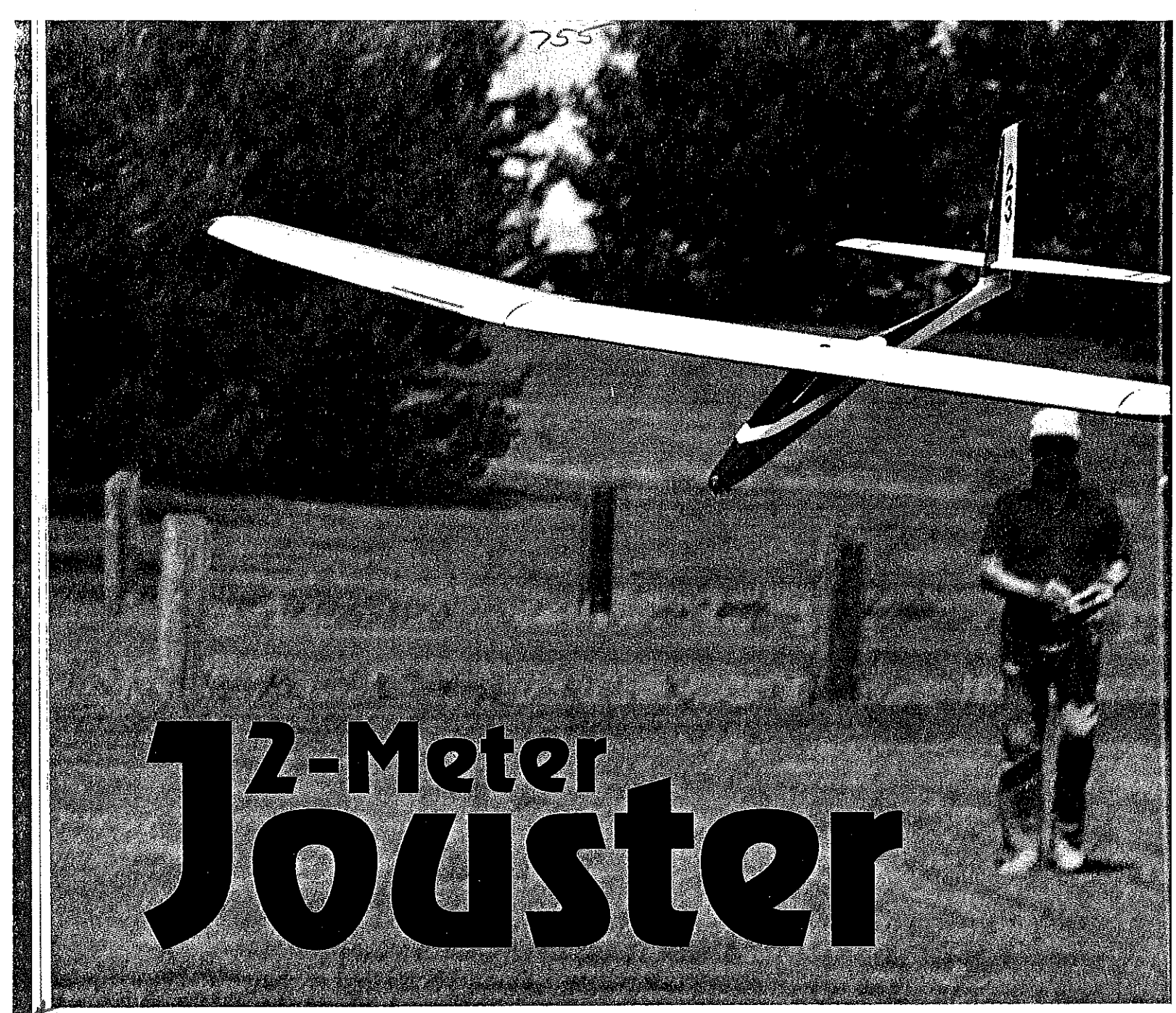


J2-Meter Jouster

The July 1993 issue featured the full-size Jouster. Here's a look at its little brother—the J2M.

■ **Harley Michaelis**

THE JOUSTER Two-Meter (J2M) represents a dedicated effort to develop a small model particularly suited to precision/duration competition. Common techniques and materials keep it relatively simple and inexpensive. Even so, it is designed to utilize the broad capabilities of today's high-tech radios.

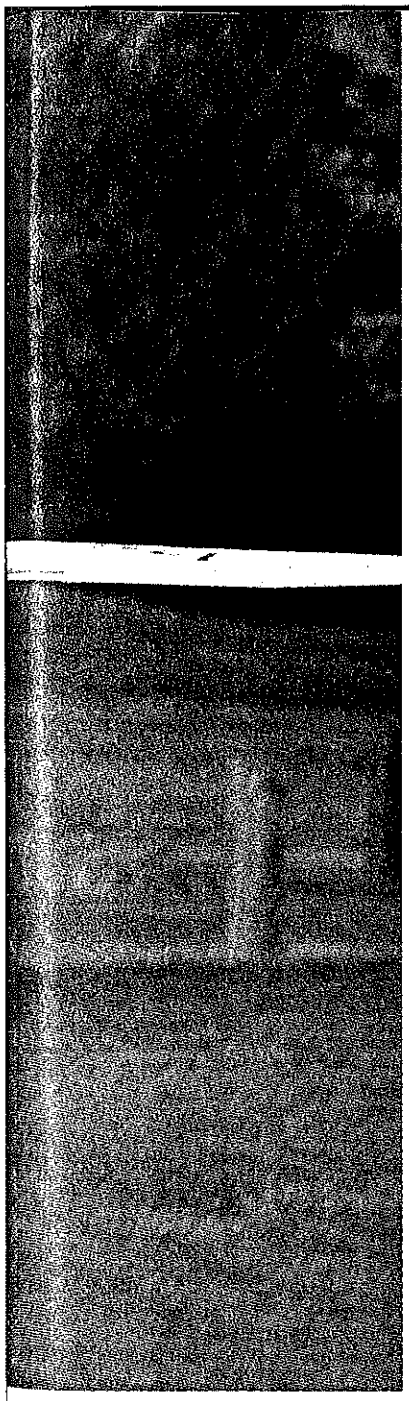
Tow is steep and fast, and the zoom is long. It can cover a lot of sky quickly or slowly work a low thermal. Stall characteristics are gentle, and it is highly maneuverable. It can safely descend straight down with flaps, and landing control is excellent.

