4-60

A SEQUEL to a highly-successful previous effort can often be a disaster—witness some of the really grim sequels we have all seen in movie theaters and in front of our TVs. Frequently the *Goodmovie* is followed by *Goodmovie II, III, IV,* etc. All are progressively worse. It seems that the creators have used all of their originality, skill, and inspiration on the first effort, and they have nothing left for the sequels.

By some smile of good fortune, fortunately *this* sequel is even more outstanding than the original version. The 4-60 retains all the virtues of the 4-40 (December 1984 *MA*) and adds easier construction, higher strength, smoother aerobatics, and markedly-improved visibility. The excellent ground-handling and takeoff/landing qualities are retained in the larger version. More importantly, the 4-60 handles much better in moderate to high wind than the smaller 4-40. We have consistently been able to fly the various 4-60 prototypes in winds that have grounded more conventional designs.

Previous experience in enlarging Old-Timers has taught us that a simple scaling up can markedly alter the model's flying qualities. Therefore, the 4-60 has some variences from the 4-40 developed by fine-tuning a series of prototypes. The resulting 4-60 presented here possesses delightful flying characteristics, simple construction, and appealing lines.

For reasons that still aren't clear to me, the 4-60's flight envelope

Some say they see a Goodyear racer in this design. Others are reminded of home-built aircraft. Still others think of contemporary aerobatic full-size designs or even something from WW I. Whatever, the 4-60 certainly is more attractive than the ordinary "Stick" designs, but it is just about as easily built as one of them.

This airplane offers a performance envelope that can encompass flying from the ease of a trainer to that of an advanced aerobatic ship. No wonder its forte is sport flying. For four-channel controls and a .60 four-stroke engine.

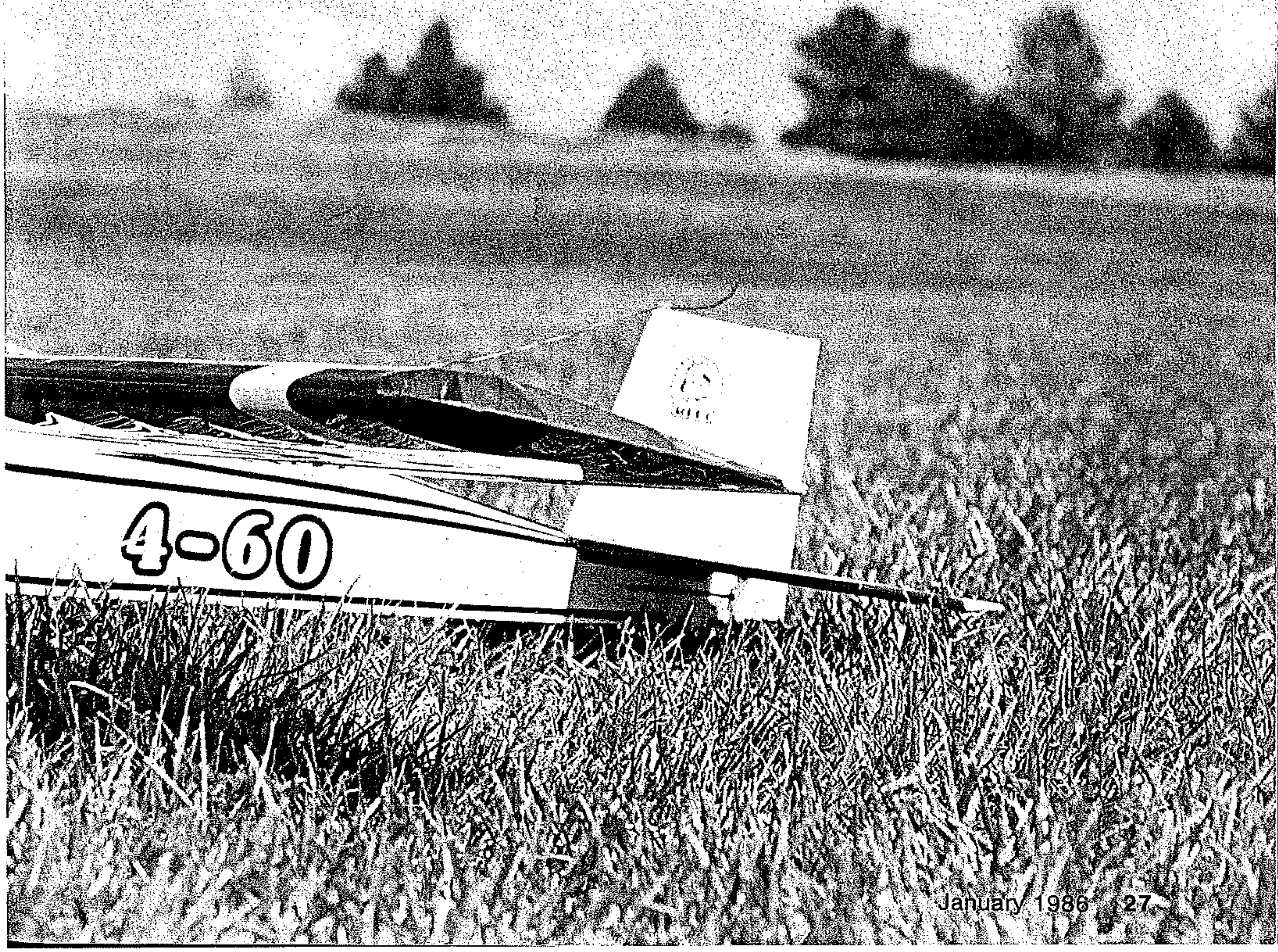
■ **Dr. D.B. Mathews**

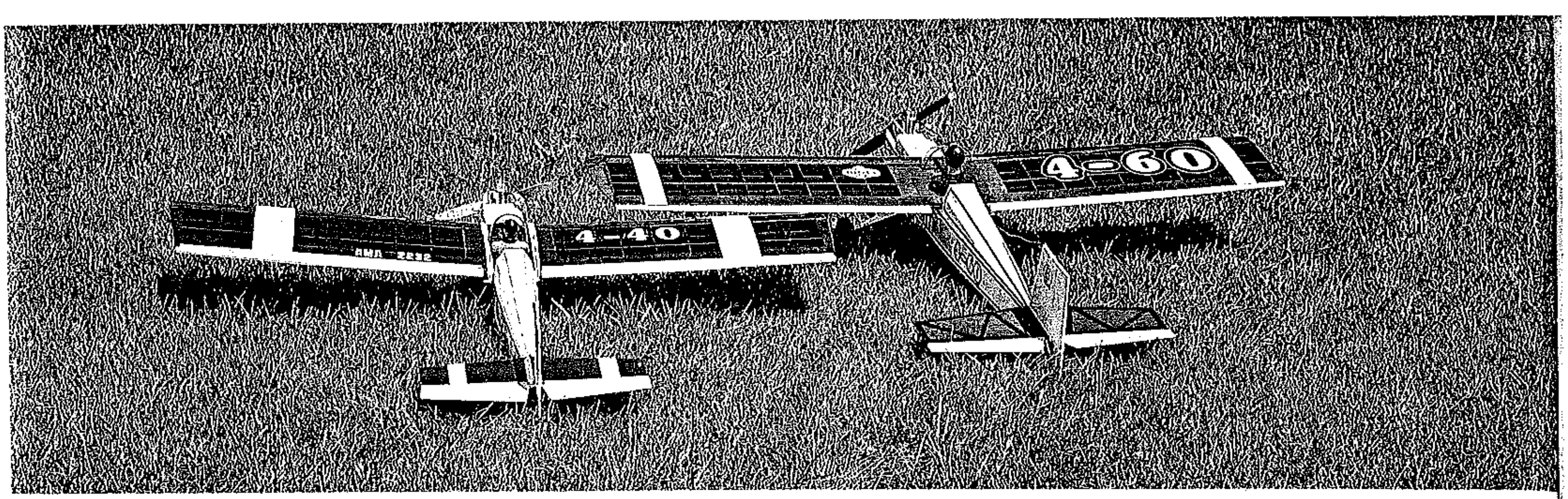
seems to be broad enough to allow docile trainer-like flying with a forward center of gravity (CG) and narrow control surface deflections; it becomes nicely aerobatic when the CG is moved rearward and the throws are increased. I will resist the temptation to say this results from brilliant designing skill; actually, I know that it was a fortuitous combination of aerodynamic features.

Several Master-class Pattern pilots who have flown the prototypes have expressed great delight in the 4-60's agility and smooth-handling characteristics. On the other end of the scale, we have encouraged several pure novices to fly the prototypes directly after flying their flat-bottom-airfoiled trainers. They are astounded to find that the 4-60 is actually easier to land and take off than their trike-geared trainers.

