Falco Builders Letter

Larry Weldon in the left seat for his first ride in the Falco.

First Flight of N811LW

by Larry Weldon

I grew up on a farm in Tallassee, Alabama, seven miles from where the Tuskegee Airmen trained. Montgomery was only 20 miles away and had two training fields, Gunter and Maxwell. Almost any time you looked to the sky there would be trainers practicing dog-fighting and air maneuvers. I spent lots of time day-dreaming about flying airplanes.

After graduating from high school, I joined the Army Air Corps. After basic training, I was stationed at Ft. Benning, Georgia and was put in charge of a flight line with twenty L19s. My first flight was in one of those planes. It was a thrill I have never forgotten.

After the Army I went to work with the Army Corps of Engineers and was placed with a water well crew. I met Jane, married her, and we traveled around the country drilling wells and studying ground water. The only flying I got to do was coming home to see Jane.

In 1970, I came home and started a water well business. Jane and I have run the business for a number of years, and it is very successful. I finally found time to learn to fly and bought a Cessna 172.

One day at the local airport, I saw a homebuilt airplane advertised called a Falco. I thought it was the best-looking plane I had ever seen. I talked to some of the guys around the airport who had built planes, and they tried to discourage me. They said it was a complex airplane, and it was very hard to build. This did not discourage me.

The next day I called Sequoia and talked to Susan. She sent me a brochure and price list. After reading the brochure, I wanted to build the plane even more, but I could not believe a wooden airplane could cost so much. I decided that was too much money to put into a wood airplane and tried to forget about it. But I could not stop looking at the brochure with the best-looking airplane I ever saw.

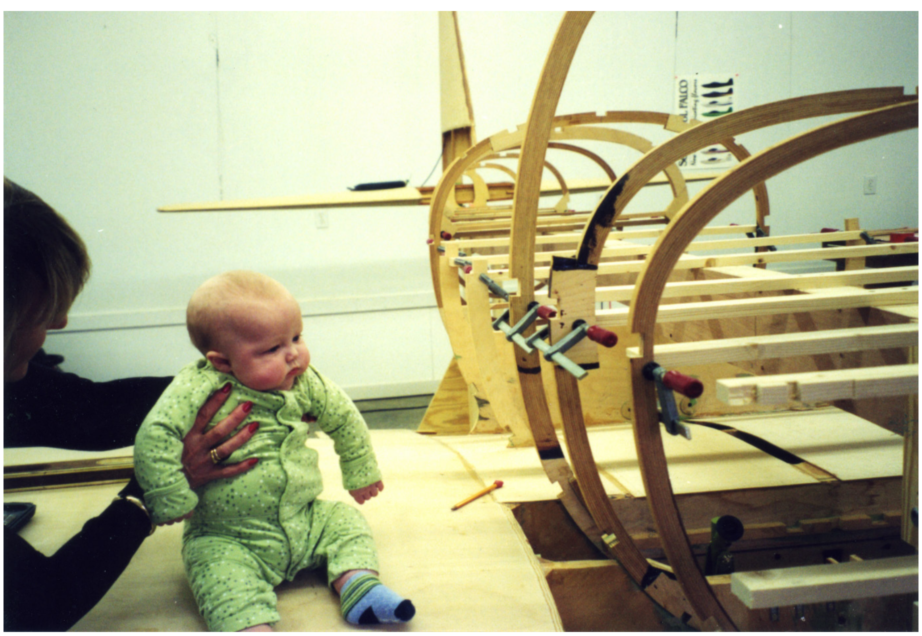
After a few months, I called Sequoia and asked Susan if there was a Falco near me that I could visit. She told me Glyn Russell was close to completion and was in Decatur, Alabama, about three hours away. I called Glyn, and he was delighted to show me his Falco.

In This Issue:

Brett Curenton breaks ground on the first flight.

I spent half a day with Glyn talking about the Falco and the construction of it. He said it was complex and time-consuming, and I really needed to talk to Alfred Scott about my skills, to see if he thought I could build the Falco. After returning home, Jane said she was on board to call Sequoia and order the plans. This gave me a green light. The next day I called, talked to Alfred and ordered the plans.

I had a 30x50 air-conditioned and heated building so I could work summer and winter. The plans and construction manual are very good. I built the tail in about three months and gained lots of confidence. I used Aerolite glue in the frame and West System epoxy under the skins. I had a swimming pool to soak the skins in, and I used an air-gun to staple skins on. I used rubber bands to pull the leading edges around and lots of hot water. I used water levels to keep it level and plumb bobs to be sure nothing moved.



Future Falco pilot, Ean Weldon, Jane and Larry's grandson

I finally came to wiring the airframe and instrument panel. I bought the electrical kit from Sequoia. I was overwhelmed.

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Articles, news items and tips are welcome and should be submitted at least 10 days prior to publication date.

After studying the plans for a while, I decided I could do it. Alfred spent a lot of time designing a set of electrical plans that even a well-driller could wire an airplane with. The wiring was the easiest part of the Falco to build. I hooked up the battery, everything worked. No smoke. I used the Sequoia instrument package, installed a Garmin 430 GPS and an STEC 30 autopilot.

I had a friend, Jim Hinz, who worked for GKN Aerospace building composite airplane parts. I asked him to come look at the Falco to see if he would like to help me with the fiberglass, canopy, cowling and paint. He was very impressed with the Falco, and he said he would like to help. Jim is very skilled at working with fiberglass, and he helped me make the Falco look good.

I installed the 180 hp IO-360 engine. We built up the cowl and cowling doors so we have no bumps. We cut out the left bottom cowl and made more room for the exhaust system. We painted the Falco white with blue trim.

I had to move the Falco 20 miles to the airport, with help of the sheriff's department, everything went well. After placing the Falco in its new hangar, I went by the Falco Flight Test Guide for the final inspection. One complete inspection by me, and two by me and the test pilot. The test pilot had a key to the hangar and he could look at the plane any time. The test pilot is Brett Curenton. He is a CFI, has 11,900 hours in many different airplanes, including the SF-260. I was very pleased to have him fly the Falco. After a visit from FAA by John Burgin, I received an airworthiness certificate. He was very impressed with the Falco.

Now the time had come to crank it up and do the taxi test. After cranking, everything worked except for the tachometer. It had a jerk in it, and I had to change the tach cable. The taxi test went well so we decided to fly in the morning. The next day was July 26, 2008. It had been nine years and 16 days. I was very nervous, and my emotions were running wild. I tried to keep the first flight quiet, but the word got out, and there was a crowd at the airport.