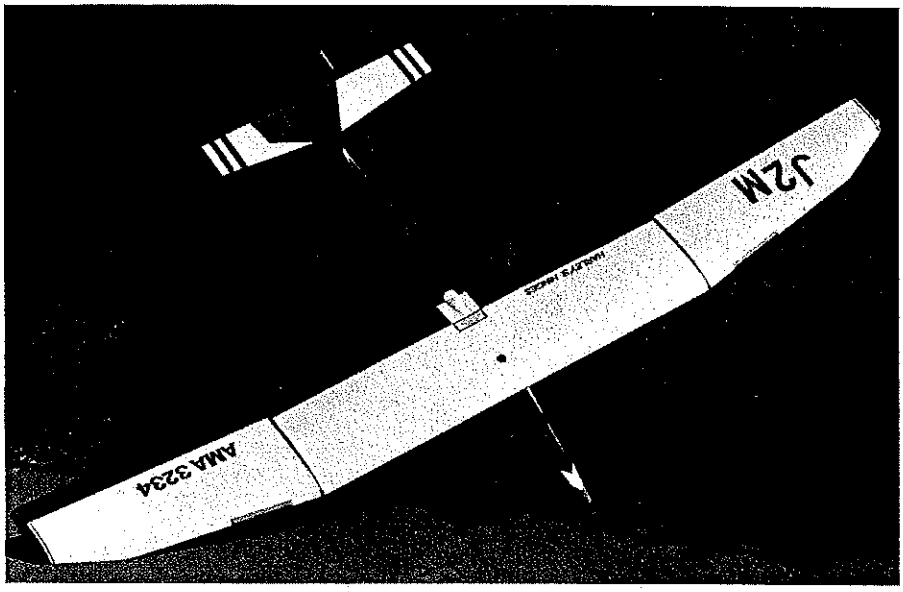
For sport flying, the ailerons may be eliminated by increasing dihedral. For simple radios, a Y harness may be used to run two aileron servos. Without ail-rud mix, a third lead may be wired in for rudder on the same stick. The throttle stick drops the flaps, and the trim tab will reflex them for speed. Elevator compensation with flap can be manually input.

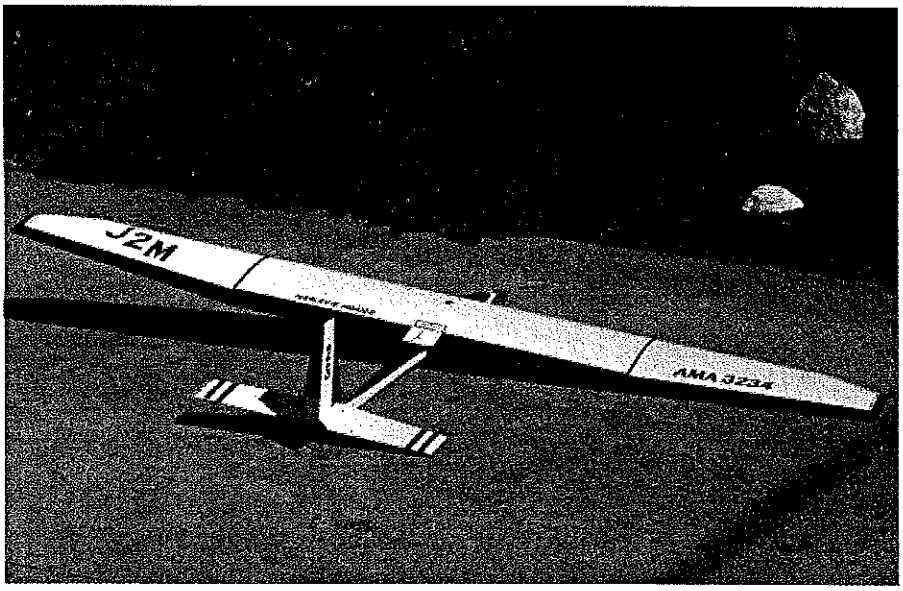
With carefully selected balsa and five small servos, the J2M weighs 38-40 ounces, for a wing loading of approximately 8 oz./sq. ft. With more than 700 square inches of area, low drag, low mass, and a camberable wing that can handle a high-stress zoom, launch heights can be awesome.

The airframe has a host of special features worth noting: With only the tandem-mounted rudder and elevator servos, the fuselage can be very slim, but it still takes up to a 650 mAh "flat" pak for long air time. The "hangy-down" fuselage profile helps keep the tips from dragging, lowers the CG for greater hands-off stability, and avoids belly-rotation that can lose landing points. It also helps avoid stripping gears if the flaps are down.

Selig and Donovan's work defined superior airfoils for this application, including the SD7032 used here. At these chord widths it is thick enough at the spar to fully recess miniservos. It is especially suited for what we do; it has the desired flight







The Two-Meter Jouster at rest and in flight. Although the model has more than 700 square inches of area, it can be built to 38-40 ounces with careful wood selection and five miniservos. SD7032 airfoil gives desired flight characteristics while allowing servos to be fully recessed.

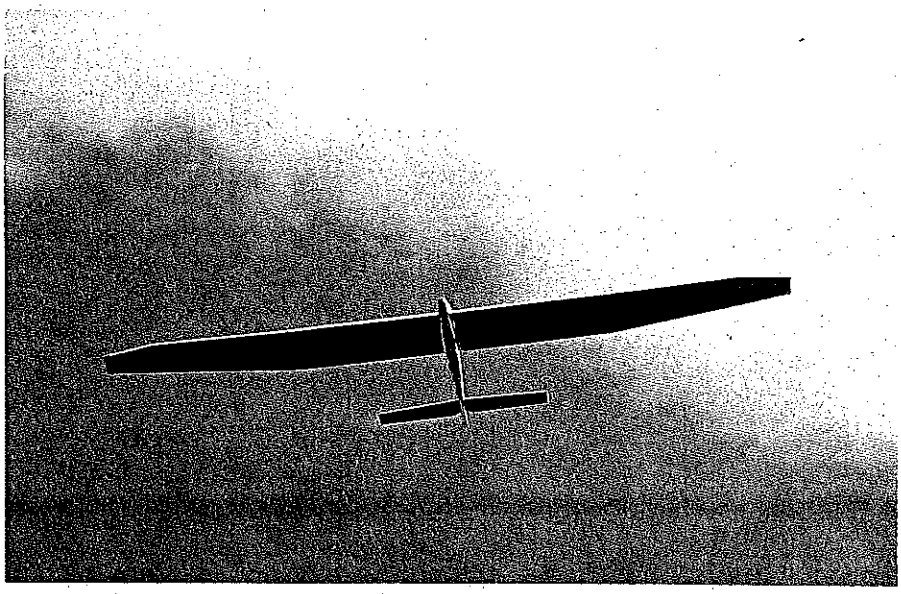
characteristics and is easy to build with normal techniques. The wing may be built-up or foam core.

A ¼-inch nylon bolt secures the wing firmly; a smaller bolt keys it in place. The J2M's servos are center-clustered to avoid long leads and help get a *bang-bang* roll response with small aileron deflection. The filleted saddle covers the flap servo well. A simple plastic cover is used over the aileron servo well.

The simple flap mechanism is internal, and needs no fussing to fly. It allows full down and ample reflex.

The ailerons feature Direct Aileron Drivers (see September 1993 *Model Aviation* for details). They are easily made from common hardware, and provide slop-free, wholly internal operation. A pushrod directly to the servo gives positive action.

For sealed, gap-free, butt-fitted hingelines, all hinging may be done with



rubber Harley's Hinges (#50L317) from ACE R/C. No rounding, spacing or beveling is needed for deflection. The hingelines can be hairlines. The hinges are installed under slight tension to help eliminate slop, bind, and flutter. Faster cruising and dramatically reduced noise levels speak volumes about cleaner airflow.

