

GETTING THE WIND UP



Bengt's story in this edition of HindSight (The first officer is my mother-in-law) touches on an issue that is very important to pilots - perhaps more important than some controllers realise. That is the question of the surface wind, its strength and direction relative to the runway, and the different ways in which it affects the take-off and landing phases of flight.

There are several closely interrelated aspects of the surface wind which are of particular interest to pilots: its direction relative to the runway direction; its strength; its variability - i.e. the extent to which its direction and strength vary in gusts; the way in which its direction and strength vary with height; and the vertical component of the wind - updrafts and downdrafts. When the wind changes significantly over a short time period, this is known as wind shear; wind shear may occur in a vertical or a horizontal sense, but the effect of vertical change is likely to be more dangerous because it is more uncommon and therefore unexpected. Extreme vertical movements of air, usually occurring in the region of thunderstorm clouds, are called microbursts.

Although new technology is becoming available, wind is usually measured using cup-and-vane anemometers, which have not changed much over the years. Most aerodromes have a number of anemometers positioned at strategic positions; this allows the wind to be measured as close as possible to the landing runway and provides redundancy in case of failure. This is

especially important at airports where the terrain produces widely different wind conditions in different positions. Conventional anemometers are vulnerable to extreme weather conditions and have been known to fail just when they are most needed; this was the case in the 2005 runway overrun accident at Toronto, referred to in the article 'Predicting Thunderstorm Activity'. At some airports, combinations of anemometers are used to predict wind shear.

CONTROLLABILITY

The wind characteristics affect flight in several different ways. First, there is the question of control. The lower level of the atmosphere is always somewhat turbulent for a variety of reasons; if the wind is strong, then as it blows across the surrounding countryside its speed and direction are constantly changed by the obstacles it meets, so that a strong wind is never stable and the already existing turbulence is increased. This makes handling difficult, especially on the approach and landing phase.

Strong wind shear, too, can generate control problems. If the wind strength or direction changes considerably as the aircraft descends, it may be difficult to maintain the optimum descent profile accurately. In extreme cases, the aircraft may become uncontrollable and a go-around must be commenced without delay. Some airfields and most modern aircraft are equipped with wind shear warning devices so that action may be taken before a dangerous situation develops.

STABILISED APPROACH

Stability is really only an extension of the controllability issue. It is an established fact that good landings result from good approaches, while bad approaches often lead to uncomfortable or even dangerous landings. This is why in the flying world, so much attention is paid to the principle of a stabilised approach. Put simply, the aircraft must be in a stable condition and prepared for landing by the time it reaches a specified height; if not, the approach must be abandoned and a go-around flown.

If the approach is unstable, and the pilot does the right thing and goes around, fuel is wasted, the passengers get cross and maybe the rest of the day's schedules are delayed. So even if he/she should not, the pilot may be strongly tempted to press on and make the most out of a bad situation.

Wind is important in establishing a stabilised approach. In gusty or strong cross-wind conditions, it may be difficult to maintain the approach profile accurately, especially if wind shear is present.

Landing gear, flaps, slats, etc. usually have critical maximum speeds above which they may not be extended; extension of these devices increases drag which assists in the slowing down process, so in tail-wind conditions, the pilot must allow extra time to configure the aircraft for landing. If a marked change in wind is un-forecast and/or is not noticed by the pilot, he/she may have difficulty in main-

taining the correct speed and approach profile.

Runway choice must take into account the wind direction and should aim to provide a head-wind component for landing. It is easy to forget that although the wind may be light on the surface, a few hundred feet higher a tailwind may exist. When there is a tail component of 5 kt on the runway the tailwind at 1000 ft may be 10 or 15 kt.

AIRCRAFT PERFORMANCE

Aircraft take-off and landing performance is affected by many factors, among them the following:

- Manufacturer's or operator's limitations (e.g. maximum permitted take-off or landing weight, maximum crosswind or tailwind component);
- Airfield elevation;
- Runway length;
- Runway width (a wide runway is especially welcome in a strong crosswind);
- Runway slope (uphill is always preferred);
- Obstacle clearance data;
- Ambient temperature;
- Braking action (especially, when the runway is contaminated² by rain);
- Surface wind.

