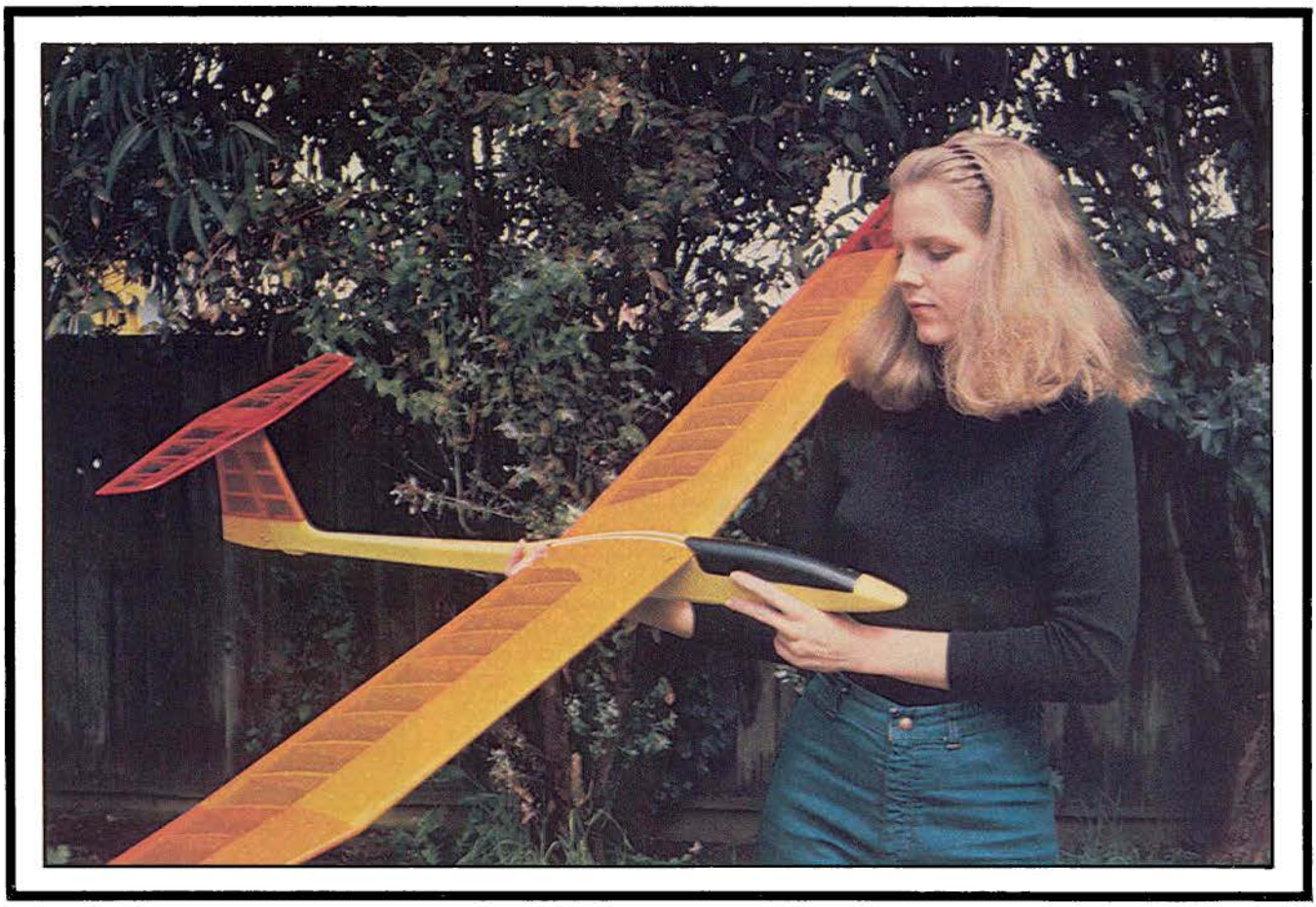
LE GRAN FROMAGE



Phetsy Calloway and Le Gran Fromage.

By Steve Calderon

In looking for something special in a 2-Meter sailplane, Steve's design gave him the results he was looking for from the high start to the landing.

The story opens in a small truckstop, outside of Winnemucca, Nevada, where a retired hang-glider pilot is intently watching a redtailed hawk through the window. The redtail, circling effortlessly in a boomer thermal, suddenly dives vertically on its prey. In a dazzling display of speed and maneuverability, the hawk sinks its talons into the mouse and invites him home to dinner.

About two years later, the same pilot was at the remote controls of a 2-Meter sailplane circling effortlessly upwards into a blue Bavarian sky. But this mechanical bird thirsted for altitude, not mice. Although not capable of out-racing a hawk, the glider was a delight to watch as it came blasting down out of the sky in a high speed pass.

My introduction to radio control soaring came to me almost by surprise. After retiring from hang gliding with no broken bones, but sad memories of dearly departed friends, I wandered aimlessly through the flying world. With insufficient funds to buy a full scale glider, my glider lessons were only partially satisfying. Then it dawned on me. Where did those graceful model gliders that I used to share my airspace with at Pacifica and Fort Funston, California, come from? Why hobby shops, of course! I ran off to buy an R/C glider without really knowing what to buy.