Brett made one taxi run. Then he taxiied back to the end of runway, applied full power and the Falco jumped into the air. It was a great feeling watching it fly away. The first flight was 20 minutes and uneventful. The stall clean is 68 knots. With gear and flaps down it stalls at 62

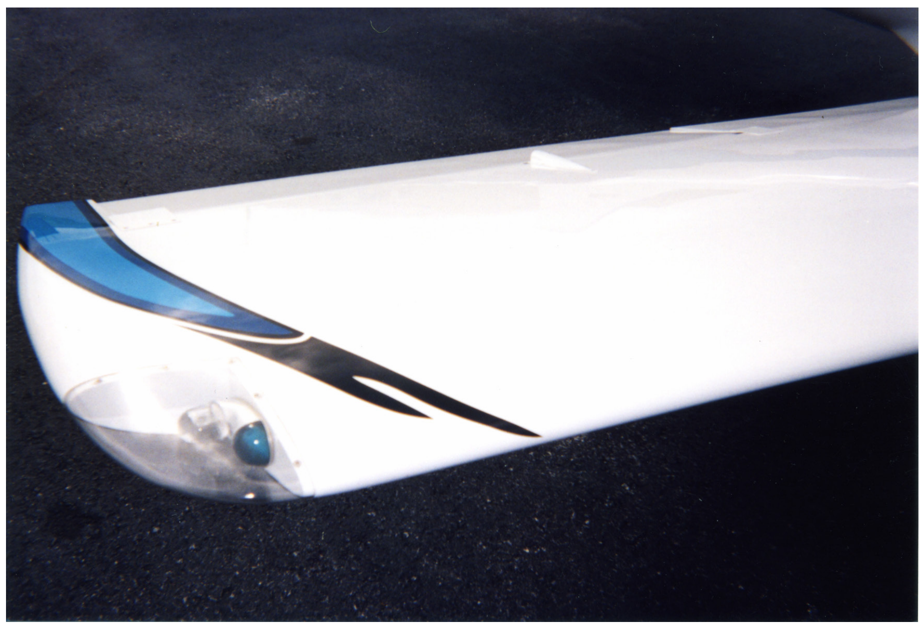
knots. On landing you cross the fence at 80 knots for a smooth touch-down. Brett was excited about flying the Falco, and he wanted to go back up as soon as we could check the plane over.

On the second flight, he flew for 30 minutes, pulled the gear up and did a fly-by with the gear up and then one with it down. Everything looked good, and he made a smooth landing.

The third flight was the most exciting. Brett put me in the left seat, and he let me fly the Falco that I had worked so hard on for nine years. There is no way to explain the emotional feeling you get the first time you apply full power and feel the Falco racing down the runway, lifting off and heading for the sky. I have five hours in the Falco now, and I am enjoying flying more every day. The right wing is a little heavy. I have to put a trim tab there.

I would like to thank everybody who helped make this experience happen. Jane supported me all the way. My daughter, Heidi Weldon came from Birmingham, Alabama, once every month to see the progress of the Falco. She was very impressed with this project. My son, Adam Weldon, helped me set up jigs and move the plane in and out of the shop. Jim Hinz made the Falco look good. Alfred and Susan were very supportive. Bob Brantley came to my shop two times, and he was very helpful. He also gave Brett Curenton flying time in his Falco.

Glyn Russell became a great friend and visited my shop many times. He gave me my first ride in his Falco. I wish he could have lived to see this one fly.



Son, Adam Weldon, Jane Weldon, Larry Weldon and Test Pilot, Brett Curenton

Frati and Napo

by Alfred Scott

We had a family reunion in Italy in July, and on our final day we hit Milan and I had a visit with Stelio Frati. Enesto Valtorta picked me up at the airport hotel, and we drove the nearly one-hour drive from the Malpensa airport to Mr. Frati's apartment in an old section of Milan.

Stelio Frati greets us at the elevator, and he looks little different from when I last saw him in ten years ago. He's in good spirits and has a copy of *Aviation Week* spread out with the news of Vern Raburn's forced resignation from Eclipse Aviation, and he's mystified and upset by the news. (As it turns out, Vern once bought a set of plans for the Falco, though he never pursued building, and he gets the *Falco Builders Letter*.)

He's also in a reflective mood, noting that it was about 30 years ago that I first contacted him about the Falco, and how he only responded after being prodded into it by Carla Bielli. It's been a long and wonderful relationship, and his life is greatly enriched by the news of what goes on in the world of the Falco. There are plenty of people flying around in his other designs, but the Falco holds a special place in his heart. It was the first plane that he really got right and created what we all now know to be a masterpiece. And he feels a special bond with anyone who would take the time and effort to build a Falco.

Now with Falcos in Brazil, Chile, New Zealand, Canada, Norway, England, Denmark, the Netherlands, Australia, France, Luxembourg, South Africa, Germany and the United States, people experience flying in a plane that handles as close to their wildest fantasy as any plane ever built. Across the Atlantic. Over the Great Barrier Reefs, the barren stretches of desert. And a well driller in Alabama who never could have imagined even building an airplane is now is flying one of his creations.

All of this is made possible by a man who is far removed from aviation. General aviation in Italy is almost non-existent, a sign of the times and an Italian government that is bureaucracy gone mad. Taxes on private planes are often higher than they are worth, so most have been sold to other countries.

But his drawing board always has a design in progress. I asked to see what he is working on, and he had his four-seat F.1000 Jet

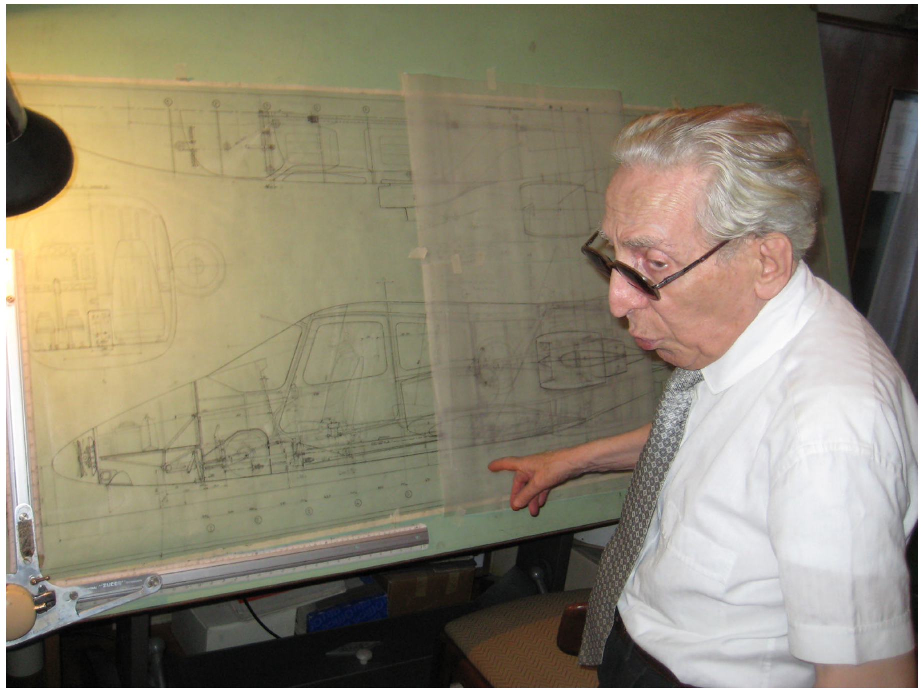
design on the board. It's a passenger version of the single-engine F.1300 Jet Squalus military trainer, and Mr. Frati is looking at the possibility of putting an engine on each side of the fuselage.

