Erik Fair does it right.

FIRST INSTALLMENT (Hang Gliding - July 1986)

RETURNING TO EARTH

by Greg DeWolf

Landings, the nemesis of the hang glider pilot. The most important of all flying skills to be mastered, landing is also the most complex and difficult. It is just about the only way a pilot can get hurt, and it is the most visual portion of the flight to the public. FLY AMERICA, in its attempt to improve both safety and public opinion in the sport of hang gliding offers another educational article.

"#$%&*! What is wrong with me? I've never had this problem before", I said to myself after pounding my Harrier's nose plate six inches into the soft dirt. My landings had been good ever since I had started flying three years previously. My SST hadn't given me any trouble and the Raven flared even easier. Now I was considering replacing my keel with a pogo stick so that when I pounded, the nose would bounce back up, possibly fooling the spectators into thinking that it had never touched the ground in the first place. The more I WACKED! the worse it got. Finally, in a fit of frustration, I took my glider to The Beach to analyze the situation.

The Beach is a thirty foot sand dune where the wind blows straight in at 10-15 MPH every afternoon. It's the perfect

place to practice landings, because the smooth breeze reduces the anxiety-producing ground speed, to almost zero and the soft sand is very forgiving of most mistakes. As it turned out I stayed there for six years, racking up some 10,000 flights.

BACK TO THE TRAINING HILL

The first thing I learned was that my landings were much better if I was looking at the horizon. This came to me one day by accident as a skimpily clad vision of beauty caught my eye as I was launching. Keeping my eyes up, watching this natural phenomenon, it struck me that not only could I now see where I was going and feel the wind on my face, but that the feeling of speeding across the ground was reduced to floating in slow motion. This lessened the anxiety level produced by the perception of high speed and lead to another discovery.

Once I wasn't so tense, my grip on the bar relaxed and to my surprise the glider flew much better. It injured my ego to realize that the less control input I used, the smoother the glider flew, but I recovered when my landings became more graceful. I could better use the energy thinking and being aware, than trying to make the glider do something unnatural.

Another benefit to a light touch on the control bar was the ability to feel feedback from the glider. When having my head up, I noticed that the feeling and sound of the airspeed of the glider close to the ground became imperceptible long before the glider stalled. This, of course, made judging flare timing by airspeed impossible and rendered only two methods available, luck and glider feedback. Luck in some things is always with me, but not so with flare timing so I had to resort to letting the glider tell me when to flare.

HELLO GREG! THIS IS YOUR GLIDER SPEAKING.

I discovered that the force needed to pull in while ground skimming at a constant altitude was relative to the airspeed of the glider. If I had my hands cupped around the down tubes, so that I was touching the bar with my fingertips only, I could readily determine the reduction in bar pressure as the glider slowed down. Letting the control bar out an amount corresponding to the reduction in airspeed would hold me at a constant altitude until the bar was at neutral position. The glider would continue at trim, losing speed slowly, and maintain altitude as I brought my hands up, even with my forehead, and put my palms lightly on the back of the down tubes. Then three things would happen simultaneously. The glider would start to settle, the nose would begin to drop and the control bar would start to exert pressure against my palms. This was the perfect time to flare! And it was a less subjective decision than trying to judge airspeed.

Simply put, just get the glider down to the ground (feet just inches above the surface with knees slightly bent), let it run out of airspeed until it's at trim, then flare when the nose drops. I figured it was easy and that I was ready to go out to the mountain and impress my friends.

The Sylmar landing area at that time was a narrow strip of land between a mountain on one side and a barbed wire fence on the other. I set up for my landing in the canyon, turned onto final over the dam, skimmed the tree at the end of the I.Z. (Impact Zone) as I entered the gradient, got tossed by the rotor of the hill on my left as I ground skimmed, tried to level my wings, ran out of airspeed and flared...! Damage assessment was several scuffs on my mylar pocket, a broken down tube and a badly bruised ego not at all soothed by my friends guffaws.

THE COMPLICATIONS

It had seemed so easy at The Beach. What had gone wrong? Although I had worked out the basic tenants of a good landing I had done it in close to ideal conditions, and certainly this I.Z. was far from ideal, just like almost every other landing area in the country. So...back to The Beach.

The first parameter I decided to deal with was THE GRADIENT. Even The Beach has a gradient and just like other LZ's, the stronger the wind the stronger the gradient. On a 15 MPH day I launched, climbed five feet in the lift band and glided out, flying at trim. As the glider passed through the gradient it stalled, nosed down, couldn't gain enough airspeed to begin flying again and nosed into the sand, despite my every effort to flare.