I'll admit my first glider, a 99" Wanderer, was a good trainer, but that was about it. In my search for performance, I scratch-built a Windfreak, and I got exactly what the designer said I would --- high performance and no time to relax while flying it. A beautiful Graupner Cirrus found its way into my collection next, but it didn't have the maneuverability or speed I was looking for.

It wasn't until I was reading a borrowed copy of "Radio Control

Soaring," by Geoff Dallimer and Dave Dyer, that I stumbled upon an interesting quote in chapter 15:

"The design of model gliders is far from difficult, and most keen modelers will wish to try their hand at this aspect of their hobby."

"Blimey!" I thought to myself, "I'll invent one."

From the onset, I decided not to worry about Reynold's numbers or drag coefficients, etcetera. Instead, I would concentrate on a clean aerodynamic shape with a carefully thoughtout airframe. After all, there was enough to worry about, what with wing area distribution, cantilever ratio, tail moments and all. Engineers have a habit of burying themselves with details and sometimes don't see the overall picture.

Knowing what I wanted the finished product to do made the design problem easier. After a suitable gestation period, a design was put down on paper. As is my wont, I chose the whimsical name **Le Gran Fromage** (The Big Cheese) for my 2-Meter creation. A few weeks later, the prototype was tested on a bluff south of Big Sur, California (one of my old hang gliding haunts).

I'll never forget the thrill of the first flight. The Fromage didn't do anything nasty. It went up on the high start smoothly, cruised around nicely, and I got it down in one piece. I probably would have cried if I'd splattered it on the maiden voyage.

The following months saw dozens of test flights back in San Jose, California, as the inevitable sorting out process continued. There were also requests for plans from impressed fliers.

At this point, I decided to make my contribution to the sport by documenting my design. However, when confronted with the prospect of redesigning something, I invariably find ways of improving it. The final version has a lengthened body, a redesigned tail group, and the wing sports ballast boxes as an integral part of the spar. I drew a new set of plans in ink, and then I commenced construction of the second airplane with the help of my ol' flying buddy, Mike Palrang. Also to inject a sense of urgency into the project, I had a deadline to meet. The 4½ month trip I was planning to Europe meant that the entire project had to be completed by May 1980 (including shipping case).

The second Fromage took its maiden voyage in Munich's Englischer Garten. Since I knew how it was going to fly, it was a more relaxed flying session. Unfortunately, I couldn't answer the polite questions from the curious local folks since I didn't speak German. They enjoyed watching it fly inverted, and when it was on the ground, I attemped to explain how it worked. The only flying problem I had was that the Fromage gets hard to see when it's a long way up because of its small size. The two-piece wing and easily removable elevator were handy for transportation, since I had to rely only on public transportation during my three months stay in Munich.

As it stands now, the Fromage has delivered the performance I wanted. It is by no means the ultimate airplane, but it has a lot to offer to the competition pilot in terms of handling and speed. You've really got to be cooking to flutter the wings or peel them off of this plane, not to mention the elevator. I have not fluttered anything on my plane yet and I have a tendency to make high speed passes on my landing patterns. The raised entry airfoil and thin wing combine with the minimal frontal area of the fuselage to allow for good penetration. Yet with the powerful elevator and rudder, you can keep the Fromage from wandering around as it cruises in light lift. If you're tired of floaters, as I was, then the recipe that follows will allow you to cook your own **Le Gran Fromage.**

ABOUT THE AUTHOR

Steve Calderon's interest in flying started with his first airplane ride in a Piper Apache at age 8. At age 10, he served as passenger in his father's Luscombe Silvaire and, later, when he could see over the instrument panel, he served as co-pilot and navigator in his father's Piper Tripacer and Beechcraft Bonanza. The flying instruction Steve received from his father was in the military style (he was a flying instructor during WW II) and Steve wasn't allowed to get away with any sloppy flying.

He fanatically immersed himself in hang gliding in 1974 only to retire disillusioned after logging approximately 530 flights.

Steve has been flying R/C gliders for about 2½ years and this is his first design. This glider was flown in Munich during his 4½ month stay in Europe. Steve has worked as an illustrator for the Dornier Aircraft Works and has now returned to Livermore, California, to work in the Fusion Energy Research Division at the Lawrence Livermore Laboratory as a Mechanical designer.

Steve, who is 28 years old, has had many hobbies over the years including motorcycling, sailing, sculpture, painting, puns, photography, the classical guitar, and renaissance recorder.

Parts List

Pine:
(1) 1¾" x 1¾" x 3".
Balsa:
(2) 1/4" x 1/4" x 48".
(1) 1/4" x 3" x 12".
(1) 1/4" x 3/8" x 18".
(1) 3/8" x 3" x 12".
(1) 1½" x 1½" x 12".
(1) 1/4" triangular x 36".
(1) 3/16" x 4" x 36".
(1) 3/16" x 3/16" x 18".
(1) 3/4" x 1" x 12".
(4) 1/16" x 4" x 48".
(1) 1/8" x 1/2" x 36".
Maple:
(1) 5/16" dia. x 5/8" long.
Spruce:
(4) 1/8" x 3/8" x 48".
(1) 1/16" x 3/8" x 12".
(1) 1/8" x 1/4" x 18".
Aircraft Plywood:
(1) 1/16" x 12" x 24".
(1) 1/32" x 1½" x 3".
(1) 1/64" x 3" x 12".
(1) 1/8" x 6" x 12" (5 ply).
Steel:
(1) 3/16" dia. x 3⅞" long.
(1) 3/32" dia. x 1" long.
Brass Tube:
(2) 1/8" dia. x 3/8" long.
(2) 3/16" I.D. x 2" long.