The rudder is pull-pull cable operated. The light, frame stab is rigidly mounted. A rigid pushrod assures a well-defined neutral and positive action.

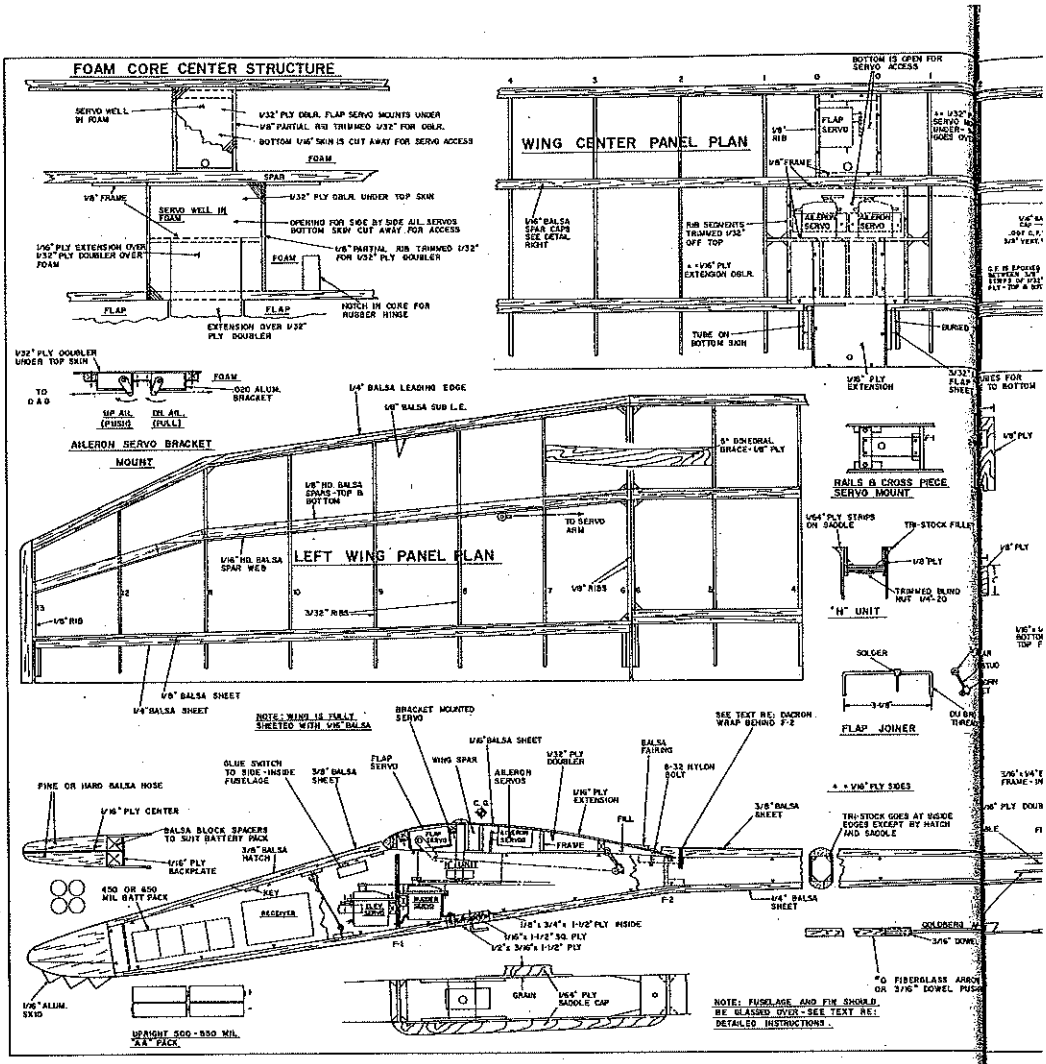
CONSTRUCTION

I have made the assumption that you have suitable tools, understand adhesives, know how to use a straightedge, can align things, and otherwise have some building experience.

Except where noted, stick to lightweight balsa. Fast-curing epoxy and assorted cyanoacrylate (CyA) glues are the basic adhesives for the wood structure. For foam work, Satellite City's UFO and Hot Shot are recommended. 3M 77 spray adhesive works well to attach paper patterns and to stack sheeting.

"Wicking" is a term I use for several steps involving gluing things together with thin CyA. It means that parts are pressed in position, then the glue is applied to the edge of the joint between the parts or surfaces. The glue seeps into the joint by capillary action and penetrates both parts or surfaces; an exceptionally strong bond results.

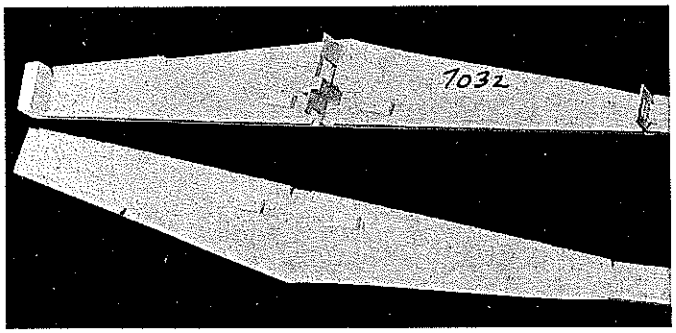
Complete instructions on fiberglassing techniques are part of the Big Jouster plan (#739).



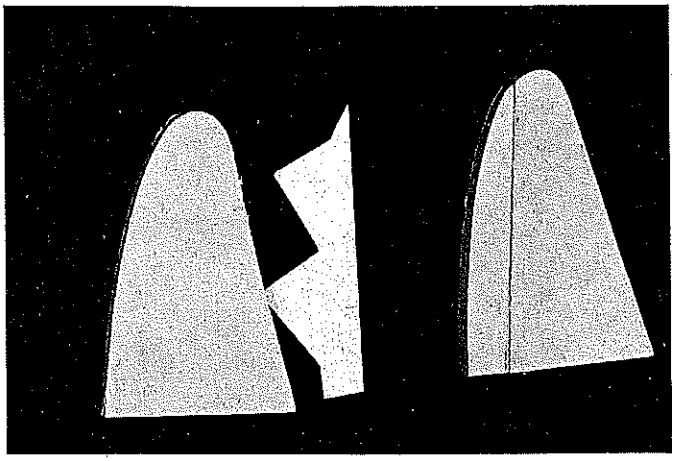
Fin and Rudder: The vertical tail area of the J2M has been increased compared to the photos, and a slight hingeline sweep has been added.

Cut the fin to profile from ultralight ¼-inch sheet balsa. Cut the rudder LE from ¼-inch-square balsa. If desired, the rudder and fin edges may be slotted for 1/64 plywood inserts.