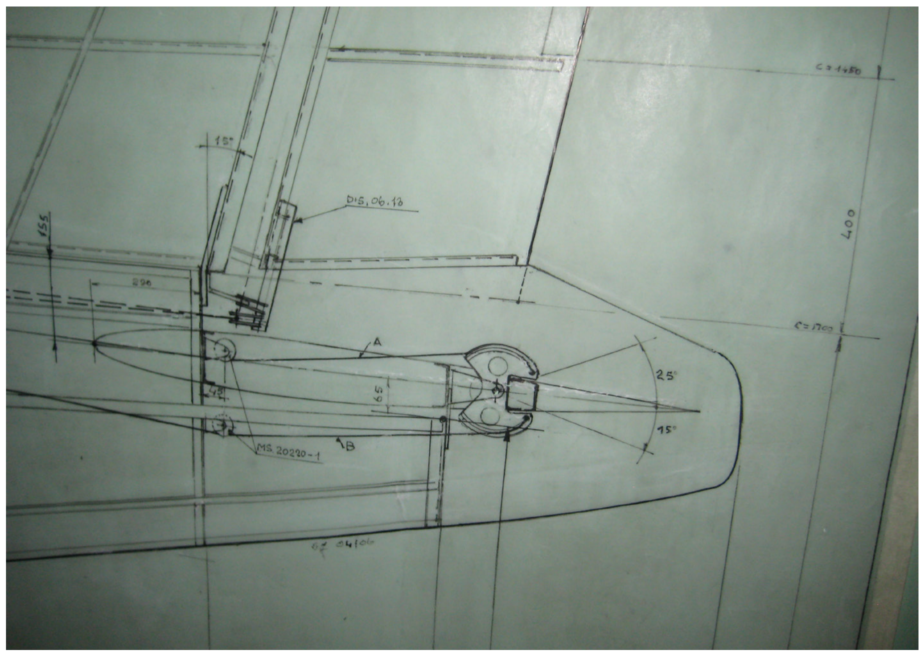
He also had drawings for the F.230.D, a variant of his 260 hp four-seater but with a French four-cylinder diesel engine that was being proposed but which came to nothing.

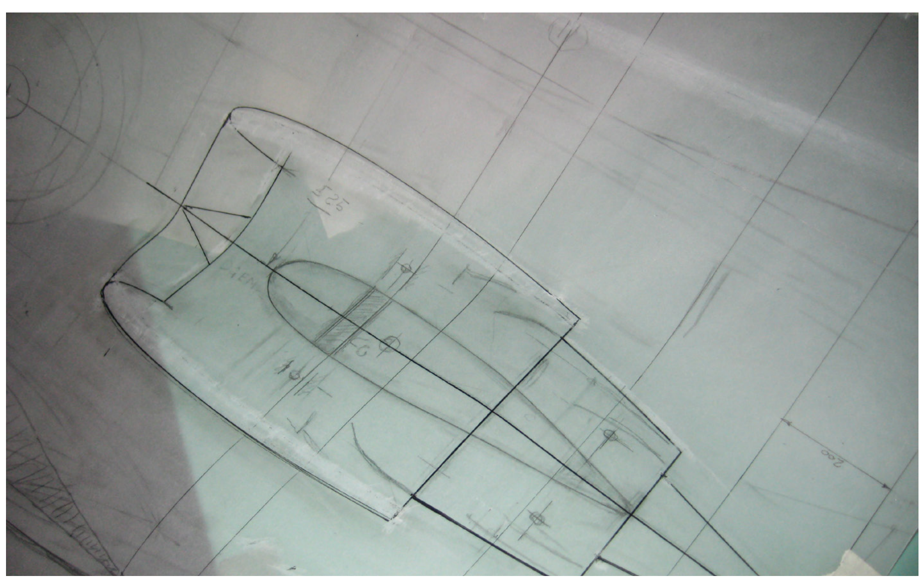
I asked about Napo, the unforgettable street-cat that Mr. Frati was thinking about adopting ten years ago. Mr. Frati began slapping the desk with a ruler and in a short time Napo wandered in and graced us all with his presence. Napo settled in long ago, and he sleeps under a curtain to the side of Mr. Frati's drawing board. He wanders among the drawings and over Frati's desk with a nonchalant distain for everything but food and affection. Napo has actually become very friendly over time, a temperament that doesn't go with his countenance and a protruding lower fang that looks more like a machine-gun in a bomber turret than actual feline dental equipment.

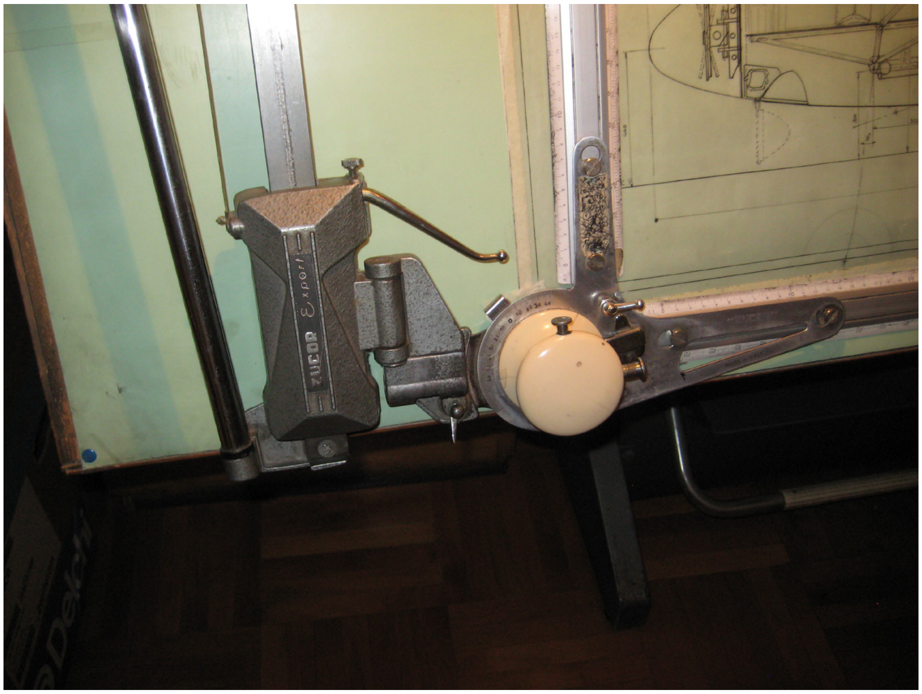
Mr. Frati is, as always, frustrated with the state of affairs in Italian aviation—and who wouldn't be—and how another engi-

