QUANTUM 20

■ Len Surtees

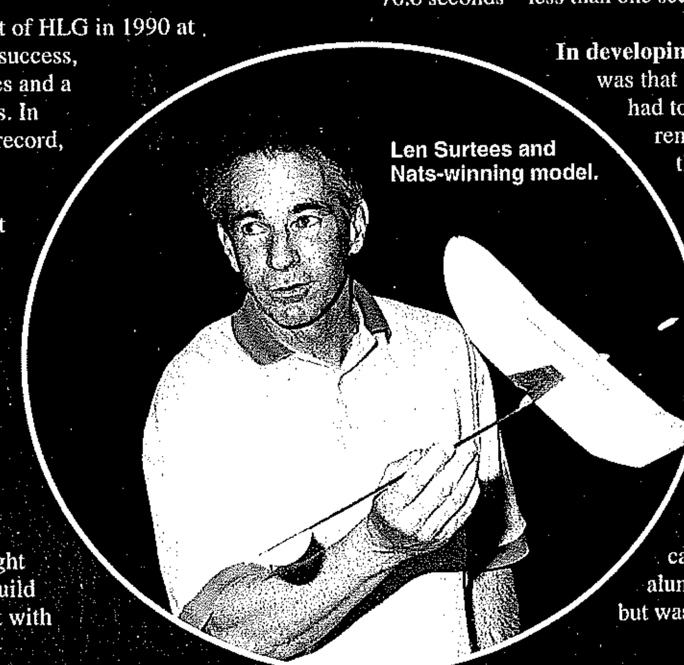
Quantum 20 won the 1997 Indoor Nats, Johnson City TN. V-tail and rod fuselage give it a distinctive appearance.

Quantum 20 was designed to compete at the 1997 United States Indoor Championships/Nationals held at the East Tennessee State University Mini-Dome, Johnson City, Tennessee.

In Australia I took up the sport of HLG in 1990 at the age of 40 and have had some success, winning two National OHLG titles and a second place out of three attempts. In 1994 I set an Australian outdoor record, which still stands.

Through correspondence with Rob Eberle (a member of the East Coast Indoor Modelers group), I was encouraged to compete at the USIC at Johnson City. It was Rob's enthusiasm that motivated me to design a Category IV IHLG and then to experience the magic of the world-class Mini-Dome at the '97 USIC.

Since I had previously only flown Category I Indoor Hand-Launched Glider (8m ceiling height maximum), I thought it wise to build three identical model layouts, but with wingspans of 20, 24, and 26 inches. The 26-inch model did not feel right; the 24-inch showed great promise; but the 20-inch flew best at Johnson City and was used for my last two official flights (75.2 and 76.6 seconds—less than one second from the ten-year-old site record).



Len Surtees and Nats-winning model.

In developing Quantum, the daunting realization was that I had to transport several models that had to fit in a carry on model box. A removable wing seemed logical, but there is always that little movement and flexing at the joints.

I managed to locate a very light, tapered carbon-fiber kite spar that was perfect for the job. (A carbon-fiber fuselage has three advantages over balsa: 1) For a given length it is lighter and stiffer; 2) It has less surface drag; and 3) It does not warp from moisture and heat.)

By cutting the fuselage behind the wing trailing edge and gluing in a matching tapered sleeve, the fuselage can be disassembled for transport. An aluminum sleeve was used in the prototype but was prone to bending on awkward hard landings. Titanium was the logical choice, and when carefully machined, the sleeve weighed about one gram.

This joint also allowed the tail to be rotated to help adjust glide turn. A major benefit of this joint is that several different tail combinations can be tested.

In the interest of reducing drag, I incorporated a V-tail. My first V-tail glider, designed in 1992, (Jonathan Livingston Seagull) proved to be successful and taught me much about trim surfaces set at angles.

If a V-tail does all that is required to stabilize the model, the benefits would be 1) A lighter tail; 2) Less drag; 3) The tail is above the wing turbulence (who said the tail *had* to be a certain distance below the wing to work best?); and 4) The tail is less likely to be damaged on landing.

The conventional blob of modeling clay on the nose had to go. The round carbon-fiber fuselage tube lends itself perfectly to inserting a brass machined bullet-shaped nose weight to ensure minimal drag.

Before settling on the wing planform and airfoil shape, I corresponded with a well-published world authority on aerodynamics. The answers to my many questions were inconclusive, and it appears that the jury is still out about small wings that are capable of hitting 100km/h in less than a split second and then maintaining flight through a transition into a 15km/hour glide.

For the wingtips, I chose the elliptical shape for low drag and all-around good performance through the massive speed changes.

The center wing panel is flat and parallel to give maximum lift with adequate tip double dihedral for safety in transition.

Wing thickness is 3/16 for good penetration; if the model is not too heavy, it will give all the lift that is required. A .007 carbon-fiber spar is needed to keep the wing together. By keeping the wing leading edge straight, the center of lift is also kept in a straight line, rather than the more conventional sweptback leading edge.

A very slight Phillips entry of about 1/64 was used with a leading edge radius of about .010. A small pylon separates the wing from the fuselage, mainly so that a good grip can be utilized.