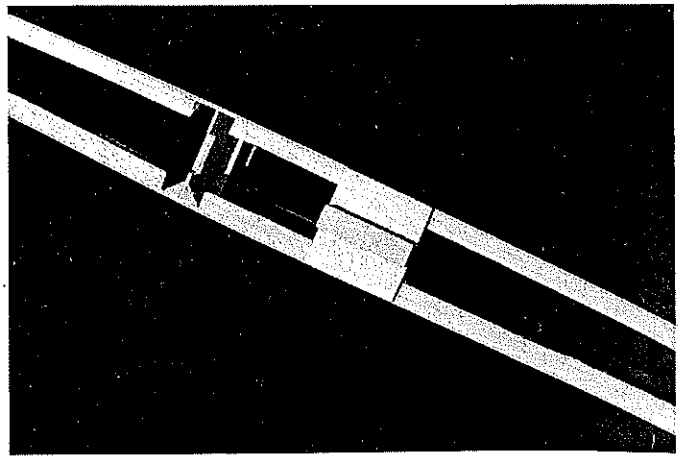
Pin the rudder LE to the fin and shape these parts simultaneously. Make the rib



Matching slab sides are cut from 1/16 plywood. Formers, servo rails, sub-nose block, and triangular stock are next.



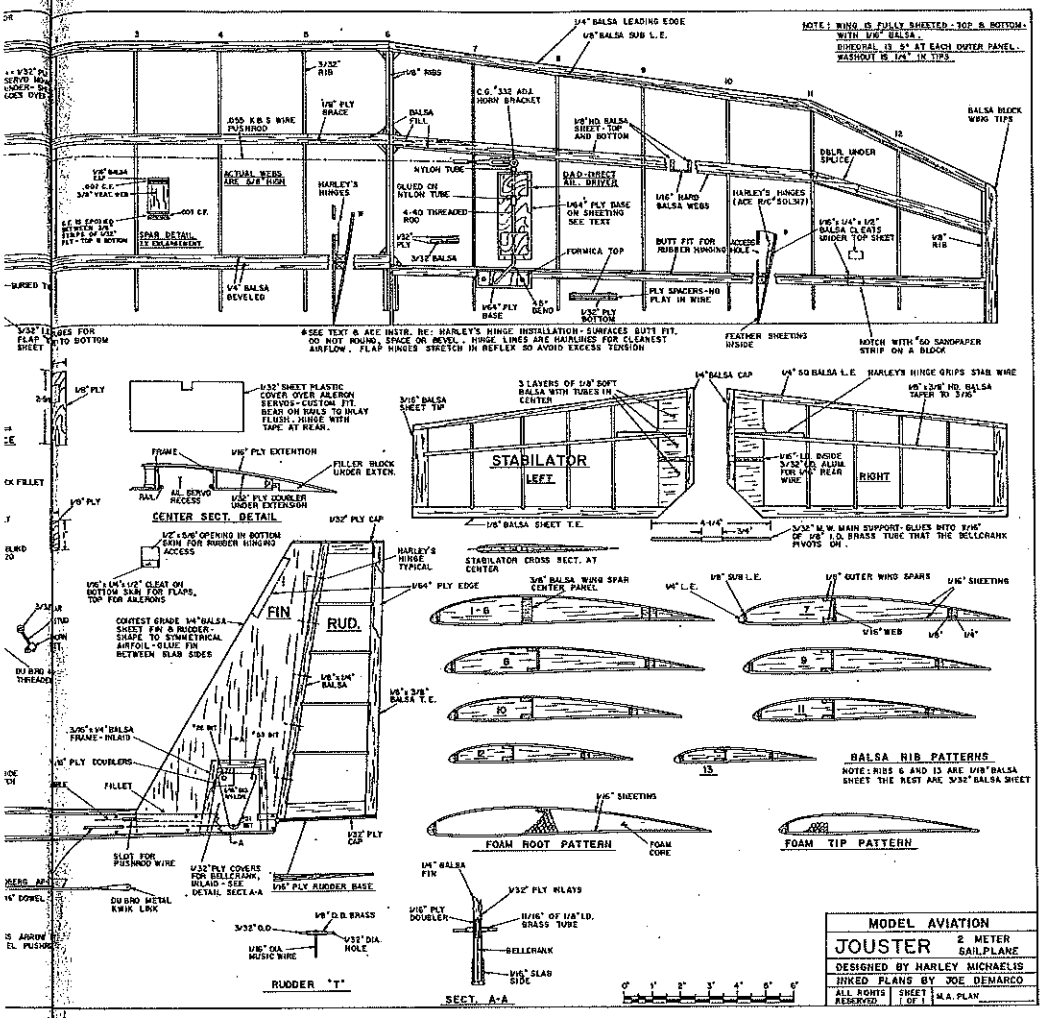
Nose block cheeks are hard balsa or pine. The 1/16 plywood core has space under it for the 1/16 aluminum skid.



Plywood towhook block is added to plywood base across slab sides. Assembly is inlaid with ¼-inch sheet fuselage bottom.

2-Meter Jouster

Type: RC Sailplane
Wingspan: 78-1/2 inches
Flying Weight: 38-40 ounces
Number of channels: Four
Construction: Built-up or foam core
Covering/finish: Iron-on film, fiberglass



notches and add the other rudder parts. Assemble the parts to the rudder T and run thin CyA down the tubes to join everything. Flatten and drill the ends for the cables.

The slotted plywood piece that the T slips into is cut overwidth; after it is glued to the rudder, the excess wood is trimmed. Add the cap in similar fashion, and notch the T for a vertical rudder key.

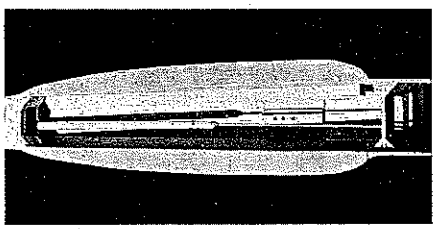
Make the bellcrank from 1/16 Sig nylon. The bellcrank pivots on an 11/16 piece of 1/8 I.D. brass tubing. Eventually the main support wire (with tube) is wicked in place to form a rigid mount.

The pushrod slot is most easily made on a table saw, but can also be accomplished with a hacksaw blade. The pushrod should use a metal clevis at the rear. Mount the bellcrank with the pushrod attached, and trim the slot so the clevis does not jam.

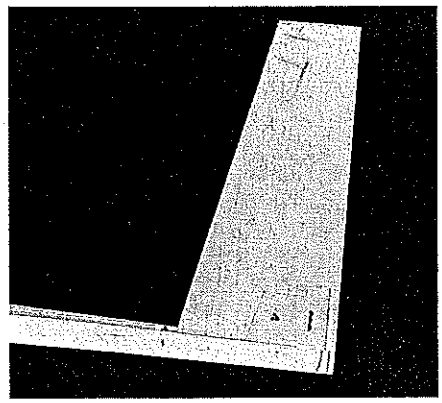
Fuselage: Triangles on the plans outline the 1/16 plywood slab sides. Push pins through the plans into the plywood to locate the ends of the straight lines and the saddle outline. Paste a plain outline of the top of the wing saddle at the saddle location. Mark the straight lines on the uncut sides, stack the first side over a blank plywood piece, and cut both sides at the same time. Drill a series of 1/16 holes where the rudder cables will exit, and open them to make shallow slots.