CONSTRUCTION

Wing:

Cover the plan with clear plastic wrap and build both wings simultaneously.

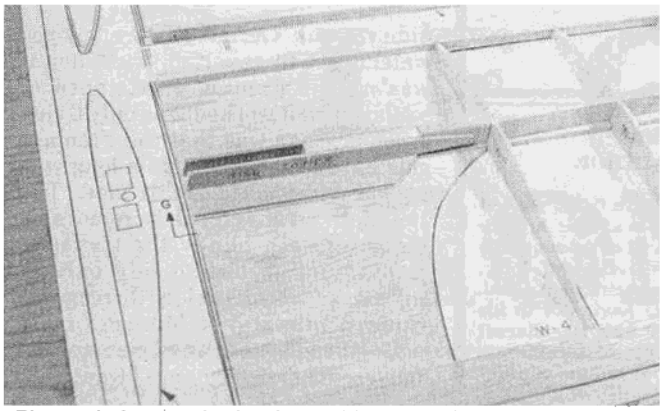
(1) Start by cutting the spruce spars to length. The upper spars are 1/16" shorter than the lower spars. The aft edge of the outboard spars tapers from 3/8" wide at rib W-13 to 1/8" wide at rib W-17.

(2) Cut the leading edge pieces and leading edge shims. The shim for the inboard panel is 3/32" x 5/16" x 25" long. The outboard panel shim tapers from 3/32" x 5/16" to 1/32" x 5/16". The shim will be flush with the leading edge. It will extend 1/16" from the rear. This ledge will provide a locating point for the sheeting and ribs.

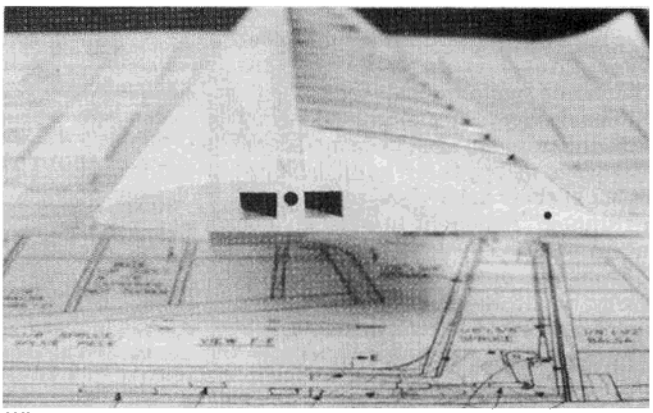
(3) Cut the lower leading edge sheeting and glue to spar and leading edge. This can be done by taping the entire length of the glue joint from the bottom, bending open the joint, and laying in a bead of Titebond. Close the joint and pin in place over the plan. Wipe off the excess glue.

The top leading edge sheeting is done in the same manner. When making the top pieces, leave an extra 1/8" of sheeting on either end to be trimmed off later.

(4) Add trailing edge, ribs W-4 through W-11 and their shear webs. Add the tapered shear webs at the polyhedral joint. The 8° angle on the



Plywood shear webs in place with stepped balsa shear webs. Ballast box floor with 1/16" balsa spacer underneath can also be seen.



Wing root showing ballast boxes and plywood root rib.

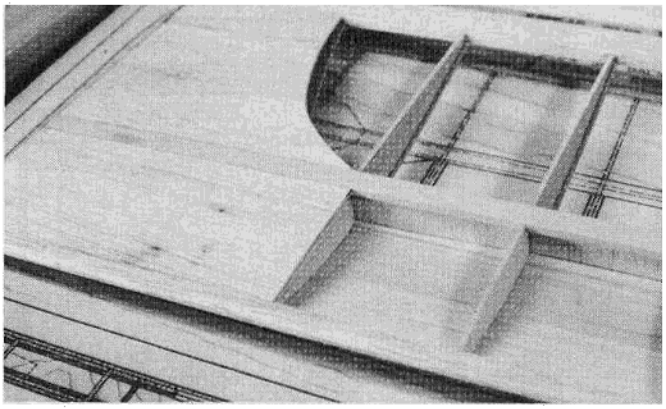
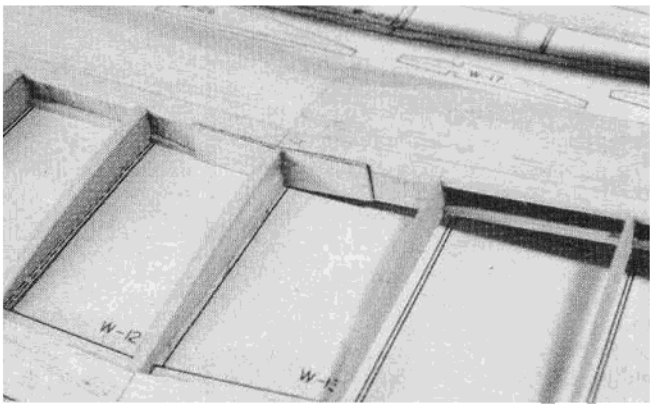
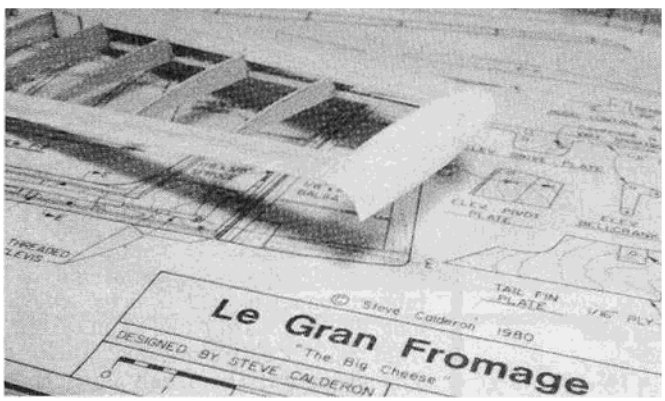