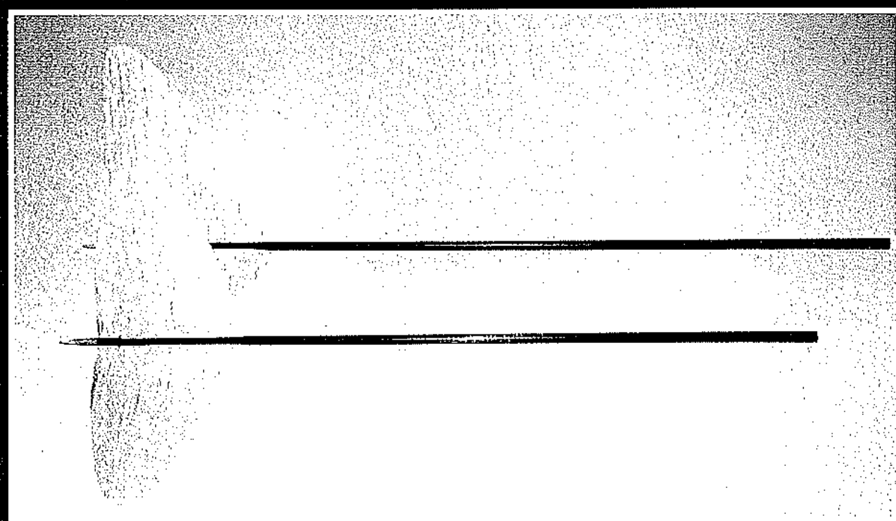
CONSTRUCTION

Fuselage: The fuselage can be ordered form Health Sports Technology Group Inc., 209 East El Segundo Blvd, El Segundo CA 90245; Tel.: (310) 414-0977, Fax: (310) 414-0007. Ask for TUBEWT06—Sky Shark, response zero G5.5gr.

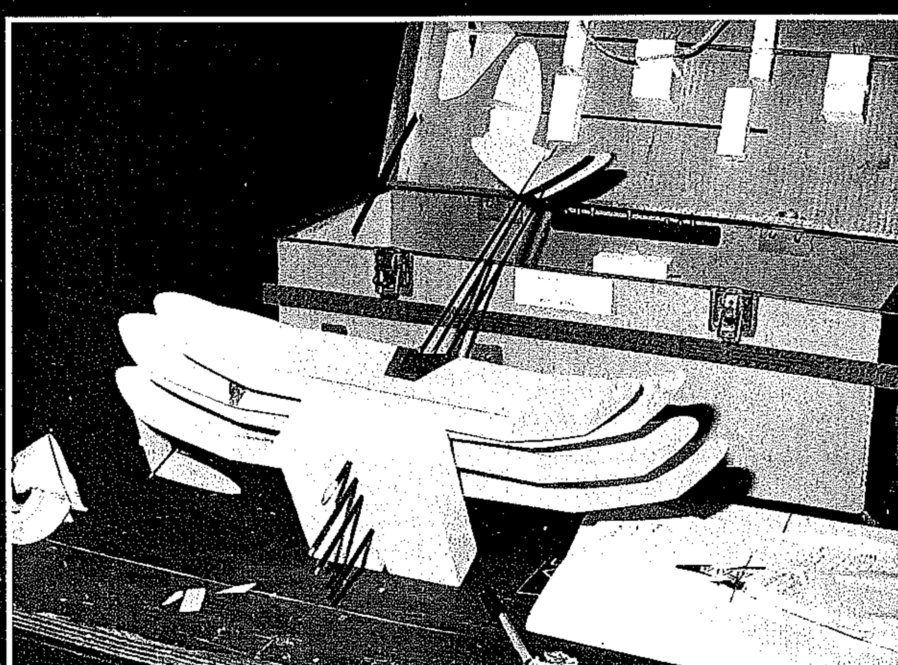
Cut the tube to correct length (see plan), utilizing the smaller end and sand

Rob Eberle (R) of the East Coast Indoor Modelers inspired the author to travel from Australia to the Indoor Nats.

Photos by the author and Jim Haught Graphic Design by Carla Kunz



Tailboom is mated to fuselage with a titanium joiner for easy take-apart.



Quantums in several sizes. Sturdy model box essential for long-distance travel.

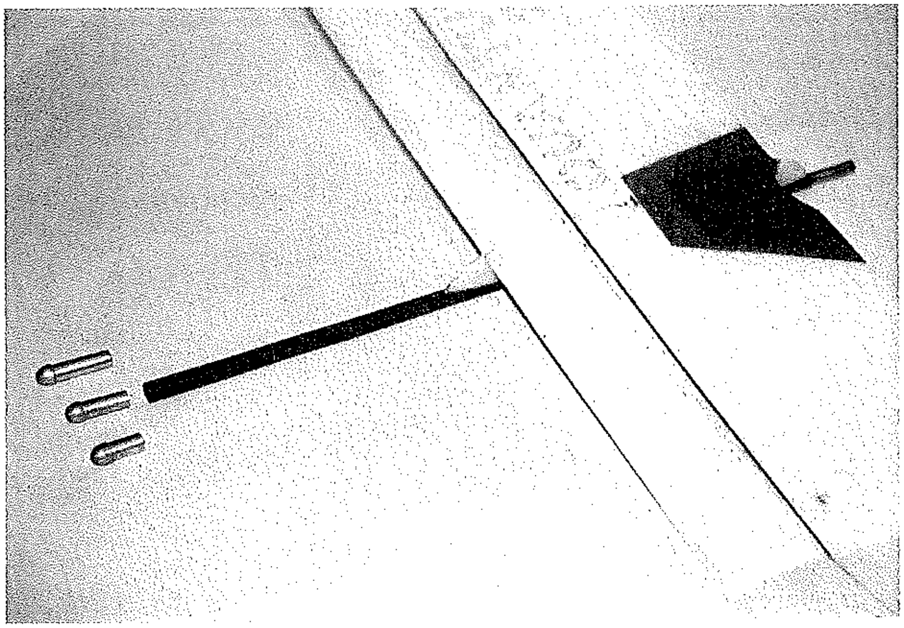
mooth using 400-grit wet-or-dry andpaper under running water. This emoves all the excess rings of resin, vhich saves weight and lessens drag. If he pull-apart joint is desired, mark the ength and wrap tightly with tape before :utting the tube. This prevents the tube 'rom splitting, since the walls are so thin. \ fine-tooth razor saw blade works best; :heck for square ends and sand if iecessary so that stress is evenly listributed.