Rather squat miniservos are best. Mount them in the fuselage as low as possible so the elevator pushrod and the rudder cables can run under the crosspiece where the main wing hold-down bolt passes through.

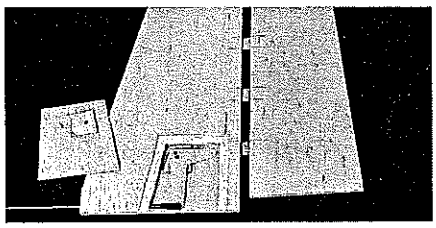
The rudder servo is highest, so the stab pushrod passes just under its output arm. The other ends of the servos can be held with an aluminum bracket, as shown for the rudder



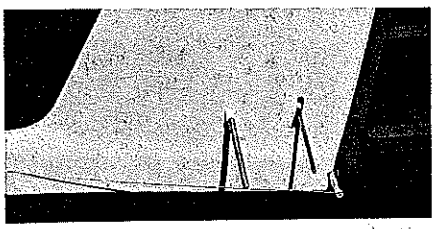
Plywood strips added to the wing saddle cover servos mounted inline. Additional 1/8 plywood gives towhook extra "bite."



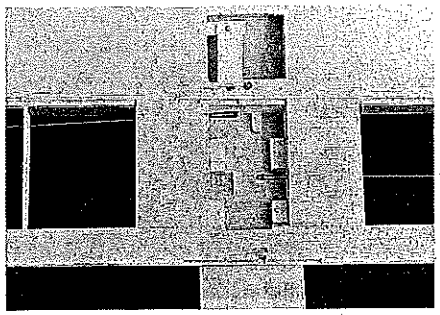
Inline openings for servos are shown here. Rails are glued beneath 1/32 plywood doublers under top sheeting.



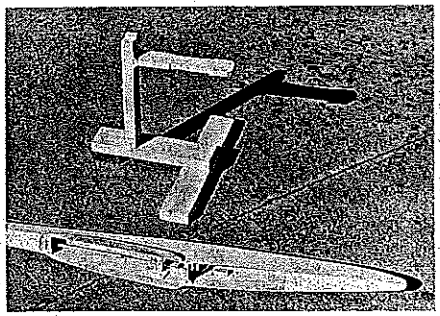
Bellcrank is made from 1/16 nylon. Cutout is lined with flush-mounted 1/32 plywood. Fin/rudder is 1/4 C-grain balsa.



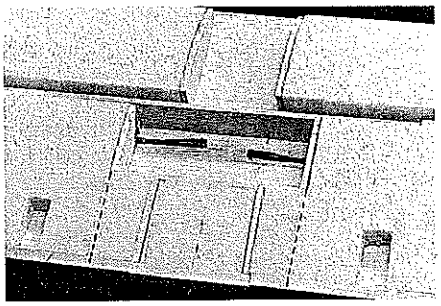
Rudder cables attach to T fitting. Rubber hinges allow hairline butt fit. Fillet smooths fuselage/fin joint.



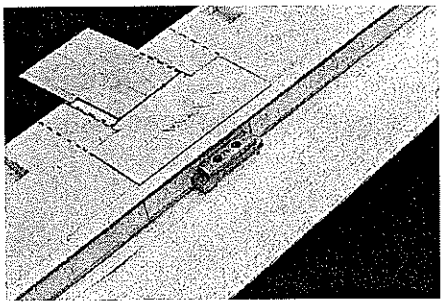
Fin is glued between slab fuselage sides. Rudder/fin is shaped to a generic symmetrical airfoil section.



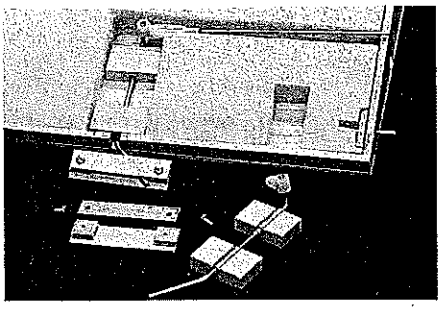
Support used as a handle to spray fuselage. Upright portion jams between sides; horizontal piece fits opening.



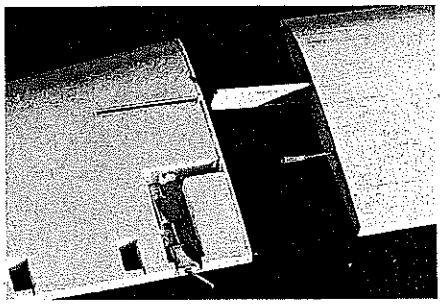
Top view of foam core center shows opening for side-by-side aileron servo mounting. Bottom sheeting removed later.



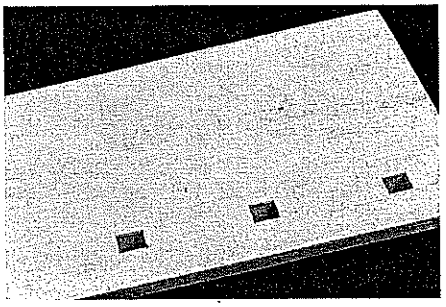
Example from Big Jouster construction shows rectangular rear doubler in place, with 1/16 plywood extension.



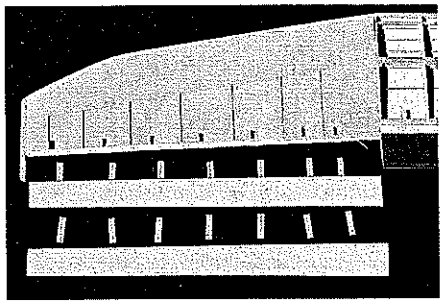
DAD assembly/installation for Big Jouster. Full details on DAD construction in September 1993 issue.



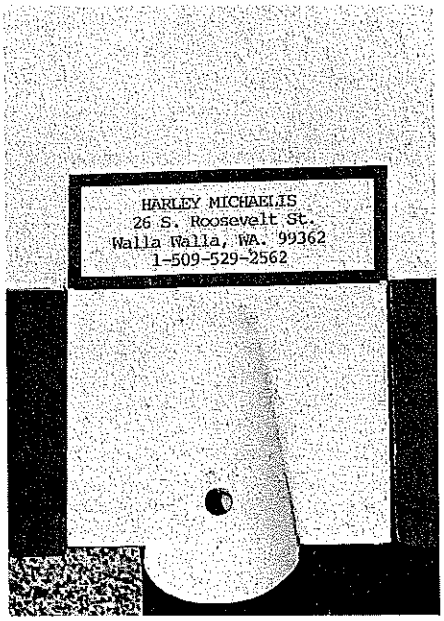
Original DAD setup for J2M; plans show more-outboard location. Dihedral brace glues between plywood tip uprights.



Access holes in the bottom skin of a fully sheeted tip. Cleats go on top skin, and hinges attach to them.



Hinges are attached to flap or aileron, fed through slots, and attached to cleats. Note access holes in foam.



After covering, name plate edge covers the MonoKote/paint line. Name/address is always good fail-safe protection.

servo, or with side rails and a crosspiece as the plans detail. If your radio equipment permits, move F1 farther forward for better access to the rudder servo's rear mounting ear.