TRUISM #1 ONCE THE GLIDER HAS STALLED AND THE NOSE HAS DROPPED BELOW THE HORIZON, EVEN MY MOST AGGRESSIVE FLARE WILL NOT BRING IT BACK UP, UNLESS FLYING AIRSPEED IS REGAINED!

Stalling at the top of the gradient could make recovery impossible so I learned that the first necessity to a GUARANTEED GOOD LANDING was to HOLD MY AIRSPEED (30-35 MPH) until I reached the altitude at which I wanted to flare.

EMERGENCY PROCEEDURES I developed to deal with a stall above the ground include only two options, which depend on the altitude and the depth of the stall. #1- In a mild stall at least 10 feet above the ground, I relax all bar pressure and let the glider nose down and then flare aggressively just as my feet reach the ground. #2- The deeper the stall, the more altitude is needed to recover so in a deeper stall or without much altitude I flare hard, before the nose begins to drop, and parachute down. I judge the depth of the stall by listening to airspeed and determining attitude through sight and bar position.

The second parameter I worked with was KEEPING MY WINGS LEVEL. It seemed that the harder I worked to keep my wings level, the greater the chance I would drop one on landing, which would almost certainly lead to the nose falling through.

TRUISM #2 WITH THE BASE TUBE TWO FEET ABOVE THE GROUND THE GLIDER TENDS TO KEEP ITS OWN WINGS LEVEL, AT ALL SPEEDS ABOVE STALL, WITHOUT ANY IMPUT FROM ME!

The secret is to bring the glider to the ground with speed and level wings and then relax. The glider may yaw around in turbulence, but it is just reacting correctly to varied gust and should be allowed to do so. Usually, the wings stay level during all but the most severe turbulence.

EMERGENCY PROCEEDURES I use for leveling my wings close to the ground vary with airspeed. #1- If I have a couple of miles an hour above stall I will give a little tug on the high down tube and immediately return to center. This seems to work much quicker and with more chance of success than holding my weight over. Beware! Any control input to the glider uses up energy (read airspeed) and will bring the glider closer to stall speed. #2- If the wing drops within two miles an hour above stall, but the glider has not begun to yaw in the direction of the low wing, I have found that an aggressive flare will most often bring the glider to a halt and level the wings. #3- In the same situation, if the glider has already begun to yaw, a hard flare will tend to make the glider ground loop and actually increase the speed of the pilot, as the glider whips around the deeply stalled wing. In such a case, a mild flare, just enough to keep the nose above the horizon, along with an aggressive run, seem to give me the best chance of containing the damages.

The third parameter I played with was actually three aspects of the flare: EXTENT OF FLARE, SPEED OF FLARE, AND FLARE TIMING. Extent of flare is the effective rearward weight shift accomplished by the pilot—how far

you push out. Speed of flare is the rate at which that weight shift is accomplished—how fast you push out, and flare timing is the airspeed of the glider—relative to stall—when the flare is initiated.

TRUISM #3 THE PERFECT FLARE NEEDS TO BE A PRECISE COMBINATION OF ALL THREE ASPECTS OF FLARE- EXTENT OF FLARE, SPEED OF FLARE, AND FLARE TIMING

For example: the later the flare timing, the greater need be the speed and extent of flare to keep a BONK! at bay. The earlier the timing, the slower the speed and the less the extension of flare needs to be in order to keep from climbing out.

A few other points are essential to clarify here. Fully extended arms do not necessarily mean a full flare extension. A full flare extension has been accomplished when the entire system's (pilot and glider) center of gravity has been shifted rearward the maximum possible distance. This was never the case if I had my feet forward, had my hands too low, or exerted any downward force on the downtubes with my hands during flare.

I realized that the shorter height, shorter arms and lighter weight of smaller pilots meant that their maximum flare extension was not as great as their counterparts.

EMERGENCY PROCEEDURES involved with the aspects of flare are many. #1- If I waited too long to flare then I needed to give full extension at maximum speed. #2- If I needed to flare early in light winds, then Dan Skadall's "crescendo method" worked best to keep the glider from climbing out. This is where I would begin to flare slowly and increase the speed to full extension. #3- If I started my flare too early and quickly, and started climbing out, I found that unless I still had an excess of flying speed, that pulling in was a big mistake. Instead it seemed best to relax, let the bar go to neutral position and let the glider surge to the apex of its climb, slowly extend just enough to hold the nose up at an attitude of 45^{o} and then to parachute down. So long as the glider started the parachute mode with the nose at this attitude, it took little extension and effort to parachute down successfully from 10 feet.