Titanium Joiner: A very thick-walled iluminum sleeve will work, but titanium s far superior. A titanium tube 1¼ inches ong and approximately .010 wall hickness weighed just under one gram. Machine the sleeve so that half its length s parallel (this is epoxied in the rear front half of the fuselage) and the other ialf has approximately .0003 taper in ⅝ nch.

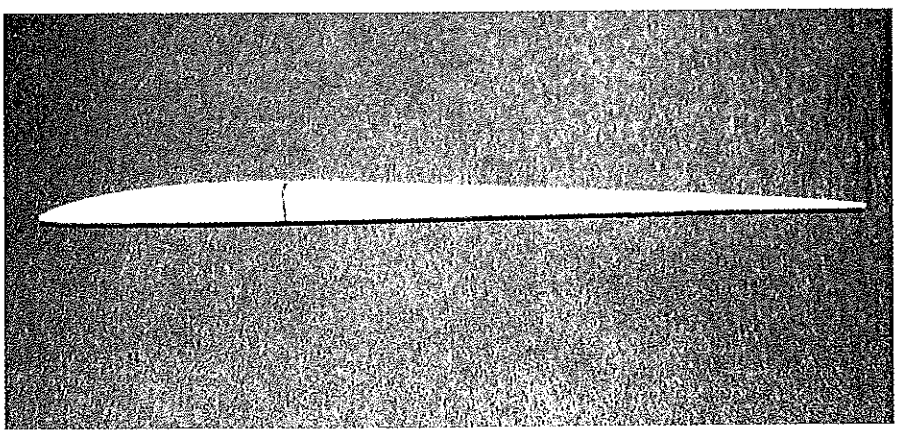
When carefully machined, the rear ialf of fuselage will wriggle up the sleeve and then seat snugly. Scuff the inside of the fuselage with a small rat-tail file to receive 15-minute epoxy and ensure that the sleeve is clean.

Smear a small amount of epoxy inside the forward fuselage, press the sleeve firmly into the rear fuselage, then carefully rotate the sleeve into the forward fuselage. Wipe off any excess glue and leave about a 1/32 gap at the joint. Lay the assembly on a wax-paper-covered flat surface and against a straightedge for side alignment, and leave to set. If done properly, a perfect (straight) alignment can be achieved.

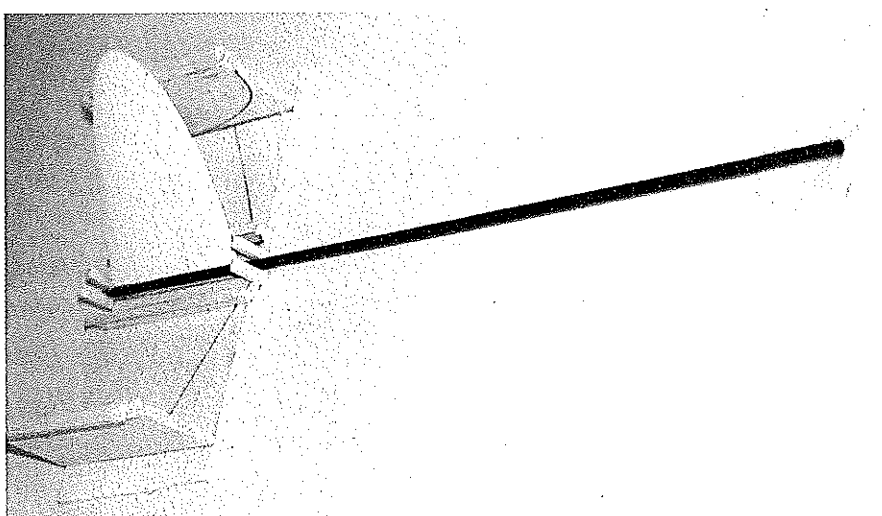
Carbon fiber does not "like" hard impacts, so to lessen the likelihood of splitting, wrap tissue around the nose and the fuselage end that slips over the sleeve, using shrinking dope. Glue a four-pound balsa fairing about ½ inch long to streamline the end of the fuselage, rather than leave a ⅛ square end.



Brass nose weight eliminates drag of "traditional" blob of modeling clay.



Wing is 3/16 thick at the high point. Note .007 carbon-fiber spar and Phillips entry.



Jig is essential for accurate alignment of V-tail to carbon kite-spar fuselage.

QUANTUM 20

Type: FF Indoor HL Glider

Wingspan: 20 inches

Flying weight: 22 grams

Construction: Balsa and carbon

Pylon: Six-pound vertical-grain balsa 3/16 x1/2 works satisfactorily. Use a 3/16 diameter rat-tail file to sand a semicircle for good fit to the fuselage.

Before gluing the pylon to the fuselage, sand in a slight symmetrical airfoil to reduce drag. Glue with 15-minute epoxy and use at least three clamps. Make the pylon parallel before gluing and this will give about .005 positive incidence built in, because of the fuselage having a .010 taper over the chord of the wing.

Total weight of fuselage, including titanium and pylon, should be four to five grams.

