Sport "Pro" Soarer

Down the up-escalator? That describes Soaring! Harley's is a proven winner.

by Harley Michaelis

The competition has become keen. Efficiency and smooth technique pay off. Harley and his Soarer.

Lately things have been going badly for me at the glider meets. For some reason I don't get as close to the spot as I used to. Either my depth perception is getting worse, especially on contest days, or I'm being "psyched out" by the bigger and more sophisticated birds. Whatever, to hopefully help, I've been moved to try a variable airfoil approach on a 3rd channel. However, before capitulating to a big bird, I just had to give the 100" class ship one more designing effort. The result is the "Sport-Pro" which can be built in a regular 2-channel version for those who wish to keep things simpler, or with flaps on a 3rd channel for variable airfoil and a new world of performance from launch to touchdown. Either way, the ship surpasses anything this size I have designed or flown to date, and should be a welcome addition to the many fine soarers that have been adding so much enjoyment in our leisure hours.

As with prior designs, the ship is an evolutionary creation using good ideas of the past, and refined with newer ones. The design is strongly influenced by LSF work and several years of active competition in the Pacific Northwest area.

While primarily designed with multiple task competition in mind, the ship is easily controlled and stable enough, especially in the 2-channel version, for sport and Sunday flying. The 3-channel version requires considerable care and effort to properly fit and align the extra linkages and should be built by those with considerable building and flying experience. Properly done, it really pays off. With a little down flap used on the tow, release altitude can be optimized, and this can also be used to reduce airspeed and sink rate for thermalling. In extreme down, sink rate can be increased while airspeed decreases to give a new dimension to descent and landing control. Rather than risking the chance of undershooting the spot, a higher approach can be maintained and then the flaps dropped as needed to bring the ship in. A little up flap will greatly increase the airspeed for slope work and make inverted flight easy with the elevator control left in neutral. Response to stab alone, however, is very sharp and the ship can be put into inverted flight with full down elevator and flaps in neutral. Without elevator trim compensation, the use of flaps is very nerve-wracking. Down flap abruptly raises the nose, while up makes the ship dive. A trimming device built into the linkage, takes care of this automatically to avoid this hairy problem. The "Sport-Pro" will spin nicely to lose altitude or can simply be put into a steep dive without danger, as both wing and stab support are extremely strong and rigid. By proper coordination of speed, stab and flaps, outside loops can be performed. A dual tail moment is utilized . . . long for rudder as needed for small turning radius, and shorter for sharp control in the pitch axis. Stabilator area is less than 12%, but entirely adequate with the short moment used.

An entirely new wing support is used, made possible by clock spring steel in cross-section of 1/16" by 3/8". The steel just won't bend on edge, but gives fore and aft to spare wings. The laminated support block and receptacles of 1/16" ply that receive the steel bars are simple to build and have never failed. A nylon ball and socket fitting used for hatch holdown in the Top Flite "Nobler" is adapted to firmly snap the wings to fuselage shoulders. Rudder linkage, as well as stabilator, are internal. Pushrods can be removed after assembly for adjustments or repairs. MonoKote is used for rudder and flap hinges in a fashion that is simple and practical, thus eliminating tricky hinge alignment. All ribs are simply cut by a system using the 1/16" ply root rib as a cutting guide. No rib patterns are needed.

Arrangement has been made for a fine parts package from Hartman Fiberglas R/C., Argenta, Ill. 62501 for those desiring such fabrication. This parts package includes fiberglass fuselage halves that are a cinch to join, seaming tape, fiberglass hatch, spring steel supports and the ball and socket fittings. Each fuselage is made

by master craftsman and fellow soaring enthusiast, Dwight Hartman, who understands our needs. The fuselage is amply proportioned and with the fiberglass hatch needing no base, gear installation is not cramped. However, flat battery packs will not fit well. The smaller 450 mil packs by Ace, or the new Kraft KB-4M 450 mil "space saving" pack or older 225 mil will fit best. Plans show a ballast compartment, but both my ships balanced out with these smaller packs with no need for lead. There is ample room for three of today's smaller servos and even a thermal sensor, if desired.

In spite of amply rugged construction throughout, the ship is light. My 2-channel version weighed just 2 lbs. with KPS-12's and small battery. I built this after my 3-channel version which weighed 2½ lbs. However, I can save 2 oz. on the ¼" steel wire wing support system first used and with smaller servos and a better wood choice than I had, I feel I can get this down to 35 oz. easily. Wing loadings at these weights are 7.6 and 8.3 oz. in the 2 channel versions. Span can be made under or over 100", depending on width of tip blocks.