I found that it was very important to practice parachuting, for without being secure in the knowledge that it worked, my natural instincts were to try to support my falling body with my hands and arms by pulling down on the downtubes and/or by throwing my feet forward, both of which would bring the c.g. radically forward and necessitate the use of the pogo stick keel. It was easy to see how previous poor landings made me tense enough to cause subsequent bad landings. The only way I could break this vicious circle was to return to The Beach, where I could relax and practice 20-30 landings in one day instead of one a week in widely varied conditions.

The fourth parameter I dealt with was OROGRAPHIC TURBULENCE. There are days when the gods are so angry that even the winds coming off the ocean have severe gust running rampant through them. There I was, at the beach, the 30 gusting to 10 MPH winds whipping the tops off the waves and tossing the spray in my face. I thought I was going to die and I was only standing at the top of a little 30 foot sand dune. It was a good day to experience high winds and turbulence. What I learned that day became invaluable in dealing with the same conditions in future, less forgiving situations.

TRUISM #4 IN HIGH WINDS AND/OR STRONG TURBULENCE, I SHOULDN'T FLARE (EXCEPT OF COURSE IF I WAS FLYING DOWNWIND).

EMERGENCY PROCEEDURES #1- This was obvious in winds that exceeded the stall speed of my glider, for if I slowed down more than the wind speed I would be going backwards. But in gusty situations, the lulls could be considerably below stall speed and when the wind speed suddenly dropped, and my glider and body plummeted towards the ground, my natural instinct was to flare as quickly and extensively as possible. Now I was fully flared as the wind gusted back to thirty and I shot skyward as quickly as I had plummeted. Since I now had airspeed I pulled in to keep the nose as low as possible. Still the glider stalled and I gently resisted the downward rotation of the nose as the glider picked up speed heading for the ground. Approaching the ground I letthe bar out just enough to level the glider out, took a few steps and pulled the control bar to the sand while the glider was still flying. I learned that radical control inputs in radical conditions could produce more problems than they solved.

This concludes the first part of Returning To Earth. The second installment will explain the more complex aspects of landing such as dealing with strong convection turbulence, downwind landings, top landings, modified crashes, unusual terrain, tight landing areas, etc. Until then, happy landings.
END FIRST INSTALLMENT

SECOND INSTALLMENT (Hang Gliding Magaine August 1986)

RETURNING TO EARTH -PART 2

by Greg DeWolf

Landings, the nemesis of the hang glider pilot. The most important of all flying skills to be mastered, landing is also the most complex and difficult. It is just about the only way a pilot can get hurt, and it is the most visual portion of the flight to the public. FLY AMERICA, in its attempt to improve both safety and public opinion in the sport of hang gliding offers another educational article.

In the first half of this article I discussed the landing techniques I use in ideal conditions. Briefly they include flying the glider to flare altitude with lots of speed and wings level, keeping a relaxed hold of the control bar and minimizing control input, letting the control bar go to neutral as the glider slows, raising the hands to eye level and flaring upwards just as the glider starts to settle.

Although these techniques work perfectly in laminar conditions, any variations from smooth air or flat, level landing areas require modifications in the technique. Additionally, each phase of landing is dependent on the successful completion of the previous phase. In the conclusion of this article I will deal with various parameters of landings in other than idea conditions.

ALTHOUGH I AM ATTEMPTING TO DEFINE THE CONTROL TECHNIQUES NEEDED TO DEAL WITH PARTICULAR PARAMETERS, REAL LIFE IS MUCH MORE COMPLICATED. THE TECHNIQUES I AM ESPOUSING CANNOT BE ADOPTED BLINDLY, BUT ARE ONLY PRESENTED HERE AS A GUIDE TO LEARNING AND TO PROVOKE THOUGHT. LANDINGS WILL ULTIMATELY BE LEARNED THROUGH PRACTICE. TO FULLY UNDERSTAND THE SECOND HALF OF THIS ARTICLE, THE FIRST HALF MUST BE READ.

I couldn't learn about the fifth parameter, CONVECTION TURBULENCE, at the beach, but I did experience it just about everywhere else I flew. Its ubiquitous nature makes it a threat in almost every landing area and the large variety of adverse conditions it can spawn make it difficult to deal with.

TRUISM #5 THE EASIEST WAY TO DEAL WITH THERMALS IN THE LANDING AREA IS TO AVOID THEM.