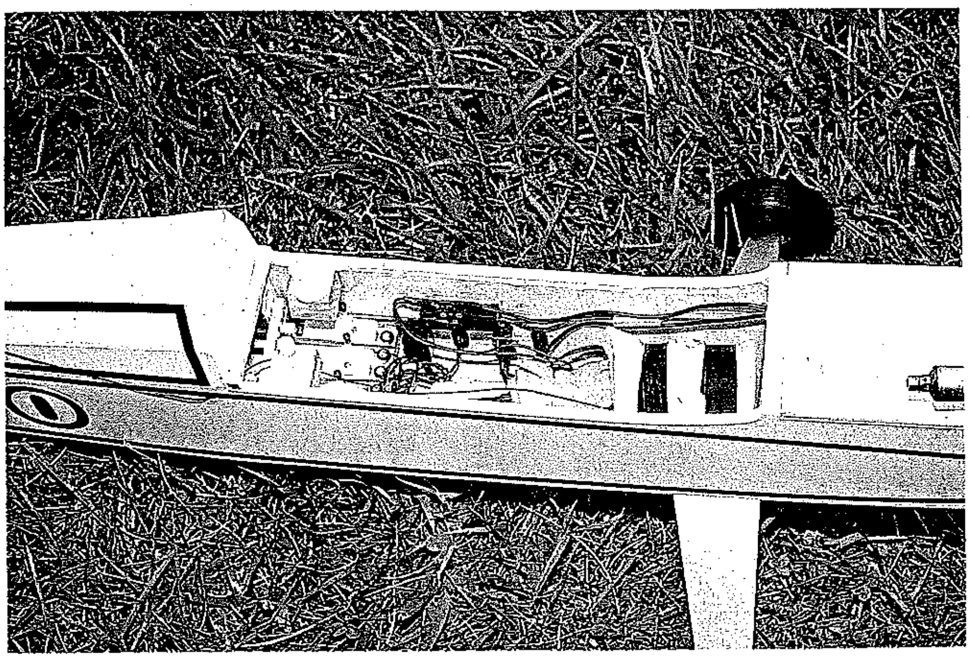
The model flies on its lifting surfaces (as an airplane should). It is not an overpowered projectile that uses brute power for flight. As a consequence, the maneuvers are slow and stately as opposed to abrupt and violent. We feel some special magic happens with slow-flying, quiet models performing beautiful concentric large loops and slow rolls. The great success of the original 4-40 design seems to indicate that many other builders-fliers also prefer that sort of flying.

This design is especially recommended to those who have grafted .60 four-cycle engines onto conventional two-cycle-engine designs and have been disappointed. It should also appeal to those living in windy areas, to those seeking a model no more difficult to build than a Stik type but with more eye appeal, and to those who have a tight building budget.

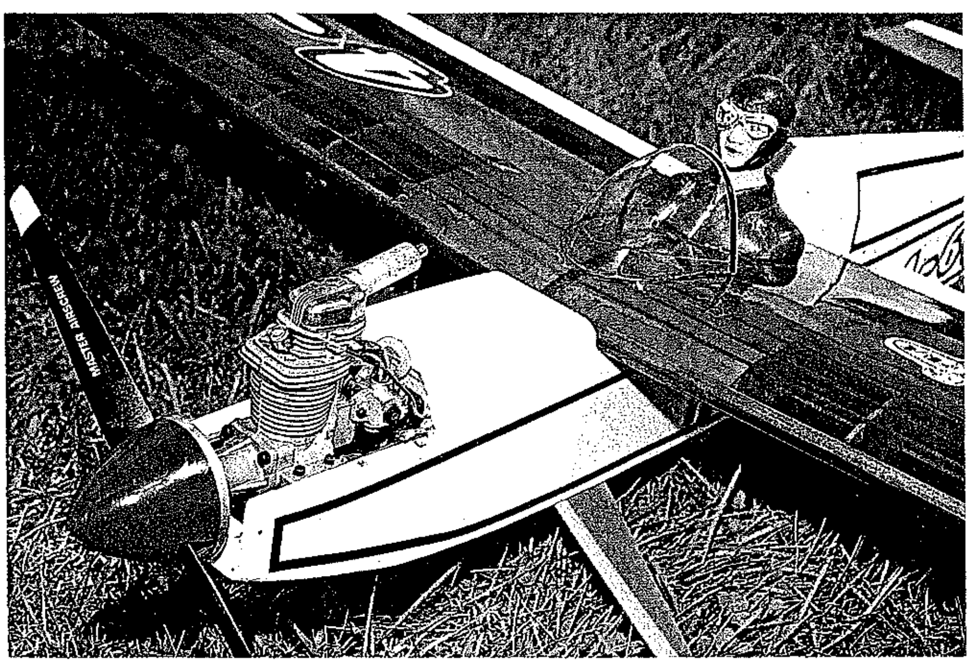




Side-by-side comparison shows the 4-60 is not just simply scaled up from the smaller 4-40. Both are specifically matched to their respective four-cycle power plants (but they also perform excellently with two-cycle engines), providing a wide range of usable engine sizes/types.



With wing removed, there is excellent access to components. The on-board Ace Nilite III makes engine performance totally reliable while adding an insignificant amount of weight.



A D.G.A. pilot figure looks out over the Enya .60 four-stroke engine, C.B. spinner, and 14-6 Master Airscrew. Notice the Head Lock on the glow plug. Simple wind screen adds to looks.

Construction. The 4-60 may look a bit flimsy at first glance, but one must realize that spruce is 10 times stronger than equivalent-sized balsa (while costing less). Lite Ply (poplar) weighs about the same as 3/16 balsa but has the strength of 3/8 balsa, and the Lite Ply can be cut smoothly with a knife or saw. The cost for spruce and Lite Ply is much lower than balsa of equal strength. This allows a large model like the 4-60 to be built for little more than the cost of building a conventional smaller airplane. Spruce and Lite Ply are available at many local hobby shops, or it can be ordered from several *MA* advertisers. *Do not substitute the spruce in this design with balsa, regardless of its density or size.*

Hardware items are standard and may be stocked by your hobby dealer (or he can order them). Substitutions are also possible if the builder wishes.

Read the text and study the plans until everything is clear. Then cut out a "kit" of parts by transferring the shapes from the drawings to the appropriate wood with the aid of carbon paper. All holes should be drilled at the time the part is shaped.

A simple jigsaw (such as Dremel, etc.) is helpful in building this model, though not required. Cutouts can be made easily by drilling 1/4-in. holes into the ply, then threading the saw blade into the hole. Tabs and slots can easily be cut with a sharp modeling knife.

This model is very easy to construct and keep in alignment. Use a smooth, *flat* building surface, and follow sound principles of craftsmanship to assure good flight performance. The prototypes were constructed almost entirely with cyanoacrylate (CyA) adhesives, the exceptions being the firewall and wing joints. *Covering this model with anything other than MonoKote or silk is not recommended.*

Fuselage. The sides can either be cut from 48-in. stock or cut from spliced 36-in. stock (as I did). The splice joint is plenty strong, being well supported by the internal doubler.

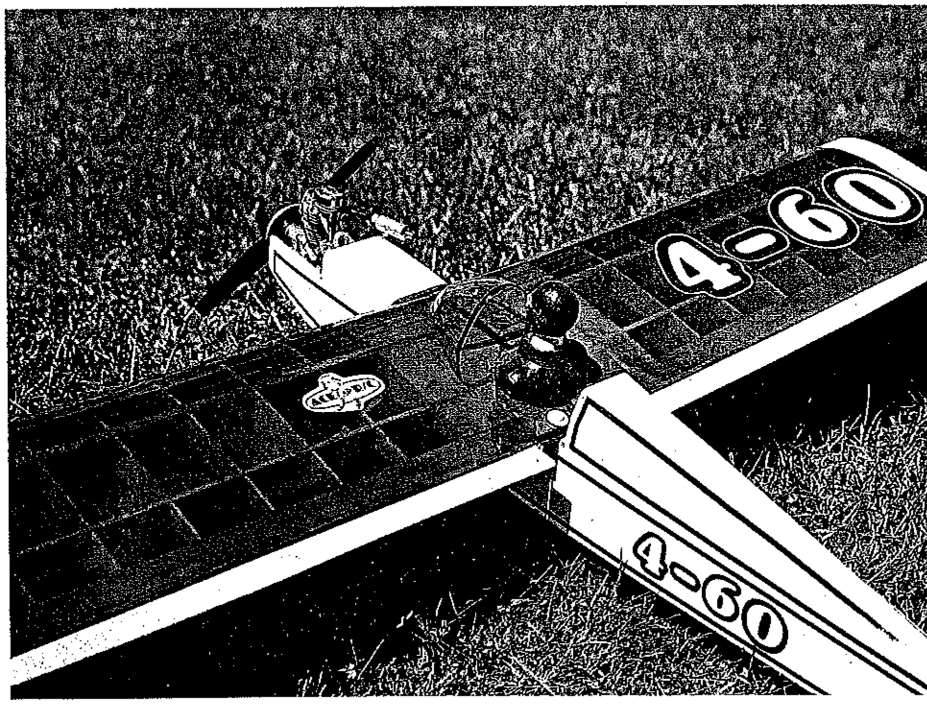
Make a right side by tracing over carbon paper onto Lite Ply. Mark the bulkhead and slot locations at this time. Cut it out, and then use it as a pattern for the left side and both doublers. Note that the ply called ⅛ in. is actually 3mm (slightly less than ⅛ in.); the slots should be a tight fit for the Lite Ply.

Similarly trace and develop the other parts, then try the fit of everything before final assembly. Cement the doublers, firewall reinforcing, and landing gear blocks to the fuselage sides with epoxy.