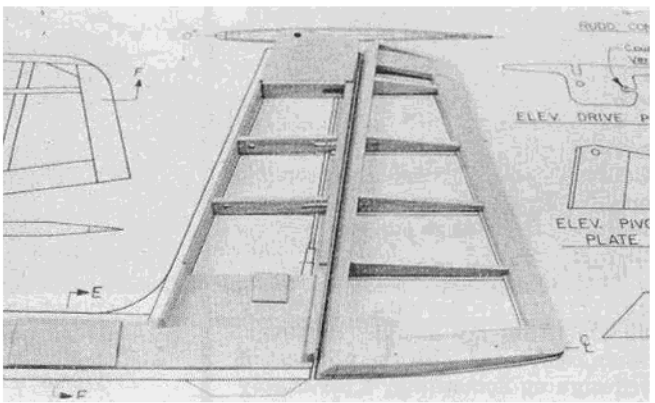
Photo of inboard lower sheeting as seen from bottom side.



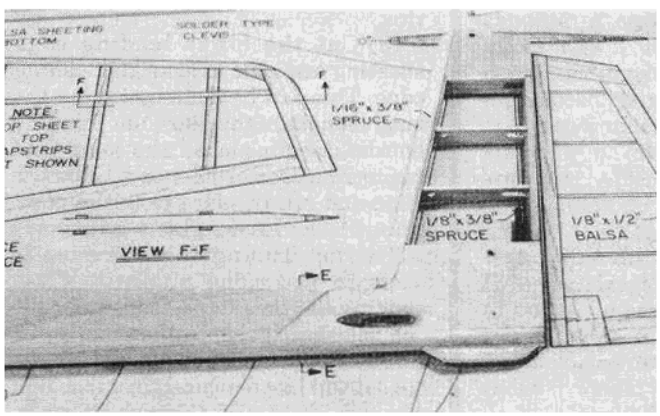
Top view at polyhedral break showing 1/16" plywood brace on rear side only.



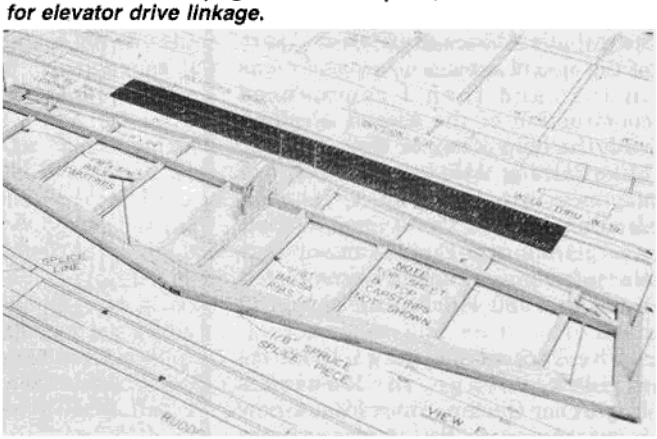
Closeup of carved droop tips. Note lack of shear webs or capstrips in outboard wing panel.



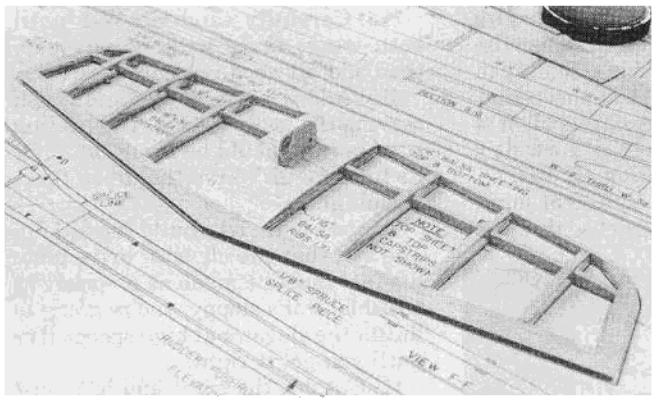
Shows tail fin partially framed-up and completed rudder. Note notches in tail fin, uprights for tail fin plate, and notches in ribs for elevator drive linkage.



