuel efficiency and increasing CO_2 emissions.

Is 57 decibels the wrong measure of annoyance?

Scientists at Southampton University have suggested that 57decibels is the wrong measure of annoyance and that nearly 1 million residents who live just outside the 57dB contour but who experience 50dB are suffering noise pollution. The researchers suggest that the 50dB contour line should be used when planners make decisions about the maximum number of flights that is acceptable, flight paths and decisions about a third runway at Heathrow or a second runway at Gatwick.

Acknowledgements:
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