

THE CLUTCHING HAND

The BGA Safety Team considers some hazards on final approach in strong winds

Gliding lore has long described a phenomenon known as *the clutching hand* [1,2], which in windy conditions appears to unsuspecting pilots in the form of strong sink on final approach. It's cited in a steady trickle of BGA accident reports when it has caused a glider to run out of energy before reaching the landing area and land short of the airfield, hit an obstacle, or stall in during the round-out. The reports commonly refer to *The Clutching Hand* as if it were the supernatural terror in a Victorian melodrama.

The clutching hand represents at least three different phenomena, some predictable and all somewhat foreseeable. All involve the flow of air over the ground – but the details of the airflow and how we deal with it can be subtly different.

WIND DOWN A SLOPE

Ridge-soaring pilots know well the lift that occurs when wind is deflected up a rising slope. When, under approximately laminar conditions, the wind instead causes air to flow downhill downwind of the landing area, the reverse happens, and the motion of the airmass through which the glider approaches the airfield has a sinking component, which adds to the glider's rate of descent (see figure (a) below).

For example, approaching in a 20 knot

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wind over the 10% slope down to the River Clwyd before Denbigh's westerly runway, a glider would experience an extra 2 knots of sink. This would steepen the approach and require the glider to fly faster than normal to achieve the best range over the ground.

Friction between layers of air, and with the ground, means that the wind speed on approach will generally decrease as the glider descends. Other things being equal, the sink due to the slope should thus weaken as the glider approaches the ground.

WIND GRADIENT

This wind gradient itself is another cause of energy loss, because the headwind contribution to the glider's airspeed will be progressively lost unless the pilot lowers the nose to trade height for regained speed (figure (b)). This unfortunately speeds up the

glider's descent through the wind gradient, further reducing the headwind component; in a sufficiently steep wind gradient it may be impossible to gain forward airspeed at all [3].

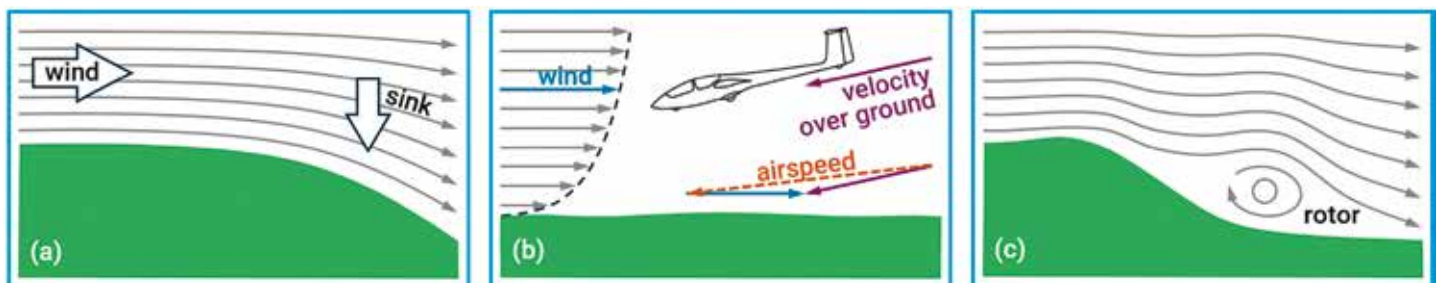
Wind gradients depend upon conditions such as the nature of the ground and the stability of the air above it, but generally are greatest close to the surface [4]. Under typical strong wind conditions, maintaining airspeed through the wind gradient could triple the glider's still-air descent rate [5]. This apparent sink, which adds to any sink from sloping ground, increases with airspeed and use of airbrakes, so flying faster will not necessarily extend the glide.

The effect of wind gradient is reversed when flying downwind, so reduced sink on the downwind leg could presage heavy sink in the stronger wind gradient on approach. It could also be a sign of turbulence. Either way, ensure you have adequate airspeed before turning onto final approach.

Wind gradients tend to be lower over water and smooth ground, and greater over rough terrain; ridge pilots should beware that wind gradients can be severe over forestry.

TURBULENCE

The flow of the wind over the ground may be far from laminar and, particularly in strong winds, can diverge into whirls and vortices



(a) Sink as air flows down a slope adds to a glider's descent rate. This sink weakens as the glider reaches slacker wind near the ground. For best glide range, the glider should fly faster than normal. (b) The glider's airspeed is the difference between its velocity over the ground and the headwind, so as the glider descends airspeed will be lost if the reduction in headwind is not compensated for by trading height for speed. Sufficient speed must be retained for safe flight and round-out, but flying faster will not necessarily extend the approach. (c) Turbulence and rotor can create violent air motions in all directions, but vertical motions diminish as the ground is approached.

which result in localised lift and sink, and can enhance, subtract from and even reverse the airflow velocity, causing different windsocks to point in different directions.