Fuselage Assembly

Note the reference lines molded in near the raw edges. Work down to these with razor saw, sanding block or file to get a perfect fit of the halves. Prepare a pair of 1/16" ply shoulder plates shown on the root pattern. Secure in shoulders with thick layer of polyester putty, so these plates are not recessed. Glass micro-spheres (Prather Products) make a nice fill for resin. Keep exposed plates clean of resin. Warm air directed on resin helps speed its cure. Fuselage halves are pulled together with masking tape across and along the seam line. Prepare the rudder post and trial set into stub fin rear, making sure the bottom is a full 9/16" wide. Eyeball for good vertical alignment of post with straight edge across the canopy lips. Twist rear of fuselage, adjusting masking tape and/or heating the rear end to render pliable so a new set can be put in to get the post vertical. Set post aside. Cut a length of seaming tape to extend from near nose tip to out of the tail end and drop down fuselage with clothespin. Carefully center over bottom seam line. Make a long handled brush with a metal throw away type stuck on a long dowel. Bend end at an angle and insert through tail end. Mix up about 1 oz. of polyester resin (flexible, non-casting type) and pour down the fuselage along seam line. Work resin well into tape and let all excess run out the tail end. Use small lengths of tape to do the nose interior and lay up a second length on the bottom to extend to under where the towhook block will go. Secure block with resin and tape. Let bottom cure up and similarly do top seam. Use clothespins or clamps at hatch ends over Saran Wrap to keep the tape down. Clamp internal ply plates in fin for main stab support wire. Prepare a ply base to place the front servos where you desire. Note a little keel is glued to underside to touch fuselage bottom. With edges and keel bottom smeared with a good bead of silicone adhesive such as Dow-Corning Silastic, the base will stay put, but give a little. Coat the base top before installation with resin or epoxy to make smooth and non-porous, so the servo tape will really hold. I run the Rx antenna down the fuselage on a balsa stick and hold the switch to fuselage side, inside with servo tape. A pin of 1/32" wire extends through the switch via a little slot on side to keep things tidy.

Canopy

Trim to reference lines and bevel edges to nicely contact the opening. Set the front key in with a big glob of Silastic, positioned to jam slightly under the lip. Prepare and attach the little blocks with wires that make the squeeze attach-detach setup at rear end. If you want a clear canopy, the Cox replacement parts pack (#8673) for their F-1 trainer has one that fits. Fiberglass finishes nicely with epoxy paints if a base coat of white is first put on. Imperfections can be filled with epoxy or polyester putty and wet sanded smooth.

Pushrods and Linkages

Make stab bellcrank from 1/16" sheet nylon (Sig, etc.) Drill hole for 1/16" wire undersized for tight fit. Other holes should allow free movement without slop. Before installing, use the bellcrank as a hole spacing template in making the stab root caps. Epoxy the rudder post in place with Devcon 5 Minute. Good alignment through the internal ply plates is not easy and the holes are best started with a small bit. Check alignment with a length of wire run through and adjust as needed as holes are further enlarged. Shims with 3/32" holes can be glued to the plates to help out, but at least 1/8" clearance should remain for the bellcrank. Run support wire through and with bellcrank placed outside fin, score fin with sharp point in front hole to establish arc front wire moves in. Use it as guide in cutting the slots on either side of fin.

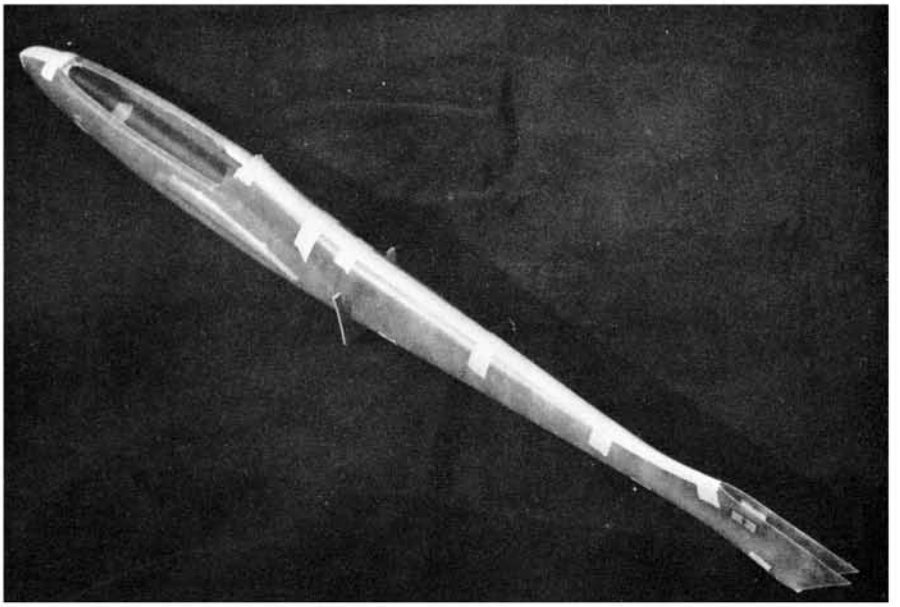
After pushrod with bellcrank is installed, affix 1/16" ply discs with 3/32" holes over wire against outside of fin. I favor 1/4" O.D. fiberglass rods for pushrods. I drill holes through 1" lengths of 3/16" dowel to accept threaded rods with ends roughed up and epoxied into the dowels, and then the dowel is epoxied into the pushrod end. Where threads are desired on both ends of a connection, such as flap lever to flap servo, the Dubro Threaded Coupler is used with 1/16" wire. The rudder pushrod involves fairly long wires on its ends to be routed over the wing support block and to give most clearance to the stab bellcrank it passes by. I used a Dubro Kwik-Link at rudder and Goldberg Mini-Clevis otherwise. All possible points of bind in the linkages should be carefully checked so servos don't overwork and return to a definite neutral from both directions of motion.