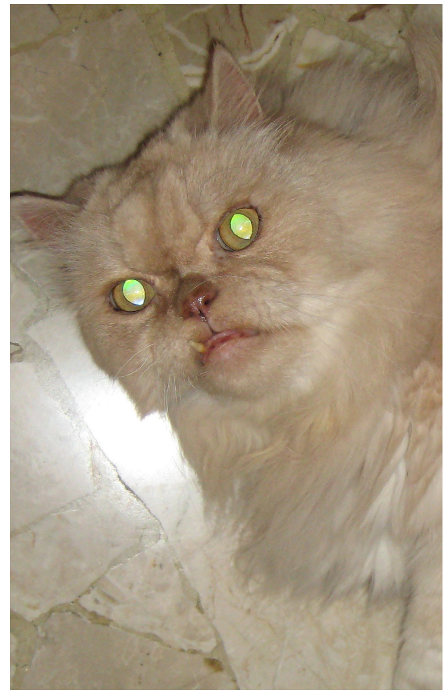
Ernesto Valtorta

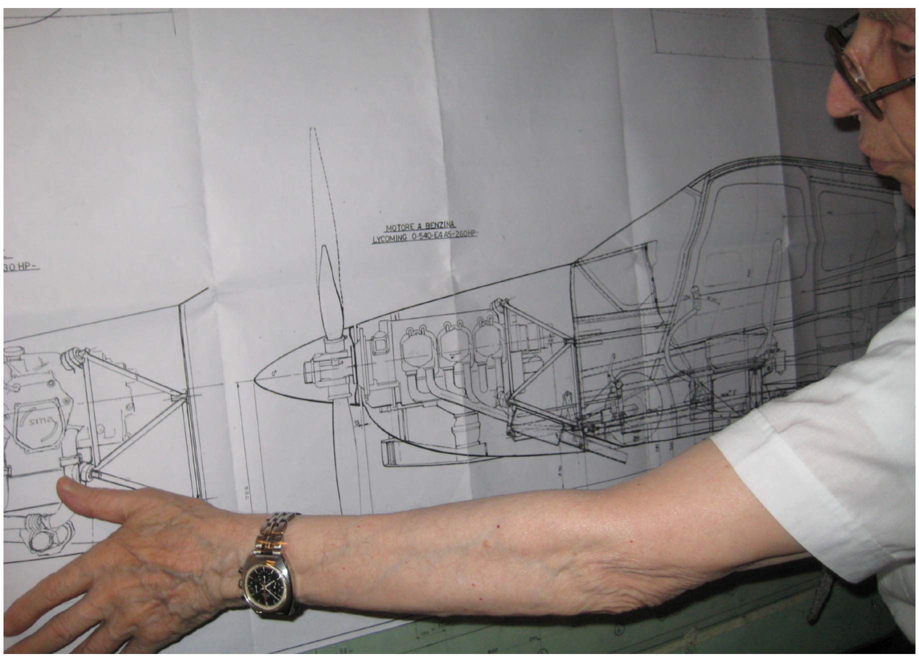












neer at Partenavia in Naples will not start work on any project until he knows there is a government grant already in place.

I asked Mr. Frati what will happen to all of his drawings when he dies, and he hasn't really thought of it. He supposes that one of his nephews will just clean up things and maybe if someone is interested in the drawings then they could get in touch with his nephews. It seems a pity that the drawings might end up in the trash, and that they really should be archived somewhere. There are literally thousands of drawings, and this would make great study materials for engineering students.

In the typical archival process, historical materials are donated to a museum or historical society and then, without meaning any harm, the archivists protect the materials, limit access and require that you wear white gloves when you handle the materials. Thus in the process of caring for the materials, the typical archivist builds a wall around the materials.

What should happen here, either before or after Mr. Frati passes from the scene, is that there should be a plan in place to save the drawings. Ideally, the drawings should be scanned and then made available for anyone on the Internet. Whether we can pull this off, I really don't know, but I've decided to make an effort at getting something under way. I've asked Mr. Frati to give his nephews my card and to contact me when the terrible day comes, and in the meantime, I'm trying to promote the idea in hopes of finding the right person or institution that might want to take it on.

The Glider

Part 25 of a Series

by Dr. Ing. Stelio Frati
translated by Giovanni Nustrini

2. Maximum speed condition. In this flight condition we have a smaller load than in the previous calculation. In fact, for each half wing, it has a value of

$$0.75n(Q-Q_a)$$

For a single-spar wing, it would be pointless to calculate the shear and moment loads as these are less than the ones we have already calculated. But we should find the shear values, because in this condition we also have torsion, which induces a shear stress. The total stress in the spars could be even greater than in the maximum lift condition.

In normal gliders, however, the shear stress on the spars from torsion is always smaller than the bending loads, and we can safely skip this verification. Since torsion is smaller than for a zero-lift conditon, this verification is pointless. In this last condition we will see how to determine its distribution along the wing span.

The maximum speed condition we are about to analyse, given the aft position of the aerodynamic force on the chord (see Figure 9-2), will particularly concern the strength of the elements behind the spar, wing ribs, and of the wing attachment to the fuselage. The wing rib can be considered as a restrained beam, (Figure 9-21) stressed by a triangular load.

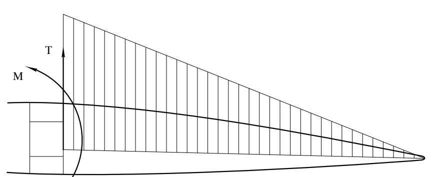


Figure 9-21

In practical terms, especially for normal gliders, it is not necessary to calculate stresses in the various parts of the wing rib. It is enough to obtain the maximum values of shear and bending moment loads at the attachment to the spar. To obtain these loads T and M_f we have to find the load on the wing rib. Therefore, let's consider the sum of wing ribs lengths on a half wing and divide the load on it by this total length. This way, we will obtain the load per linear metre of wing rib. By multiplying this value, for the wing rib length, we will have the load on it.

This load is distributed on the chord as shown in Figure 9-2, in which the maximum value—2.56 C/l—corresponds to 22% of the chord, and it decreases in a linear manner until it is zero at the trailing edge. Since the spar is always in an aft location, we will be interested in the aft triangular part of the load diagram. Of the load on the wing rib behind the spar, we will determine the resulting R', which is, in fact, the value of the shear at the attachment to the spar. The bending moment will be the product of the resulting $R' = T$, *i.e.* of the shear, for the distance from the attachment to the spar (Figure 9-22).

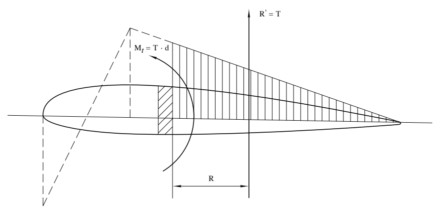


Figure 9-22

By dividing the bending moment found by the spar height H, we have the axial stress on the wing rib at the attachment to the fuselage. If we want a greater approximation, we can calculate the wing rib as a truss, thus also obtaining the stresses in the struts and the braces of the trellis.

3. Zero lift condition. This condition mainly concerns the torsion to which the wing is subject, (and it is the maximum that can be reached) and for which the structure is calculated. The value of the torsion moment M_t established by certification standards for the whole wing is:

$$M_t = 0.20 \cdot 2n \cdot Q \cdot l_m$$

and, therefore, for the half wing:

$$M_t = 0.20 \cdot n \cdot Q \cdot l_m$$

where:

n = limit load factor
Q = aircraft total weight
l_m = wing geometric mean chord

Since the torsion moment M_{tx} in a generic section X of the wing is a function of the area, once its maximum value M_t is established at the wing attachment, we now have to determine its distribution along the wing span. Let's consider a virtual wing, referred to a system of axes whose origin is at the end, as we have already done for bending.