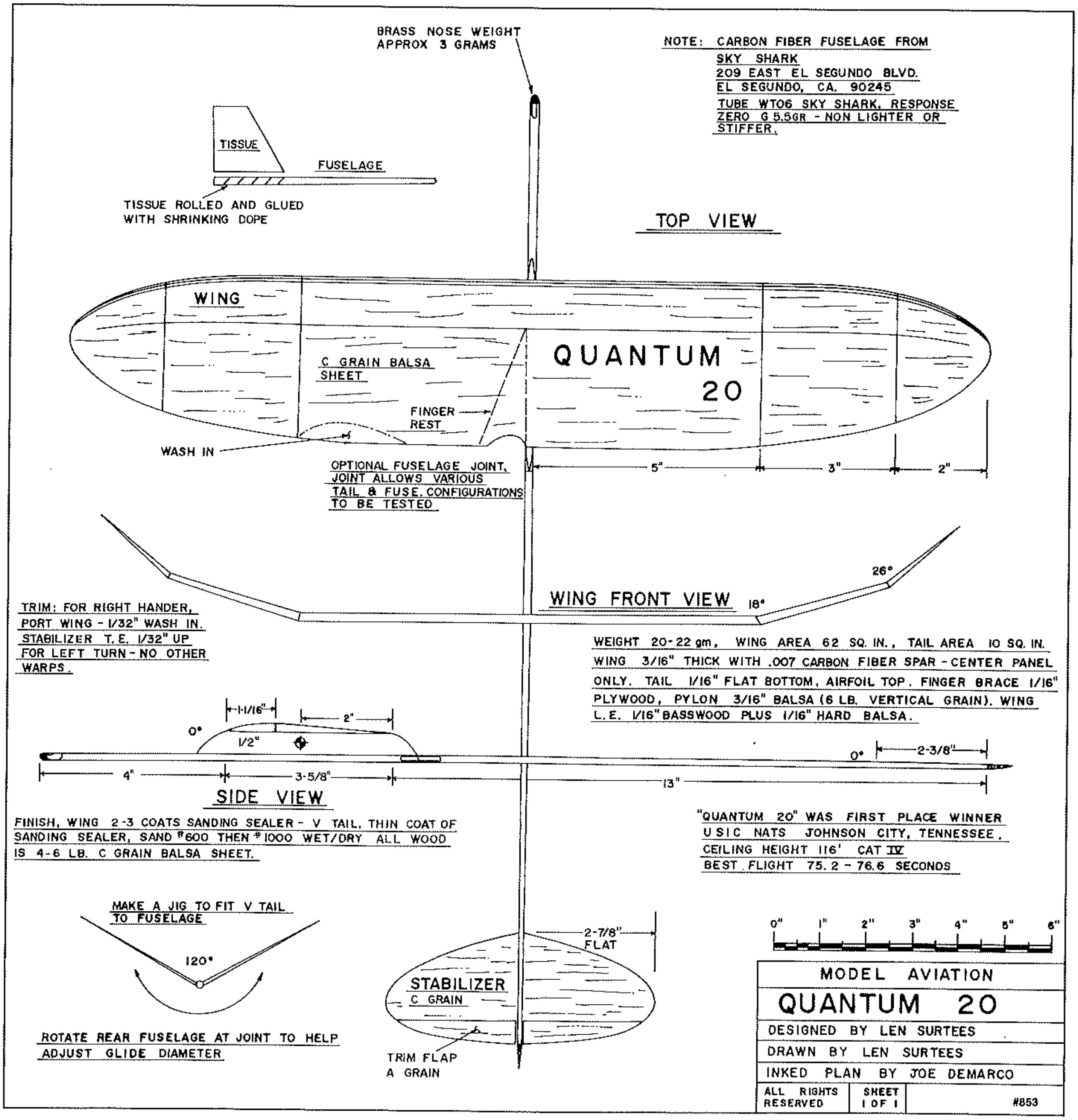
V-tail: Use good-quality four- to five-pound C-grain balsa. I recommend that 1/2 of trailing edge, four-pound A-grain balsa be glued in place before cutting the profile. This enables bending of trim tabs, as C-grain will invariably crack because it is so stiff and brittle.

Cut the profile and sand with a conventional lifting airfoil. Give one thin coat of sanding sealer, sand with 1,000-grit, and cut the centerline with a new razor blade. Hold the razor blade perpendicular whilst cutting against a straightedge for a guide. Sand a slight recess at the trim tabs so they do not get glued to the fuselage (these trim tabs need to be movable).

Alignment of the V-tail is absolutely critical, and a simple jig (see photo) is the only way to achieve this. Make a cardboard template of the V angle (120°), cut to the same span as the tail, and use this as a guide to set up the jig.

I used thin cyanoacrylate (CyA) glue to attach the tail feathers. Before gluing, rough-sand the glue area on the fuselage

Full-Size Plans Available—see page 165



ith 200-300-grit and glue each side :parately. Some packing is required to ıpport the front end of the fuselage to atch the thickness of the jig base.

/ing: Use only quality four- to six- ound C-grain balsa. Because I had such limited supply and varying lengths, ıe wing had five different pieces of ood in it. This is OK, provided that the dges are accurate for gluing. I used itebond for this job satisfactorily.

If you are a very hard thrower, you ıust epoxy a .007 carbon-fiber spar in ıe center panel. Attach with 15-minute poxy; smear a small amount on the 'ood edges, push together, lay on a flat ırface (a thick plate of glass is the best 'ork surface), and carefully clamp in lace using weights on top and along the 'ing edges. When dry, tack-glue the 'ingtips to the center panel and attach ıe leading edge protective strips with 'itebond.

I have found that a 1/16 basswood LE ffers little protection, as the soft four- ound wood simply crushes on impact, llowing a major ding to spoil that arefully sanded LE. I now use 1/8 ıedium-to-hard A-grain balsa strip with he basswood or spruce strip in front for very tough, durable LE that will give ;ood service for a negligible weight ›enalty.

Shape the wing using conventional nethods. The Quantum 20 wing, sanded ıut with no finish, weighed nine grams. 3efore cutting the dihedral breaks, strive 'or the best finish possible, keeping in nind your overall target weight Quantum 20 weighed 22 grams). Note here is no washout in Quantum; cut the lihedral breaks parallel, take care in ;anding the joints, and glue with CyA.

For the finger grip, I used 1/16 ›lywood sanded to a functional wedge ›hape. Being right-handed, I prefer the 'inger grip on the left side of the 'uselage—just as the masters (Lee Hines ınd Bill Blanchard) advocated.