Triangular-stock balsa pieces (TS) edge the inside of the fuselage sides. See the plans for the details aft of the saddle. Forward of the saddle, they are not used by the removable hatch and along the saddle itself. The same TS can be used along the edges of F1 and F2 where they meet the slab sides, except forward of F2 where the block for the rear wing-keying bolt goes.

The formers are added next. One of the photos shows the 1/16 plywood nose core ending at the rear of the balsa-block fairing cheeks. This was glued to a spacer block, and works fine if it is fiberglassed later.

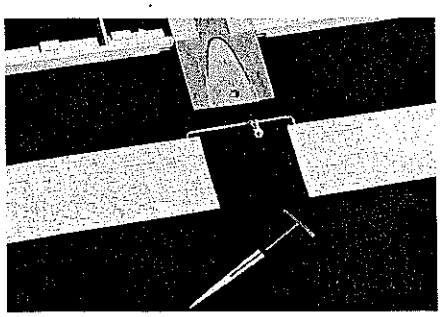
The plans detail a preferred, stronger version, where the core extends ½ inch behind the cheeks between two matched spacer blocks beveled from a piece of ½-inch-square wood. In any event, leave space under the core to receive the aluminum landing skid, which is added later.

Trim the TS ahead of the fin so that the edges meet when the fin is clamped in place. Align the fuselage from the rear and apply CyA where the TS meets to hold the alignment. Slip the pushrod through F2 and glue the fin to one side. When dry, glue the other side, making sure the alignment is still correct. The sides of the fin are filleted with beveled strips of 1/8 x 3/8 balsa.

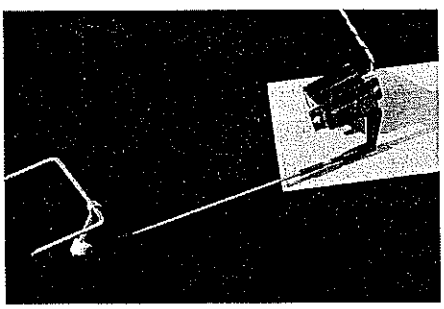
After the towhook block and the fuselage top and bottom planks have been added, the fuselage is ready for shaping as per the plans. The wing saddle area has 3/8-inch-wide strips of 1/64 plywood added at this time. Fillet underneath the strips with TS and epoxy putty.

Nylon-coated fishline in the 18-20 lb. test range works fine for the rudder cable. The cable is routed by fishing a piece of thin music wire down the exits and through F2; then the cable is glued to the wire and pulled through the fuselage. Knot or crimp the cable to the T; attach Du-Bro 2-56 rigging couplers in front.

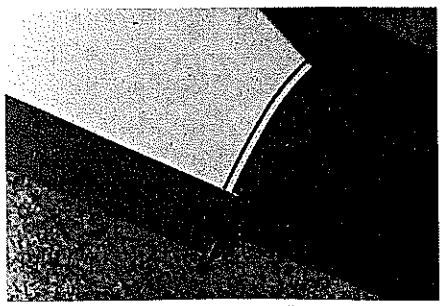
Stabilizer: Use hard balsa for the spars.



Uncovered flaps with U partially inserted into square tubes. Rudder T also shown with slotted plywood piece.



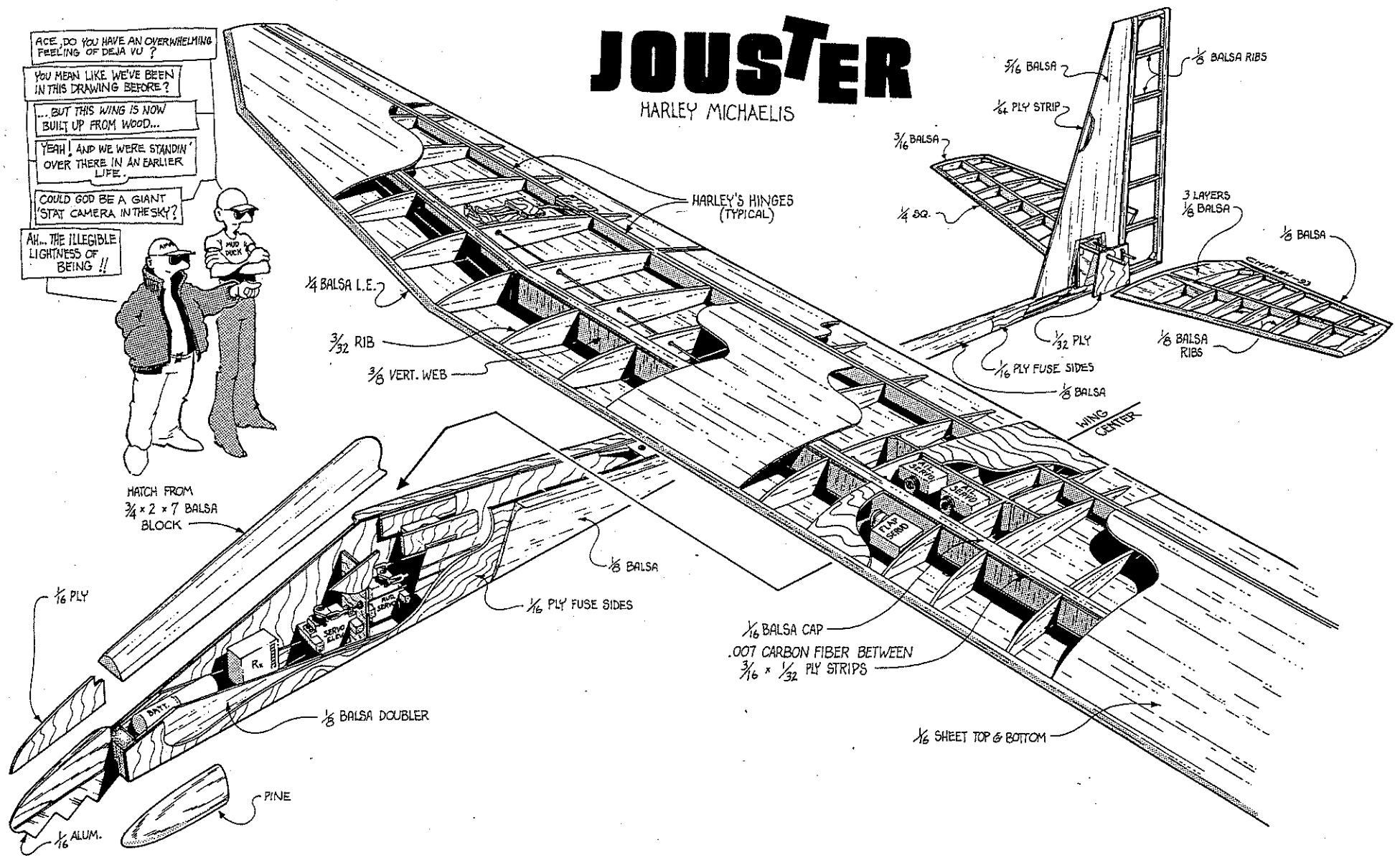
Flap U is made from 4-40 threaded rod. The 3/32 collar in soldered in place. Square tubes are buried in the flaps.