The torsion moment M_{tx} is:

$$M_{tx} = \frac{S_x^2 \cdot L}{S^2 \cdot x} \cdot M_t$$

where:

S_x = area of the part contained between section X and the wing tip
L = half wing span
S = half wing area
M_t = half wing maximum torsion moment
x = distance of section X from the origin

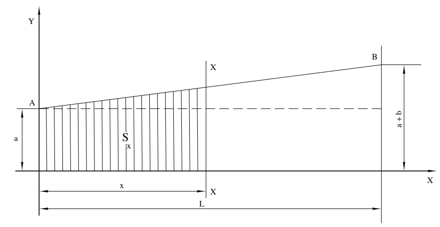


Figure 9-23

The relation seen can be undoubtedly used when introducing in it the value S_x, which is a function of distance x. Let's consider then the equation of the straight line AB of the wing area:

$$y = \frac{b}{L} \cdot x + a$$

that, once integrated, gives us the area equation:

$$S_x = \frac{b}{2L} \cdot x^2 + ax$$

By replacing this expression of S_x in the expression that gives us the moment, we have:

$$M_{tx} = \frac{\left(\frac{b}{2L}x^2 + ax\right)^2}{S^2 \cdot x} \cdot L \cdot M_t$$

an equation whose unknown quantity is only x; therefore, for each value of it, we have the torsion moment M_{tx} in section X, at x distance from the origin.

Example. Given:

L = 8 m	S = 9.20 m^2
Q = 300 kg	a = 0.60 m
n = 3.5	b = 1.10 m
	$(a + b)$ = 1.70 m

The mean chord will be:

$$l_m = \frac{a + (a + b)}{2} = \frac{0.60 + 1.70}{2} = 1.15\text{m}.$$

The maximum torsion moment M_t per half wing is:

$$M_t = 0.20 \cdot 3.5 \cdot 300 \cdot 1.15 = 241.5 kgm$$

By replacing the known values in the expression of the rudder torque M_{tx}, we have:

$$M_{tx} = \frac{\left(\frac{1.10}{16}x^2 + 0.60x\right)^2}{9.20^2 \cdot x} \cdot 8 \cdot 241.5$$

from which:

$$\frac{\left(0.0688x^2+0.60x\right)^2}{84.64\cdot x}\cdot 1932$$

By simplifying:

$$M_{tx}=\left(0.00473x^3+0.36x+0.0825x^2\right)22.82$$

and finally:

$$M_{tx}=0.108x^3+1.885x^2+8.22x$$

which is the equation sought from the distribution of the moment on the wing span. As a verification of this, we find the moment at the attachment with the wing spar, which as we know is: M_t = 241.5 kgm. Let's introduce x = 8, as this is the half wing span, and we will have:

$$M_t=0.108+512+1.885\cdot 64+8.22=55.20+120.50+65.80=241.50$$

a value that, as we can see, perfectly coincides with the established standards.

With a similar procedure, we can obtain the values of the M_{tx} moment in any section of the wing by introducing in the relation found a given value for x.

Graphic determination of torsion moment. In a very similar manner to what we have done to find the shear and the bending moments, we can also get the diagram of the torsion moment with a graphic process.

From the formula of maximum moment:

$$M_t=0.20nQl$$

we see that M_t is proportional to chord l and to load Q, which, as we know, is in turn proportional to chord l.

The torsion moment is, therefore, proportional to the *chord square value*.

Using an appropriate scale, we build the diagram of the chord squares, which we obtain by multiplying by themselves the values of the load diagram, or the area diagram, which is the same.

Then, by integrating this diagram as we already know, we obtain that of the torsion moment that we are looking for.

Now we have to determine the scale to read the ordinates. This is easily found, as we already know the value of the maximum ordinate at the wing attachment, since it is M_t given by the standards.

By dividing this value by the maximum ordinate, in cm, we will have the moment scale:

1 cm = x kgm.

Example. Let's consider the wing of the previous example and obtain the torsion moment diagram.

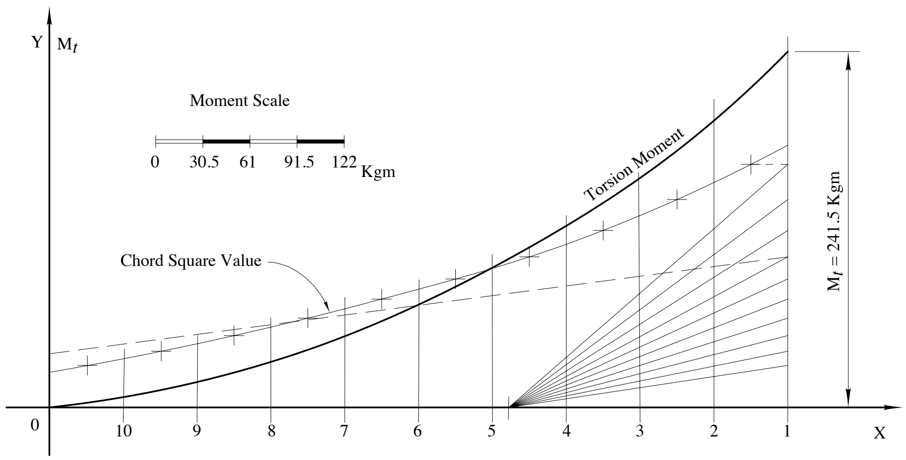


Figure 9-24

Let's build, for this purpose, the diagram of the chord squares (which is a parabola) and divide it into ten parts (Figure 9-24).

Using the procedure known, we integrate this diagram. The scale is immediately obtained from the drawing.

The maximum ordinate, in fact, is:

$$y = 7.9 \text{ cm}$$

therefore, since the moment must be:

$$M_t = 241.5 \text{ kgm}$$

we have:

$$1cm=\frac{241.5}{7.9}30.5kgm$$

From the diagram, let's find, for example, the torsion moment in a section at 4 metres from the end. The ordinate in said section is:

$$y = 2.3 \text{ cm}$$

therefore:

$$Mt_x=2.3\cdot 30.5=70.15kgm$$

Sudden landing condition. Finally, let's see which stresses occur in the wing in this condition; stresses that have an opposite sign to those in the other conditions. The forces of inertia developing from the top towards the bottom are supposed to be applied with a 15° forward inclination compared to the wing reference plane. The limit load factor is fixed at n = 4 for all aircraft categories.

Assuming the load is evenly distributed on the wing according the the wing area, the bending load for the half-wing is:

$$n\cdot Q_a\cdot\cos 15°$$

where

Q_a = wing total weight
n = limit load factor.

This load is generally a lot lower than that of the sudden pull-up in the first condition. Anyway, once the load is determined, the shear and bending moment stresses derived from it are found as we have seen in the first condition.