Turbulence is common in the lee of hills, woodland and similar features. A simplified model describes small ripples developing from laminar flow and building until they produce cross-wind rotor (figure (c)), which then distorts into streamwise vortices that in turn break up into less structured turbulence [6]. If there's a sharp edge, such as an escarpment or warehouse, streamwise vortices can start directly from a sharp corner, and in stable atmospheres they can persist far downwind.

Rotor and vortices are generally held to be of roughly circular cross-section, limited to roughly the same size scale as the features that created them. This means that, unless you track along a streamwise vortex, any lift or sink on approach is likely to change within a hundred feet or so and, as air can't flow from or into the ground, should reduce as you near the surface. Horizontal flow, such as from wave-related rotor, can extend further.

READING THE AIR

While it's hard to judge the airflow from aloft, experienced ridge pilots are good at reading the shape of the terrain to work out where the lift will be best, where wind is funnelled, and where turbulence is most likely. In gentler conditions, balloon pilots can predict low-level airflow with remarkable accuracy. Windsocks, flags and soaring birds can be useful clues; local knowledge is invaluable.

STRONG WIND APPROACHES

The airspeed on approach must be sufficient to maintain flying speed down to and through the round-out, provide control authority in turbulence, and avoid stalling in rough air. This means having a margin to cover loss of airspeed in the wind gradient and achieve a reasonable glide angle into wind. Set yourself both a minimum approach speed and a higher initial value which, because of the difficulty regaining speed in a wind gradient, should be attained before the final turn. The margin above the minimum may sometimes be reduced as the glider descends.

The circuit should position the glider so that the landing area is within easy reach. The amplification effect of the wind gradient means that airbrakes will be particularly effective, so a very steep descent is possible and can keep the approach clear of rotor. Aim to land well beyond any obstacles, and if

'AIRSPEED ON APPROACH MUST BE SUFFICIENT TO MAINTAIN FLYING SPEED DOWN TO AND THROUGH THE ROUND-OUT'

there's any doubt about reaching the landing area, fully close the airbrakes immediately. The airspeed for best range depends upon the origin and strength of the clutching hand.

Assessment of the glider's approach path with respect to a reference point is crucial, though it can be difficult to judge if turbulence prevents a stable approach. You'll often sense the glider's deceleration before the loss of airspeed becomes apparent.

STRONG WIND ROUND-OUT

The high approach speed will involve a more nose-down attitude than in lighter winds, so the pitch change during round-out will be greater – still more so if the glider is flying through the sinking air of the clutching hand. To avoid the heavy stalled landing described in many accident reports, the round out needs to begin with a higher airspeed to allow a sharper pitch change or prolonged transition, as well as a margin for remaining wind gradient. A further margin will be needed if the landing is at all uphill.

There are no simple rules for approach speeds and techniques in strong winds: experience, judgement and local knowledge are necessary, and pilots should consider their own – and their gliders' – limitations before deciding to launch in such conditions.

TIPS TO EVADE THE CLUTCHING HAND:

- **Plan ahead:** use visual clues and local knowledge to anticipate sink
- **Attain approach speed** before final turn
- **Maintain adequate speed** for wind gradient, turbulence and round-out
- **Keep well within reach** of the landing area
- **Close airbrakes immediately** if in doubt
- **Round-out** with sufficient speed.

Tim Freearge and the BGA safety team

■ The BGA Instructor Manual has a general discussion of the effects of wind and terrain on glider flight [7]; gliding clubs can offer specific advice for local conditions.

[1] R S Scorer, *S&G* 11 (3) p119 (1951)

<https://tinyurl.com/flyright2601>

[2] BMGC Site Briefing

<https://tinyurl.com/flyright2602>

[3] *The effects of wind gradient*, *S&G* (Oct/Nov 2020)

<https://tinyurl.com/flyright2603>

[4] Wind profile calculator

<https://tinyurl.com/flyright2604>

[5] For example, a 70kt approach into 20kt wind at 35ft over low crops in a 40:1 glider, would add about 6kts descent rate. The multiplying factor, in SI units, is $1/(1 - v w/g)$, where v is the glider's horizontal speed, w the wind gradient, and g the acceleration due to gravity.

[6] C Quine et al., *Forests and Wind*, Forestry Commission Bulletin 114 (1995)

<https://tinyurl.com/flyright2605>

[7] BGA Instructor Manual, section 15B (2025) and section 7-27 (2017)

<https://tinyurl.com/flyright2606>

■ All previous 'Fly Right' articles are available from the *S&G* website. See: www.sailplaneandgliding.co.uk/safety-articles which may be accessed using the QR link below.