This sounds like one of those "easier to say than do" statements, but the technique is simple. I come over the L.Z. with at least 500' AGL and do a 360°. If there's a thermal breaking off I work the lift, being careful not to climb too high or to drift out of the area. When I fall out of the lift, I swoop down and land in the smooth sink.

EMERGENCY PROCEEDURES I use if I have to come down, while there is a thermal breaking off, are to land upwind of it with my nose pointing away from its center. Another technique follows and helps in all turbulent conditions.

The sixth parameter I dealt with was my HEIGHT ABOVE THE GROUND DURING APPROACH.

TRUISM #6 THE CLOSER TO THE SURFACE I AM, THE LESS EFFECT THERMALS HAVE ON MY GLIDER AND THE SAFER I AM.

All turbulence has less effect when the glider is close to the ground. The turbulence itself is modified by the ground. Vertical winds are almost impossible as the air can neither rise out of the ground nor descend through it. This tends to reduce all gust to horizontal disturbances.

Due to the gradient all wind speeds are lowered which in turn lowers the possible gust differential.

I believe—although I'm told that theoretically it is not true—the glider stalls at a much lower airspeed in ground effect. The closer the wing is to the ground, the lower the stall speed, lowered by as much as fifty percent. This all means that I can fly slower close to the ground with less chance of a gust induced stall.

Being next to the ground also means having no distance to fall in the case of stall and greatly reduces the possibility of getting turned around, downwind during a tip stall.

My FLYING SPEED DURING APPROACH was the seventh parameter I experimented with.

TRUISM #7 THE MORE FLYING SPEED I HAVE THE EASIER IT IS TO COUNTER THE EFFECTS OF THERMAL INDUCED TURBULENCE.

TRUISM #8 THE MOST DANGEROUS ALTITUDE TO BE AT IN ANY TUBULENCE IS BETWEEN TEN AND FIFTY FEET ABOVE THE GROUND.

This is the altitude where the turbulence can be extreme and the room for recovery minimal. A moderate stall can use up fifty feet of altitude during recovery and roll control during that time is minimal. This means that a stall at these altitudes could turn me downwind and toss me to the ground with my nose down and carrying lots of groundspeed. I can't think of any situation that I would rather avoid, so I approach the ground with 30-40 MPH airspeed in my HP.

Now, it's not impossible to dive a glider into the ground but once I'm ground skimming, the more airspeed I have the more the glider wants to climb out, away from the ground. I believe that it is much harder to hit the ground while ground skimming at high speed than at low speed. Approaching the ground at a steady state high speed is the safest approach for landing, providing you are comfortable, and have smooth control of your glider, while flying fast.

EMERGENCY PROCEEDURES I use when I'm slow on approach are to gain as much speed as possible, by pulling in slowly, and praying.

The following deals with part of the third parameter, mentioned in last month's article, SPEED OF FLARE. This has a great effect on the landing sequence.

TRUISM #9 A SLOW FLARE, AT LOW SPEED, CAN BE WORSE THAN NO FLARE AT ALL.

A half hearted flare brings the glider to mush speed, where the glider and I still have forward velocity and yet I have lost most all roll control and the ability to flare further. This is a most dangerous situation. I got into this predicament while trying to correct for the habit of flaring too early and/or too quickly and climbing out.

EMERGENCY PROCEEDURES #1- I was on final, ten feet off the ground (too high), flying at trim speed (too slow), when a gust stalled one wing. The glider started to yaw towards the low wing and drop its nose and head for the ground. My natural reaction was to push out to keep from hitting the ground. Boy! Was that a mistake. The pitch input stalled the inner wing more, banked the glider even steeper and yet the outer wing continued flying as it and I picked up speed like a whip. I wasn't descending very quickly but was flying out of control towards the crowd that was standing nearby watching.

I already had my weight on the high side when I decided to pull in and hit the ground rather than the spectators, which included children. I didn't actually pull in, but rather let the control bar go neutral. To my surprise the inside wing immediately started flying and began to level out as I headed towards the ground. The yaw rotation stopped enough to allow me to flare again. I hit the ground with my feet, base tube, nose, and leading edge, but no one was hurt and the damage to the glider was minimal. This was when I realized the real value of letting the glider fly itself as much as possible. Of course, if I had had extra speed and been closer to the ground on my approach, I never would have had the problem in the first place.