Solid wingtips look best if they are resin coated and spray-painted. Trim tape hides raw edge of covering.

JOUSTER

HARLEY MICHAELIS



Taper them to 3/16 at the tips. The root area (from the center outboard to the next rib) is three layers of soft 1/8 balsa. Add the wedge and bottom front and rear layers to the spar, keeping everything flush to the work surface. Glue the front tubes in place.

Use Zap to attach 5/16 x 1 pieces of Harley's Hinges adjacent to the wedges for the stabilizer's main support wire to slide *part way* on the rubber. Friction with the hinges retains the stab.

The rear stabilizer tubes are telescoping pieces of 3/32 I.D. and O.D tubing. Slip the partial assemblies on the main wire, square them up, and tack-glue the tubes to the wood (with CyA) for perfect alignment. Finish the structure and shape it to a symmetrical airfoil section.

Wing: The airfoil plots provided are for use in making ribs or for templates for cutting foam-core wings. They are drawn slightly oversize to allow practical TE thickness.
The bottom spar goes in flush with the airfoil bottom. The top spar is capped with soft balsa for shaping purposes. Be sure to allow for the 1/16 sheeting and 3/8 LE.

The tips are 21 inches long and have 1/4-inch washout. Tip cores are cut single taper, trimmed for the break at the LE, and are sanded to a generic airfoil. If the LE is kept fairly blunt, favorable stall characteristics will result.

The overall length of the center-section assembly with 1/8 endcaps is 35 3/4 inches. This allows 1/8 overlap on each end (assuming a 36-inch sheet of balsa) for wicking the sheeting in place and truing the ends of the panel.

The center core is divided into sections and rejoined by the spar and servo-well structure. Two 18-inch core blanks could be used here, but alignment is critical.

After the cores have been cut (with the allowance for the LE wood), draw lines 1/4 inch from each side of the flap hingeline for the first cut. Saw just inside the lines, and true the cuts with a long sanding block. The remainder will lay flat, so a table saw or bandsaw blade set for 90° will make a cut perpendicular to the core bottom. Mark the spar location and make the front cut first, then

Continued on page 40

Jouster/Michaelis

Continued from page 36

the rear.

Rubber Hinges: Use of these is optional, but I've used this technique successfully for several years now. It involves the use of cleats to anchor the front ends so there is rubber free to stretch. This is an easy way to have gapless hingelines and avoid flutter problems. The cleats are attached with slow CyA and are positioned with an X-Acto knife. The plans show the size and location of the cleats.

Spars: On zoom launches, I've exploded wings with ordinary spruce spars, so I now sandwich strips of .007 or .014 carbon fiber between strips of 1/32 plywood for the top and bottom spars. Adding 3/8 vertical webs between the spars may seem like overkill, but even "leadfoots" can do vertical zoom launches with this structure—assuming all glue joints are solid!

I use five-minute epoxy for the spar laminations. Glue the dull side of the carbon fiber to one strip, rub with an alcohol-dampened rag, and keep everything in good contact and alignment until the epoxy sets. Sand the shine from the carbon, then add the other strip.

For a built-up wing, the general order of construction is: bottom sheeting, bottom spar, ribs and webs, sub-LE, forward-beveled hingeline strip, plywood servo doublers, dihedral braces, top spar, spar cap, servos, aileron pushrods, top sheeting, LE, flaps.

For a foam-core wing, the main spar is assembled first. The various wood parts for the center section are made next, and the core pieces are joined to them. Otherwise, proceed as you would for a built-up wing. Pushrod grooves can be made after the bottom sheeting is attached.

The plans illustrate typical miniservo well sizes. The servos mount flush to 1/32 plywood doublers under the top sheeting, using rails and brackets.

The flaps' beveled hingeline strips are cut on a table saw (use scrap to determine the

Continued on page 42

Jouster/Michaelis

Continued from page 40

correct angle). Cut the front strip first, then the shorter (rear) one. If rubber hinges are used, notch the undersides at the hinge locations with a strip of 50-grit sandpaper glued to a ⅝ block.

Rubber-hinge access openings in the center of a foam wing are made by making ⅝ x 1½ notches in the core at the flap locations. Use the previously made notching tool for this step. The skin is marked to show the location of the cutouts, and 9/16 x 1½ openings are cut in the forward area, just ahead of the cleat position. The wing covering will hide these openings.

Skinning: I have used Satellite City's UFO Thick CyA and Hot Shot accelerator for simple, light, and quick skinning. Dave Brown Products' sorghum contact cement is an inexpensive, quick alternative. Only the bottom beds will be needed using these procedures.

Wick the hingeline strips to the bottom skin. The 1/16 plywood extension is flush with the top skin. Bond to the doubler with a coat of quick-curing epoxy; use pressure to maintain good contact until the epoxy sets. The skin should be cut for a precise fit around the extension, to help position the skin on the core. Leave some overhang all around for wicking.

If CyA is used, place the skin in its bed and spray lightly with Hot Shot. Then apply a bead of CyA to the core bottom around its perimeter, at the cutouts and chordwise at a three-inch spacing. Don't rush! Keep glue away from the sub-LE and endcaps (wood-to-wood is wicked together after skinning to avoid gaps).

Press and hold the core in contact with the sheeting, using loose sheet on top to avoid depressions. Mark the pushrod groove on top and cut with a hacksaw blade held against a straightedge.

Flaps and Flap U: Use a table saw to determine and cut the correct bevel on the inside edge at the TE. Cut the bevel into three-inch sheets for flaps and ailerons. Wick on the rear beveled/notched strip to make a 2¼-inch-wide flap bottom, keeping glue out of the slots and away from the last inboard inch.

With the slots aligned, trim the inboard edges to the extension edges. Butt the flaps to the wing, tape the flaps to the work surface, and remove the wing.

Make the U with the collar on. The front of the wire should be at the hingeline, with the rear ends in the square tubes (placed as far forward as possible). Notch the unglued area of the strip for this, then tack the tubes to the skin and remove the U.

Place ⅛-square strips on each side, and cap with 1/32 plywood and a wedge. Fit a 2½-inch-wide beveled block to fill underneath the extension and meet the saddle.

Continued on page 55

Jouster/Michaelis

Continued from page 42

The extension top looks best if it's covered with lightweight fiberglass cloth and painted. The U is installed after the flaps have been hinged.

You may wish to add .007 carbon fiber between the skins at the flap and aileron TEs. Epoxy in place and add the foam flap core or ribs. Cut the top flap sheeting for overhang all around, and lay it down inverted over Saran Wrap. Coat the TE area and core or ribs with quick-curing epoxy. To prevent bow, hold everything flat, wick along the LE, and press until the epoxy sets.

Built-up Wingtip: The spars are hard ⅛ balsa; the dihedral braces fit between them with balsa fill. Webs are 1/16 hard balsa with vertical grain. The ¼-inch washout may be built-in or twisted in during the covering process.