Shoulder to Root Alignments

The shoulders are perfectly aligned on the fuselage and identical incidence as-

Photos: Harley Michaelis

sured if panels are well aligned to their respective shoulder. Accurate centering of the ball keeper, rear support wire, flap arm and pin can be facilitated by 1/16" dia. holes drilled through a root shaped ply template at the key center points. Since the flap arm pivots at the shoulder edge, a brass plate with a 1/16" hole can be epoxied to the template, centered at its edge to guide the drill bit. Holes can be gradually increased in size, checking their centering as you go, and shifting one way or another. The centerlines of the main support slots are best custom located with the panel held to the shoulder. Masking tape on the shoulder can be marked. The slot can be a bit oversize to allow good alignment and easy attachment of panel. Since the flap pin is horizontally adjustable on the flap arm, alignment of the flap tube is not critical. The flap arms and the vertical brass lever are soldered in and on a length of 1/8" sq. O.D. tubing, working through the hatch opening. Position the lever to give a fairly straight shot to the output arm of the flap servo. Flap arms can best be shaped from soft 3/32" wire (coat hanger) to permit bending for field adjustments. You want about 10 degrees of up and 45 degrees down flap, so try different output arm holes and different locations on the brass lever to get this. Plans show what worked for me. Also, put your positional control in what you want to be neutral flap position on the transmitter and then solder the arms in the square tubing with the flaps supported or clamped in neutral position, radio running. I made my elevator trim compensator from the aileron bellcrank in the Kraft accessory package, removing one arm. This attaches to the top of the lever. Use of the two top holes as shown gave me just the right amount of trim as flaps moved. The thing pivots on the clevis leading to the elevator servo and would give more if that clevis were hooked lower. You will have to experiment. Be sure all linkages are free of binds and that the servos are firmly secured, or your flaps will be a disaster.



The fiberglass shell halves are joined. Don't rush it, a clean job here will produce a polished finish. Masking tape holds nicely before seaming inside. "U" shaped clamp retains an oval shape.

I cradle my transmitter in my left hand and fly "single stick" rudder and elevator on the right stick. I wanted to run flaps with my left thumb, so put an auxiliary pot and thumb control on top of my transmitter above the right stick. Kraft sent me the proper pot, control and bracket for my transmitter. I soldered three wires from the motor control pot to this auxiliary pot and put a normal centering spring on the motor control to keep it in neutral. No wires were disconnected on the original pot, but you have to get the PC board off to have working room and some other wires may have to be temporarily disconnected. I eyeball engineered where the pot had to be located and cut the slot on top with my Dremel tool and cutting disc and a small file. Fortunately it didn't end up looking like I took a can opener to it. and I can fly "single stick" and twiddle flaps with my left thumb. I marked the case top so I know where the flaps are positioned in flight.

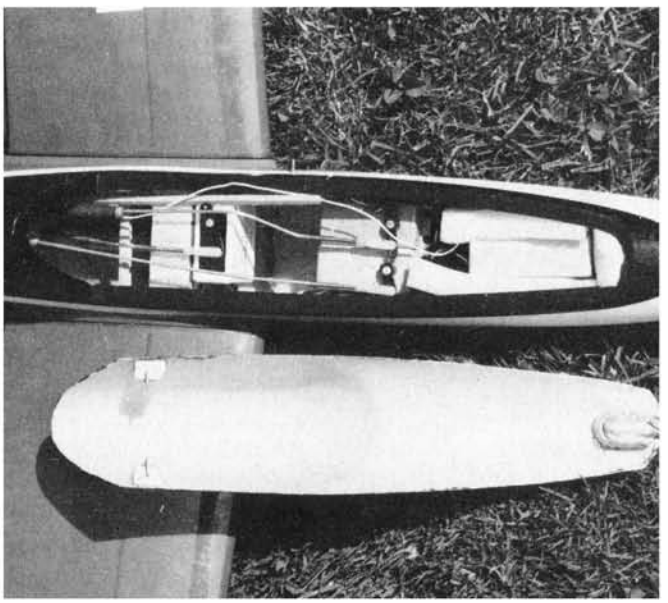
Spring Steel Supports

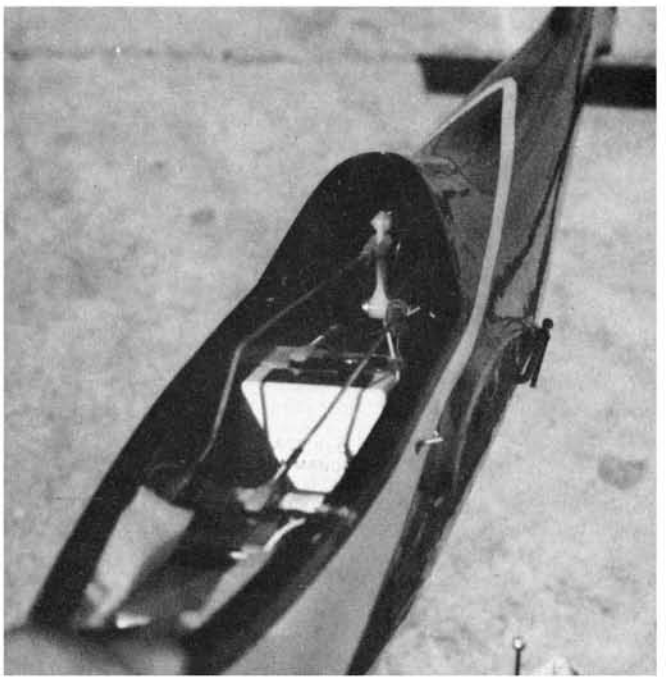
Due to the spar line sweeping back, it is necessary to bend the steel supports so the protruding portion is at right angles to the root. This can be accomplished by positioning in a vise and springing slightly with heavy pliers.