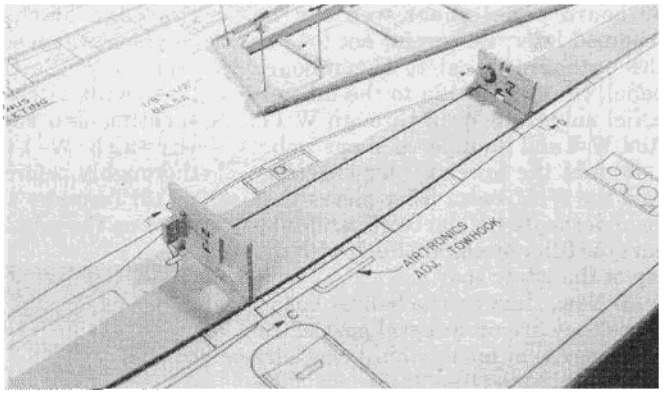
View of completed fuselage at fin location.



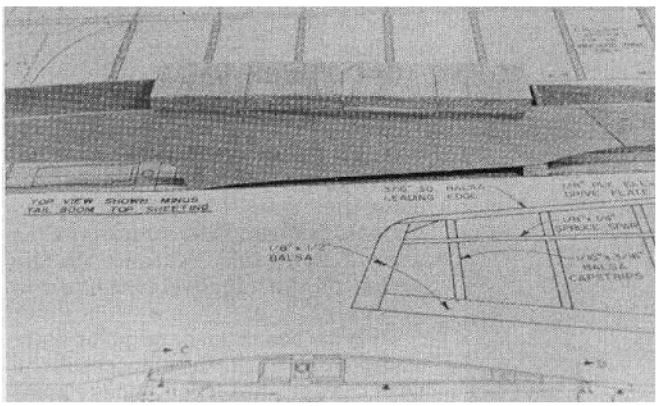
Shows elevator with countersink for drive clevis. Note the shims that provide a locating ledge for the capstrips and sheeting.



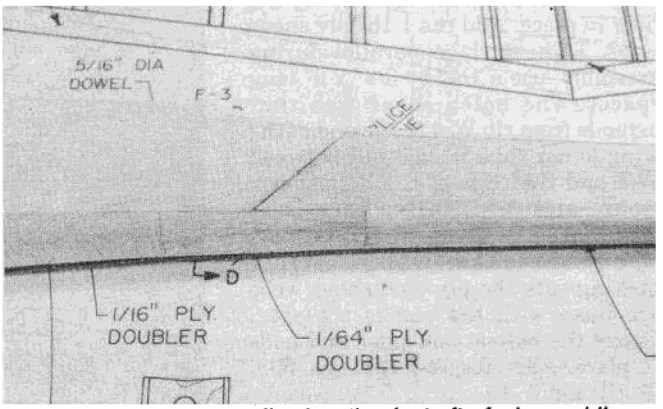
Complete elevator (or flying stab) ready to be covered.



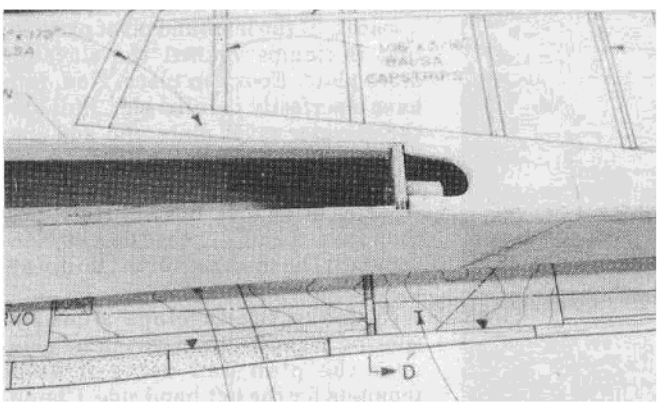
Fuselage side with wing saddle doublers, F-2 and F-3. Guess who forgot to drill access hole in F-3?



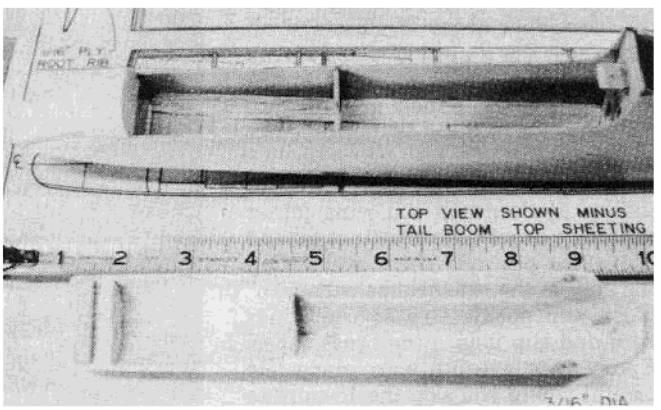
Bottom sheeting being installed crossgrain; 9/32" shim can be seen under F-3.



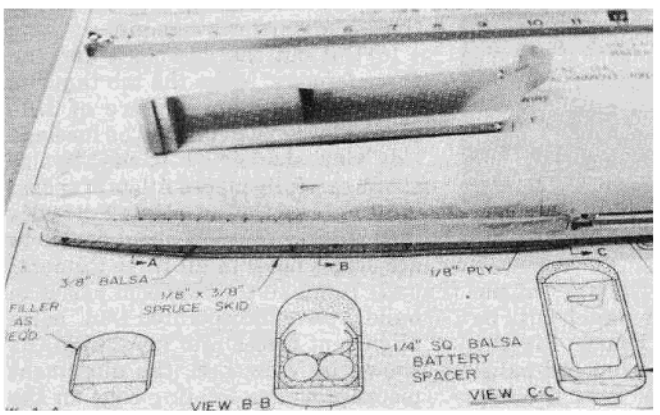
Section of fuselage at splice location just aft of wing saddle.



