



# SQUARE RIGGER

**A quick, rugged, easy to build aileron trainer for .40 size engines. A real pleasure to fly and is ideal for a club trainer.**

**By Paul F. Denson**

**T**he first Square-Rigger was so called because, except for the wheels, there was not anything that even approached being round on the whole plane. She is the latest development in a chain of similar aircraft.

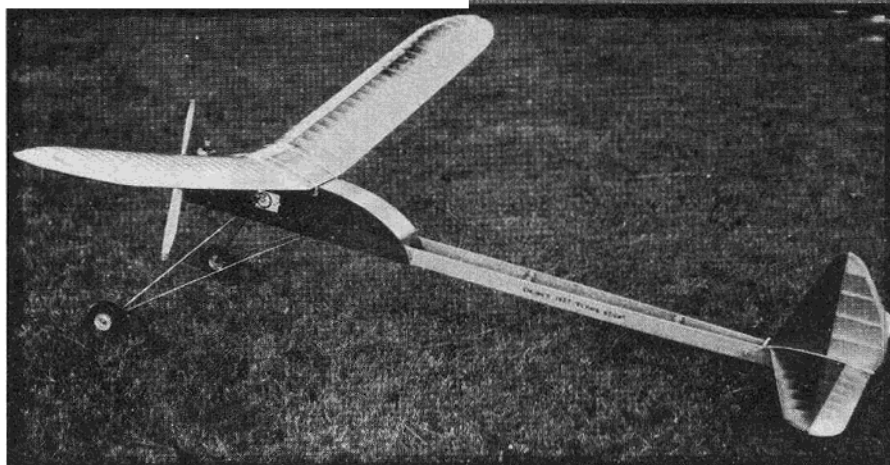
When he joined the Wingmasters R/C Club, a member brought to the field a little .20 size quick build plane with a simple wing, a plywood box for a fuselage and a twin stick boom on which to hang the tail. It may have been new to the fellows at the field but he has been flying it around the area for years. We can personally attest to the fact that it has more miles on it than a restored Model A.

After watching all the fun he had flying the little tail dragger, other members of the club decided to enlarge the fuselage, fit it with Senior Falcon wings and tail and power it with a .60. Even in the larger size, they fly great. They can do practically any maneuver, are as strong as an ox and last forever. If you bash one, the wing flies off, the tail bolts shear and a new fuselage can be built in one afternoon. They are a real practical airplane.

The prototype of the little .20 powered plane was developed and flown while the designer was stationed with the Navy at Corpus Christi, Texas, in 1969. Even before this, he flew similar rubber powered free flight planes.

From what we can find out, the Grandpappy of this whole chain of planes was pictured in Clarence Haught's column in Model Aviation and modeled by Bob Schafer who found it in an early Frank Zaic Yearbook. The original was a 1937 design by Frank Ehling. High wing, boxy fuselage and twin booms from each side of the fuselage bottom tapering together under the empennage. (See photo.)

Not only was Square-Rigger I enlarged in size, but it was modified to fly with trike gear and a .40 in the nose. The boom departs from the top of the fuselage and still functions to hold the tail in place. Moving the boom to the top of the fuselage seemed to make more sense when using a trike landing gear. All of the club planes use the front end of the booms as beam engine mounts but, because of the necessary



*Story in text.*

size up front, this made the tail booms very heavy. Square-Rigger uses a radial engine mount; therefore, the size and weight of the booms may be reduced considerably. By the time the third Square-Rigger evolved, even more lumber was whittled from the booms.

The basic concept for Square-Rigger was to see just how simple a plane could be made. Chuck Cunningham's parameters in RCM were carefully studied. The whole plane was built around the wingspan and chord. A set of Wing Mfg. constant chord, semi-symmetrical wings were on hand, they had been ordered some time previously with such an idea in mind. The S-4 wing has a 9 $\frac{3}{8}$ " chord and a 54 $\frac{1}{2}$ " span. After adding a trailing edge and 1 $\frac{1}{4}$ " ailerons, the resulting wing has a chord of 10 $\frac{5}{8}$ ".

The wing is sheeted with 1/16" balsa back 4" from the leading edge and 2" forward from the trailing edge. The center and tips were sheeted and capstrips were placed in between. After the wing was covered you could not tell whether it was foam or built-up.