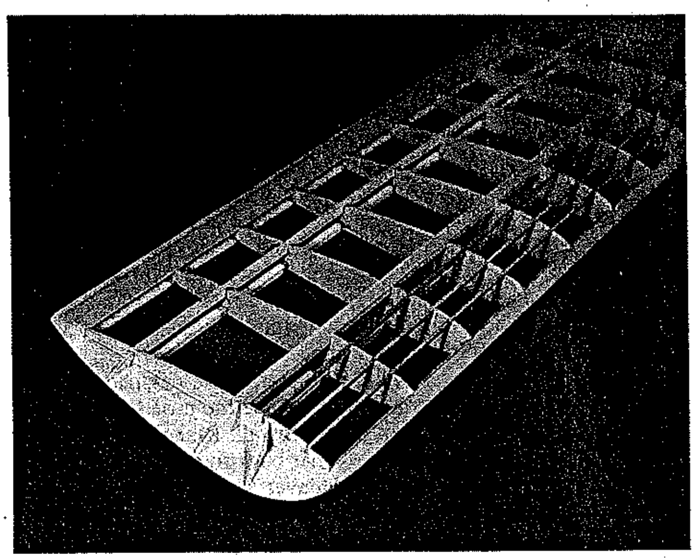
Drill ¼-in. holes in the F-2 assembly. Without gluing, fit the fuselage sides, F-2, F-3, and the middle bottom unit together, noting that the tabs in the floor fit into the slots in the sides. The middle bottom holds the unit squarely. When satisfied, flow thin CyA into all the joints, then follow with a bead of thick CyA for extra strength.

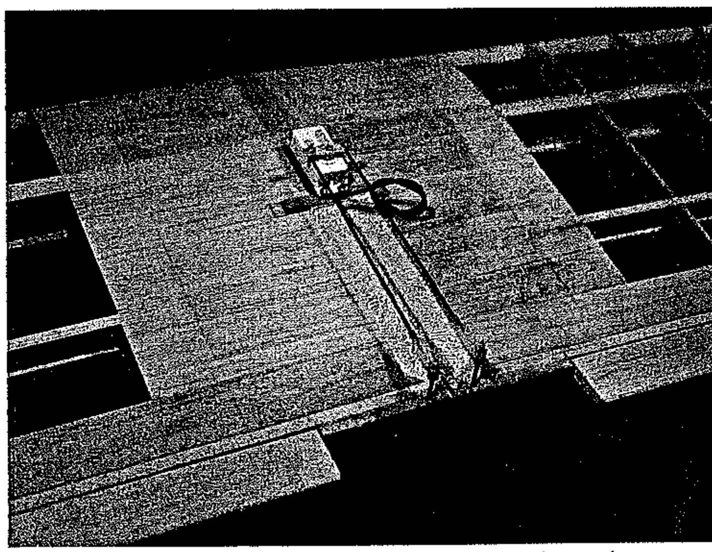
Fit the rear bottom section, and adjust it as needed. Clamp the tail post together with clothespins or the like. Keep the edges aligned and make sure the fuselage is square, then repeat the gluing sequence with CyA. Add the turtle deck formers, tail wheel mount, and spruce stringers.

Drill the firewall for the engine mount, fuel lines, and throttle wire. Place the thrust line according to the drawings. Epoxy the firewall onto the sides and also the tri-

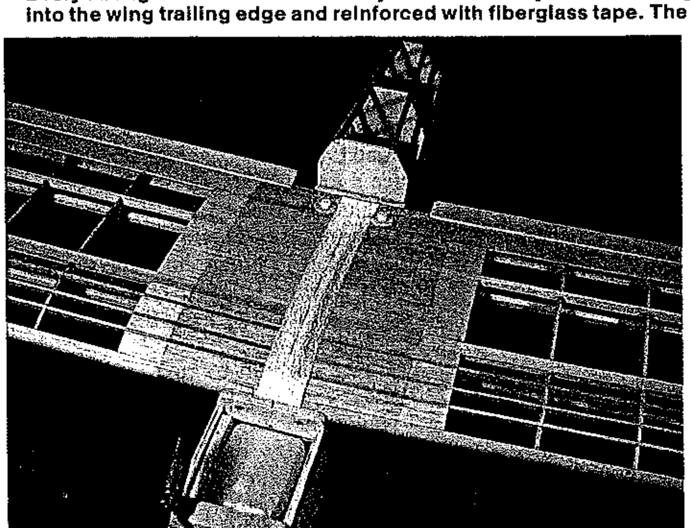


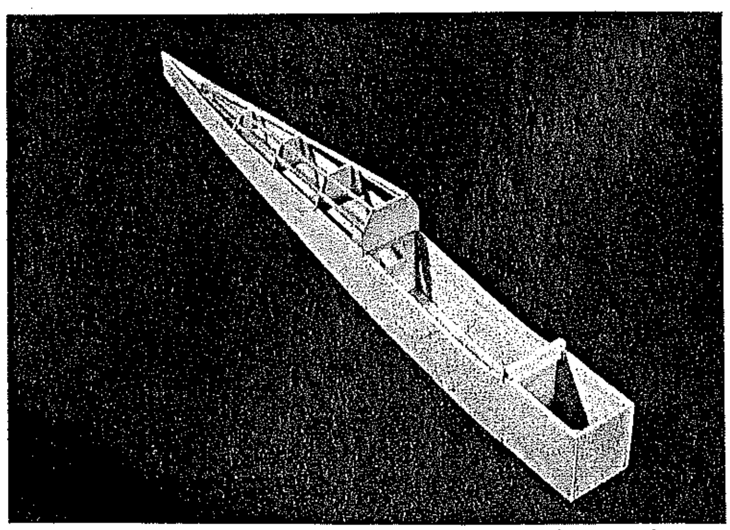
Something about the 4-60 seems to be whispering, "Fire me up, and let's go flying." Many who have flown it say it makes the best takeoffs and landings of any airplane they've flown.



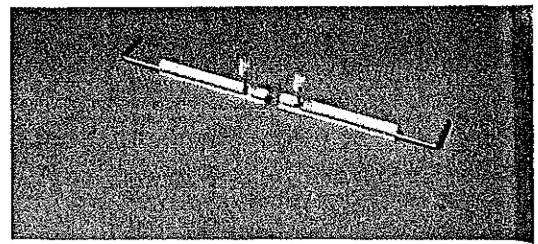


Left: Wing construction reveals Doc's Free Flight and RC Old-Timer background. Combination of spruce spars and shear webs produces a very strong structure with economy that is also easy to build and lightweight. Right: Aileron horns and their basswood blocks are blended into the wing trailing edge and reinforced with fiberglass tape. The servo is mounted in a cutout at wing center on simple hardwood rails.

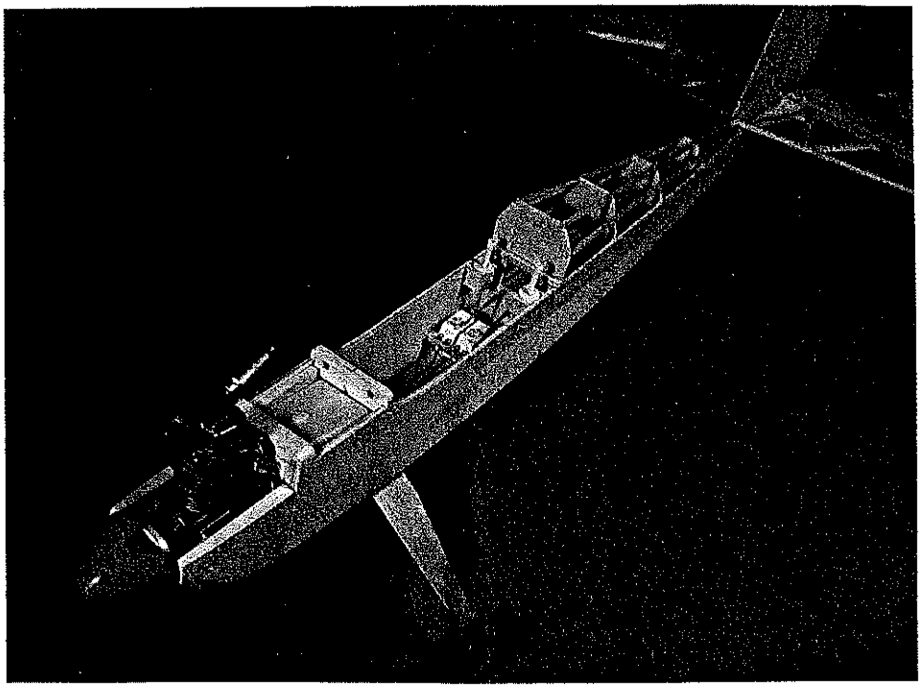




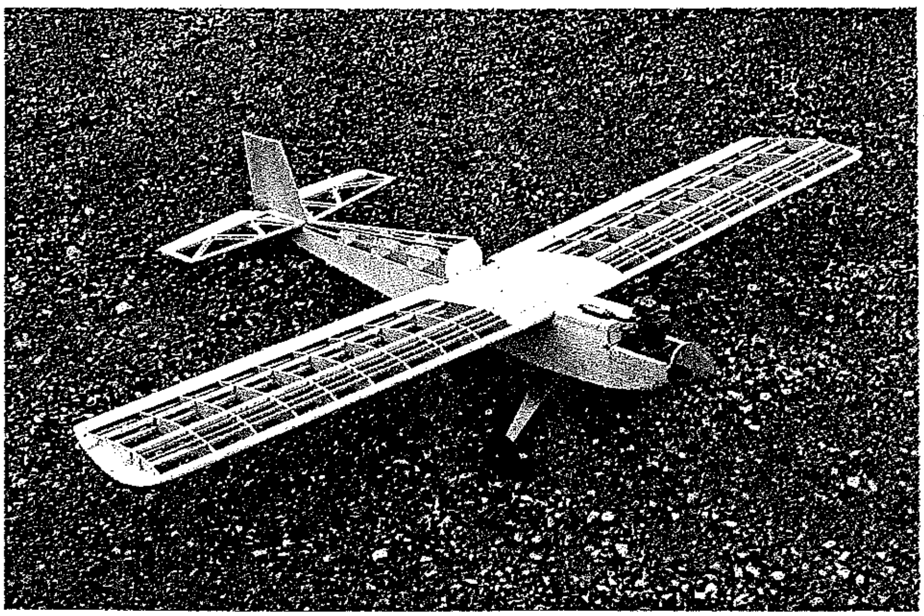
Left: Drilling for and installation of the front wing hold-down dowels can be done with the wing bolted onto the fuselage. Tank compartment has a removable hatch. Right: A simple Lite Ply box with turtleback formers/stringers combine to make a sturdy, attractive fuselage.