Foam-Core Tip: Measure 15½ inches out and taper the core so the tip chord is five inches. make a line ⅛ inch ahead of the aileron hingeline, and make a cut there; also make cutouts for the hinges and DADs. Good sheeting yields ample strength without using spars or webs.

The ⅛ plywood dihedral braces are sandwiched between full-depth pieces of 1/32 plywood. Attachment of the dihedral braces is a no-compromise matter. You must use an adhesive that will give unpartable glue joints (quick-drying epoxies work well. CyA makes a brittle joint that parts easily). Add balsa strips to the tops and bottoms of the braces for a good fit with the core. If you do not plan to use ailerons, the dihedral should be increased to 10 degrees.

Beveled/Tapered Hingeline Strips: The front strip is ⅛; the rear is ¼. Use ½-inch-wide strips to cut the bevel (a small bandsaw and table saw make this easier). Pin the strips against a straightedge, then mark and cut the taper. Notch the top for the rubber hinges (to match the cuts in the foam).

Top Skin: Prepare to attach the top skin by applying CyA or sorghum. Plan to press in the bottom bed, but invert the top skin so the core can be positioned.

Gently press the ends to tack the skin into position, then transfer to the bottom bed. Press to join securely and to preserve the washout, then wick the top skin to the sub-LE, etc. Add the main LE and the cleats under the top skin (through the openings in the bottom skin).

Mark the main bolt location on the wing saddle. Make the H unit that secures the wing and epoxy in place. Add a block of hard wood in front of F2 for the 8-32 bolt. Bolt and align the wing, then drill a pilot hole, tap 8-32, and treat the threads with Zap. Repeat twice. Open the hole in the extension for the bolt shank; the head is recessed into the fairing.

Aileron Core Strip/Ribs: Trim ⅜ inch from the front edge of the core strip removed for the ailerons, so it will fit behind the beveled and tapered strip. For built-up structure, add the rib bits. Assemble in the same manner as the flaps.

Rubber Hinging: Some thin CyAs do not fire quickly on this rubber; pink-label Zap works well without accelerator. Use the fine Teflon tube to control its application, and practice to find out how *little* to use (and how long parts should be held in place).

Hinges are installed first in the covered/glassed fin, flaps, and ailerons. If film covering was used, make slits at the slots and seal inward. I use a tool cut from 1/16 aluminum ⅝ wide, tapered on the end. When heated on an iron and inserted, it seals the covering inward at the slots.

Continued on page 73

Jouster/Michaelis

Continued from page 55

Cut the hinges ½ inch wide and two inches long. Mark one end ¼ inch in, insert ¼ inch into the fin, flap, and aileron slots, and square up the hinges. Wick a small drop of glue on the *inside* surfaces *only*. The fin's hinges should also be glued on only one side, to allow for replacement.

The center section can be covered with a 9¼-inch-wide piece of material. Apply rearward on the bottom from a point about ⅜ inch from the hingeline, then go up ther hingeline face, around the top, and seal at the extreme LE. Leave a loose flap to overlap the bottom piece later.

Slit the covering over the slots and heat-seal inward. The loose hinge ends are bonded *last* to the cleats in the wing, before the bottom is covered.

Tape the flap or aileron to the wing, and curl the hinges to insert them. Let gravity dangle the ends under the cleats. Use a bent wire to coax out the shy ones. Invert the wing to attach the front ends of the hinges.

For the ailerons, put the CyA on the cleat. Use a waxed stick to press the slightly-stretched rubber to the top sheeting *in front of the cleat.* This causes good contact. Leave some excess hinge to pull on.

For flaps, just pull on the hinge, apply Zap, and let it go back under slight tension, and pull it upward for a good seal to the cleat.

It's not necessary for all hinges to be under tension; if overdone, it may tax the servo to reflex the TE.

Setting Up: The balance point shown on the plans gives moderate, hands-off dive recovery. I prefer to move the center of gravity rearward and retrim the stab accordingly; the model then zooms faster off the tow, cruises faster, and responds better.

For starters, set the control throws for about 3/8 inch of up and down travel at the stab front and about 3/8 and 1/8, respectively, of up and down aileron travel. You may prefer less at times, and you can use dual rate, etc., set at low rate to avoid overcontrolling the model.

Try one inch of rudder deflection each way if rudder control is mixed with ailerons, but use maximum deflection on the separate rudder channel. Adjust the horn bracket on the stud and the clevis location on the flap output arm to get about 90° down travel.

If your radio has mixing capability, couple the rudder and ailerons, mix in down-elevator compensation with flaps, and use camber, trailing edge reflex, and the crow landing option.

For simple radios, use a Y harness to run both aileron servos. A third lead can be wired in to operate the rudder on that channel. Use the throttle channel for flaps, reserving the trim tab to reflex the trailing edge for speed. Manually input elevator compensation with flaps for speed control.

I have my Vision in Mode 2 and use the both the Standard and Alternate setups. On Standard, the throws are set for best handling while cruising.

Rather than using preset flaps during launch in Standard, I manipulate the flaps with my thumb on the left-stick cylinder and grip the transmitter that way. I use none of the options that preclude this independent flap manipulation.

Trailing edge reflex and camber are on the Flight Mode switch, assigned to the left side. I don't use a preset on launch; I prefer to manipulate the flaps as required. If the flaps are reflexed near the top of the launch, zoom speed can be increased for a big chunk of extra altitude.

On Alternate, I have up aileron programmed with down flap for crow to affect the sink rate. If the flaps are fully down, switch the ailerons to the selected maximum *up* throw. Manipulation of the stick gives proportional crow for good sink rate control on final. Different elevator compensation is required, and more throw is used on all controls.

The versatile Ace MicroPro (with updated software) can be programmed to raise the ailerons at a selectable threshold point as the flaps are dropped. This preserves independent flap operation for launch and cruise but makes crow available, if needed, on that same stick.

The fact that the model has flaps doesn't mean that you always *have* to drop them. Doing so just before touchdown is usually fruitless—the plane needs a bit of time to slow down, and the flight path usually needs correction. Neutralizing lowered flaps just before touchdown will pancake the model and help it stay put.

When I fly an aileron-controlled model, I find it useful to apply ailerons, neutralize, pause, and then repeat the cycle. This prevents "winding in" from continuously-deflected ailerons.

I also find it useful to apply some opposite rudder to flatten the turn. When making left turns, I simply nudge the side of the stick with the tip of my thumb while gripping the transmitter with the lower part of the thumb. The J2M can be gently turned on rudder for flat thermal turns.

Because of its low fuselage profile, the Jouster 2M flies "nose hangy-down." Resist the impulse to straighten the model out to level flight. Let the model bore in and get up to speed; it will likely fly faster than you expect. To slow the airplane down, drop the flaps a bit or camber the trailing edge.

In more than 22 years of continuous experimentation with RC sailplane design, this is the only Two-Meter competition model I liked enough to offer for publication. The J2M and its big brother, Jouster (July 1993 *MA*) have many innovations, fly superbly and should please most anyone who can do a respectable job of building and trimming. I hope you enjoy this smaller, highly maneuverable version of the Jouster as much as I have. ✈