Ruler in hand and a sharp blade on the table saw, we whacked out all the pieces for the fuselage in less than an hour. There are three 3/8" square sticks of balsa in the fuselage, all the rest is either pine or lite ply. The firewall is, of course, aircraft ply. That evening the fuselage was built and sanded. The next evening it was painted and was flown that weekend. The most time consuming job was the installation of the radio gear and controls.

Square-Rigger I was adobeized, the wing and tail did manage to survive in a rather unscathed manner. Later on Square-Rigger II was cementized which is similar to the above only more so. This time the wing and tail didn't survive. A novice pilot was at the controls both time and all was forgiven.

For a variation in design,

## SQUARE RIGGER

Designed By:  
Paul F. Denson & Kenton Krauss

### TYPE AIRCRAFT

Aileron Trainer

### WINGSPAN

54 Inches

### WING CHORD

10 $\frac{5}{8}$  Inches

### TOTAL WING AREA

567 Sq. In.

### WING LOCATION

Top of Fuselage

### AIRFOIL

Semi-Symmetrical

### WING PLANFORM

Constant Chord

### DIHEDRAL EACH TIP

1 Inch

### O.A. FUSELAGE LENGTH

44"

### RADIO COMPARTMENT SIZE

(L) 11" X (W) 2 $\frac{1}{2}$ " X (H) 3 $\frac{1}{2}$ "

### STABILIZER SPAN

18 Inches

### STABILIZER CHORD (incl. elev.)

6" (Avg.)

### STABILIZER AREA

108 Sq. In.

### STAB. AIRFOIL SECTION

Flat

### STABILIZER LOCATION

Top of Boom

### VERTICAL FIN HEIGHT

7 Inches

### VERTICAL FIN WIDTH (incl. rud.)

5" (Avg.)

### REC. ENGINE SIZE

40 Cu. In.

### FUEL TANK SIZE

8 Oz.

### LANDING GEAR

Tricycle

### REC. NO. OF CHANNELS

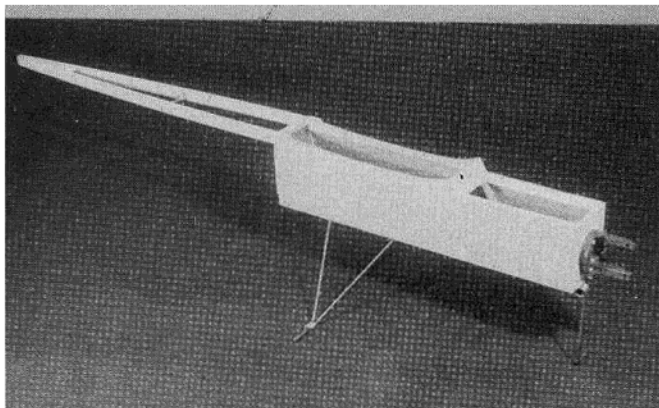
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### CONTROL FUNCTIONS

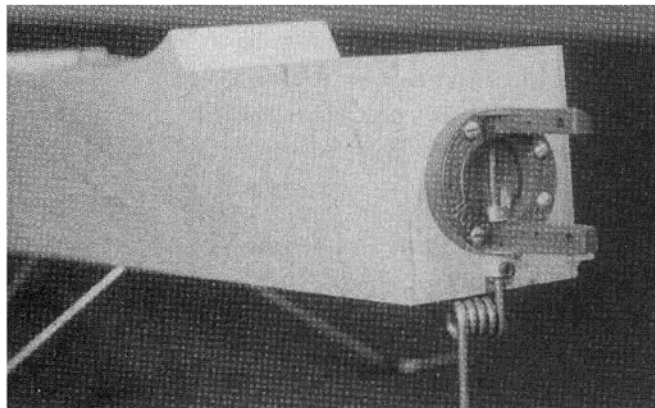
Rud., Elev., All., Throt.

### BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Pine & Ply
Wing	Balsa & Spruce
Empennage	Balsa
Wt. Ready To Fly	52 Oz.
Wing Loading	13.3 Oz./Sq. Ft.



Early version of fuselage with heavier booms.



Close up of Kraft engine mount and nose gear installation.

Square-Rigger III has a built-up wing. The airfoil was made similar to that of the foam wing only flat from the bottom spar to the trailing edge for ease of construction. The tail was changed slightly for cosmetic reasons and here we finally violated the direct square law. The rudder was rounded at the bottom and don't think we didn't hear about it, especially from our young friend Kenton Krauss who did most of the construction on Square-Rigger III.