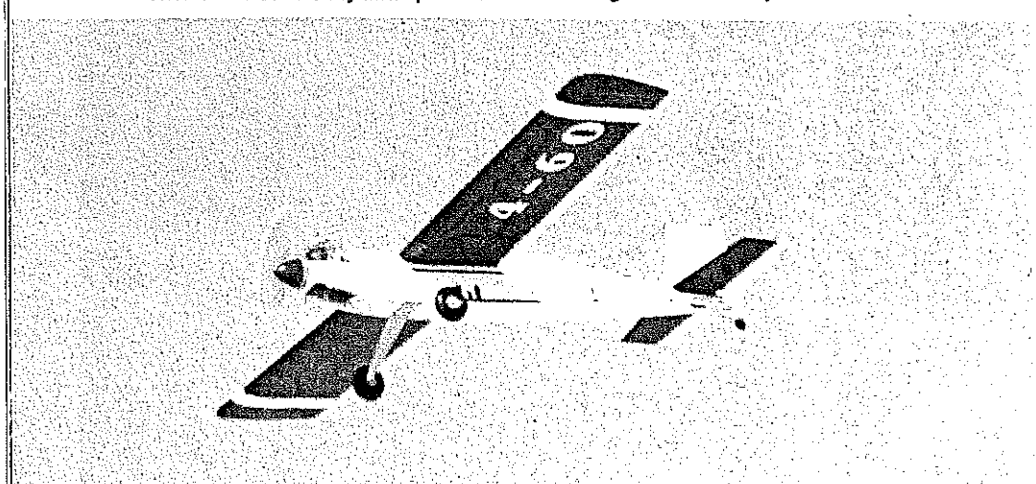
Aileron torque tubes are mounted in grooved bass trunnion blocks, then glued to the wing trailing edge with CyA. Simple and strong.



This view shows the wing mounting system (front dowel holes, rear nylon bolts) and the simple balsa-block cowl (faired to the spinner shape, though it could be left squarish).



At first glance the framework (with lack of extensive sheeting) may appear weak, but extensive use of Lite Ply and spruce make it stronger than most open-framework structures.



Framed against its natural element, the sky, the 4-60 demonstrates its strongest virtue: superb flying characteristics. Beginner and expert alike praise its broad flight envelope.

angular stock; use masking tape to hold it in alignment while the epoxy sets.

Install the fuselage front bottom section and the ¼ ply landing gear mount. Tack-glue the block for the removable hatch onto the top, then cut the front segment with a razor saw. The prototype model uses two sections of hardwood at the front and a Goldberg Angle Hold-Down fitting to keep the hatch in place; however, any of the popular hold-downs should do the job.

This is a good time to set up the fuel tank and its plumbing. A Sullivan SS-10 works well; just be sure to place it all the way to the top of the compartment. Coat the tank area with a fuel-proofer (we like to use warmed 30-min.-cure epoxy for this). The tank should be set in a foam-rubber cocoon on top of the battery pack.

Conventional cable can be used for the throttle linkage, though there isn't much room between the engine mount and throttle arm on most four-stroke engines, making such a linkage difficult. A simple length of .047 music wire with a right-angle bend running into the arm makes a great substitute for the cable. The inner (yellow) Goldenrod should run straight from the throttle arm to the servo in this setup. A threaded coupler and clevis should be used on the servo end.

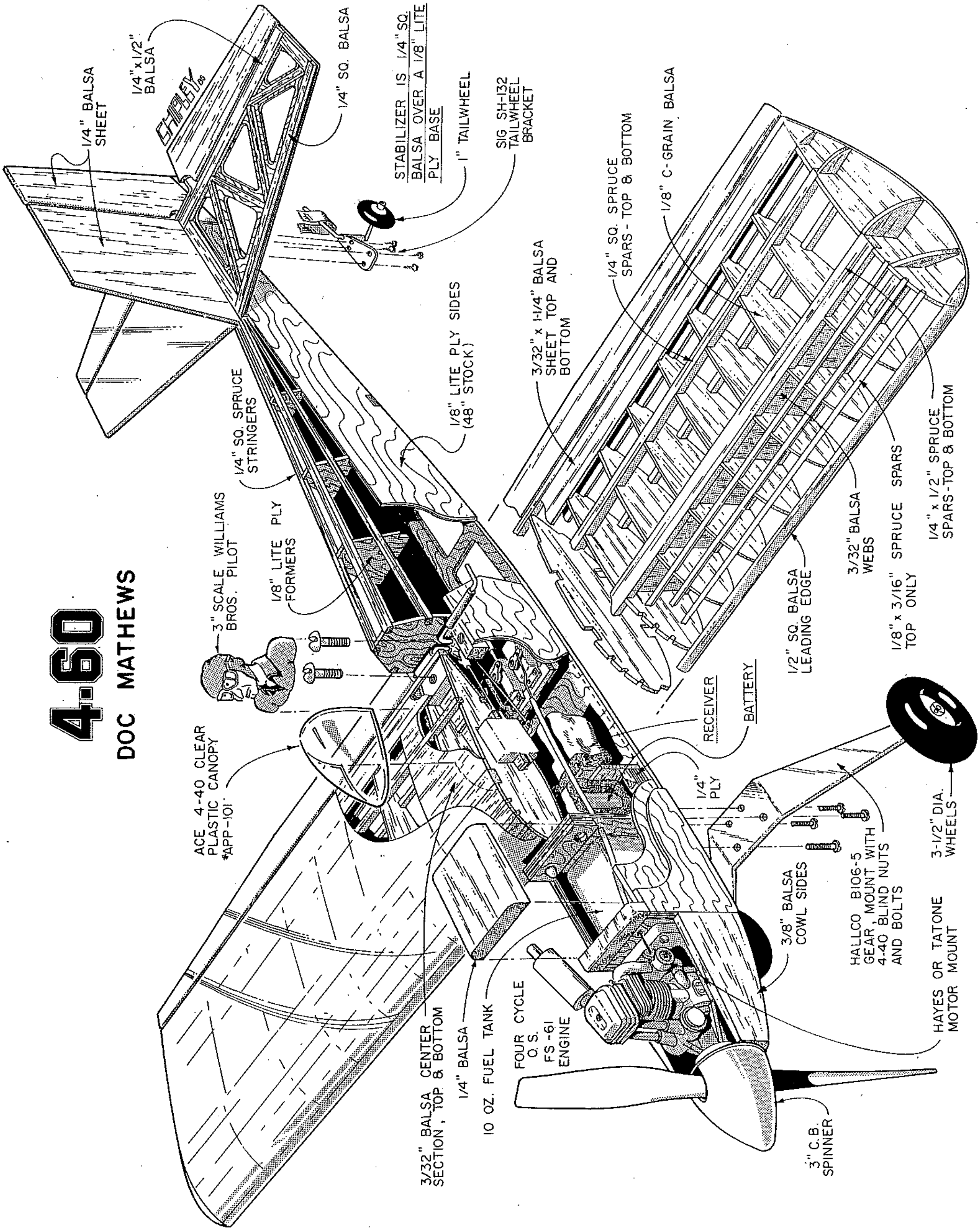
Temporarily install the engine and engine mount, then glue the nose blocks with CyA onto the firewall. Make sure they all clear the spinner backplate, then carve the blocks to whatever shape appeals to you. Set the fuselage aside, and work on the other units.

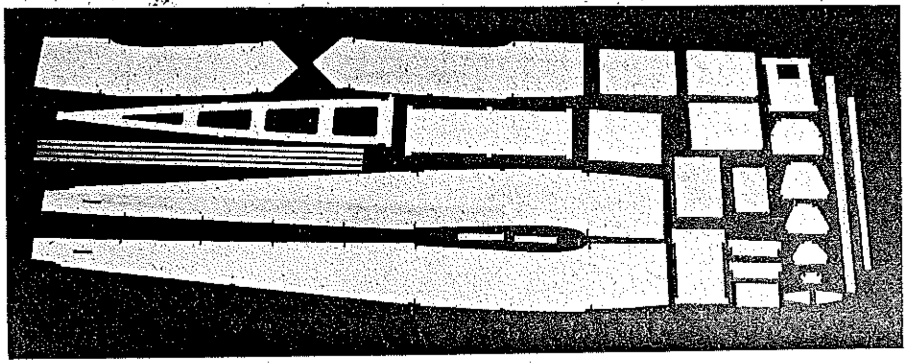
Tail surfaces. The elevator construction is rather unusual, but it is a very strong unit and weighs only an ounce or so more than a ⅜-in. balsa stab. The ply will almost certainly be warped a bit after the cutouts are made, but pinning it flat on the building board and CyA-gluing the frame over it will produce a totally warp-free unit.

The hinges are slotted entirely in balsa, and I have never had them pull loose. If the builder just can't bring himself to use this stab construction technique, he should by all means cut it out of balsa if the expense isn't a bother.