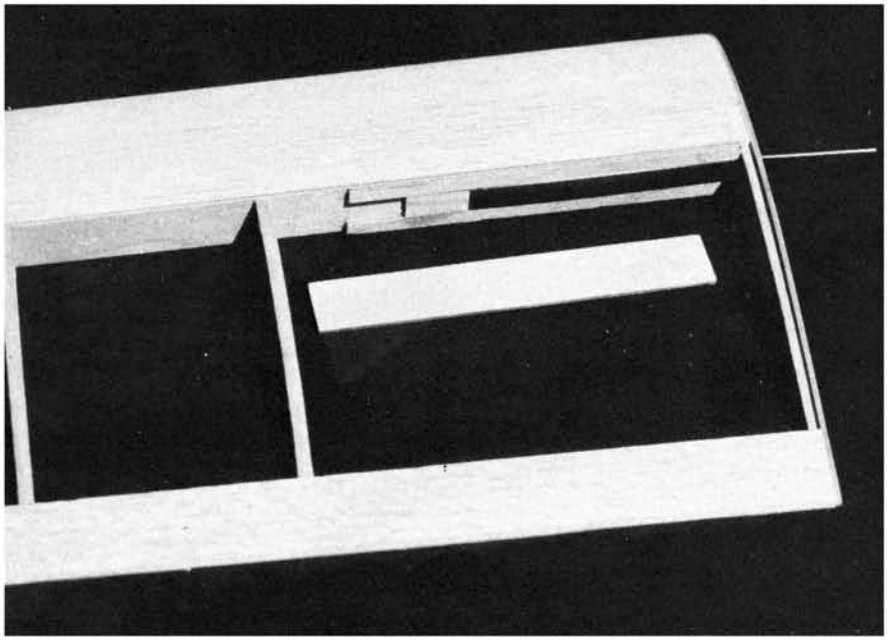
Upper Fin

Using very soft balsa, prepare the fin to fit in the stub fin top. It should recess about 5/16" and also bear against the rudder post. Shape to impart a nice contour and to give a "one piece" appearance with the stub fin. Join with Devcon 5 Minute

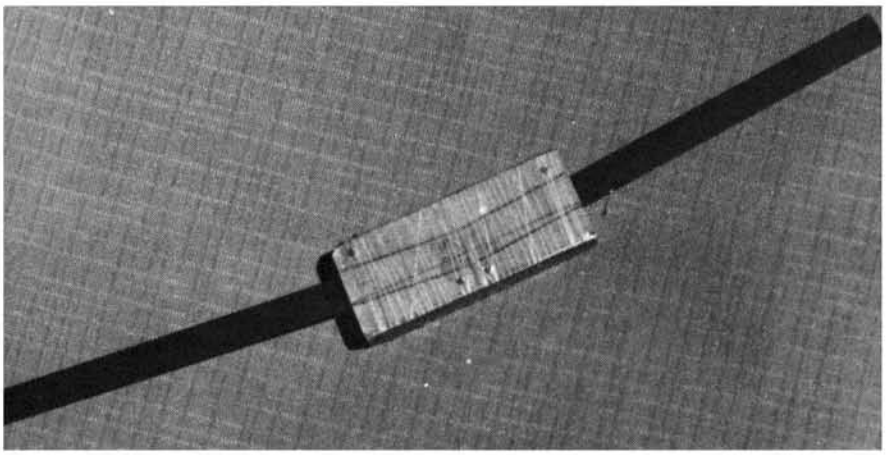
Left: League of Silent Flight Awards. Harley has impressive expertise.
Right: Pushrods duck down over servo. Note wing fillet, low-drag lines.
Below: Simple to uncork the R/C system, weight far forward, keep tidy.







The wing tongue is contained in plywood sandwich, extends far enough to support the wing panels. **Beneath:** The tongue is locked into a hardwood mount within the fiberglass fuselage and aligned.



epoxy. Saran Wrap can overlap the joint and a couple of strips of balsa sheet about ¾" wide can be hand held over the joint as the epoxy sets up to keep the fiberglass against the balsa fin for a smooth joint. Viewed from rear, the post edges should be a pair of perfectly straight lines to within about ½" of its top, to later facilitate applying the MonoKote hinge.

Rudder

Make from soft balsa with front edges straight to match the post. Bevel to place the MonoKote hinge toward the side you want the most turning response, as the side hinge gives a differential action. Bevel to permit at least 30 degrees deflection the other way. Lightening holes can be roughed out with coping saw and finished with sandpaper wrapped over a tapered tumber or shot glass. Cut a hole about ¼" wide and ½" high through the side of the rudder post the clevis will pass. Due to the swept post, the pushrod end will move up and down as rudder turns. I used the long control horn in the Kraft accessory package for my internal rudder horn. If necessary, make a little cutaway as shown in dotted line on the plans, if your horn and clevis do not clear the fin inside. Position the hole in the horn to align with the hinge line in neutral.