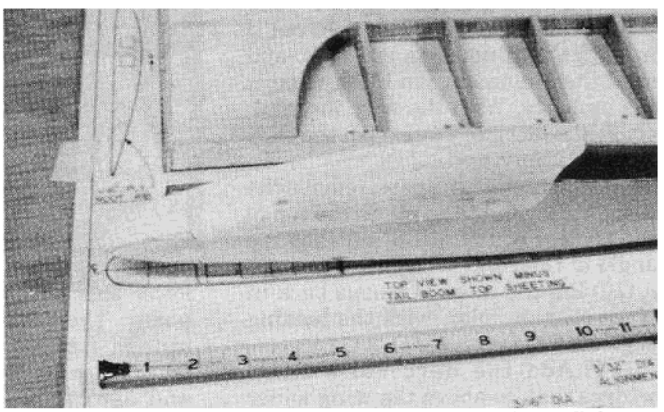
Shows cut-out in top sheeting for wing hold-down rubberbands.



Completed fuselage and hollowed out canopy. Note small radio compartment.



Underside of fuselage showing 1/8" x 3/8" spruce skid.



With canopy in place, this makes a very sleek looking sailplane.

outboard panel shear web can be trimmed later. Be careful not to glue the outboard panel to the inboard panel. Glue rib W-12a to the inboard panel only. Add W-13 through W-17. Add W-4 and its tapered shear web.

(5) Add the lower center sheeting. Add the 1/16" balsa filler pieces that go underneath ballast box floor. Make sure the filler pieces are flush with the top of the lower spar.

(6) Now, start on the ballast boxes. Since they are an integral part of the wing spar, they must be built carefully to insure that the final thickness of the wing is 3/4". The floor will need a 1/4" wide by 1/2" long clearance slot for the end of the wing joiner tube. Epoxy the floor in place. Add the 1/16" ply shear webs. To keep them parallel during assembly, use a 1/4" by 3/8" x 2" long spacer. The balsa shear web that extends from rib W-4 to the end of the wing joiner tube is 1/2" tall between W-4 and the edge of the ballast box floor, and 3/8" tall where it is sandwiched between the ballast box. Epoxy the shear web assembly making sure the plywood shear webs are flush with the end of the spar. Epoxy the ballast box sides and ends in place. Add ribs W-1 through W-3. (5° tilt for W-1.)

(7) Now for the wing joiner. Pull one panel off the plan and line it up with the other. Shim this panel up so that the lower spar at rib W-12 is 4⅜" off the board. Put a piece of plastic wrap between the two panels (to be trimmed later). When the panels are lined up properly, pin in place taking care not to deform the shimmed-up wing.

(8) Add the hard balsa filler wedges that go underneath the wing joiner tube. The brass tube must not extend above the plywood shear webs. Cap the ends of the brass tubes with 1/16" balsa and epoxy. Grease the joiner wire and slip it into the brass tubes. Epoxy this assembly in place. Be careful where you slop the 15-minute epoxy; we're trying to build a **two**-piece wing! Make the alignment pin block by drilling through a 1" long piece of 3/8" x 1/4" spruce; then cut it in half. Cut a notch in rib W-1b and sand the alignment pin block until it fits properly. With the wire inserted, epoxy the block in place. Cap the ends with 1/32" plywood.

(9) Pull the wings apart, remove the wing wires, and then plane the top of the leading edge until it matches the angle of the ribs.

(10) Pin the inboard panels back in place over the plan with the leading edge shims.

(11) Add the hard balsa filler wedges that go above the wing joiner tubes. Add the ballast box top. The stack height at this stage is 5/8".

(12) Fit the top spar/sheeting. Trim the edge of the sheeting at the polyhedral joint so that it fits down the center of W-12a. Glue this assembly in place with Titebond. Add the center sheeting and capstrips (top of W-4 through W-11 only). Let dry thoroughly before pulling off plan.

(13) To make the polyhedral joint, shim up the inboard panel so that the lower spar at rib W-1 is 3½" off the board. The outboard panel will be pinned flat to the board. Fit the outboard panel to the inboard panel and epoxy in place. Add the top sheeting/spar assembly. Epoxy the plywood polyhedral brace in place. Add W-12b.