#### CONSTRUCTION

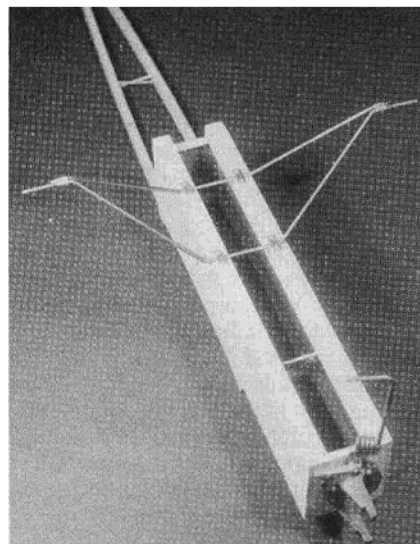
Cut the two sides according to the little triangles on the plans, rip the booms from 3/4" white pine, spruce, or even Philippine mahogany if you have it. Glue the booms to the top of the sides; remember students --- make a left and a right side, then cut out the wing saddles. Glue the rails to the bottom of the sides leaving 1/4" at the front for the firewall.

Mark the bevel for former F-1 on both fuselage sides. After beveling F-1 itself, top and bottom, glue it in place on one side. When dry, erect the fuselage over the top view and glue the other side to F-1. Insert the 3/8" square cross brace in the front and both 3/8" square cross braces at the rear. Add the firewall and F-2. The firewall is backed up with 3/8"

triangular pine strips using a 5-minute epoxy to seal out fuel. Cut the hatch cover from 1/8" lite ply. The hatch cover is secured in place with four small No. 2 wood screws.

Pull the booms together at the rear and cement. A triangular scrap of 3/4" pine is cemented in place between the booms; this is the anchor for the stabilizer and fin. Cut the fin, rudder, stabilizer and elevator from 3/16" medium grade sheet balsa. The bottom of the fin is cut from boom stock and cemented to the balsa top part. Using your best centering ability, drill and tap two holes vertically into the bottom of the fin for 6-32 nylon bolts. Drill matching holes in the stab and anchor block so the bolts will slip through. We used 1 1/2" bolts allowing them to penetrate the fin about a half inch. Do not despair, the only time a bolt ever sheared was in a crash and that was planned for.

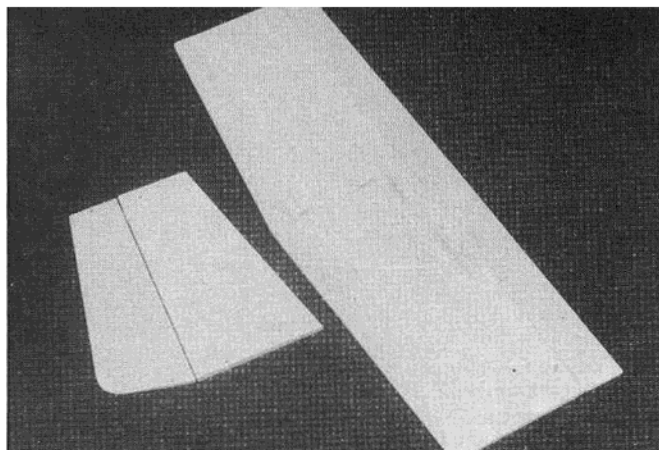
The rudder horn is built from readily available hardware. Bend a right angle about 3/8" from the threads on a clevis rod. This rod is inserted in a hole drilled through the anchor block and the stab at the rear edge of the fin (see plans). Do not make that second bend until everything is covered and the fin and stab are mounted to the boom. A tab from an



Early Square Rigger landing gear. Next version placed L/G on outside of bottom sheeting.

aileron horn kit is drilled, tapped and screwed on the threaded end of the rudder horn. This tab takes the clevis from the rudder pushrod and may be adjusted in or out as you feel necessary for maximum movement.

Use your favorite brand of glass filled engine mount. Mounting the engine on its side or at 45° puts the muffler down under and keeps the goo off your plane. Whether you mount at



Tail group showing hardwood bottom on fin drilled and tapped for 6-32 nylon screws.