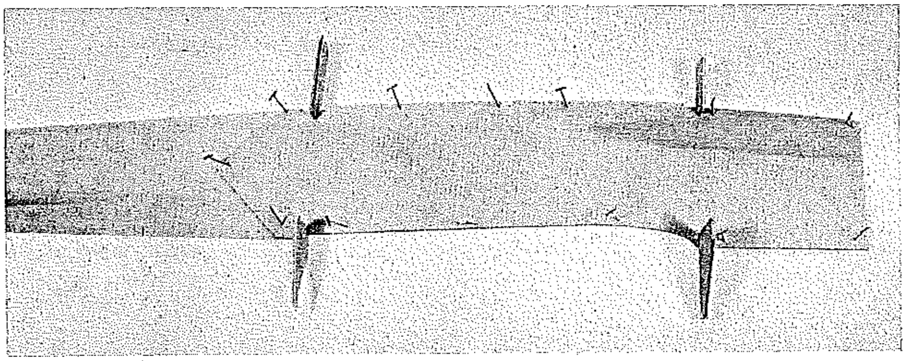
Form the elevators by beveling the fronts and either rounding the backs or sanding the whole thing to an airfoil shape (we haven't been able to detect any difference in flying characteristics either way). Notch and drill for the ⅛-in music wire joiner, making sure the elevator ends match the ends of the stab.

The rudder/fin are totally straightfor-

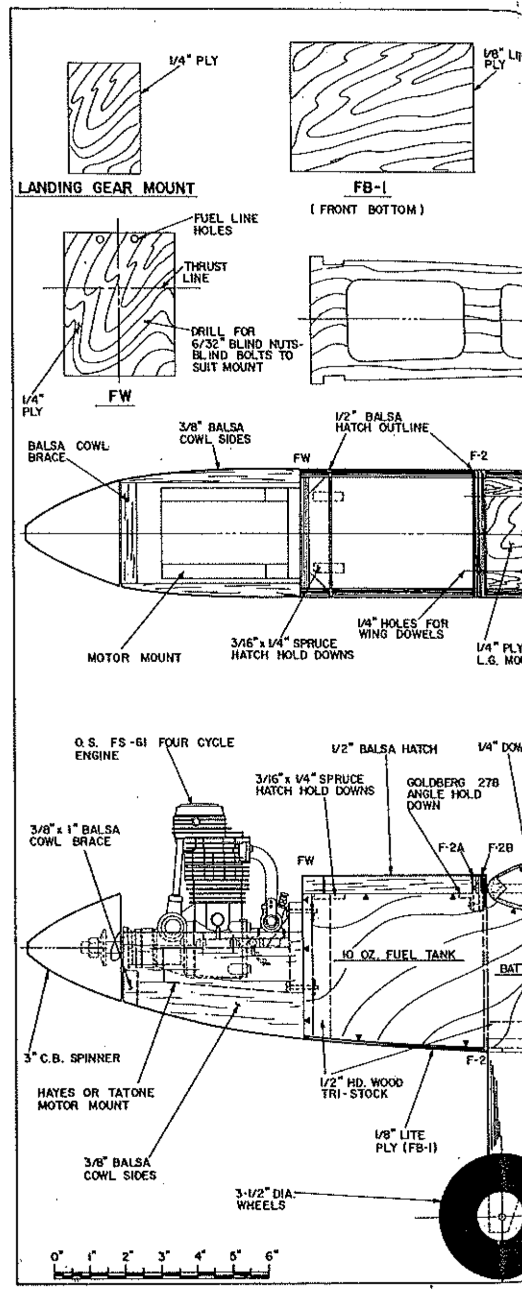

4-60
DOC MATHEWS
1/4" BALSA SHEET
1/4"x1/2" BALSA
1/4" SQ. BALSA
STABILIZER IS 1/4" SQ. BALSA OVER A 1/8" LITE PLY BASE
1" TAILWHEEL
SIG SH-132 TAILWHEEL BRACKET
1/4" SQ. SPRUCE SPARS - TOP & BOTTOM
1/8" C-GRAIN BALSA
3/32" x 1-1/4" BALSA SHEET TOP AND BOTTOM
1/8" LITE PLY SIDES (48" STOCK)
1/4" SQ. SPRUCE STRINGERS
1/8" LITE PLY FORMERS
3" SCALE WILLIAMS BROS. PILOT
ACE 4-40 CLEAR PLASTIC CANOPY #APP-101
RECEIVER
BATTERY
1/4" PLY
1/2" SQ. BALSA LEADING EDGE
3/32" BALSA WEBS
1/8" x 3/16" TOP ONLY
SPRUCE SPARS
1/4" x 1/2" SPRUCE SPARS-TOP & BOTTOM
3-1/2" DIA. WHEELS
HALLCO B106-5 GEAR, MOUNT WITH 4-40 BLIND NUTS AND BOLTS
3/8" BALSA COWL SIDES
HAYES OR TATONE MOTOR MOUNT
3/32" BALSA CENTER SECTION, TOP & BOTTOM
1/4" BALSA
10 OZ. FUEL TANK
FOUR CYCLE O.S. FS-61 ENGINE
3" C.B. SPINNER



All the fuselage components. Notice extensive use of slots and tabs to simplify assembly and assure good alignment. A good practice is to begin by cutting a complete "kit" of parts.



Internal plywood doubler being epoxied to a fuselage side. Small scraps of Lite Ply are placed into the notches for alignment purposes and removed before the epoxy cures.



ward. Slot the vertical and horizontal tail surfaces for hinges, but don't install the hinges permanently until after the covering has been applied.

Wing. Stack-cut the ribs using a master plywood template as a guide. Notice that two wing rib patterns are required. Carefully cut the spar notches, as the spars must fit them snugly for thick CyA to work properly. The wing panels are mirror images of one another, and they are built flat from the front spar and rearward.

Construction is from the bottom up. Pin the sheet trailing edge and the rear center section sheeting flat on the work surface. Position the bottom spars and then the ribs (using the shear webs for squareness). Add the top trailing edge sheet and spars, followed by the leading edge and nose stringers.

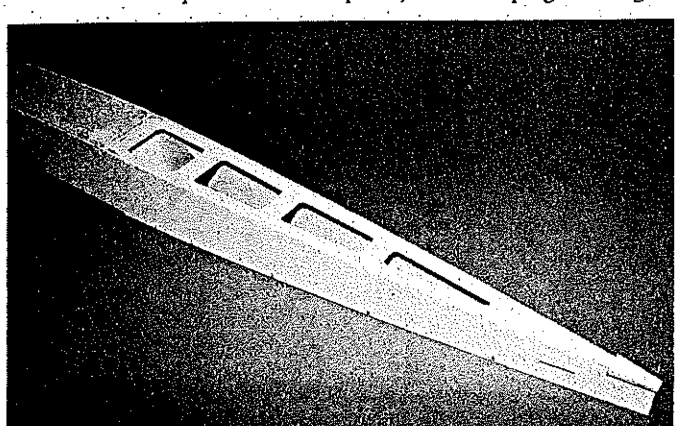
Remove the panel from the plans, and add the center section sheeting and trailing edge cap strip.

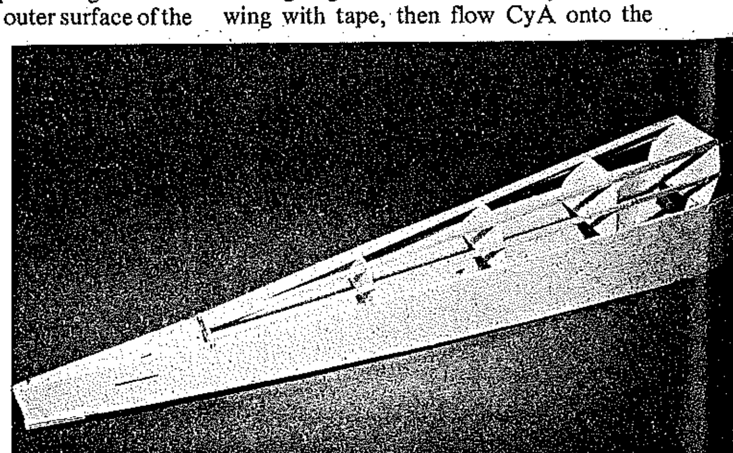
Build the opposite panel in the same way, making sure the center ribs have been angled (with the jig) for the dihedral.

Block up the tip of each panel 1½ in., and sand in the bevel against a flat work table edge. Test the fit, and make sure the total dihedral is 3 in.