We still have to determine the stress from the load on the wing, where the maximum value is set by the rules at:

$$\frac{1}{8}\cdot n\cdot Q$$

for the half wing. Therefore, we can say that in the usual single spar wings of gliders these stresses have a small value and the verification of the structural strength for such stresses is not required.

We have now looked at the various load conditions for the wing, and we have also seen, through some examples, how to determine the various stresses to which the wing structure is subject. These stresses are supported by several elements of the structure.

The spar, or spars, support bending and, in particular, the spar caps support the tension and compression loads resulting from the bending moment, while the sides or webs of the spar support the shear loads.

As far as torsion is concerned, it is the wing skin that has the task of giving the wing strength to resist this stress.

Accounting for the actual stresses that occur in each and every element of the wing would greatly complicate the calculation without compensating for the slight lightening we might obtain the structure. Instead, it is always necessary, within limits, to simplify the structure so that calculation is made easier and so that it does not produce any uncertain results. The structures of today's aircraft are considerably simpler than those of the past and, therefore, calculation results are safer and more reliable.

In gliders, wooden structures are now universally adopted and for the wing the single spar with a wing skin on the leading edge that resists the torsion is the dominant structure. So, let's consider this type of structure and see, with some examples, how we proceed to calculate it, based on the loads on it.

We have thus come to the third phase of our work on dimensioning the structure, in other words, to the verification of strength, or as it is said using the terminology of construction science, *stability verification*. We talk about verification because in any construction first we proceed to an approximate dimensioning in an arbitrary manner of the structure, and then, based on the loads on it, we verify that the resulting *unitary stresses* do not exceed the maximum stresses allowed by the materials used.

57. Verification of the bending strength of the wing spar.
Let's start with the spar. This is a longitudinal beam in the wing that supports bending. It may have a hollow section or a solid one (Figure 9-25).

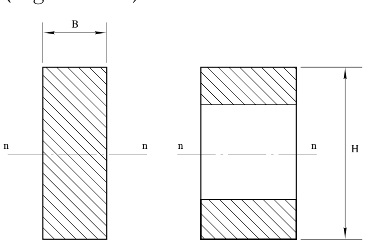


Figure 9-25

In case of a hollow spar, it is generally formed by two spar caps connected by sides, called webs. The caps carry axial loads; the upper cap for compression and the lower one for tension derived from the bending moment, while the webs carry the shear loads.

In case of inverted flight, axial stresses on the caps are inverted, but we are not interested in this flight condition, which is not even considered by certification standards, as gliders are not intended to fly inverted and the maximum inverted load is always much smaller than the up-right load.

To draw the sections of the spar, certain data must be established. The height *H* is already known, from the thickness of the airfoil we are using.

We have to fix the width *B*, which may also be constant along the entire wing span (for example with the spar in low aspect ratio wings, as we can find in gliders) or, as is more common, it may be tapered and decrease in thickness towards the wing tip.

Full spar. Let's first consider that the spar is a full beam. In this case, once *B* and *H* are fixed, we can obtain the normal unitary maximum stress, since the bending moment M_f is known in that section:

$$\sigma = \frac{M_f \cdot y}{J} = \frac{M_f}{W}$$

where:

σ = bending unitary stress
M_f = applied bending moment
y = distance of the most stressed fibre from the neutral axis
J = moment of inertia of the resisting section in relation to the neutral axis
W = resisting moment of the section = J/y

In our case of a rectangular section, the neutral axis is in the centreline, therefore:

$$y = \frac{1}{2}H$$

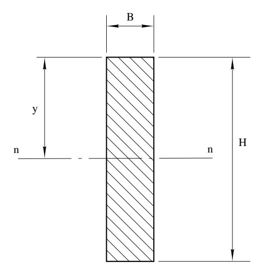


Figure 9-26

The *moment of inertia J* of a rectangular section in relation to the centroid is:

$$y = \frac{1}{2}H$$

The *resisting moment W* will then be:

$$W = \frac{J}{y} = \frac{1}{12} \cdot B \cdot H^3 \cdot \frac{2}{H} = \frac{1}{6}BH^2$$

The expression of the unitary stress is:

$$\alpha = \frac{M_f}{W} = \frac{6M_f}{BH^2}$$

from which we can obtain, after assigning a value to σ, the unknown width *B*:

$$B = \frac{6M_f}{\alpha \cdot H^2}$$

Example. Let's determine the required length *B* of a spar with a full rectangular section, in whose section we have:

M_f = 850 kgm = 85000 kgcm
H = 15 cm
σ = 380 kg/cm^3

By applying the last formula, we obtain:

$$B = \frac{6M_f}{\alpha \cdot H^2} = \frac{6 \cdot 85000}{380 \cdot 225} = 6cm$$

We have said that the full section spar is used only for low aspect ratio wings with low characteristics, such as in gliders, for the sake of construction simplicity.

In gliders, as also in all motor aircrafts, the spar is always hollow.

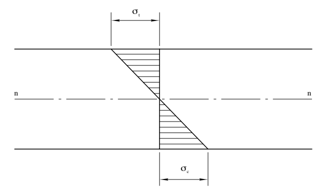


Figure 9-27

This is done because bending in a rectangular section causes a distribution of stresses as shown in Figure 9-27, where they vary from a maximum, at the ends of the section, to zero at the neutral axis, and by inverting the sign, we change from tension on one extreme to compression on the other. Stress is nil at the neutral axis, and near to it, it is always small.

It is therefore better to distribute the material as far as possible from the neutral axis, to make it work at the maximum allowed for it. In other words, the moment of inertia of the cross-sectional shape should be the greatest for the material used.

In practical terms though, this is limited by construction reasons, such as that of not excessively increasing the width *B*, which would lead to complications for the joints of metallic parts, etc.

Therefore, it is advisable that the spar width should never be greater than the corresponding height *H* and as a starting point we can keep *B* = *H/2*.

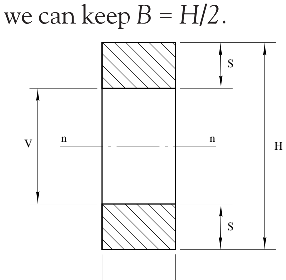


Figure 9-28

Symmetrical box spar. Let's now examine a spar, whose section is symmetrical in relation to the neutral axis, with equal caps (Figure 9-28) of a thickness *S* and where *V* is the internal height, which is:

$$V = H - 2S$$

as *H* is the height of the spar.

The moment of inertia *J* of the resisting section, in other words the moment of inertia of the area of the two spar caps in relation to the neutral axis $n - n$ is:

$$J = \frac{1}{12} B\left(H^3 - V^3\right)$$

and having here too:

$$y = \frac{1}{2} H$$

by replacing in the fundamental relation

$$\sigma = \frac{M_f \cdot y}{J}$$

having found the value of *J* and *y*, we have:

$$\sigma = \frac{6 \cdot M_f \cdot H}{B\left(H^3 - V^3\right)}$$

a relation that gives us the spar cap's maximum stress.