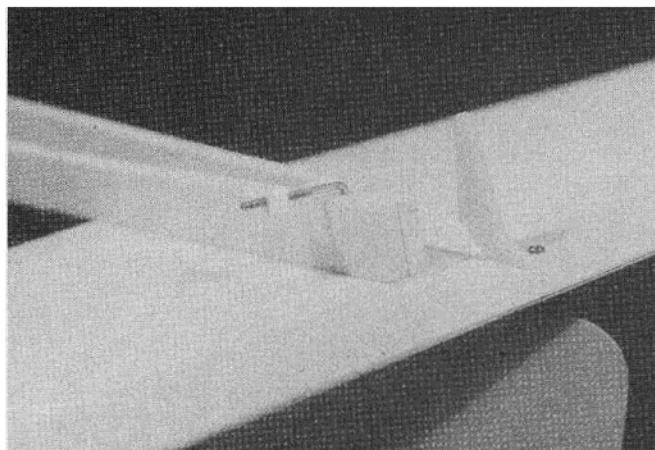
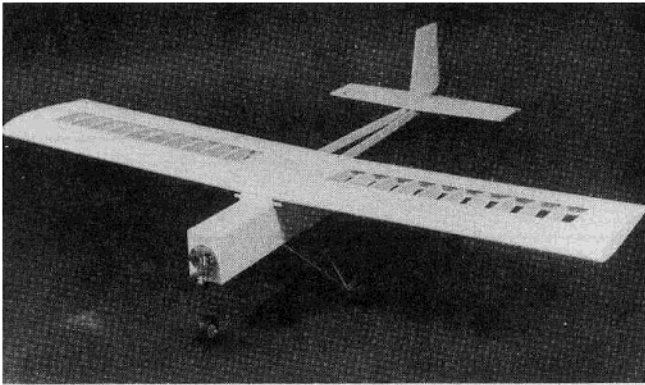
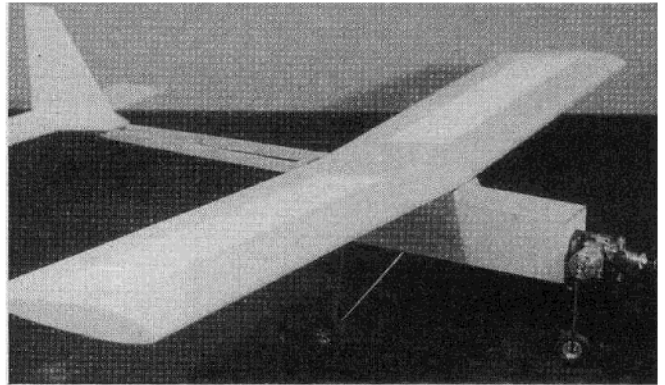


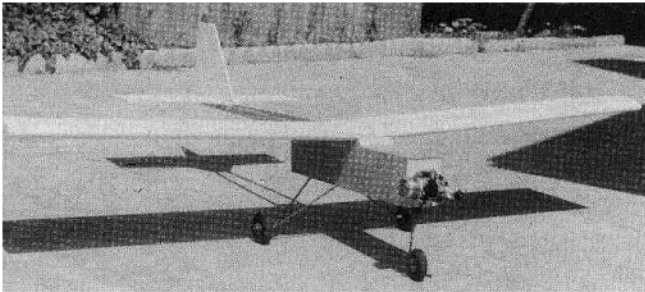
Photo shows results in "making your own rudder horn." Works very well.



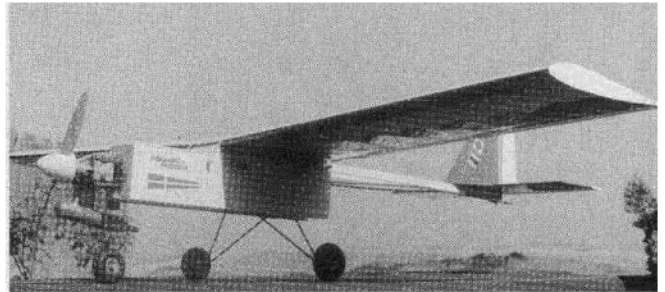
*Square Rigger with built-up wing.*



*Square Rigger with foam wing.*



*Foam wing version ready to cover and paint.*



*Original prototype of the Square Rigger.*

45° or 90° it is going to be necessary to drill a hole in the mount for the nose wheel gear. We would highly recommend using a drill press for this task, otherwise binding may occur because the holes are not drilled true. The pictures show the locking device, a wheel lock, in the center of the engine mount; the plans show it on top, either location is acceptable. In the center it is out of sight and out of reach behind the engine. On top it is easy to get at for adjustment but highly visible. Let your feelings reign.