Glue the wing to the pylon (rough up the fuselage where the wing will attach) with Titebond or 15-minute epoxy. No wing offset is used. To help hold the wing to the pylon (after the glue has set) mix some microballoons with 15-minute epoxy, and use the tip of your little finger to make a small fillet between the wing and pylon (do this after the finger rest is in place).

Trimming: Probably the most important aspect of trimming is correctly locating the Center of Gravity (CG) position to suit your own particular throwing style. For instance, the harder you throw, the farther the CG must be moved rearward to prevent looping in the climb; small shifts can have a large effect.

To determine the correct nose weight, use clay wrapped around the nose to establish proper glide trim. If this CG location also allows a good, high launch and satisfactory transition, weigh the clay and machine a streamlined brass shape of equivalent weight. Make a couple of spares ($\frac{1}{2}$ gram heavier and lighter) for fine trimming. Small amounts of weight can be filed from the inner end. Make weights a firm push-in fit so they can be interchangeable.

Initial trim testing is done by pushing the glider from shoulder height, with the nose slightly down, at the estimated glide speed. Trim until a floating glide is evident, with a slight turn to the left (for right-handed throwers).

Bending the right stab trim tab up will induce left turn, with the nose wanting to rise. Bending a little left stab trim tab down will also turn the model to the left but with the nose wanting to fall (go easy on this trim).

It always amazes me how little deflection is needed to make a model that seems to be out of control just be "in the groove." Remember that as little as $\frac{1}{64}$ deflection can turn a penguin into an albatross. Take your time in evaluating which warp is needed to get the result you desire.

Once you are satisfied with glide trim, you are ready for the tricky part.

Hold the model with the wing and fuselage parallel to the ground, throw firmly in the horizontal position, and trim for the following sequence:

If the CG is right, Quantum should fly straight and true for about 50-75 feet; then, as speed washes off, the nose should slowly start to rise into a large left circle. The model should then complete two circles and land back at your feet.

At this point you're ready for a hard launch. Bank Quantum 20 at about 30° and launch at a 60° angle of attack.

Quantum 20 has no spiral-up tendencies, but rather holds its angle of bank in an elliptical curve to the transition point, arriving approximately right-wing-down in a vertical position. Because of the severe wingtip dihedral, Quantum then simply flops down into its glide mode, facing approximately 180° from launch position.

The best piece of advice I can give, other than to be extremely fit and getting lots of practice in achieving high times, is *you must grip the model tightly*. The old style of having two fingers placed at the rear of the wing and either side of fuselage is now fairly uncommon. This style of grip is OK for outdoor gliders, where catching thermals is the name of the game.

Hold the model tightly at the beginning of the runup, and make a conscious effort to continue squeezing until you are practically crushing the model at the point of release, and your index finger is loaded like a tightly wound spring.

Unless you can grip the model tightly and unleash that dynamic power, you have no future in the real world of Indoor Category IV Hand-Launch Glider. ✈

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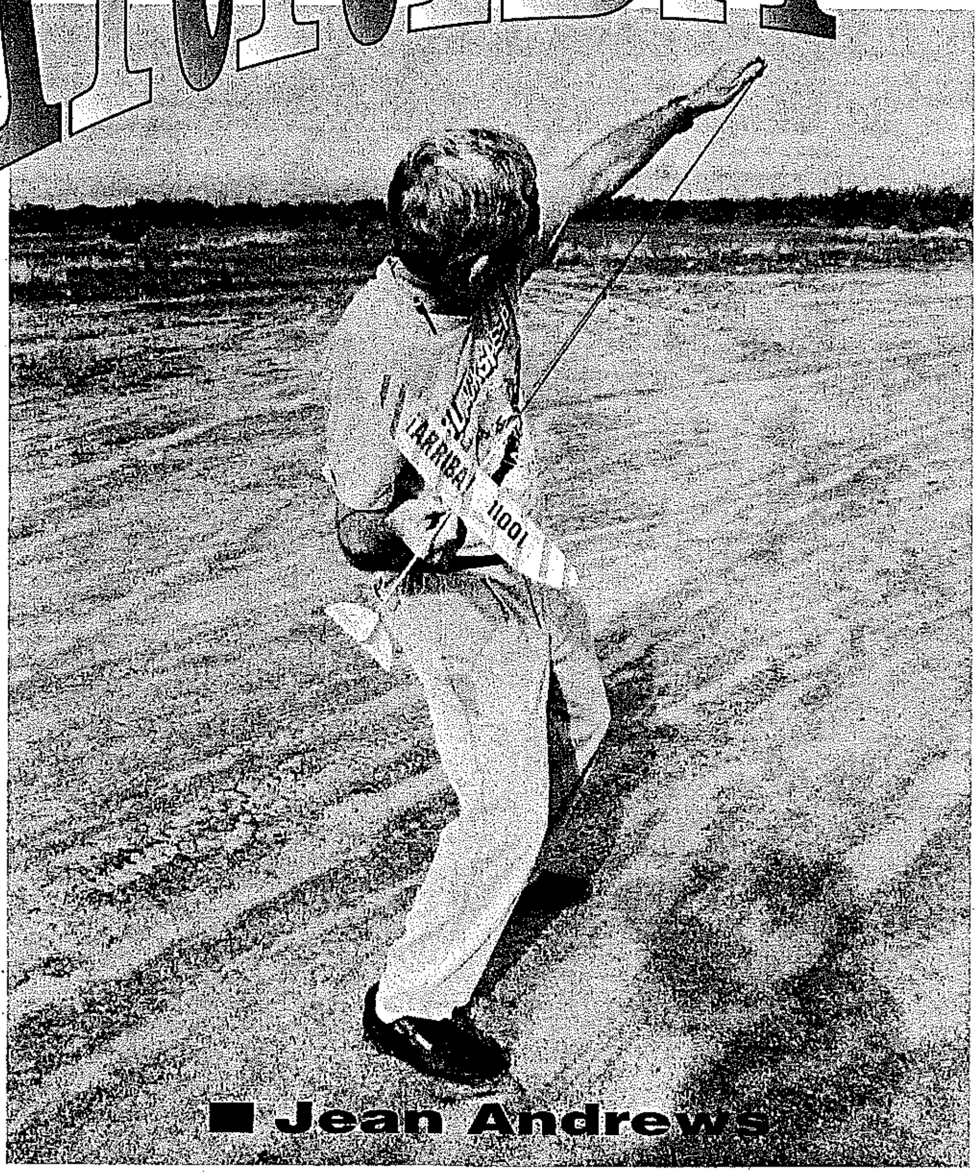
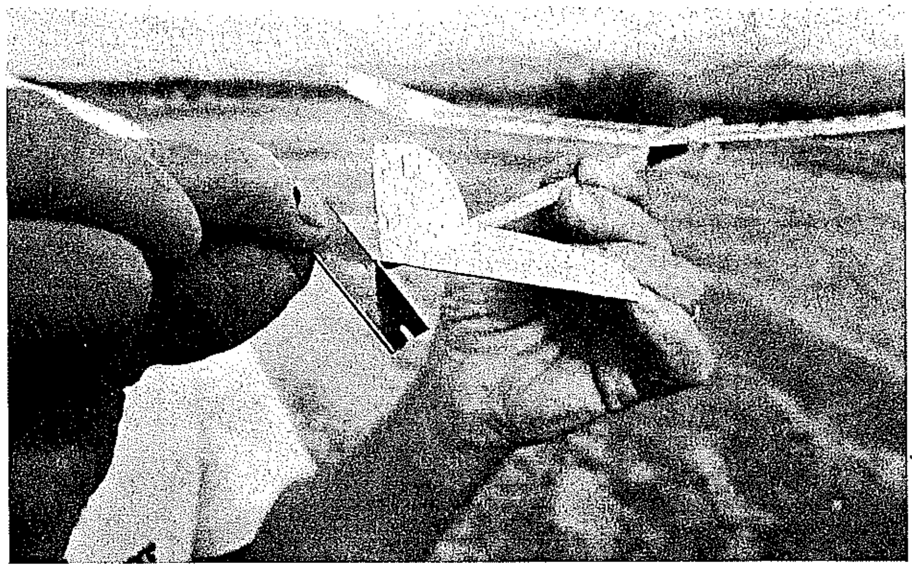
ARRIBA