LE GRAN FROMAGE
Designed By: Steve Calderon
TYPE AIRCRAFT
2 Meter Sailplane
WINGSPAN
78 Inches
WING CHORD
Root 7¾", Tip 4⅜"
TOTAL WING AREA
550 Sq. In.
WING LOCATION
High Wing
AIRFOIL
Mod. Flat Bottom
WING PLANFORM
Constant Chord Center Sec.
Double Taper Tips
POLYHEDRAL, EACH TIP
Ctr. Sect. 2-3/16"
Tip 1-13/16"
O.A. FUSELAGE LENGTH
37¾ Inches
RADIO COMPARTMENT SIZE
(L)11" x (W)1-3/16" x (H)2"
STABILIZER SPAN
18 Inches
STABILIZER CHORD (incl. elev.)
4" (Avg.)
STABILIZER AREA
85 Sq. In.
STAB. AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Top of Fin
VERTICAL FIN HEIGHT
7 Inches
VERTICAL FIN WIDTH (incl. rudder)
4¾" (Avg.)
REC. ENGINE SIZE
NA
FUEL TANK SIZE
NA
LANDING GEAR
NA
REC. NO. OF CHANNELS
2 (mini servos)
CONTROL FUNCTIONS
Rudder & Elevator
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa & Ply
Wing ..... Balsa & Ply
Empennage ..... Balsa & Ply
Wt. Ready To Fly ..... 25 Oz.
Wing Loading ..... 6½ Oz./Sq. Ft.

(14) Carefully sand rib W-1 until both wings mate without any gap, then add plywood root ribs.

(15) Add wingtip blocks and finish carving the leading edge. The leading edge radius should be about 3/32" for its full length. Carve the droop tips.

Fuselage:

To start with, let's build the tail fin. The slot that the elevator drive plate fits into must be made as precisely as possible! If it's sloppy, you're going to flutter the elevator at high speeds. Try until you get it right.

(1) Cut out the right and left hand elevator pivot plates and their doublers from 1/16" plywood. Mark the location of the 1/8" diameter hinge pin hole. Line up the doublers and glue in place.

(2) Cut out the elevator drive plate from five-ply 1/8" aircraft plywood. Three-ply "Lite Ply" will not do! Next, cut out the spruce tailfin uprights. Both uprights have 1/16" reliefs filed along their sides to allow the plywood plates to fit flush. The rear upright has a relief to provide clearance for the action of the clevis/elevator drive assembly.

(3) With the right-hand pivot plate clamped down over the plan, check the fit of the uprights. Their edges should lie flat against the building board. When satisfied, epoxy in place.

(4) Using the elevator drive plate as a spacer, fit the left hand pivot plate so that it clamps against the elevator drive plate. Epoxy in place. Now you have a perfectly parallel slot. Pull out the elevator pivot plate and add the tailfin ribs. There is a 'U'-shaped notch in the aft end to clear the elevator drive link and a 1/8" hole in the forward end to pass the antenna through. The thickness of the tailfin at this stage will be 3/8".

(5) Make the fuselage sides by splicing together the right hand side over the plan and using it as a template for the left hand side. Clamp the two back-to-back until dry. Don't forget to add the 1/16" plywood tailfin plate doublers. Mark the location of the 1/8" diameter hinge pin.

(6) Cut out the noseblock and the three formers. Make the tab that fits through F-2 from a piece of 1/8" plywood. Epoxy in place. The fuselage side view shows how it sits. It also shows carefully placed fillets of epoxy! A 5/16" dowel is epoxied into F-3 and is inclined downward at about 5°. There are access holes in all three formers.

(7) To make the tailboom easier to build, I have incorporated 1/16" balsa alignment pieces into my design. As shown in View E-E, the alignment pieces provide a locating edge for the tailboom sides. The side view shows the alignment pieces start at the aft

edges of the forward 1/64" doubler and extend back to the tailfin uprights. Thev are cut from hard balsa and must be notched where they pass the rear 1/64" doubler. When cut, the alignment pieces must fit over the top view without being curved or cockeyed. The top and bottom of the tailboom are then cut out from 3/16" balsa. The length can be seen on the side view and they are 1/8" wider than the alignment pieces. They can be hollowed out to save a little weight. Hot Stuff the alignment pieces to the top and bottom.

(8) The fuselage is now assembled upside down over the plan. F-2 rests on the plan, F-3 will be 9/32" off the plan and the tailfin plates will be 3/32" off the plan. Epoxy F-2 and F-3 in place. With 2" x 3/8" balsa, add the lower sheeting (cross-grain) starting at F-2. After the first four pieces are in place, work on the tailboom.

(9) Clamp the tailfin plates around a 1/4" x 3/4" x 2¼" long spacer and line up over the plan. Add the tailboom bottom. Add the 1/4" sheeting (grain lengthwise) at F-3. Add the noseblock and F-1. Finish the bottom sheeting.

(10) Turn the fuselage over and shim up the tailboom 5/8". Add the tailfin carefully! The hinge line will be 7½ degrees from vertical. Remember to pull out the 1/4" spacer. Add 1/32" plywood plate for towhook. Add 1/4" triangular corner gussets from noseblock to F-3.

(11) When you have decided on your servo location (mini or micro servos only), install the pushrod tubes. Finish the top sheeting. Make sure that there is a cut-out for the rubberbands in the top sheeting at F-3. See fuselage top view.

Elevator:

The elevator is built upside down over the plan. The outer framework will be shimmed up so that a symmetrical airfoil can be shaped. Elevator thickness is 3/8".

(1) With the elevator drive plate that was cut out in Step 2 of the fuselage construction, drill the 1/8" hole for the hinge pin. Make sure this is done very carefully and accurately. Sand away the outer layers in the area near the drive slot as indicated by the phantom lines on the plan. This is required so that the drive plate can fit between the clevis plates.