If instead we fix the maximum admissible value of stress σ for the material used, we can obtain the value of *V* and, therefore, the spar cap thickness:

$$V^3 = H^3 - \frac{6 \cdot M_f \cdot H}{\sigma \cdot B}$$

a commonly used formula for dimensioning caps when they are the same. The thickness is given by:

$$S = \frac{1}{2}\left(H - V\right)$$

Example. Let's keep considering the previous example, so that we can find which is the advantage obtained in weight with a hollow spar.

We had:

$H = 15$ cm $\quad M_f = 85000$ kg/cm
$B = 8$ cm $\quad \sigma = 380$ kg/cm^2

by applying the last formula:

$$V^3 = H^3 - \frac{6M_f \cdot H}{\sigma \cdot B} = 15^3 - \frac{6 \cdot 85000 \cdot 15}{380 \cdot 8}$$

$$V^3 = 3375 - \frac{7650000}{3040} = 3375 - 2520 = 855$$

and by extracting the cubic root:

Mark Wainwright with his flaps and ailerons.

$$V = \sqrt[3]{855} = 9.49\text{cm}$$

The spar cap thickness is, therefore:

$$S = \frac{1}{2}\left(H \pm V\right) = \frac{1}{2}\left(15 \pm 9.5\right) = 2.75\text{cm}$$

Let's analyse which is the material reduction obtained compared to the full spar.

The resisting section is, in this case:

$$2 \cdot S \cdot B = 5.5 \cdot 8 = 44\text{cm}^2$$

while in the previous case it was:

$$H \cdot B = 15 \cdot 6 = 90\text{cm}^2$$

As we found in the instance of a full spar, the resisting section, *i.e.* the material used, is more than double even though the stress σ is the same.

As a verification, it is a good rule to draw, even in a small scale, the resisting sections calculated, because the eye can give good advice. For example, it is a good rule that the relation between the cap thickness and its width *B* is not too small.

Let's draw in scale the calculated section and, as we can see, it is quite well proportioned (Figure 9-29).

In the examples we examined, we considered a rectangular section. In reality, this hardly ever occurs, because the spar follows the shape of the airfoil and, especially if it is quite wide, the top surface and the underside are sloping and not perpendicular to the sides.

In these cases, we should keep into account the average height in correspondence with the centreline (Figure 9-30) for the height *H* and, similarly, *S* for the cap thickness.

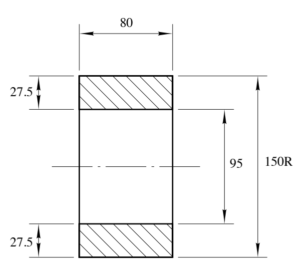


Figure 9-29

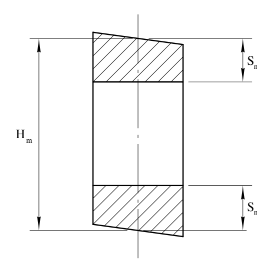


Figure 9-30

Construction Notes

Art Domingues is by far the highest-time Falco pilot in the U.S. He flies Quentin Rench's Falco, N828TS on business, so he's boring holes in the sky all the time.

Recently the Falco has developed a problem with a soft spot on the left wing near the trailing edge. After investigating it, the mechanics found that the wing fillet was built by shaping polyurethane foam and then covering it with fiberglass. And the foam was completely saturated with water, indeed when they punched a hole in the fillet on the bottom, water ran out all night long.

The result of all this water is that the wing trailing edge rib at Station 1 was rotten and there is a 3-4" diameter area of plywood on the bottom fuselage skin that is rotten. The aft wing spar is fine.

The repair is to replace all of the wood, and they are eliminating all of the foam. It appears that there was a hairline crack in the wheel well that was the entrance point for the water, but they don't really know for sure.

Angus Buchanan asks about using sealants in the fuel system. As a general matter, you don't need to use a sealant. Certainly not on the Swagelok fittings that compress on the tube, and no need for this with plastic to plastic or plastic to aluminum.

About the only place where it might be considered is in a pipe thread joint between aluminum and aluminum. You have the worst problems when you have two similar metals, because that's when you can get galling. The flop tube fittings are a candidate for a sealant or thread-lube.

The easiest and cheapest thing to use is Teflon tape, and it's what we use on air lines here at the office. But it's always recommended against in an aircraft fuel system for the simple reason that bits of the tape can fall off and end up in the fuel lines and clog things up. The normal products are things like SealLube or the equivalent, sold by Aircraft Spruce and other supply companies. Any aircraft mechanic will have a little bottle of something they use.

Angus also asked about the terminal block on the front of frame 12. He got one from the electrical kit and came up one short. As I recall we didn't include a terminal block in the kit for the front of frame 12. I wasn't sure if people were actually going to do that, or if it might be a goofy idea on my part. As you may know, there are any number of ways to provide a quick disconnect. In the US, we have Radio Shack stores where you can buy things like this.

As Susan mentions, Falco builder Corin McCrae does this in his day job.

Ian Vickers notes that the plans call for cadmium plating for the bronze bushings, and he asks if the plating should cover all surfaces or are the bearing surfaces to be left unplated.

The normal practice is to plate the entire bushing, and press it into place. It's assumed for any part that the plating will be for the entire part unless otherwise specified. Once the bushing is in place, you might have to ream the bushing, in which case the plating is obviously removed, and also with use the plating on the inside tends to wear off.

In the U.S., cadmium plating is effectively outlawed by the Environmental Protection Agency. Nothing wrong with the parts, just the plating factories tend to be huge sources of pollution, so yellow zinc plating is the norm.

Coast to Coast with Susan

My first summer at Sequoia has been a really exciting and busy time. I have almost completed a full warehouse inventory, implemented a new accounting system, archived files and designed a new database to hold all of our builder information. I have also researched more efficient methods (meaning economical) to ship to builders. We are all feeling the impact of fuel prices. Overseas shipping has been dramatically affected. Trust that I will be shopping your shipping costs no matter where you build!

So many of you have shown me how great it is to be aboard! Thank you for all of the personal welcoming telephone calls. Leif, I really enjoyed your description of your travels to China. Angus, I am certain your children will learn to appreciate true tenacity while watching their dad lovingly work on his Falco. Tim, is was a pleasure to have you here at the office for a personal tour. Everyone has shown kind patience while I continue to "broaden my horizons" in learning to work with our builders living in all the different world time zones. Even though e-mails appear instant, I try to remember that some of you are still sleeping while I am electronically communicating with you!

Getting to know you has also helped me learn more about all the special interests of our Falco builders. I knew nothing about the famous de Havilland Mosquito bomber of World War II. I do now because of one of our new Falco builders in New Zealand, Corin McCrae. He works for Mosquito Aircraft Restoration, where they build this incredible airplane from scratch! Check out their website: www.mosquitorestoration.com. See photos on previous page.

We had a good response to our Falco Store sale of tee shirts and golf shirts. The next sale involves our inventory of sweatshirts and the remaining smaller-sized golf shirts. We have an all-new line of golf shirts coming to the Falco Store as well as new long-sleeved shirts. Everyone should be pleased with the quality of the new clothing. I will also have a limited number of two new items for you that I hope will be a hit: a signature Falco watch and a travel/sports bag. Oh yes—the famous bucket hats are back!