#2- In very gusty conditions I try not to flare at all. This eliminates the situation where I get hit with a gust just as I flare and climb out ten feet and then get dumped. I avoid flaring by pulling in and getting my feet on the ground and running, while the glider is still flying in the positive (high wind portion of the) gust. As the gust dies the glider stops flying and comes to rest on my shoulders still at a low angle of attack.

#3- A flare can be advantageous, especially in light wind, gusty conditions. The flare needs be of short extension and abruptly executed just as the glider experiences a negative gust (airspeed slowing).

The eighth parameter I taught myself was BODY POSITION. Maximizing control and safety during landing is of paramount importance and it all hinges on the right body position.

TRUISM #10 I CAN RUN FASTER ON MY FEET THAN ON MY EARS.

The best way to get hurt on a hang glider is to land head first. I believe that being in the prone position during landing approach and especially during ground skimming is responsible for the vast majority of injuries and deaths. Because of the relatively slow speeds and the energy absorbing properties of aluminum tubing, I believe that the death rate in hang gliding could be brought to zero if everyone landed on their feet. Landing in the prone position often results in the pilots head being the first thing to contact the ground. The head is pile driven into the surface by the entire weight of the body following closely behind. This results in massive head injuries and broken necks and backs. These are the most vulnerable and essential portions of the body and should be protected by the strongest and best shock absorbers the body has available, the legs.

EMERGENCY PROCEEDURES Forcing myself to get my feet underneath me was the hardest maneuver I ever learned in hang gliding. I found it very difficult to overcome the inappropriate, knee jerk reaction of picking my feet up, out of the way of the approaching ground. I have since proved to myself the benefits of having my feet be the lowest point of the glider-pilot combination.

#1- The greatest benefit to having my landing gear down is that in most tense situations it prevents any kind of crash what-so-ever. I have been tossed to the ground many times by a rotor during a top landing and have touched down lightly with my feet and taken a couple of steps, only to have the glider pick me up again and fly away. Had my base tube contacted the ground, I would have a least sustained glider damage and very possibly bodily injury.

#2- Other advantages of having my feet under me on approach and ground skim, include improved roll control, better airspeed recognition, and it's easier to watch the horizon rather than the ground. Also I'm closer to the correct position for flaring, in case I need to exercise that option suddenly.

The ninth parameter I originally dealt with by accident was the EFFECT OF SLOPE on landing. The Crestline L.Z. is on a slight rise. The approach is an up slope with the bull at the top and overshooting means having to land on a gentle down slope. I found it almost impossible to have a good landing on this downgrade.

TRUISM #11 IT'S EASIER TO LAND UPHILL THAN DOWN HILL.

The problem with landing on a down slope is that the wing and pilot lose airspeed so slowly that they spend a great amount of time very close to stall, where control is difficult and tip stalls happen easily. Other problems include increased flare pressures and gaining altitude in the lift generated by the wind blowing up the slope.

EMERGENCY PROCEEDURES The only effective way of landing on a down slope is to bite the bullet and flare early, climb out and parachute down, and this doesn't even work very well.

The best method I have found for landing on a slope is to land uphill. I can land with a 5 MPH tailwind, uphill on a gentle slope better than downhill with the same strength headwind. The steeper the slope, the greater the tailwind I can deal with. The strongest tailwind I have landed in was 15 MPH on a 25 degree slope, and I did repeated NO STEP LANDINGS to prove the concept to myself and some students.

The method I use for uphill landings requires good speed and altitude recognition skills, as well as good high speed control and quick reflexes. I dive the glider from about 200' from where I will start my ground skim on the slope, and carry as much speed as possible towards the ground. I start a pull up just far enough from the hill so that I end up climbing the slope a couple of feet away from it. The glider loses speed quickly due to gravity and a flare is hardly needed, as the nose is already high. (Of course if the pull up is not started in time, I hit the ground at high speed, which is highly unpleasant.)

I practiced uphill landings first on gentle slopes, in very light headwinds, before trying steeper hills. Then it was a long time and a lot of practice before trying them in light downwind conditions. I believe strongly in the principal of never subjecting myself to more than one variable at a time. Even though it lengthens the skill acquisition time, I feel that it also lengthens my life span.

The skills I now possess are a result of 1800 logged (and 6000 unlogged) flights and 1100 hours logged airtime.

The more I write about landings the more ideas come to mind, and they all are important. Although they all are in my subconscious, my left brain has not yet organized them, and it will be some time before I can effectively explain them. Therefore, this is the end.

If anyone has questions about landings, you can write to me:
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I will include answers to those questions in a later article.