Stabilator

Cut a pair of main spars ⅜" on root end and 3/16" on tip. Pin one down and proceed with other members. It is easy to assemble with all pieces unshaped, and later shape with razor plane and sanding stick. Make identical pairs from plans. If one panel is low when placed on the support wires, run the 3/32" tubing downward to raise its tip. Epoxy tubing in place when finalized. Balsa shoulders to match the stab ends could be epoxied directly to the fin sides if desired. Smear exposed wood with Devcon 5 Minute epoxy as a base for epoxy paints. The 1/16" support wire can be bent a bit to hold stab on best. Be sure stab moves easily on the main support wire.

Laminated Wing Support Block

Custom fit 1⅛" high scrap sheet balsa between the shoulder plates, getting length and end angles just right. Use to shape the front and rear plates. Shape item "B" for bottom and carefully glue to back plate, wiping any excess glue from top edge. Prepare "A" and with the spring steel supports in position, glue on so there is no play. When dry, clamp on the front plate keeping all surfaces in good contact as the glue dries. Slip supports in and out to clear slot of glue. Drive brads through in the key points shown and file away excess. Prepare a strip of brass to fit bottom edge and epoxy in place. Tightly and evenly wrap the assembly with nylon thread to within ⅛" of the ends and coat smoothly with epoxy. This will be installed later.

Wing Panels

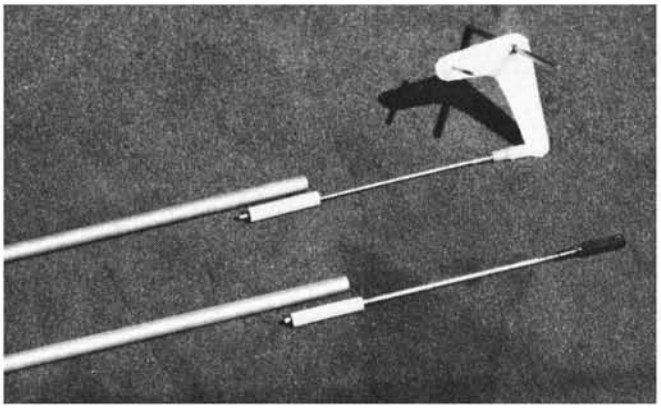
Make a sanding stick about 1½" wide and 30" long, sticking roll type sandpaper of different grit (medium and fine) on either side with contact cement. This is an invaluable tool in making a glider panel straight and true. With a fine point carefully draw a "Rib Front Height Gauge" as shown on the plans (thick lines had to be used on plans). This gives height of front of rib where it butts the sub L.E. Cut rectangular pieces of 1/16" sheet to rib length, taken from rear of sub L.E. to the extreme T.E. at each rib station. Use the Height Gauge to get rib front height. Lay point "A" of the root here and with guide 1/16" up on other end, cut the top curve. Trim ⅛" off bottom and make a duplicate. Lay on plan to locate spar notches and number each rib. The general order of construction is bottom sheeting, bottom capstripping, bottom spar, ribs, top spar, shear webbing, sub L.E., L.E. sheeting, L.E., main ply brace (ribs #0 to #4), wing support receiver box, tubing, block for wing hook, top capstripping, bottom and top center sheeting, tip blocks. Note a bit of ply inlays in rib "O". Cut a hole for this before gluing this rib on and inlay the ply which will secure the nylon ball keeper.

The main ply brace is full thickness of the wing. The sheeting butts against it. Be sure the wing contacts the building surface well and that this brace is also flush with the surface. Also be sure the brace has a smooth even surface to contact so the glue bond is very good. Several ribs have to be sectioned behind the spars, so identify the pieces as you cut. If flaps are built, fully sheet top and bottom, otherwise continue with 1" sheeting to the root.

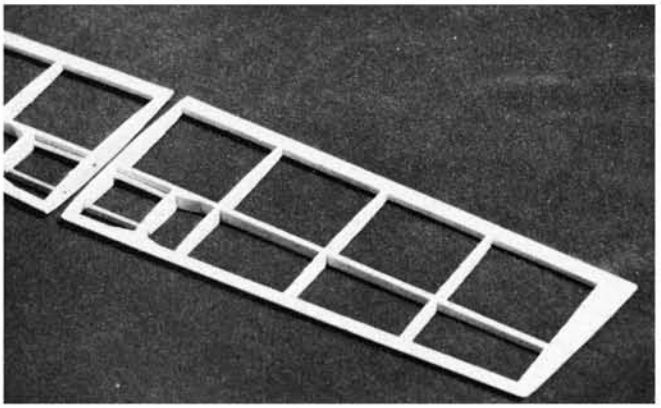
In making the laminated receiver box for the spring steel supports, make bottom guide rail a uniform 3/16" high. These also contact the work surface. Weight wing down if necessary so bottoms of all members are in contact. Top rail goes to top of main brace. Place the steel support bar on bottom rail and mark the line of the top rail with it in position. Carefully cut and sand to just go to top of wing. For these various glue joints, I favor a thin coat of Elmer's Glue-All on both surfaces. Let it set a bit and jam the various pieces tightly in position, one by one, cleaning away any excess glue to keep the slot clean. You can jam some ¾" sq. strips against the ply, use strips and C clamps, or with the panel off the bench, wind flat rubber around the ply and L.E. The L.E. can be shaped and sanded with a razor plane and the sanding stick. Keep the radius proportionate to the root pattern, eyeballing as you go along.