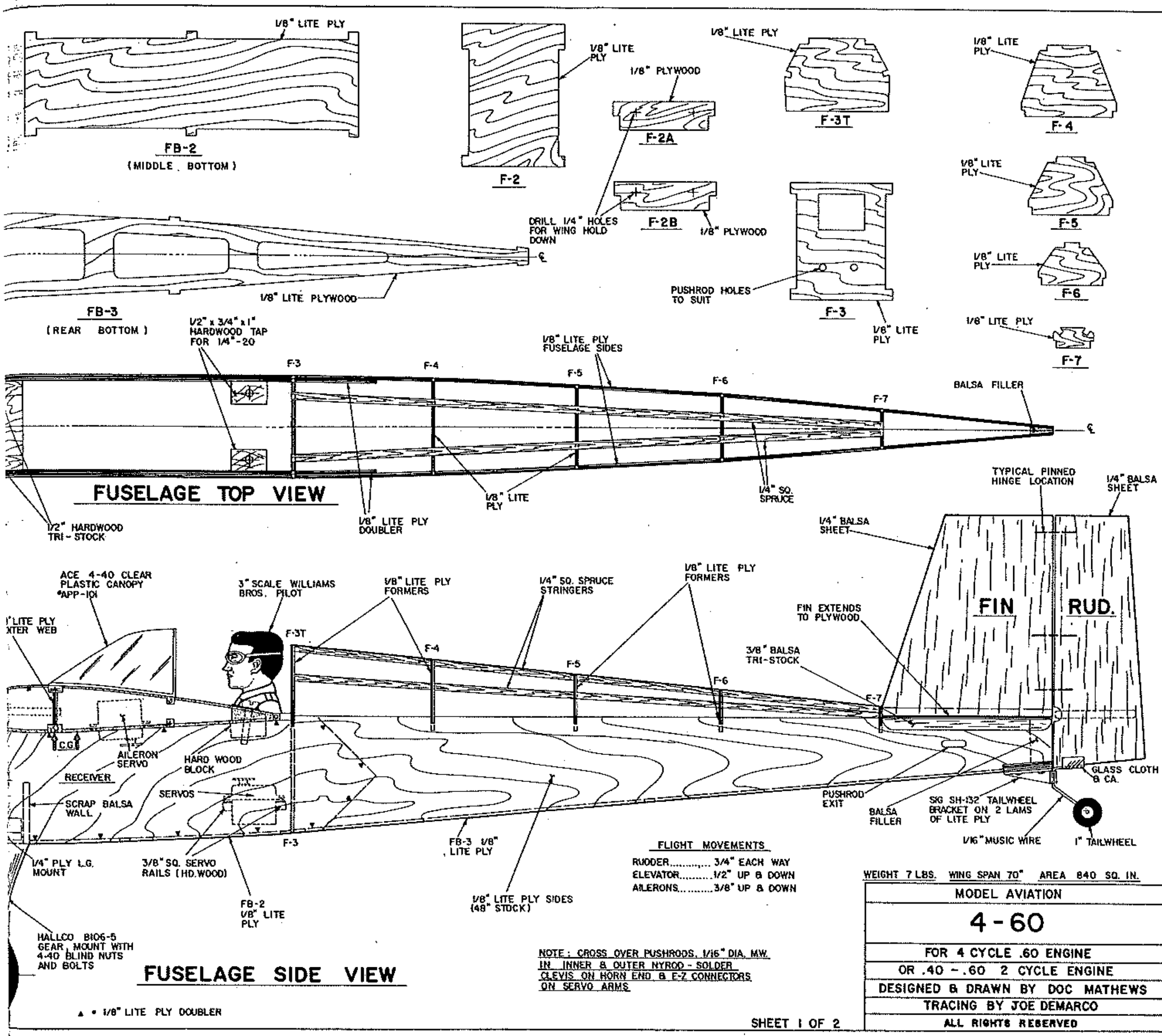
Using pre-notched bass trunion blocks, make a left and a right aileron torque rod assembly. Make sure the nylon tube is on the wire before bending it! Grinding a point on the aileron end of the wire will make it easier to set up later. Thread the nylon fitting all the way down on the rod, and cut off most of the excess with a side cutter or a grinder cutoff wheel. This allows internal clearance—very important! Apply some Vaseline to the rod where it runs through the tubing; this will prevent glue from seeping in. Roughen the outer surface of the tube with coarse sandpaper.

Notch the slotted hardwood block to clear the torque rod; also repeat on the wing trailing edge. Hold the assembly onto the wing with tape, then flow CyA onto the





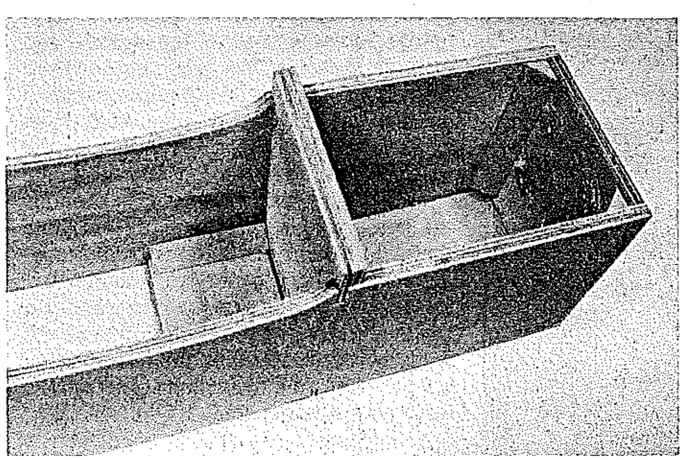
Left: Fuselage bottom rear is formed with a Lite Ply section that features tongue-and-slot alignment, making it practically impossible to build in a twist. Tail wheel mounting block is oversized to provide a solid surface for affixing the bracket. Right: Four Lite Ply formers and some stringers convert a plain-Jane box into an appealing turtleback fuselage. Also note the location of control rod exit holes.

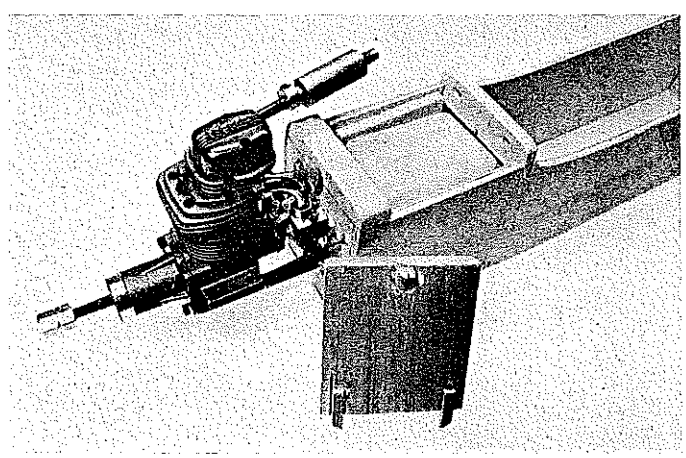


joint. Carve the excess basswood to blend into the trailing edge.

Pin one panel flat on the building board, then epoxy the other panel to it with a 3-in. block under its tip. Make sure both panels are flat and even. Complete the wing by applying the center section tape/epoxy (or thin CyA) and making the servo well cutout.

The ailerons are beveled at the hinge joint and rounded at the trailing edge. Flutter problems were encountered with





Left: This view of the fuselage box illustrates the triangular hardwood used to reinforce the firewall and landing gear mount. Two layers of Lite Ply epoxied together produce a super strong front end. Right: Removable hatch details. Hardwood pegs anchor the front of the hatch, and a Goldberg latch secures the rear. Photo shows a Tatone engine mount in use, but other varieties should also work okay.

tapered ailerons, so *do not carve/sand them to airfoil shape.* The hinge gap should be kept to a minimum, or even taped shut, for best aileron control response.

Lite Ply wing tips with scrap fillers were used for the sake of economy. They work well, have good strength, and are quite simple to construct. Use ⅜ balsa instead, if you must.

Wing mounting. Early prototypes of the 4-60 were flown with rubberbands and dowels holding on the wing. However, since some fliers think rubberbands are messy, we show a bolt-on wing.

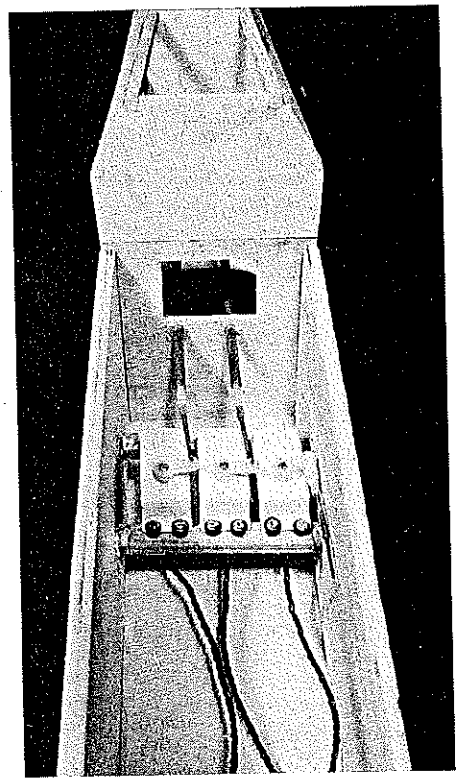
Mark a centerline on top of Former F2, then measure out 1¹³⁄₁₆ in. from the rear center of the wing and make a mark on both sides on the top (this marks where the outer edge of the fuselage should sit). Place the wing in the fuselage saddle flush with F2 centered on the mark. Check the rear marks for alignment. When properly positioned, hold the wing tightly and drill ¼-in. holes into the leading edge through the pilot holes in F2. Remove the wing, and complete the drilling all the way into the ply shear webs. A 6-in. drill makes alignment and drilling much easier, but a shorter bit can be used if barely inserted in the chuck.

Round one end of the ¼-in. dowel, and sharpen the other in a pencil sharpener. Push the sharpened end into the holes in the leading edge, inserting it all the way to the ply web (leaving about ⅜ in. sticking out). Check the fit on the fuselage; if necessary, file out the hole in the leading edge for proper seating.