Before beginning to assemble the built-up wing, the trailing edge must be fabricated. It may be planed to shape from 3/8" x 1/2" balsa stock or the front 1/2" of a piece of 1/4" aileron stock. The price for the two pieces is almost the same. Notches for the ribs should be cut into the front of the trailing edge, three thicknesses of hack saw blade does it handily. We have found Super Jet cyanoacrylate glue indispensable in wing making and practically everything else.

Lay down the bottom spar over the plans, then add the trailing edge. Glue the ribs in place, the two center ribs will cant slightly for dihedral. Add the top spar on each wing half. The leading edge may now be cemented in place. At this point, plane the leading edge to match the angle made with the ribs, do not round. Add the 3/32" vertical grain webbing.

The leading edge sheeting may be made by cutting a 1" strip from the 1/16" x 3" trailing edge sheeting and edge glue it to the leading edge

sheeting making it 1/16" x 4". If you can find 4" sheeting, great, then buy 2" sheeting for the trailing edge. When applying the sheeting, remember, it overlaps both the leading and trailing edge stock. The total thickness at the trailing edge should be 5/16" to match the thickness of the aileron.

To join the two wing halves, place one half on the plans, weight or pin in place. Place the two inner wing ribs in contact and prop the outboard wing tip up two inches. Using epoxy, cement the two halves together. Lately, we have not been using dihedral braces, we find the 3" glass tape, installed completely around the wing at the mid point, sufficiently strong for the most vigorous maneuvers.

When you come to the installation of the aileron horns, it is suggested you

buy the type that use a metal or nylon tube for the pivot. First cut a rounded groove in both the trailing edge of the wing and the hardwood block, center wing section. This groove must be wide and deep enough to allow a wood-to-wood fit between the block and the trailing edge. Both the trailing edge and the inner end of each aileron must have a similar groove. The aileron must be drilled to take the shorter of the two right angle bends of the horn. On a high wing plane such as this, the longer bend must point down and the shorter bend to the rear. Arrange the two so they do this. A cut-out in the wooden block is necessary so the long bend can exit, then pivot fore and aft. See the side and top views for the approximate location of the wires, grooves and



*Second fuselage on prototype Square Rigger.*

## From RCModeler June 1983

exits. The various type of tabs to which the pushrod clevis is attached comes with the wire. Should you encounter any difficulty, we highly recommend the RCM Flight Training Course manual which not only explains the whole process but has many fine construction photos. In fact, if you do not have an extensive library of back magazines, the Flight Training Course is one of the best investments you can make in background. Most of the material contained therein is taken from the vast experience of the RCM editors.

The landing gear is held in place with metal or plastic landing gear clips screwed into the bottom of the fuselage. If you are very careful, the whole landing gear can be bent from one 36" length of 5/32" piano wire. The photo shown is of the underside of the original Square-Rigger, it is included to show the manner of attaching the assembled landing gear and the tiller location on the nose wheel gear. The fuselage bottom was to have been inserted from the top, in two pieces, and placed above the beams leaving an open channel below, from the firewall back. It was later felt that this groove was a catch-all for dirt and oil and it was difficult to clean under the landing gear. The last design greatly increases the volume of the radio compartment by putting the 1/8" lite ply bottom sheeting below the 3/8" square spruce beams.

If the landing gear was mounted directly on the bottom of the fuselage, rather than in grooves in the beams, it would probably be knocked off during a hard landing, rather than destroying the whole fuselage.

Painting the fuselage is much easier than attempting to cover it with anything. Sand it well, using progressively finer sandpaper down to 320. Zynolyte puts out an excellent white primer in a spray can; sand this coat with 400 wet or dry sandpaper. Finish the fuselage with the Formula U spray paint in your favorite color. Any other paint and primer you prefer is great. NyRods or Gold-N'Rods are recommended; be sure to anchor both ends securely to the fuselage to prevent flexing.

### **Flying:**

The biggest surprise we had was how this plane glided. When the engine was pulled back prior to making the turn for landing, it just hung in the sky then floated the full length of the field. Cautiously, we added throttle and went around again losing more altitude, this time she came in and flared to a perfect landing.

This has been a fantastic fun airplane, takes the abuse and easily comes right back for more. The Square-Rigger is forgiving, she is square, she looks square and will treat you square --- an old sweetie. □