I had a suggestion from a builder that we needed to offer a Falco picture poster. Great idea! The best possible way to do this is to have a picture of *your* Falco to select from. We have an inventory of older pictures to choose from, but I would really like to have a more recently built Falco to highlight. So, send me your picture!

If you have checked the website lately, we are surveying builders that would prefer their *Falco Builders Letter* sent to them electronically. I realize that a lot of you would like to not be dependent on your local mail service to deliver your *FBL*. David Gauger likes the idea—he says it would save him some space, since he has been collecting them since 1983! If this is the way you would like to go, please let me know.

Susan Arruda
support@seqair.com

***Top:** The guys in the picture with me are Albert and Joshua—very retired former racing greyhounds. If you like to see what I do when I am not here at the office, check my website: www.colonialgreyhounds.com. This has been a passion of mine for nearly 15 years. If you are not familiar with this effort, greyhound racing is a large sporting industry in this country. Rescue groups all over the country work at finding these marvelous dogs homes after their racing career has ended. I have three at my house. They are large, quiet, sweet and loving "couch potatoes" who once ran 3/8 of a mile in 30 seconds!—Susan Arruda*

***Above:** Andrei Efremov, our first Falco builder in Russia.*

Mailbox

I am almost through with the complete rebuild of N64SB that I bought from Steve Bachnak and I'm now up to final paint, detail and nose gear doors. I have the cowl and rear of the aircraft and all surfaces balanced and in color. I have discovered many minor things that will make a huge difference in the performance of the aircraft, mostly cosmetic in nature. If anyone would have told me how much time this would have taken I would have never agreed with them. It seems I have a habit of getting into things and vastly under-estimating the time commitment required to do even the simple things.

I have included a complete avionics upgrade including aux tank with flop tube, new panel, all new wiring, Garmin 430, 340, King ADF, fuel flow, and EI ultimate engine analyzer and auto pilot. As well as adding an E-Mag / P-Mag system, and fuel injection and a pressure chamber to the engine.

I must say repainting the bottom of an airplane is not a fun job. I would have much rather done this project the first time from scratch. I don't know what kind of paint was on the bottom, but I can say it was as hard as a brick.

One of the most interesting things I found was related to the first flight report Steve's report indicated it had a heavy right wing. This aircraft has been flying since 1989 and in my opinion is very well constructed for the most part.

I had also noticed that on my first take-off that the right wing dropped as soon as you lifted off. It was easily arrested by moving the stick to the left and once corrected you would not notice it again in the flight. Apparently at the speed just above take-off in a nose-high attitude which would of course be just above stall, the left wing was flying and the right one was not. The major work I did was on the flaps and correcting gaps, etc. I had thought that just by doing these it would be better and maybe it would have corrected the problem, I am now certain that the speed will increase from this effort, but the built-in wing stall would not be changed.

One comment Alfred made was that he would concentrate on the front edge of the wing if he was looking for speed. That got me to thinking differently about the problem. I researched that a little, and I am now sure he is right on that. Some work had been done on the flaps previously and

Top: Steve Crisp's Falco in the shop. Center: Glyn Russell's gravestone. Bottom: Pierre Aubrey with Falco project in Switzerland, begun by Don Stark.

while not fitted properly they were obviously not the whole problem. The lift is generated in front of the front spar and even from the beginning this aircraft apparently had this problem. The flap problem obviously had come to existence after the fact.

While I was sanding on the right wing preparing to paint I noticed that there seemed to be some "wrinkles" (actually felt more like a wash board), and low spots in the skins before the main spar. These were horizontal in nature and really wasn't very noticeable to the eye. While block-sanding my fingers detected the dips, which I have now worked out and I now think the shape is close to the same as the left wing. I theorize that the lift generated was just not as good on the right as it was on the left due the imperfections in the center two skins on the right wing. This should be a major boost to performance in this airplane.

I also noted he had large trim tab installed on the right aileron to compensate which I removed. I am hoping that the changes in the profile will make that unnecessary thus reducing drag, coming closer to spec, and increasing speed and decreasing the fuel burn.

Time will tell but I hope to fly sometime this month.

Steve Crisp
Chewelah, WA

I thought you might like to see the manner in which Jonnie remembered Glyn's passion for the Falco. The etching is very nicely done. You can almost read N72GR.

Paul Montgomery
Decatur, AL

Current status… tail surfaces framed, rudder skinned, fuselage frames populated with all the bits that get glued to them. Spent most of the last year building a workshop and machining little bits and pieces.

Slow progress, but progress. The workshop is all done plenty of space to work on the bigger bits. Now I just need some more time…

Went to OSH this year, saw Bill and Charlie Nutt's and Dave Nason's Falcos…

Peter Lloyd
Walnut Creek, CA

I am an aspirant Falco builder resident in

Top and Center: Bjørn Brekke and his project. Avove: If you would like to 'fly in' for a visit, in Google Earth, type in Via Enrico Noe 1, Milano, Italy and this will take you to the sidewalk just outside Mr. Frati's apartment building. He's in a quiet apartment up in the building on the northeast corner of the tree-lined street.

South Africa. As yet I have not started building, but have been studying and analysing the plans for some three years now, (interspersed, of course, with many periods of dreaming about my Falco!) Until I can afford to begin buying materials, etc., I busy myself by preparing my workshop, and making up jigs etc.

I was about to contact Sequoia about taking out a subscription on the Builders' Letter, when you announced the publication of the letter in PDF on-line. This certainly seems to be the way things are going, and it certainly does simplify things, particularly for us here where the postal service is unreliable at the best of times. Please advise whether I need to register for the on-line letter, and what fee might be due.

It is an absolute pleasure to be part of a community of builders/pilots of such enthusiasm, and I must say that Sequoia's professionalism and dedication is inspiring.

Patrick Largatzis
Kwazulu-Natal, South Africa
patrick@konstrukt.co.za

Everything is ok and I am working on my Falco and I am finishing the aft wing spar. The next is the main wing spar.

I am also going to extend my garage so I can build the fuselage and wing in it. It is funny thinking of all the parts soon will be put together to an airplane.

Bjørn Brekke
Bødo, Norway

I purchased my Falco plans in 2005 studied them for over a year and started building in 2007 after taking delivery of the spruce kit from Western Aircraft Supplies. I have now completed building the wooden tail parts and now started building the wing ribs. I hope to assemble the tail next year when I make space in the shed.

I have to say that it's a great project and enjoy every moment I can work on it. Your website and newsletter is a great source of help and inspiration. Locally, I get help from our Sports Aircraft Association (SAAA Chapter 20) and regional South Pacific Falco Forum. One day I hope to visit your office and Oshkosh. Keep up the great service.

Garry O'Leary
Horsham, Australia
gjoleary@yahoo.com

Top: Garry O'Leary gluing a tail spar. Center: Before they built the Falco, Ian and Juliet Ferguson had an SF.260, shown here at Malpensa, Milan 1981. Bottom: A recent photo of Ian's former plane.