SSF Soaring Safety Foundation

FOCUS ON INSTRUCTORS

Pilot Induced Oscillations and Grobs

by Dean Carswell

In the last twelve months, there have been several reported cases of substantial damage to Grob sailplanes arising from the pilot's failure to control the glider correctly during the flare and touchdown phases of landing. Both the two-place G103 and single-place G102, with nosewheels, are prone to the problem of pilot-induced oscillation (PIO). Here is an example taken from a recent NTSB factual accident report [amended to remove identifiable references]:

". . . a Grob G103 was substantially damaged during landing. The certificated private pilot and passenger were not injured. The pilot stated that the purpose of the flight was to conduct a local area glider flight. He estimated the winds at the time of the accident to be 270 degrees at 10 - 15 knots. The sky was reported as clear. The pilot departed from Runway 23 and released from the tow aircraft at 3,000 feet above sea level. The pilot stated that he searched for thermals, but found none, and that he remained within two miles of the airport until he decided to abort the flight due to insufficient lift. After deciding to abort the flight, he positioned the aircraft on a left downwind for Runway 23 at 800 feet above the ground. From downwind, he turned onto the base leg, and then final approach approximately 500 feet from the approach end of Runway 23. According to the pilot, it was the last flight of the day, so he planned to land long. It was the club's policy to land long on the last flight of the day because the glider was to be tied down at the opposite end if the runway."

The pilot stated that while on the final approach, he had his hands full just to keep the glider lined up with the runway, and that the ride was very bouncy. According to the pilot, he carried approximately ten knots of extra airspeed while on final because of the turbulence. He did not recall his exact airspeed, but estimated it to be approximately 70 knots. The pilot added that the glider touched down at the intended touchdown point, but bounced back into the air. He stated that after the first bounce, he was focusing on maintaining runway alignment [so] that the glider started to oscillate from the Pilot Induced Oscillation.

After contacting the runway a total of four times, the pilot was able to regain control of the glider and complete the landing. The pilot estimated that from the point of initial contact with the runway until he regained control of the glider was approximately 500 feet.

The pilot inspected the glider and found the tail-wheel crushed into the tail of the glider. He also observed several cracks in the tail that penetrated the gel-coat and the underlying fiberglass.

Dissecting what occurs in a Grob PIO can be instructive. There are two scenarios which usually precede arrivals such as the one reported. The first occurs when the glider touches down on the main-wheel and bounces back into the air. The pilot pitches the nose down and the glider strikes the nose-wheel resulting in the nose pitching up rapidly.

The second scenario occurs when the nose-wheel of the glider touches the ground first [the flare is initiated too late]. The nose-wheel strikes the ground and causes the nose to pitch up rapidly. Alternately, during the flare the pilot may raise the nose up too far, then pitches the nose back down. The nose-wheel then strikes the ground followed by it rapidly pitching up again.

What happens next is that the nose pitching up causes the tail to pitch down, striking the ground. After the tail strikes the ground, the glider pitches nose down again, striking the nose-wheel even harder. This process continues in a divergent oscillation which increases until something else occurs - usually, and all too often, structural failure just ahead of the fin unless the pilot takes action to correct the oscillation.

In the first case, it's simple - neutralize the controls after the first bounce - the glider will level out above the ground. Do not force the nose back down on or towards the ground. If the glider has bounced or climbed just a few feet, it will sink at a relatively gentle rate, and safely back to the ground of its own volition. If it is a BIG bounce, gently lower the nose and this time flare at the correct height. If the airbrakes are more than one-half open, gently closing them a little will allow additional time to flare correctly. Remember that lowering the nose decreases both angle of attack and lift, causing the glider to sink quite rapidly. Consequently, any forward stick movement must be gentle.

In the second case, damp out the oscillation motion - i.e. pitch down gently (stick moving forward) as the nose comes up, and vice versa. When the oscillation stops, centralize the controls and let the glider land itself (as in Case One). DO NOT FORCE the nose back onto the ground. If for any reason the glider continues to oscillate (if your timing is bad and you aggravate the oscillation), neutralize the controls and apply full airbrake. This will quickly reduce energy and stop the glider from flying, even if in a rather unpleasant and abrupt manner. It is less likely to cause damage than permitting the oscillation to continue unchecked.

The undignified and possibly expensive method of arrival can be avoided by

1. Establish the landing approach at the correct airspeed for the conditions. The greater the airspeed, the greater the pitch sensitivity.
2. Establish the landing approach with half or more airbrake (the more the airbrakes are closed, the less pitch stability the Grob will have, making a PIO more likely if otherwise mishandled).
3. Flare at the correct height. Don't fly the glider into or force it onto the ground. Aim to arrive with low energy, touching down with the main-wheel and tail-wheel simultaneously.

It should be noted that a correct approach (i.e. preparation for the flare and touchdown) is important in preventing this problem. Fly the correct approach speed (not too fast or too slow) using at least one-half airbrake, thus eliminating the pitch instability. These simple steps will greatly reduce the problem and risks of pilot induced oscillations.