■ Jean Andrews

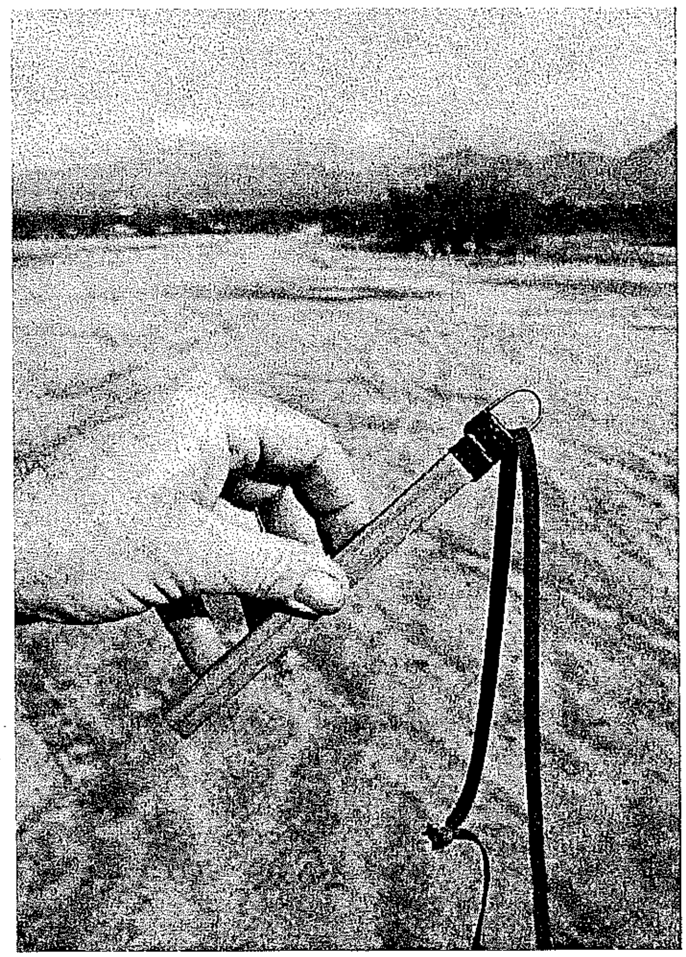
Hand-Held Catapult Glider is a new event in the AMA Competition Regulations. Although it has been popular in the midwest and southwest for quite a few years, this event might be unfamiliar to some, hence this article.

These airplanes yield fun out of all proportion to the amount of time devoted to building them, and the use of a catapult that can be carried in a hip pocket (instead of the semi-permanent pole and long



Cut adjustment tabs into the stabilizer trailing edge. Angled cut helps tabs stay in place.

ARRIBA



Catapult is a nine-inch loop of ¼-inch rubber attached to a dowel not exceeding six inches in length.

rubber motor mandated by the previous rules) should make this a much more popular event throughout the country. Once you've flown one of these gliders, you'll be intrigued at the subtle challenges presented by this simple-appearing category.