Ball and Socket Keeper

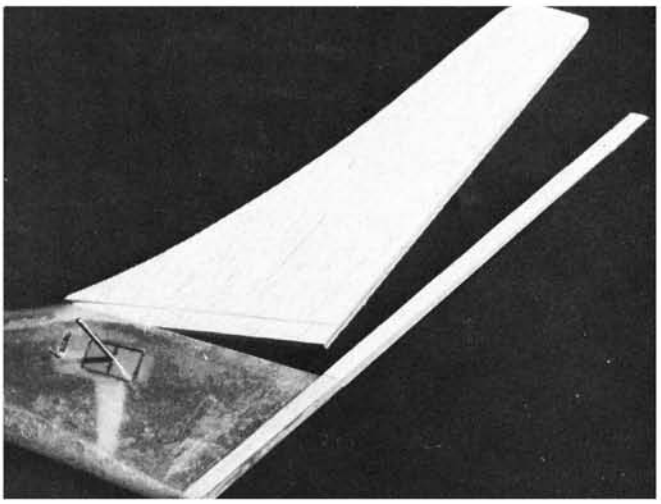
Centered vertically on the root, carefully drill at right angles through root and ply inlay with a 7/64" bit. Shank should be



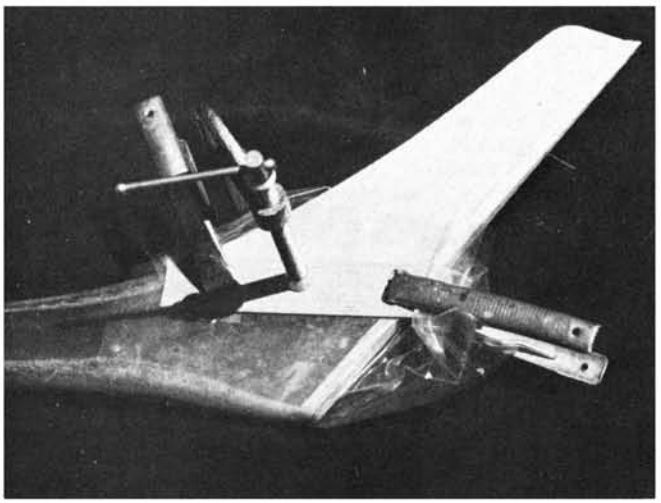
The suggested rear end linkages. Straight, trouble-free, eases the work load on the servos. Note pivot wire for stab. Length is easy to adjust.



The flying stab halves, simple and functional, no problems with flutter. It eliminates the need for a hinged elevator, cleaner on a Soaring ship.



Flying stab bellcrank visible beneath fiberglass. Note wire, a slot for leading edge to change attack angle. The rudder fin's being test fitted.

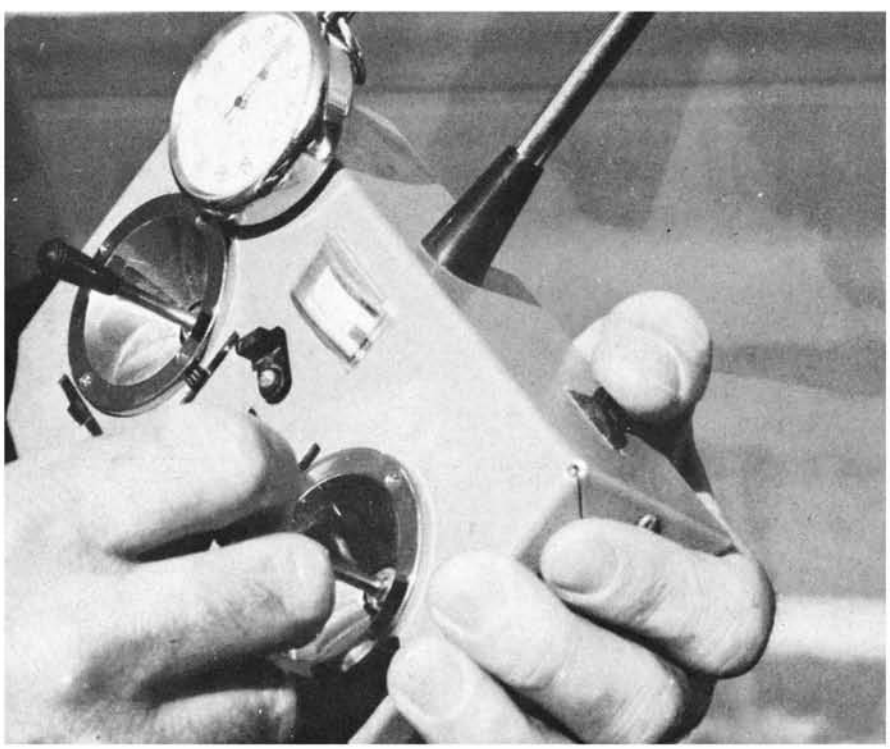


The fin joins the fuselage. Note Saran type wrap to contain the cement, clamps to hold all together. Do watch alignment to be sure, fair it in.