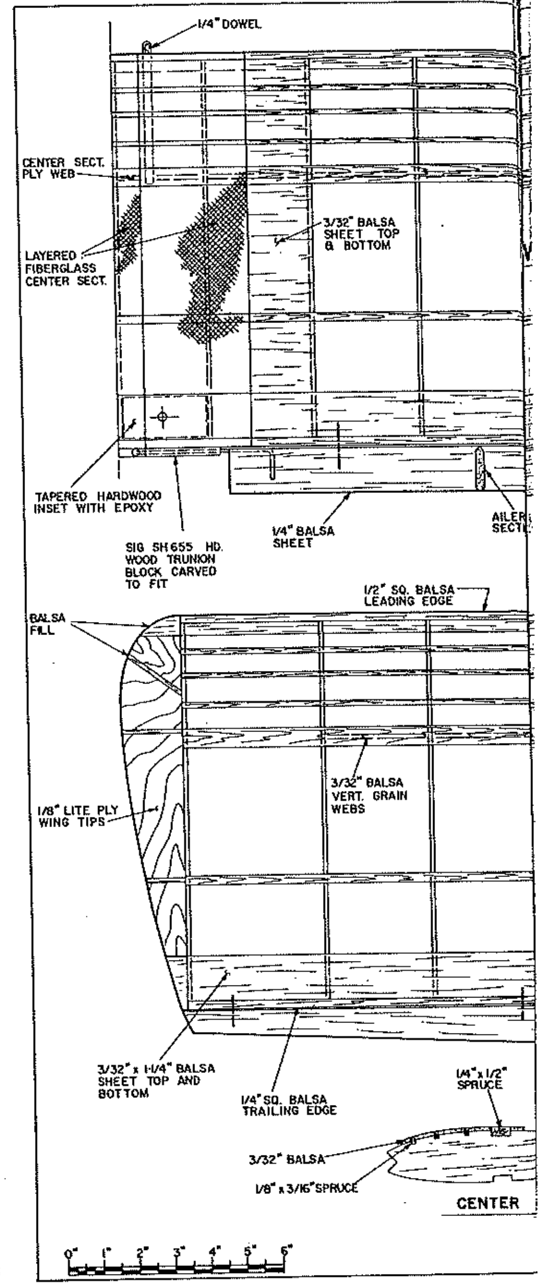
Remove the wing and dowels. Apply some Vaseline to the holes in F2, then apply 5-min. epoxy to the dowels and reinsert them in the wing holes. Hold everything steady while the epoxy sets.

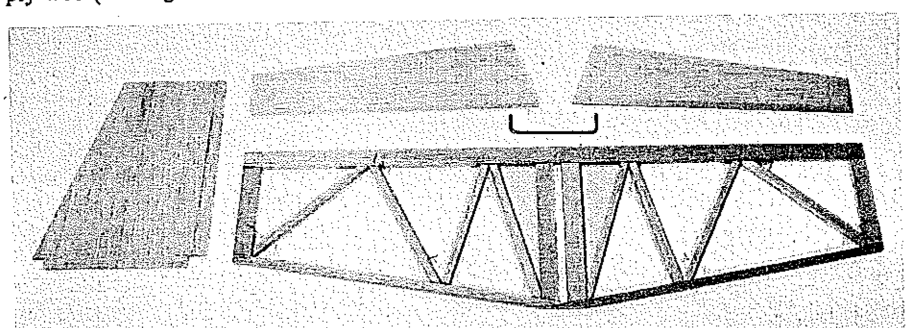
Glue the hardwood wing hold-down blocks with 5-min. epoxy securely to the fuselage side with the top flush with the wing saddle. Mark the proper location for the holes on the wing. Drill a ³⁄₁₆-in. hole through the wing and into the block, keeping the drill perpendicular with the top surface of the wing. Remove the wing, and tap the blocks for ¼-20 bolts. Enlarge the wing holes to a ¼-in. dia. Use nylon washers with your nylon bolts to spread the force over a larger area.

Last things. The fuselage and tail surfaces can be covered and/or painted any way the builder prefers, but the wing is designed for

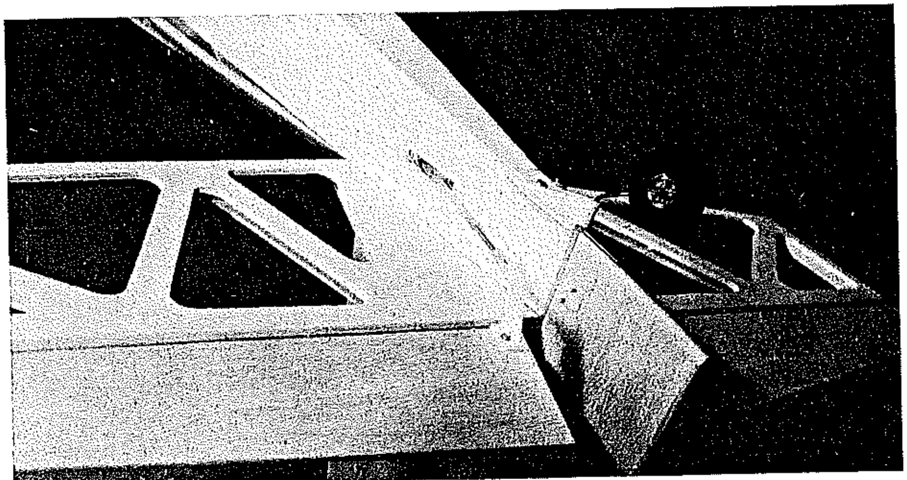


Plenty of room for the servos. Regular inner and outer Goldenrod was used in this instance; see the text for an interesting alternative. Drill holes in the bulkhead to suit your setup, and provide the necessary anti-flex bracing. Servo mounting rails are Hot-Stuffed directly to the inner Lite Ply doubler.



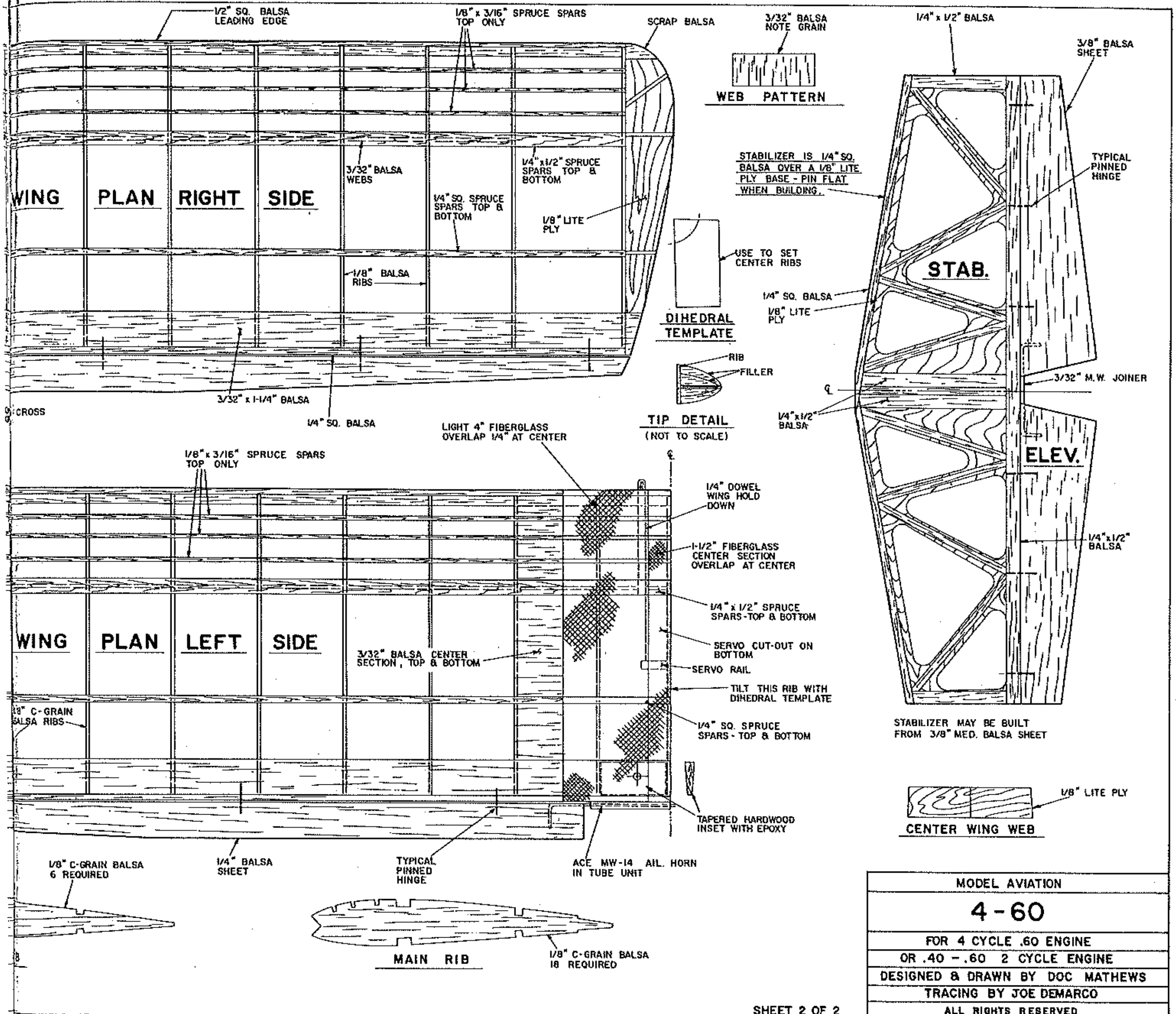


Tail surfaces have a totally conventional fin, rudder, and elevator; but the stabilizer is really unique. The stab's combination of a Lite Ply base with ¼-in. balsa frame produces an extremely strong and lightweight unit at a fraction of the alternative sheet balsa cost. The fin is notched front and back; it fits into a slot in the stab frame for more rigidity.



Moving the tail wheel is a simple matter, as the tiller is attached to the bottom of the rudder. Although not shown in the photo, it is a good idea to slide a small section of the inner Goldenrod over the tiller wire first and then glue the rod to the bottom of the rudder with CyA.