(2) Drill the 1/16" hole at the inner end of the drive slot. Countersink with a 1/8" drill on one side. This countersink is **very important** as it retains the solder clevis. The clevis pin has a head which has been spot welded to the clevis side plate. This head must fit snugly in the countersink! Do not use plastic clevises or any clevis that doesn't have the aforementioned head! Du-Bro and Carl Goldberg clevises are acceptable. My airplane's elevator has remained completely functional in screaming dives, slow rolls, inverted flight, tail slides ... shall I go on? Before you faint, don't forget to sawcut the 1/16" wide slot.

(3) Shim up the elevator leading edge 3/32", and the trailing edge 1/8". The shims should be oversize to provide a 1/16" locating ledge for the capstrips and sheeting. Add the spruce splice piece, capstrips, and center sheeting.

(4) The spar is added next. This assembly is now ready for the elevator drive plate. Epoxy the drive plate in place as squarely as possible.

(5) Add the two ribs to the sheeting. Cut a slot in the sheeting to clear the drive plate and install. Add the remaining capstrips. Shape to symmetrical airfoil.

Miscellaneous:

The rudder is made in the same manner as the elevator. Its forward edge will be chamfered at a 30° angle for the hinging action. Make the control horn from .035" aluminum and screw in place with #2-56 machine screws and nuts. Make the elevator bellcrank from 1/8" plywood or aluminum. The phantom lines on the plan show the areas that should be relieved for the clevises. The hinge pins are 1/8" diameter brass tubes 3/8" long. Now you can drill the holes for the hinge pins (with a drill press if possible). Buy an Airtronics adjustable towhook and shorten it to 2¼". Carve a recess in the fuselage as shown, and add the towhook. Add the skid (you may have to kerf the inner side to get it to bend). Carve a canopy or make one from plastic. Shape the fuselage.

I suggest painting it because trying to MonoKote those compound curves would be as much fun as scrubbing skid marks off the jet runway at San Jose Muni.

Cover the wings, elevator, rudder, and tailfin with MonoKote. Add 1/8" washout in each wingtip.

Radio Installation:

The radio compartment isn't exactly roomy. I juggled the components around until I got a suitable arrangement, and then wrapped the smallest fuselage I could around them. The major area of concern is the batteries. I used the standard AA size batteries because of their storage capacity, but I had to remove the plastic case to make them fit. I used about 1/8" foam rubber along the sides and 1/4" foam underneath.

The receiver fits nicely when stood on edge with foam padding on sides, bottom, and front. I can't see any reason to have foam padding on top, because the Fromage is not designed to land on its canopy. Also, install some rubberband hold-downs for the battery and receiver to keep them in place during inverted flight. When I built my Windfreak, I followed the designer's suggestion to incorporate a toggle switch in the wiring rather than a slide switch. I have incorporated this same excellent idea into my design. Besides, a slide switch wouldn't fit anyway. To activate the electrical system, you just lift the canopy and flick the switch. Nothing hangs out to flap in the breeze.

Continuing aft, the mini-servos fit snugly in place, end to end on spruce rails. These same rails keep the fuselage from being crushed by your hand while you're preparing to launch. Anything larger than a Futaba S-20 probably won't fit. I suggest using plastic pushrods only because of their light weight and ease of installation. The pushrod lengths are fairly short, and the expansion contraction problems in this application will be minor. Set the rudder pushrod throw to give plus or minus 30° rudder deflection. The elevator should be set for plus or minus 1/4" deflection measured at the leading edge for the initial flights. This adjustment can be made only at the servo. When you set up the elevator, shim up the tailboom on your workbench so that the fuselage centerline is level. Then measure up to the centerline of the elevator. Adjust the elevator drive link until the measurement at the leading edge is equal to that of the trailing edge. The plan shows the upper clevis extends only to the tip of the rudder. This is a good place to start in making your adjustments. Set the balance point and towhook location as shown on the plan.

Test Flying:

The first testing should be done by running along with the plane held high. Let it go for a moment to see if it wants climb or dive. Reset balance or trim until (as you're running alongside), the airplane glides nice and comfortable. Then you can toss it. With its light weight and quick control response the Fromage makes a nifty hand launch glider.

The first high starts should be made gently, and then gradually increasing in strength. When I flew in Munich, as a guest of the ModellKlub Kermess, my host, Herr Schumacher, was using a heavy duty high start to launch his 3-Meter, five pound glider. I used the same launch tension as he did, but where his plane grunted and groaned on the way up, mine went up like a rocket. They really got a kick out of it. A light duty high start works best though.

The completed airplane should weigh about 25 ounces, which gives a wing loading of about 6½ oz./ft.^{2}. The ballast boxes are sized for 3/8" x 1/2" stock. Make up ballast slugs for 7½ oz./ft.^{2} (@ 3-2/3 oz.) and 9 oz./ft.^{2} (@ 9-1/3 oz.) by drilling out the wood slugs and adding lead. Try not to overdo the ballasting. If you must fly on the slope in more than 30 mph winds, buy a slope glider.

The Fromage is not a difficult airplane to build or fly, but I didn't intend it to be a trainer. It would be a sensible choice as a first scratch-built glider because it's not time consuming to build. I've got other designs in the works, so you may here from me again. Well, as we say in Munich . . . oscillator! □

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