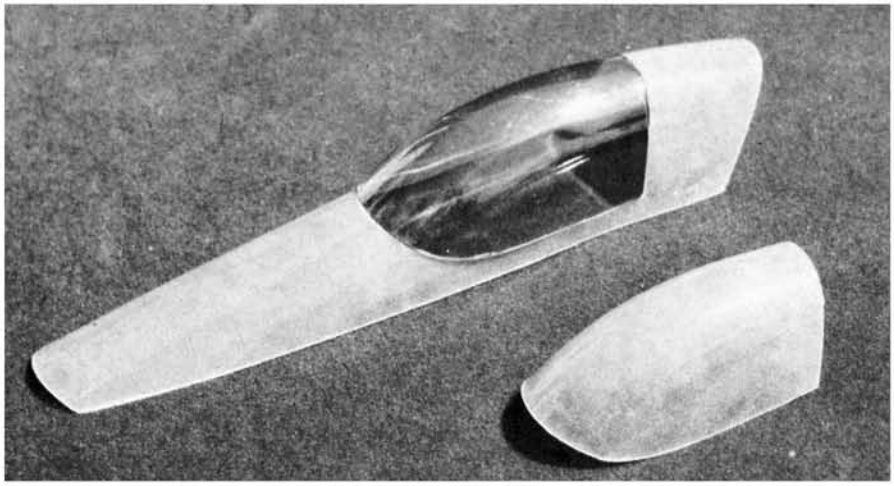
movable without mashing its threads. Drill ¼" holes in shoulders so ball can pass through. Use a round file to enlarge where needed. After the next step below in which the main wing support block is secured between shoulders, remove the ball fitting from the panel and attach panel. Take one of the laminated assemblies with the nylon membrane with the hole in it, making sure the bevel faces the panel. Smear with quick epoxy and place against shoulder plate. To align, run the shank of the ball fitting through the assembly into the panel, without epoxy, and jam against the nylon membrane to center it against the ball. When cured, remove the panel. Smear the shank of the ball fitting with fast setting epoxy and fill the hole in the panel with it. Quickly attach panel in place, run shank back snug against the membrane. Point wing tip up, so the drop of epoxy forced through the hole will settle around end of threads and the ply inlay. Let it thoroughly cure. To break wing away, hold fuselage near tail and pull wing sharply rearward near its tip. Snap in with firm grip on nose and the main ply brace. Hooks and rubber add an extra safety feature.

Wing Support Block

Position the block across shoulders and put on panels. Make necessary vertical and horizontal adjustments of main slots and rear pin holes to permit perfect alignment



Finger on the button. Flaps may be deployed to your advantage, for spot landings or recalled for a cross-country dash to next thermal. Fly with a minimum of control motion for least sink rate.



The fiberglassed cockpit-hatch area removes like so. Advantages of a molded fuselage are a built in skid resistance and rigidity plus minimum of wall thickness for reduced cross-sectional area.

of panel to shoulder. Bits of ply with a 1/16" hole can be placed inside shoulders to align and hold the rear pin wire if the hole gets oversize. The main slots can remain a bit oversize. Secure the support block against the shoulders with bits of 1/8" by 1/4" spruce and epoxy at front and rear.

Hinging with MonoKote

Make sure the post and rudder front form straight lines. Place fin and rudder back to back with 1/32" sheet between the surfaces and iron on a strip of MonoKote to extend from horn to near top. Trim to edges. Then with 1/32" sheet jammed between post and bevel and in contact with the line of MonoKote exposed, iron on MonoKote to side of fin and rudder. The adhesive sides should make contact along the hinge line. I cut this piece of covering to just overlap on the stub fin and to otherwise cover the upper fin and rudder. On the other side, overlap the strip on the post and beveled edge of rudder. The hinges for flaps can be similarly done. Cut three strips about 3" long and iron to inside edges of flap and spar adjacent, spacing with sheet between the two surfaces. Then do the entire underside with a single piece of covering unless you are using a color scheme of several colors.

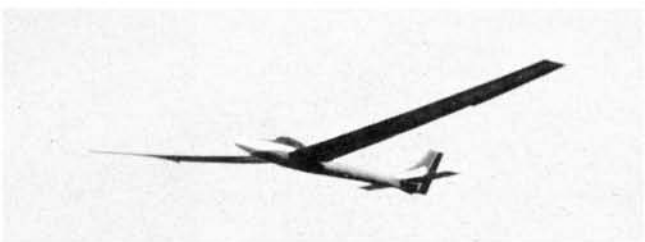
Washout

I find if MonoKote is used, I can hold the panel between the knees at rib 10, twist and shrink in the 1/4" washout. If you prefer to build it in, keep panel flat to rib 10, and wedge tip up about 3/8" before you add the shear webbing and top L.E. sheeting. This springs back to about 1/4".