Full-Size Plans Available . . . See Page 172



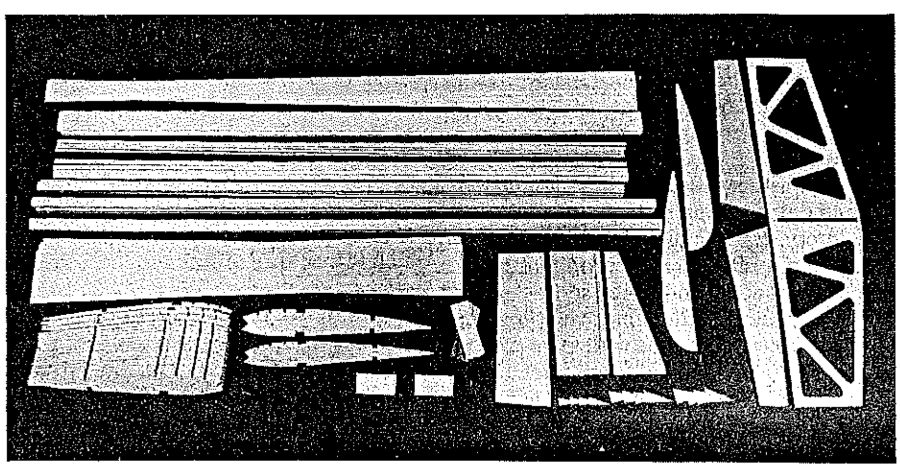
MonoKote (or silk) covering; any other material may be too flexible.

Once the 4-60 is covered, it's time to install the hardware and adjust the balance position. Servos can be secured with ⅜ sq. basswood rails. Pushrods can be any of several types: solid stick, flexible rod, etc. Our preference is 1/16-in. music wire running inside inner and outer Goldenrod. This type is not affected by temperature changes, is very simple to install, and requires only one or two braces to prevent flexing.

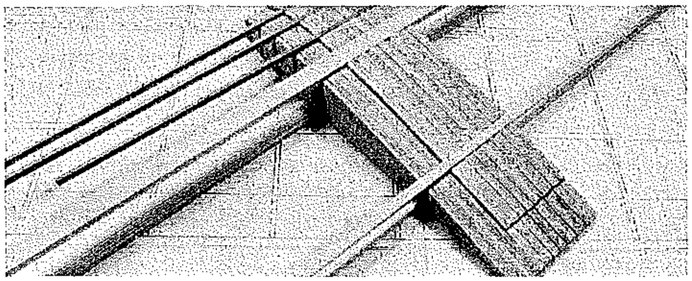
We use EZ connectors on the servo ends and solder links on the horn ends. Of course, the wire should be filed flat for the EZ connector screw as a safety measure, but we have never had one loosen in flight. Z-bends could also be used on the servo ends.

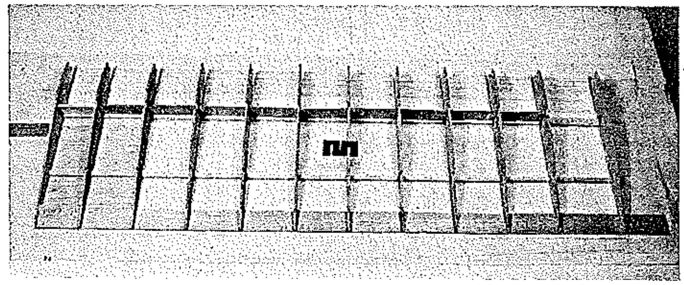
When gluing the tail onto the fuselage, it is necessary to cut away some of the covering material at the joints. Just make sure the edges are well adhered. It's best to cover the triangular braces before installing them. Make sure everything is perpendicular and even with the adjoining structure.

Subsequent to photographing the construction model, we found a rather neat way to operate the tail wheel. A short length of inner Goldenrod can be roughened and CyA-glued to the rudder, further strengthened with a strip of CyA-applied glass cloth

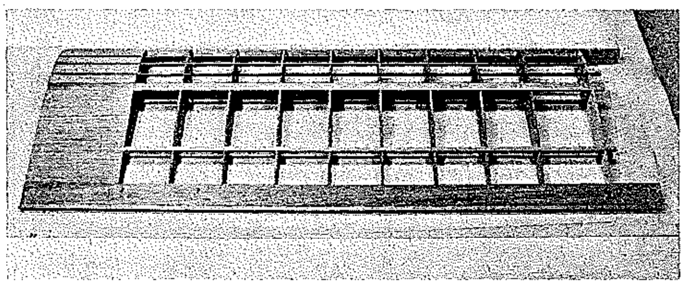


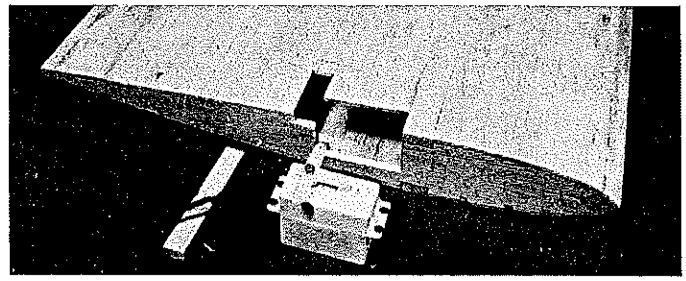
All the pieces necessary for the wing and tail surfaces. The two rectangular pieces just below the ribs are tapered hardwood inserts through which the wing-mounting bolts pass.





Left: Wing ribs are stacked, checked for spar fit, and then stack-sanded. Notches need to be snug for good adhesion with CyA. Right: The wing builds flat from the main spar back. Shear webs are used to position the ribs. Notice that the inboard rib has been tilted for dihedral.

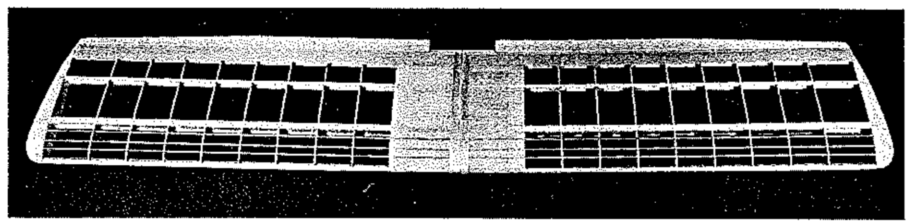




Left: Addition of top spars and center section sheeting completes the wing assembly. The trailing edge cap provides a seat for the aileron and hinges. It's a simple wing to construct without warps. Right: Make the necessary servo well cutout for your servo; mount it on bass rails.

and MonoKote over it all. This gives a neat tube-and-tiller operation without much danger of it tearing loose from rough handling.

The canopy is a stock unit from Ace RC which can be obtained by mail. Many of the larger WW II canopy fronts could also be used. The pilot figure can be any of the fine ones currently being offered for sale. An excellent adhesive for installing the pretrimmed canopy is R/C 56; dress the edges with trim tape.



The completed wing with judicious use of shear webs and spruce spars is every bit as strong as one built in a more-conventional manner. Those who have built RC Sailplane wings will have no trouble in recognizing that similar construction techniques are used.

Prepping for flight. The balance point shown on the drawings (middle of the main spar) is a starting point. Recommended control surface deflections: rudder, ¾ in. each side; elevators, ½ in. up and down; ailerons, ⅜ in. up and down. All measurements are at the widest part of the surface.

The engine should be run at home to set the high and low ends of the throttle and to obtain reliability. Range-check the radio, and be sure that the control surfaces operate smoothly and in the proper direction. Adjust the wheels as needed until the model will roll straight ahead (larger wheels work better on grass runways). Once everything is "just right," charge the batteries overnight in preparation for flying the next day.

Depending a bit on model weight, altitude, temperature, and humidity, a 13-5 or 13-6 prop is a good starting point. The aerobatics setup, with a ½ to ¾-in. rearward balance point, seems to work best with a 14-5 prop. Each individual flier should experiment a bit to get the prop that best matches his model and flying style.

Flying a model with a four-cycle engine is much different from one with a two-cycle engine. It takes constant self-reminding that it is not in low throttle even though the sound level seems to say so. Four-cycle engines seem to sort of shift gears under flight loads rather than bogging down. There is a sound not unlike that of a semi-trailer truck down-shifting when the model is working its way through maneuvers.

This aural deception makes it unwise to set the needle valve on a four-cycle engine by ear. A tachometer is almost mandatory to get the best setting.

One of the 4-60 prototypes was flown with a two-cycle .40 with Schnuerle porting. Performance was a bit sluggish, though satisfactory as a sport hack. The same model was also flown with a sport .60 two-cycle; although it flew well, the noise level was distracting. The tests certainly showed that the model is suitable for a wide range of power plants.

Let's fly! Start up the engine, point the model's nose into the wind, add just a touch of right rudder until the 4-60 gains a bit of speed, and watch it take off on its own with no problem. This has to be about the easiest tail-dragger to take off and land as anyone has ever flown. Only a deliberate ham-handed effort could possibly ground loop it. Seemingly there isn't a critical speed at which it would snap roll without warning, and even an absolute klutz would have to work at it to mess up a final landing approach.

The flier making a transition from a trainer with a flat-bottom airoil will find the slowness of the flight envelope nearly ideal as he learns to execute outside loops, rolls, snap rolls, spins, inverted flight, and horizontal eights. As the flier's skill increases, the balance point can be moved rearward in steps by screwing Sig lead weights to the tail post; aerobatic figures will tighten up and become more brisk.

In the hands of an experienced flier, the 4-60 will do most of the "squiggles and bumps" done by the piped two-cycle—but more slowly. How about eight-point rolls at a slow enough rate that they can be counted out loud at each point?

The 4-60 presented here and the smaller 4-40 may well be the most deceptive-looking designs around. They look like trainers, but they possess flying qualities that are satisfying to a wide range of experience levels.