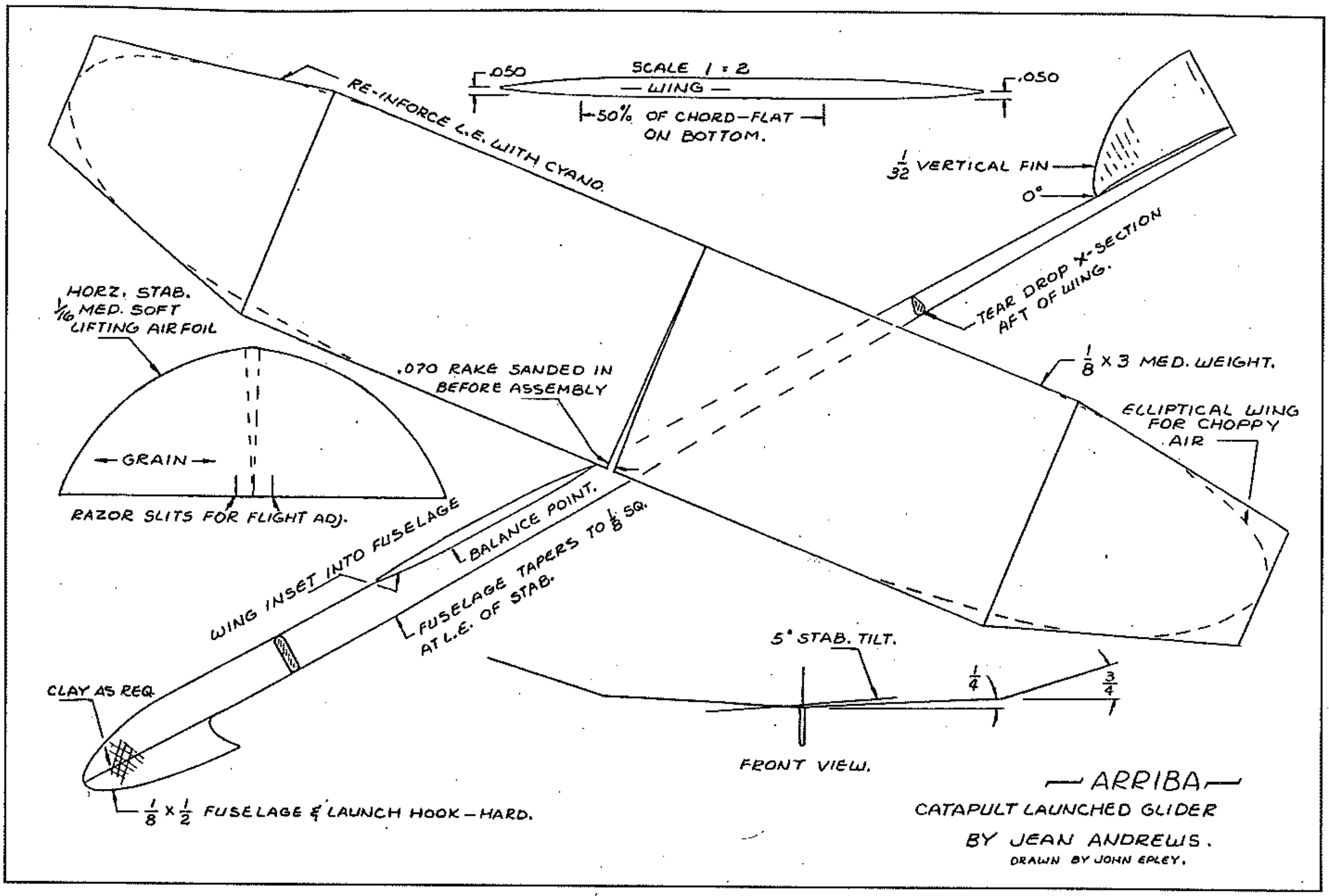
Arriba began as a result of the Central Indiana Aeromodellers' Catapult Glider event, flown at Wright-Patterson Air Force Base in 1988. The event looked like so much fun that we started building gliders to their rules on our return to Southern California, even though the event hadn't caught on out there at that time.

We quickly learned that there is a lot more to these little airplanes than first meets the eye, and Arriba is the culmination of four years of experimenting and refining the idea.

You'll notice quite a few differences between Arriba and a hand launched glider. For instance, a semisymmetrical airfoil is used to allow the higher-speed stability without sacrificing lifting ability in the glide. The added benefit, unique to symmetrical airfoils, is that the center of lift doesn't change with variations in angle of attack, yielding better stability in turbulent air. The dihedral angles are considerably less than most hand launched gliders, which gives better directional stability under launch.

There are two different wing planforms shown on the plans: oval and straight taper. The straight-taper wing seems to be more stable under most circumstances. However, the oval wing is much better in choppy, small-diameter thermals. We have no idea why these two wing planforms should fly so differently, but they do, so we'll have to learn to cope with it.

Full-Size Available—See Page 168



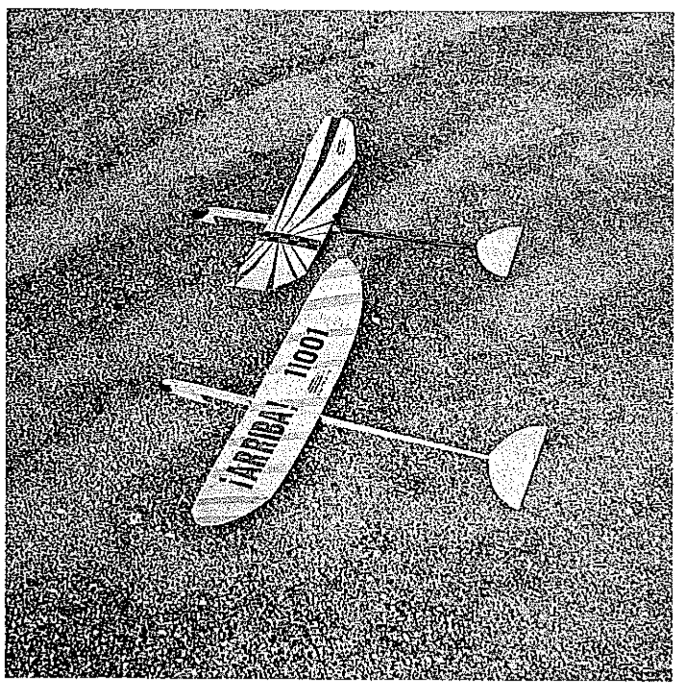
ARRIBA

Type: FF Catapult Glider

Wingspan: 16 inches

Construction: Sheet balsa

Covering/finish: Butyrate dope/ tissue



Basic Arriba design has had several variations. Each performs best under certain conditions (see text).