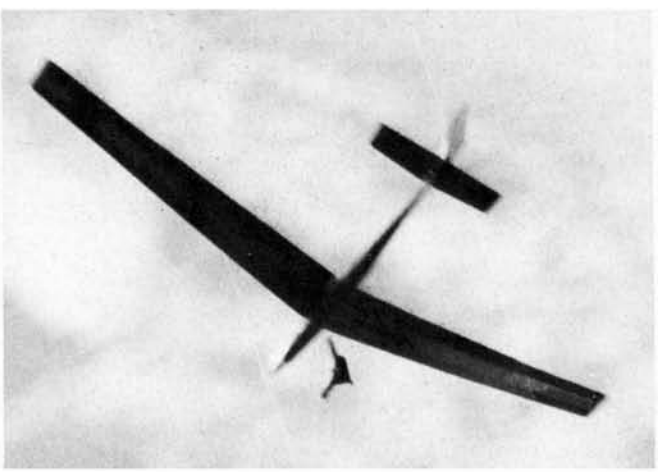
Balance and Flying

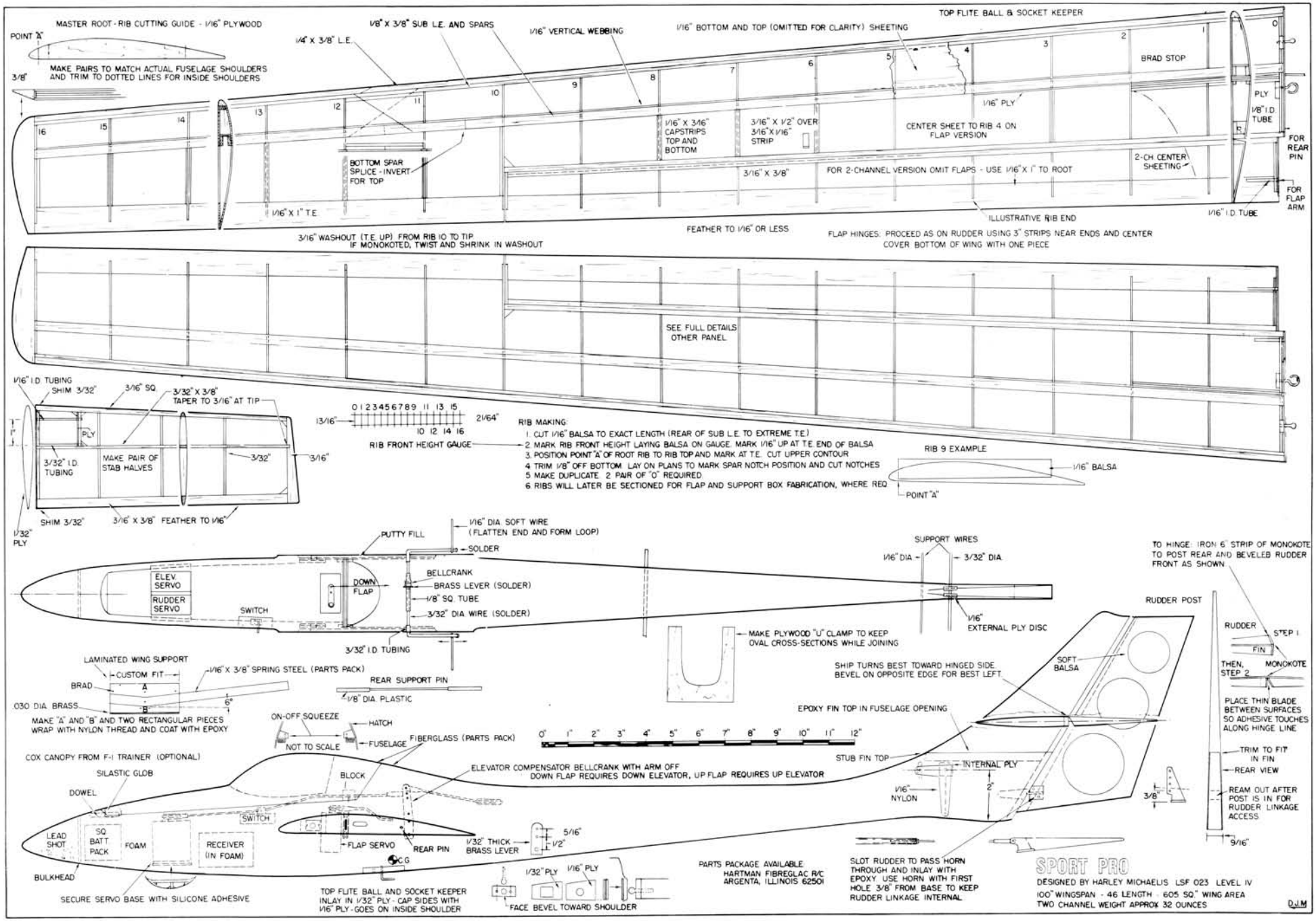
The C.G. position on plans looks out of place, but remember this is a swept wing design. With the all-moving stab the ship is very responsive, so initially rig for moderate throw, at least 30 degrees deflection from neutral. Make a few hand launches and adjust the clevises as needed. I find the ship very stable with the towhook close to the C.G., but this is a fast ship with no flaps or neutral flap, so let the tension build up on the winch and throw to impart enough airspeed. Be right on rudder control to keep it straight and true, lest you go off to one side and get into trouble. Experiment with down flap to slow the towing speed and gain more altitude. As you become familiar with the characteristics, start applying up elevator to increase the climb angle.

I compete in the Northwest amongst many good friends who include fine designers and flyers. Notable are Bob Dodgson who kits the "Todi" and beautiful new "Maestro," and Randy Holzapple who kits the "Gull" and "Hi-Jacker." Bob was our champ last year, and this year Russ Young, flying a "Maestro," will be. Randy took Precision in the 1973 LSF Tournament and will be runner up in our Northwest Championship this year, while I'll be 3rd. We all take turns beating each other and periodically somebody whips us all to keep us humble. At the Spokane Oktoberfest, the 5th & 6th it was "my day" with the 2-channel "Sport-Pro." Two day totals were made. I was first overall, first in Precision, tied for first in Duration and 3rd in Precision Duration. With a little practice I might be a threat in 1975, even if my depth perception doesn't improve.



Left: Flaps are a nice 3-channel option, vary the airfoil's geometry.
Below: Just a touch of up grabs the altitude. Anticipate rudder needed.





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