As I said before, a strong wind is never constant, so performance calculations always assume that a headwind will drop or a tailwind increase from the mean at the critical moment.

Most modern aircraft can make a safe

landing or take-off even when conditions are quite adverse, but we have only to read the report of the August 2005 A340 overrun at Toronto³ to remind ourselves that things can go very wrong even for highly experienced pilots at major international airports.

Lots of safety factors are built into performance calculations for very good reasons, but they cannot cope with every situation, so pilots are required to recalculate data for each take-off and approach and if the runway (or other important data) unexpectedly changes. The following is a true story - only the details have been changed (to protect me from prosecution!)

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The captain of the Boeing 747 freighter was very experienced. He had learnt his craft in the military and had flown on many combat missions, in fighters at first, then on bombers, and later, on heavy transport. The first officer was a young man, new to the type and anxious to learn. He had heard some of his captain's war-stories and knew that this was a man he could trust.

They had planned the inter-continental flight with care. They did not expect any trouble at the departure end, but there were warnings of deteriorating weather at their destination so they wanted to carry as much reserve fuel as possible. Their take-off weight would not be much below the maximum, calculated for the runway in use (Rwy 26L) and the expected weather conditions. At the aircraft, they did their

checks, copied the ATIS, got their ATC clearance and requested start.

As they taxied out, ATC informed them that the wind was backing and asked them if they were happy to stay with 26L or would prefer to wait while they changed the runway. "The wind will give us a 5 kt tail component on take-off," the first officer reported, "we'd better wait for the new runway." "No, it'll be alright," the captain replied, "I don't want to waste time and fuel holding and taxiing to the other end of the runway; besides, Rwy 08 slopes downhill. Tell them we'll stay with 26."

The first officer did as he was told, and got out his books to recalculate the take-off data, but now they were close to the runway threshold and the captain told him to run the take-off checks.

As they accelerated down the runway, a flock of birds rose from the side and flew across their path. One went into the No 4 engine, causing it to stall. As they had not quite reached the decision speed (V1) the captain abandoned the take-off, calling for reverse thrust on Nos 2 & 3 engines and applying full braking.

They only overshot the end of the runway by a few feet, but the heavy aircraft sank into the wet turf and had to be unloaded before it could be towed out. Rwy 26L/08R was out of use for the rest of the day, but fortunately the parallel runway was unaffected.

You will know (and the inquiry agreed) that the captain was wrong to take off

² For JAR-OPS definitions of runway conditions see the article "9 \sqrt{P} and All That".

³ The February 2008 edition of Aero Safety World contains a useful summary of this report. See http://www.flightsafety.org/asw/feb08/asw_feb08_p40-45.pdf

from the out-of-wind runway without first checking his take-off performance, especially as he knew they were close to maximum take-off weight. It did not help that the inexperienced co-pilot was too trusting and insufficiently confident in his own judgement to insist that they should do so, but he would probably have been overruled anyway. The controller did everything correctly (he might possibly have been able to warn earlier that the wind was shifting, but that is speculation and certainly not criticism).

So what is in this story for air traffic controllers? Well, just to make sure you understand that the wind component

is a critical factor in take-off performance calculations. If an aircraft is lightly laden or the runway is long, then it can usually take off in either direction, though into-wind is always preferred, especially if the runway is wet. But if the runway is short, or the temperature is high, or the plane is heavy, then a few knots of tailwind where headwind had been expected creates a problem. This is especially true for high airports. Changing the runway can also adversely affect other critical factors; not just the runway slope, as the captain correctly pointed out, but also the runway length and the stopway and clearway details.

So, if the runway must be changed because the wind has changed, that is fine and it is up to the captain to re-calculate his take-off performance if necessary. But if a runway change is being considered for environmental reasons, there are other factors to consider besides an adverse wind component, like the pressure a pilot may feel under to accept the change even though for safety reasons he/she should not. It is all very well to say that the pilot can insist on the into-wind runway, but in the real world he/she knows the problems this will create for the airport and for other aircraft and may well take a chance.