Before beginning construction, get a piece of scrap glass about twelve by sixteen inches and at least three-eighths of an inch thick to use as a building surface. It will be helpful in accurately shaping the flying surfaces, and you'll find plenty of other uses for it in your shop.

After building models for thirty years, I've acquired an allergy to balsa dust, so I recommend some type of face-mask-type respirator for protection against dust inhalation while sanding. It takes very little additional time to build more than one glider; I usually build three at a time. While these gliders go together fast, don't rush the building process. Make sure all of the surfaces are shaped properly, and dihedral angles and final assembly alignment is correct, and you'll be rewarded with a fine-flying fleet of gliders for fun and competition.

Choose enough 1/8 sheet wood for the number of wing sets you plan to build. These should be fairly straight-grained medium-weight wood. Weight is not as important as grain, since extra weight (within reason) on these gliders results in more inertia on the launch and higher climbs.

Cut the outline of the wing, and carefully mark the dihedral cuts on both the top and the bottom of the wing blanks with a sharp #2 lead pencil. To accurately mark the .050 upsweep on the leading and trailing edges of the wings, I use an old piece of .045 aluminum for spacing, and mark all around the perimeter of the wing blank with a very sharp pencil.

Sand the bottom of the wing surface on both the leading and trailing edge sections up to this mark with #150 sandpaper. Use the dihedral marks on the top of the wing for guides to redraw the cut lines on the bottom of the wing. Sand in the top contour of the wing, using the glass as support for the wood. Dust the glass often to avoid having a clot of balsa dust under the wood, which can cause a dent in the opposing surface.

Smooth the surfaces with #400 sandpaper, being careful not to erase the dihedral-cut lines on the wing blanks. Use a single-bulb desk light to examine the wings for high or low spots and an accurate airfoil shape before making the dihedral cuts. Note that the center cut is angled .070 to give a small amount of washout in the outboard sections of the wing.

Sand the tips and the outboard halves of the center sections to yield an exact butt joint at the angles shown on the drawings, and glue them with any good cyanoacrylate (CyA) glue. Then angle the center halves of the wing the same way, and join them. Lightly coat the leading edge of the wing with the CyA, then set the finished wing aside while the fuselage assembly is readied.

The stabilizer is cut from light quarter-grained $\frac{1}{16}$ balsa. Sand on the glass to about $\frac{1}{20}$ thickness, then gently (#400 paper) sand in a lifting airfoil section.

The vertical fin is quarter-grained $\frac{1}{32}$ sheet, and is merely sanded to a streamlined section.

The fuselage is made of fairly heavy, springy, straight-grained wood. This is the heart of the airplane; almost anything can fall off these gliders and be glued back on in correct alignment, but if the fuselage breaks, you might as well throw the whole thing away—it's almost impossible to reassemble a broken fuselage to its previous alignment. Cut the fuselage to length and glue the catapult hook to the front with CyA before tapering and shaping.

Assemble the fin and horizontal stabilizer to the fuselage using cellulose cement, such as Testors or Ambroid, since you may need to replace these components as they become battle-weary. Be sure the stabilizer is misaligned (by about 5°) as viewed from the rear, with the high side being the side to which you want the finished glider to turn. A left glide circle is normal for right-handed fliers, although we've flown them with right-hand glide circle, too.

Due to its semisymmetrical airfoil, the wing has to be recessed into the fuselage. This is the most critical stage of construction, since the wing cutout must be as close to 0° incidence as is possible. There are no tricks to be imparted here...just be extremely careful to mount the wing as close to 0° as you can.

The assembled aircraft is given two coats of thinned butyrate dope, sanded lightly with #600 sandpaper between coats. The underside is painted black, for better visibility from the ground, and the top of the wing is trimmed in contrasting tissue. This is not only for decoration; it's hard to see these little gliders once they have landed, and a unique color pattern on the top of the wing helps a lot in spotting them once they are down.

Now for the fun part: the flight adjusting. Use modeling clay to set the balance point at about 50% of the wing chord. When forming the clay around the nose, let some of it stick out in front of the fuselage to act as a shock absorber for the inevitable hard landings. Hand glides haven't proven to be too useful, so go right to the launcher.

For the first flight, point the nose about 10° above the horizon, with a slight right bank, and use about $\frac{1}{3}$ power. The glider should climb to the right and at least attempt to recover to a glide before touching down.

If it goes straight out, then dives into the ground, or in extreme cases flies inverted, make a couple of thin slits in the trailing edge of the stabilizer. Angle these cuts so as the trailing edge is bent up, to correct the model's being under-elevated. A little up elevator goes a long way, so move the tabs very gently.

If the glider gets loopy as power is increased, back off on the tabs and kick a little turn into the rudder if needed for recovery at the top of the climb. If the model seems to climb all right under full power, but gradually picks up speed in the glide until it underelevates and dives into the ground, try trimming a little area off the horizontal stabilizer.

Our gliders are set up to be launched under full power with an 80° right bank and about 10° nose up. At top speed they start to roll back to the left, resulting in a vertical climb as the velocity bleeds off until they roll out level at cruising altitude.

Once the desired power and glide pattern is achieved, use a touch of cellulose glue to hold the settings on the tabs. These settings may need to be changed slightly for each flying session, so don't use too much glue. ✈